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THE DEVELOPMENT OF AUGMENTED REALITY-BASED POCKET BOOKS ON LEARNING STRAIGHT LINE 3D SHAPES USING THE MARKER BASED TRACKING METHOD

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ABSTRACT

Augmented Reality (AR) is a technology that combines 2 dimensions and 3 dimensions at the same time. Augmented Reality allows a 2-dimensional object to change into 3 dimensions with the help of devices such as cameras and smartphones. Augmented Reality has many applications, one of which is in the world of education. One example of the application of augmented reality that can be done is in the Straight Line 3D shapes topic. In this topic, Augmented Reality is used to display the spatial object in the book that was previously 2-dimensional into 3 dimensions. Markers are used as objects to be scanned via a smartphone camera. From the results of the experiment in determining the ideal distance between the camera and the marker, the ideal distance was found to be between 8 - 77 cm. This depends on the size of the marker to be scanned. The following Augmented Reality applications can run well in helping mathematics learning, especially in the topic of straight line 3D shapes.

Keywords: *Augmented Reality, 3D Shapes, Learning Media*

1. INTRODUCTION

One of the trends in the world of education is to utilize technology as a learning medium. The use of technology in learning has a positive impact on learning outcomes (Sarnoto et al, 2023). This is because technology can simulate learning in 3 dimensions. So that students can see a problem from another perspective that cannot be seen in reading books.

The teaching and learning process will be of higher quality if combined with technology used as a learning medium. Learning media is needed as an intermediary for teachers to minimize failure during the learning process. In addition, interesting and interactive learning media can help students absorb the material being taught, because in the learning process many students have difficulty understanding learning with conventional methods. One of the technologies that is currently popular and developing is Augmented Reality (Indra and Idramsa, 2022).

Augmented Reality is a technology that can integrate the real world with the virtual world, allowing users to see the real world that has been added with virtual elements in 3 dimensions (Indahsari et al, 2023). Based on research conducted by Surani and Fricticarani (2023), it shows that the use of Augmented Reality in learning has a positive impact, especially on Biology learning with human digestive system material. One of the materials that can be assisted by the use of 3D Augmented Reality technology is geometry material in mathematics subjects. The use of 3D technology greatly helps students in understanding the shape, angles, and contents of geometric shapes that cannot be seen in 2 dimensions in textbooks (Wahyudin et al,

2022). Learning geometric shapes is learning that uses spatial abilities. Spatial ability is the ability possessed by a person to be able to create, store, understand, and remember mental images of space and shape (Sudirman, 2020). Spatial ability is an important ability because according to research conducted by Nasution (2023), spatial ability is one of the variables that influences students' problem-solving abilities.

Marker Based Tracking is one of the methods in the application of Augmented Reality. Based on research conducted by Putra (2023), Marker based tracking can be applied well to learning Lampung script using Augmented Reality technology. In this study, Lampung script writing can be scanned using a smartphone camera that has been installed with an augmented reality application. Based on black box testing, the application is free from functional errors and is included in the "Very Good" category. Thus, this method can be applied to pocket books to study straight line geometric shapes.

Based on the previous explanation, it can be shown that it is important to apply technology that can simulate 3 Dimensions in geometry learning, especially in spatial geometry material such as Augmented Reality technology. So the main objective of the following research is to develop a pocket book on learning Spatial Geometry, especially straight line spatial geometry using Augmented Reality assistance using the Marker Based Tracking method. The pocket book integrated with the following augmented reality application can be an alternative learning media that can improve the quality of learning about straight line spatial geometry material. So that it can improve the quality of learning both in class and outside the classroom. The pocket book integrated with the following augmented reality application will also help improve students' problem-solving abilities. So that it will provide good learning outcomes.

2. RESEARCH METODOLOGY

Research methodology is a scientific process or method that discusses the procedures for collecting data needed in the research process starting from data collection, data analysis, and designing procedures that will be used in the development of pocket books and applications (Haryanto, 2019). This research is an R&D (Research and Development) study using the ADDIE model (Analyze, Design, Develop, Implement, and Evaluate). ADDIE is a dynamic instructional model consisting of the stages of analysis, design, development, implementation, and evaluation (Mulyasari et al, 2023). The steps that will be taken based on the ADDIE model are

a. Analysis

In the following stage, the analysis conducted is related to seeing the needs and conditions that occur in classroom learning in general. In the analysis stage, interviews were also conducted with teachers and students to conduct an in-depth analysis of the needs that must be met.

b. Design

In the following stages, the Augmented Reality application is designed using a mockup application such as Figma. In the design stage, the needs obtained from the analysis process will be the basis for designing the application interface. In the design stage, the pocket book is also worked on using the Canva editing application.

c. Development

Development is done using the Unity 2021 editor application. Development is done based on design results that have met the needs. At the development stage, the logic of an application and the required 3-dimensional assets are also worked on. At the development stage, the

marker-based tracking method will also be applied to the application as a method of detecting references.

d. Implementation Phase

After the application is developed, the next step is to try or implement the application that has been created to the book that has been designed. In addition, the application will be tested with several student samples to collect data related to the feasibility and performance of the application.

e. Evaluation Phase

Evaluation or testing is done based on data collected from the implementation results. At the evaluation stage, it will also be seen whether there are bugs or errors that occur in the application. The evaluation process that will be used is Technical Performance Testing which assesses the performance of the application when it is run.

3. Related Search

Tabel 1. Story Board

Nama	Deskripsi
Marker	2-dimensional image that is used as a reference in the application
Camera	For scanning the marker
Smartphone	Devices used to run the application
Laptop	For developing the application
Unity 2021	Editor for developing the augmented reality
Vuforia	Marker's Database
Canva	Editing software for developing the book
Figma	Software for mockuping the application

4. RESULTS AND DISCUSSION

The developed application is then tested to see the possibility of bugs and room for improvement. Testing of the application is also carried out to ensure that the application can be used properly. The results of the application test can be seen in the following image:



Figure 1. Splash Screen



Figure 2. Main Menu



Figure 3. Usage Guidelines

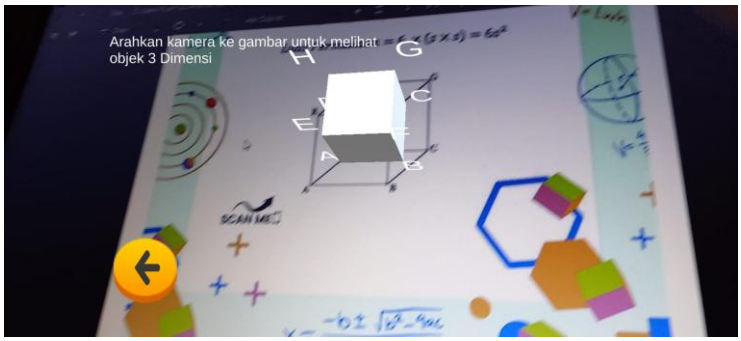


Figure 4. Augmented Reality Features (1)

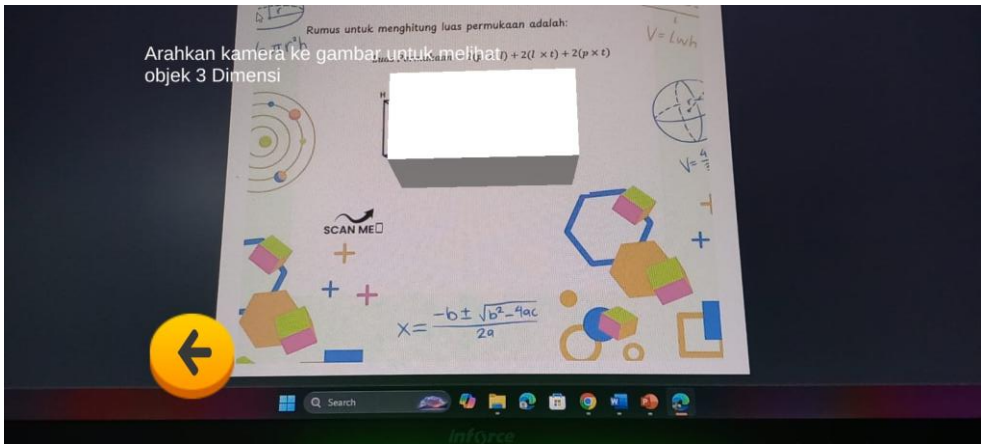


Figure 5. Augmented Reality Features (2)

Evaluation of the developed application is in the realm of Technical Performance Testing. The metrics or measuring tools used in measuring its performance include Accuracy, Latency, Frame Rate, Device Compatibility, and Distance between the camera and the marker.

Accuracy or precision is how precise the augmented reality application is in capturing references or markers. Based on testing using three different devices, the application can capture and determine what 3D objects should appear. There are no markers or references that cannot be detected by the camera. This shows that the application developed and the selected markers are very precise.

Latency, especially in displaying 3D objects, is greatly influenced by the specifications of the device used. Based on testing using devices with minimum specifications, namely Android devices with version 7.0, 2 GB memory, and dual core processors, the resulting latency ranges from 1000ms - 2000ms. Latency is also influenced by the intensity of light in the room. The brighter the light captured by the camera, the lower the latency will be. Based on testing for latency, the application that has been developed is still included in the good category and can be used without any problems.

Frame rate is the number of images displayed in a certain time unit. Frame rate is usually shown in seconds so it is called Frame Rate per second. The higher the frame rate produced, the smoother the image will look and will not experience any stuttering. Based on testing using the minimum device owned, the frame rate obtained is 15-30 fps. Frame rate is also influenced by the specifications of the device used and the intensity of light received. The higher the light intensity, the higher the frame rate produced. The following test shows that the application developed is still in the good category and is suitable for use.

The compatibility of the devices that can be used to run the following applications is very feasible. By using the minimum device, the application can be run properly. The application developed supports the use of smartphones with a minimum Android version of version 7. This version was first released in 2016. So for device compatibility, the application developed is very feasible and can be used for almost all Android devices currently available.

The distance between the device and the marker to be detected is worthy of attention so that the developed application can be used comfortably. The developed application can detect markers with a closest distance of 8 cm. While the furthest distance that can be detected is 77 cm. This shows that the developed application is very feasible. Especially its use with pocket books only requires a distance of 8 cm - 30 cm to read it.

Based on the results of technical testing to see the performance of the application, it can be concluded that the application developed is suitable for use. Because there are no obstacles in its use for various devices.

5. CONCLUSION

The developed application can be run well on the smartphone device used. The developed application can also scan pocket books that have been made to be used simultaneously. 3D objects are also clearly visible when the marker is detected on the camera. The application can be practiced perfectly both in class and outside the classroom. Based on technical testing by looking at the performance aspects of the application, it can be concluded that the application that has been developed is suitable for use in learning. Both in class and outside the classroom.

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INTEGRATED TOURISM DEVELOPMENT OF GENGGELANG VILLAGE THROUGH SIGADis APPLICATION AND WEB VIRTUAL TOUR

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ABSTRACT

The development of digital-based tourism is increasingly needed to reach tourists who are looking for virtual experiences before visiting in person. This community service aims to develop the potential of natural tourism in Genggelang Village through the application of digital technology in the form of the Si Gadis application and virtual tour website. Si Gadis application is designed as an interactive platform that presents complete information about Genggelang tourism, including maps, routes, and destination descriptions. Meanwhile, the virtual tour website provides a visual tour experience that allows prospective tourists to explore the natural beauty and facilities available online. The methods used in this community service activity include field observations, interviews with local tourism managers, and the development of a digital-based system carried out by the team. The expected results of this community service are an increase in the number of tourist visits to Genggelang Village and an increase in local people's understanding of the importance of adapting technology in tourism development. In addition, Si Gadis application and virtual tour website are expected to be a model for tourism development in other villages with similar natural potential.

Keywords: *Nature Tourism, SIGADis Application, Web Virtual Tour*

1. INTRODUCTION

In recent years, digitalization has brought significant changes in the tourism sector, especially in promoting natural tourism destinations. Tourism development is a flagship program in regional development (Suta & Mahagangga, 2018). Tourism development that is planned and managed in a sustainable manner based on the community will be able to provide economic value to the community and the local government (Nurhadi et.al, 2020). Tourism is one of the objects of local cultural sustainability and the preservation of natural beauty that provides a source of income (Lestari & Suharyanti, 2020). In addition to the material benefits that can be achieved from tourism development, it should also be noted that this will of course

have an impact on creating a challenge in several other things including the economy, environment and society (Wafik et al., 2023).

North Lombok Regency is an area with very abundant natural wealth potential. This is very supportive of business use in the tourism sector. Some of North Lombok's tourism outlites include Gili Trawangan, Gili Meno, and Gili Air with stunning natural panoramas. In addition, there are other tourist spots that support additional destinations, namely Sendang Gile, Tiu Kelep, Sekeper, Tiu Teja, Kerta Gangga, Gangga Murmas Tree House, Chocolate Village and others. In addition to tourism potential, North Lombok Regency also has the potential for agro-tourism development. One of the villages with quite good agro-tourism potential is Genggelang Village, Gangga District.

Genggelang Village has abundant natural tourism potential. It offers interesting natural beauty, such as mountain views, beautiful forests, and waterfalls. However, geographical constraints and lack of access to information have resulted in the suboptimal tourism potential of Genggelang to reach a wider range of tourists. According to Atiko et al., (2016) that tourism can have a positive impact on the sustainability and economic progress of the community, it is necessary to have the intensity and creativity of digital-based promotion. Looking at the development of information technology, especially mobile applications and Virtual Tour web-based, Genggelang Village has the potential to increase tourist visits through a digital approach. SIGADis Application and Web Virtual Tour is proposed as an interactive and easily accessible means of tourism promotion. The SIGADis app offers complete information about tourist attractions, travel routes, and local facilities. Meanwhile, Virtual Tour web-based allows prospective visitors to explore the natural beauty of Genggelang digitally before they come to the location in person.

This digitalization is important because it can help tourists plan trips, increase the attractiveness of natural tourism, and strengthen the local economy. In addition, the existence of virtual applications and web tours also provides opportunities for local communities to be involved in technology-based tourism management. This is expected to be a solution to increase tourist visits to Genggelang as well as introduce the potential of the village to a wider market. The results of previous research and service explained that application-based tourism promotion provides benefits for producers and consumers by providing current tourism information that will be targeted (Desika et al., 2022). Mobile applications are one of the most effective strategies today to support the progress and sustainability of tourism (Yanti et al., 2024). The mobile application allows tourists to access information about travel routes, the location of tourist attractions, activity schedules, and facilities available at the destination location (Dewi et al., 2023; Nurhadi et.al, 2020). This can enhance the tourist experience and encourage tourists' decision to visit the place. Apps like SIGADis, which focuses on local tourist destinations, are in line with this need, efficiently connecting tourists with specific information about the attractions of Genggelang Village.

Meanwhile, web-based virtual tours are increasingly popular as a tourism promotion tool that can be accessed by prospective visitors from anywhere. Virtual tour Helping travellers visualize their experience at their destination, thereby increasing interest in making an in-person visit (Moniaga et al., 2022; Nihayah et al., 2023). In the context of natural tourism, Virtual Tour allowing potential visitors to explore the beauty of the location without having to be in the place, providing an initial picture that often builds enthusiasm for further visits.

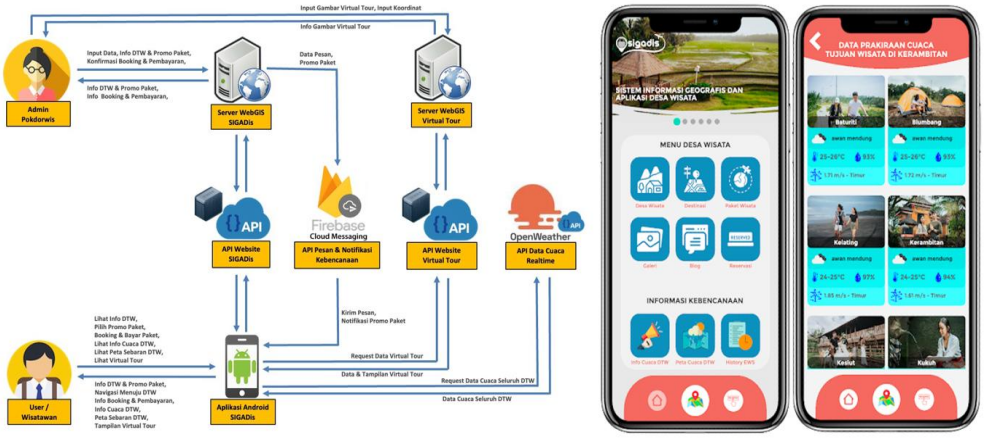


Figure 1. SIGADIs Android Architecture and Applications

The purpose of this service is to optimize the use of the SIGADis application and Virtual Tour Web in promoting natural tourism in Genggelang Village and empowering the local community to be actively involved in the tourism industry. The results of this activity are expected to support the achievement of increased tourist visits and sustainable economic growth in Genggelang Village.

2. RESEARCH METHOD

The parties involved in this Kosabangsa Program activity are 1) the implementation team (UGR), 2) the companion team (UNMAS Denpasar), 3) five students, 4) all members of the Bunga Mekar Farmers Group 5) Field Agricultural Extension from the UPTD Office of Gangga District, North Lombok Regency, and 6) the Genggelang Village Government, and NGO cooperation partners from Coastal Environmental & Fisheries. Some of the approaches taken by the implementation team in order to provide solutions to the problems faced by partners are the Knowledge Transfer approach, and Technology Transfer (TT). The work step is the first stage of socialization, at this stage the implementation team holds socialization of service activities to partners to provide an explanation of the scope of activities, the rights and obligations of group members, and post-program governance. Furthermore, the stage of implementing activities, designing and developing the SIGADis application and Web Virtual Tour. All data is collected related to tourist attractions, MSMEs, lodging facilities and others to support application features. **Transfer Technology** At this stage, the service implementation team will design and build the SIGADis application and Web Virtual Tour. **Knowledge Transfer**: The next stage will be socialization and training for members of the Gangga Murmas Tree House Pokdarwis as target partners on how to use the SIGADis application and Web Virtual Tour. **Activity Evaluation**: where at this stage it is carried out based on the improvement of the knowledge and skills of pokdarwis partner members in utilizing the SIGADis application and Web Virtual Tour which is measured using pre-test and post-test instruments.

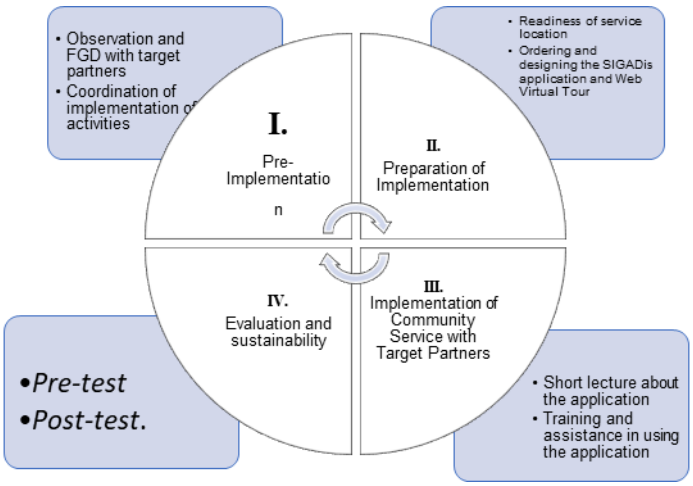


Figure 2. Stages of Community Service Activities at the Gangga Murmas Genggelang Tree House Pokdarwis

3. RELATED RESEARCH

The results of previous research and service explained that application-based tourism promotion provides benefits for producers and consumers by providing current tourism information that will be targeted (Desika et al., 2022). Mobile applications are one of the most effective strategies today to support the progress and sustainability of tourism (Yanti et al., 2024). The mobile application allows tourists to access information about travel routes, the location of tourist attractions, activity schedules, and facilities available at the destination location (Dewi et al., 2023; Nurhadi et.al, 2020). Virtual tour helping travellers visualize their experience at their destination, thereby increasing interest in making an in-person visit (Moniaga et al., 2022; Nihayah et al., 2023). Another service result explains that promotions to increase the volume of digital-based visits are still not intensively carried out by tourist attraction managers. So that tourist attractions that visitors should know about before visiting can reduce interest in tourist attractions (Yanti, 2019).

4. RESULTS AND DISCUSSION

This service was carried out in November-December 2024 located in Genggelang Village, Gangga District, North Lombok Regency. The Partner Group involved in this activity is the Gangga Murmas Tree House Tourism Awareness Group as one of the managers of the Tree House tourist destination in Genggelang Village. This Pokdarwis was established on December 3, 2022 with a total of 29 members chaired by Alan Budi Kusuma. The problem of Pokdarwis to date is that the volume of visits has decreased and even tends to be less in demand even though previously the intensity of visits was high. Therefore, the service team tried to design a mobile application in the form of SIGADis and Web Virtual Tour for online promotion.

SIGADis is a Geographic Information System and Android Application for Tourism Villages (SIGADis) with several additional features that can support business activities and tourism transactions. The goal is to support the tourism digitalization program in Indonesia. This feature includes data management for Tourism Villages, Tourist Accommodations, Tour Packages, MSMEs, as well as a reservation feature for users who want to book tour packages. SIGADis facilitates data management (insert, update, delete) and allows tourists to book tour packages and make payments. In addition, this feature is integrated with the virtual tour website of each tourist destination (DTW), allowing tourists to get an

immersive experience before visiting the location directly. This integration with virtual tours provides a 360-degree overview of the available facilities, assists tourists in planning their visits, and increases their interest and engagement. With the addition of this feature, it is hoped that it can facilitate the reservation process, help tourism village managers and related parties to monitor the development and popularity of tourist destinations, and accelerate the process of tourism digitalization. The SIGADis architecture to be built has several entities consisting of hardware, software, and brainware. As brainware, it is the operator of Pokdarwis who will add tourism potential data, news, and information on tourism promotions, and online bookings, and tourists who will get information related to DTW and tour packages. WebGIS and android applications are software entities, while hardware entities are devices used to access WebGIS or android applications, as well as servers as data processors and storage. A system architecture that describes the relationships between its entities.

The initial information done to support the SIGADis application and Web Virtual Tour collects all DTWs and then inputs them into the application. Such as tourist spots, MSMEs, lodging, local culture and so on. After the design and development of the SIGADis application and the Genggelang Village Virtual Tour Web are as follows.

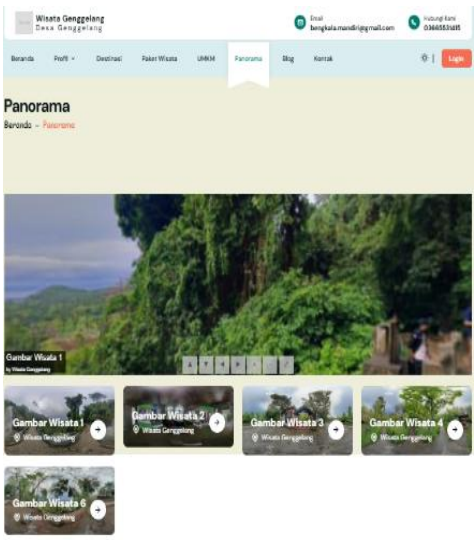


Figure 3. Web Virtual Tour Genggelang Figure

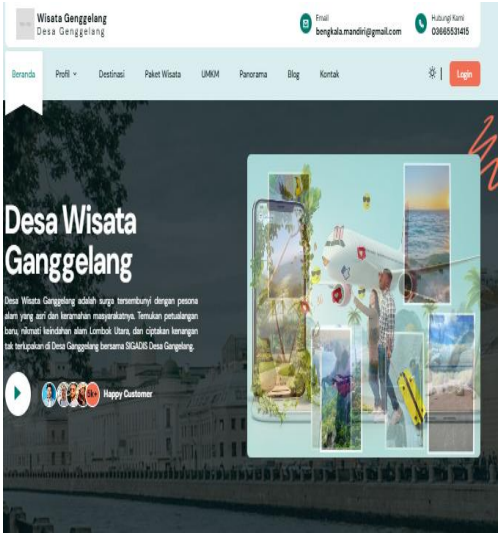


Figure 4. SIGADis Genggelang Application

Features on the Genggelang Virtual Tour Web and SIGADis Application are in the form of homepages, profiles, destinations, tour packages, MSMEs, panoramas, blogs and contacts. All of these features provide ease of hospitality and institutional governance of tourism in Genggelang Village. The hope is that visitors before going to the location can find existing tourist information. The most interesting thing about this application is that the tour package has been integrated with all tourism support sectors of Genggelang Village. So that it provides comfort and good facilities to visitors.

After designing and building the SIGADis application and the Genggelang Virtual Tour Web, training and assistance in using the application are then carried out to improve the skills and knowledge of partners in using the application. This training was carried out in the Flower Bloom Farmers group and the Gangga Murmas Tree House Tourism Awareness Group attended by all group members. According to the partner group, this application is very helpful in increasing the volume of tourism visits. Where before the earthquake and covid-19 occurred, tourism visits were very high. After the earthquake and covid-19, tourism visits dropped drastically, even more ironically, the Gangga Murmas Tree House Pokdarwis was

completely paralyzed. Meanwhile, Kampung Coco Senara is running, but the volume of visits has decreased.

With the SIGADis application and Web Virtual Tour given to partners, it is a new spirit to run and revive tourism. The most important thing in addition to the physical improvement of tourism, the most important thing is online promotion through applications so that marketing is more widespread. Visitors can immediately check the available tour packages with the views offered on the SIGADis application and the existing Web Virtual Tour. The tour packages available in the application are the result of the development of DTW Genggelang Village. From the results of training and mentoring members of the partner group, it was stated that this application is important for the development of tourism that has not been in operation for a long time. With the ease of application built, it provides technical convenience to partners. The hope is to get a high volume of visits.

The results of the Pre-Test and Post-Test of the partner empowerment level showed that the Gangga Murmas Tree House Pokdarwis had an increase in skills and understanding related to the use of the SIGADis Genggelang application and the Web Virtual Tour. The partner's ability before using the application is 50%, while after the training the level of understanding is 90%. This means that the implementing partners are skilled in using SIGADis Genggelang and Web Virtual Tour. However, further assistance is needed for further application development and partner skills.

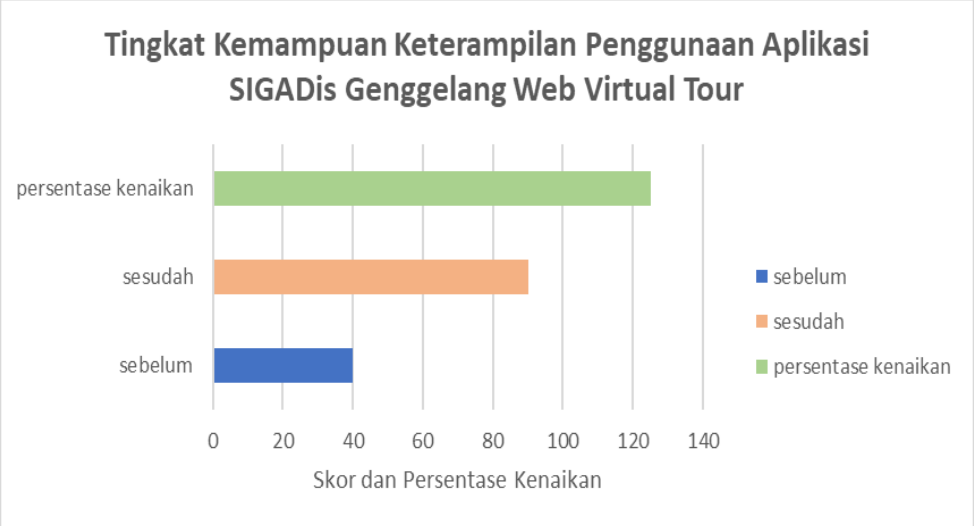


Figure 5. Results of Post Test and PreTest of Partner Empowerment Level Towards SIGADis Application and *Web Virtual Tour Genggelang*

5. CONCLUSION

SIGADis and Web Virtual Tour Genggelang is a Geographic Information System and Android Application for Tourism Villages (SIGADis) with several additional features that can support business activities and tourism transactions. The goal is to support tourism digitalization programs in Indonesia, especially Genggelang Village, Gangga District. The results of the implementation of the activity show that the design of SIGADis and the Genggelang Virtual Tour Web has been 95%, the rest is development for the sustainability of the application and the ability of partners to use the application. In terms of skills and understanding of the design, construction and operation of the SIGADis application and Web Virtual Tour Genggelang, more than 85% of the target partners understand and are skilled. However, further assistance is needed for the sustainability and development of partner group applications.

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A CNN-BASED VOICE COMMAND SYSTEM FOR SLIDE CONTROL TO ENHANCE ACCESSIBILITY FOR USERS DISABILITIES

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ABSTRACT

This study presents a robust CNN-based model for real-time voice command recognition, specifically designed to recognize "right" and "left" commands. The dataset, derived from the Speech Commands Dataset, includes audio samples augmented with additional noise, yielding hundreds of thousands of data points to enhance model performance under noisy conditions. Each audio sample, approximately 1 second in length, is transformed into a spectrogram to facilitate pattern recognition by the CNN. The model was trained over 20 epochs, achieving a training accuracy of 96.5% and a validation accuracy of 97.6%, indicating strong generalization without overfitting. Testing on real-world noisy audio further demonstrated the model's effectiveness, recording an overall accuracy of 97.7% and an AUC of 1.0 for both classes. The results underscore the model's potential for reliable deployment in noisy environments, with low false positives and rapid response times, as indicated by CPU and memory performance metrics. These findings contribute valuable insights into designing voice-controlled systems for real-world applications, especially for users in challenging auditory environments.

Keywords: *CNN, Voice Recognition, Disabilities*

1. INTRODUCTION

Presentations play a crucial role in disseminating information across diverse professional and educational settings. However, for people with physical disabilities, managing presentations can present considerable difficulties, especially when it involves direct control over devices (Lv, Poiesi, Dong, Lloret, & Song, 2022). In Indonesia, the workforce participation of individuals with disabilities has been steadily rising, with around 720,000 people entering the labor market in 2022, many of whom are involved in entrepreneurial ventures (Agnes Z. Yonatan, 2023; Cindy Mutia Annur, 2023).

Previous studies have explored various methods for developing voice-controlled systems to enhance accessibility. For instance, Muhammad Asad *et al* (Asad et al., 2018) introduced an AdaBoost-based algorithm for head movement detection, enabling hands-free control of personal computers. This system combined head movements and voice commands to facilitate interaction but primarily focused on general computer control. Similarly, Muhammad Azlan Alim *et al* (Alim, Setumin, Rosli, & Ani, 2021) developed a voice-controlled intelligent wheelchair system utilizing Raspberry Pi and Google Assistant. This system allowed users with physical limitations to navigate wheelchairs through voice commands while ensuring high accuracy and responsiveness. While these studies highlight the robustness of assistive technologies, they do not address the specific needs of managing presentation slides, especially in real-world noisy environments.

This study aims to develop a voice-command-based slide control system for presentations using Convolutional Neural Network (CNN), focusing on classifying voice commands with strong noise resilience. CNN was chosen for its ability to recognize patterns in visual data; in this case, audio data will be converted into spectrograms so that they can be analyzed as images (Peng et al., 2020). This

approach has proven effective in applications like environmental sound classification. By utilizing CNN, this system is expected to offer a more efficient and robust solution for recognizing basic voice commands such as “next” or “back” to control presentation slides. Additionally, the system is designed to operate effectively in various real-world conditions, including noisy environments, making it a more inclusive technology for individuals with physical disabilities (Xu et al., 2023).

2. RESEARCH METODOLOGY

This study develops a CNN-based slide control system using voice commands, designed to classify commands in noisy environments and assist users with physical disabilities in controlling presentations independently. The methodology includes data collection, model training, and evaluation. The Speech Commands Dataset, containing basic commands like “right” and “left” (adapted to “next” and “back”), is used, with additional noise added to simulate real-world backgrounds. Each audio file is converted into a spectrogram as input for the CNN.

2.1 Data Preprocessing

Audio files are converted into spectrograms or mel-spectrograms, visually representing frequency distribution over time for CNN analysis. Each audio sample, with a duration of 1 second, is resampled to a sample rate of 16,000 Hz. The mel spectrograms are computed using 128 mel bins (*n_mels*=128) to represent the frequency domain, while the time domain is segmented into approximately 32 frames based on a hop length of 512 samples. This results in spectrograms with dimensions of (128, ~32), representing frequency and time, respectively.
To ensure uniform size and model stability during training, each spectrogram is normalized, and an additional channel dimension is added, yielding a final input shape of (128, ~32, 1) for the CNN model. This dimensionality allows the model to effectively learn spectral and temporal features essential for accurate voice command recognition, even in noisy environments (De J. Velásquez-Martínez et al., 2023; Kumar, Renuka, & Priya, 2023; Qian, Bi, Tan, & Yu, 2016).

2.2 Model Architecture

The CNN model in this study consists of interconnected layers designed to recognize visual patterns in spectrogram data from voice commands. Each layer extracts and abstracts features for classification, as shown in the process flow in Figure 1 (Boulal, Hamidi, Abarkan, & Barkani, 2024; Lakshmi et al., 2023; Telmem, Laaidi, Ghanou, Hamiane, & Satori, 2024).

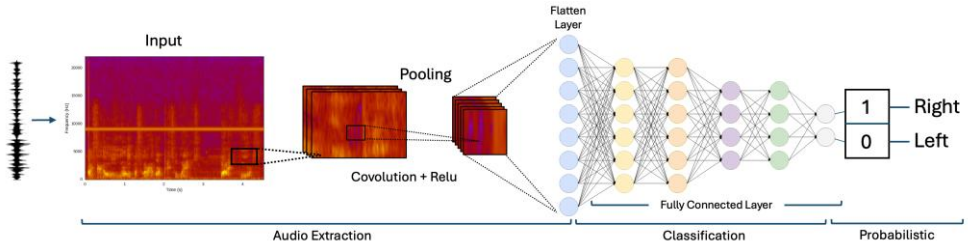


Figure 1. Model Procces

- ***Model Architecture***: The CNN model comprises interconnected layers to recognize visual patterns in spectrogram data from voice commands. Each layer extracts and abstracts features for classification, as shown in Figure 1.

- ***Convolutional Layers***: The convolutional layer applies filters to spectrogram images, extracting key patterns like frequency changes and sound intensity variations. This operation across frequency and time enables the CNN to capture unique audio features such as amplitude changes.

- ***Activation Function (ReLU)***: ReLU, applied after each convolution, introduces non-linearity by mapping negatives to zero, enhancing model convergence.

- ***Pooling Layers***: Max pooling reduces feature map dimensions and parameter count, retaining essential information while lowering the risk of overfitting.

- ***Fully Connected Layers***: The fully connected layer consolidates extracted features, linking patterns to specific classes like “next” and “back.”

- ***Output Layer (Softmax)*****:** *Softmax in the output layer converts outputs to probabilities for each class, allowing classification based on the highest probability.*

The dataset is split into training (70%), validation (15%), and testing (15%) sets, using the Adam optimizer and categorical cross-entropy loss. Early stopping is employed to prevent overfitting, and performance is measured with accuracy, precision, recall, and F1-score. To improve noise resilience, noise augmentation is applied to the training data, simulating typical background sounds (e.g., office or traffic noise), which enhances the model’s ability to classify commands accurately in real-world noisy environments.

2.3 System Implementation

The implementation of this voice recognition system begins with the collection and augmentation of voice data for two main labels, “right” and “left,” to increase data variability. The data is then converted into spectrograms to facilitate the CNN model’s ability to recognize voice patterns. Next, the CNN model is trained and evaluated using test data under different conditions (e.g., clean and noisy audio) to measure accuracy, false positive rate, error rate, and response time. The system is then tested in real-world conditions to assess performance in actual environments, including monitoring CPU usage, memory usage, and response time to ensure efficiency and reliability.

3 RESULTS AND DISCUSSION

3.1 Model Training and Validation

The data used in this study was sourced from the Speech Commands Dataset and consists of two main classes: “right” and “left.” Each audio file has an average duration of 1 second and has been augmented with additional noise, simulating real-world conditions. The noise includes common background sounds, such as office ambiance, traffic, and casual conversations, to mimic the types of auditory interference that could be present during real-world usage. This augmentation process generated tens of thousands of audio samples for each class, enhancing the model’s ability to detect voice commands even in noisy environments.

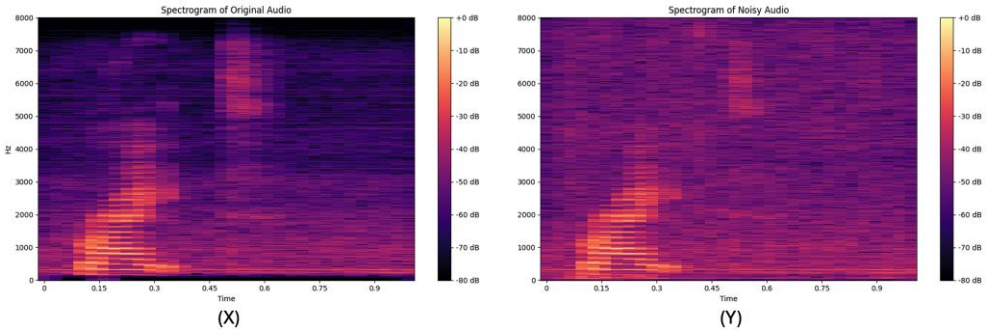


Figure 2. Audio Augmented Data Set

Figure 2 illustrates a comparison of spectrograms between the original audio (X) and the noisy audio (Y = X + Noise). The noisy version introduces additional distortions, particularly in lower and middle frequency ranges, where background noise often overlaps with the vocal frequency range.

Table 1. Data Set

Label	File Audio
Right	22301
Left	22086
TOTAL	**44387**

The CNN model was trained to recognize “right” and “left” voice commands over 20 epochs. The evaluation results demonstrate excellent performance, as detailed below:

1) Training and Validation Accuracy
The model achieved a training accuracy of 96.5% and a validation accuracy of 97.6%, as shown in Figure 3. The accuracy and loss curves indicate that the model did not experience overfitting.

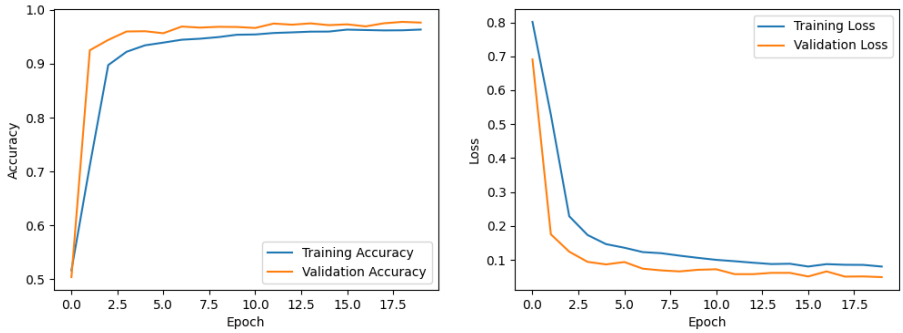


Figure 3. Accuracy and Loss Curves

2) Evaluation on Test Data
On the test data, the model recorded an overall accuracy of 97.7%. This result is supported by precision, recall, and F1-score values of 0.98 for both classes, as shown in Table 2. The Confusion Matrix in Figure 2 demonstrates that classification errors are minimal.

Table 2. Model Performance

Kelas	Precision	Recall	F1-Score
Right	0.98	0.98	0.98
Left	0.98	0.98	0.98

3) ROC
The ROC Curve in Figure 4 shows an AUC of 1.0 for both classes, indicating that the model has optimal classification capability.

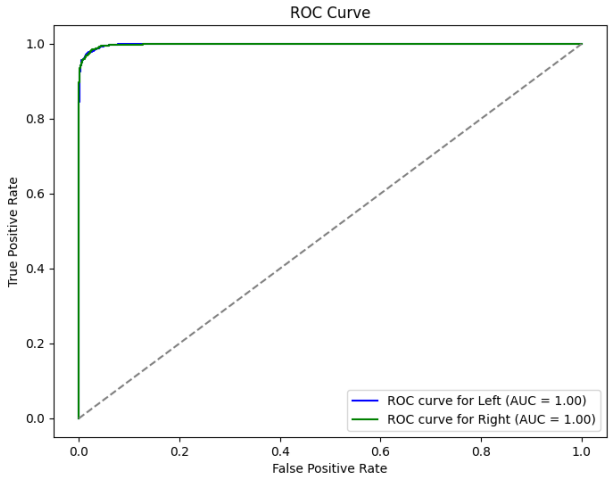


Figure 4. ROC Curve

3.2 Real-World Implementation

Each model was evaluated using 400 real-time audio samples divided into four conditions: Left Clean, Left Noise, Right Clean, and Right Noise, with 100 trials for each condition. The noise conditions were consistent with the data processing conditions and included common background sounds, such as office ambiance and traffic, simulating real-world auditory interference.

Table 3. Model Performance

Condition	Metric	CNN	RNN (LSTM)	KNN	Random Forest
Left Clean	Akurasi (%)	100.00	99.27	97.81	94.89
	False Positive Rate (%)	0.00	0.73	2.19	5.11
	Error Rate (%)	0.00	0.73	2.19	5.11
	Average Response Time (ms)	54.04	59.72	145.48	2.93
Left Noise	Akurasi (%)	96.03	94.44	88.10	82.54
	False Positive Rate (%)	3.97	5.56	11.90	17.46
	Error Rate (%)	3.97	5.56	11.90	17.46
	Average Response Time (ms)	48.70	56.50	146.99	3.00
Right Clean	Akurasi (%)	99.20	92.00	56.00	43.20
	False Positive Rate (%)	0.00	0.00	0.00	0.00
	Error Rate (%)	0.80	8.00	44.00	56.80
	Average Response Time (ms)	49.84	55.98	134.27	4.34
Right Noise	Akurasi (%)	97.60	65.60	39.20	85.60
	False Positive Rate (%)	0.00	0.00	0.00	0.00
	Error Rate (%)	2.40	34.40	60.80	14.40
	Average Response Time (ms)	49.31	51.46	136.39	3.99

The test results shown in Table 3 indicate that CNN and RNN/LSTM deliver more stable and accurate performance across various conditions compared to KNN and Random Forest. Although KNN and Random Forest achieve satisfactory results in the Left Clean and Left Noise conditions, both experience a significant performance drop in the Right Clean and Right Noise conditions. In contrast, CNN and RNN/LSTM maintain high accuracy and resilience to noise, with CNN demonstrating an advantage in response time.

This table confirms the robustness and validity of the proposed CNN model, particularly in noisy audio conditions, making it more suitable for real-world applications compared to other models. The software implementation also performs well, as shown in Figure 5, with a prediction confidence threshold set at 0.8. The application and model can be accessed and downloaded via GitHub at *https://github.com/carliapriansyahh/AI-.git.*



Figure 5. User Interface for Model Implementation

This testing also evaluates CPU performance, memory usage, and response time. The following is a summary of the highest and lowest values, as presented in Table 4.

Table 4. System Performance

Performance	CPU	Memory	Reponse Time
Highest	61%	86.1%.	354.85 ms
Lowest	25.8%	80.8%	33.88 ms

This summary indicates that CPU and memory usage show moderate variation, while response time has a wide range, suggesting an opportunity for optimization to achieve a more consistent response time.

4 CONCLUSION

In this study, a Convolutional Neural Network (CNN)-based voice recognition system was successfully developed to recognize the voice commands “right” and “left” with high accuracy, both in clean and noisy conditions. The training and validation process demonstrated that the model achieved 96.5% accuracy on the training data and 97.6% on the validation data, indicating that the model did not experience overfitting. On the test data, an overall accuracy of 97.7% was recorded, with precision, recall, and F1-score values consistently at 0.98 for both classes. Further evaluation of the system’s performance in real-world conditions revealed that the model maintained high accuracy with minimal variation in false positive rate and error rate. Additionally, the system’s CPU and memory usage showed moderate variation, with response times that still have room for improvement. The highest response time was recorded at 354.85 ms, and the lowest at 33.88 ms, suggesting potential for optimization to achieve more consistent response times.Overall, this system demonstrates robustness and adaptability across various conditions, though further improvements in reducing response time could enhance its efficiency and reliability in real-world applications. This implementation shows that the applied CNN model meets the needs of a voice recognition application for users with physical limitations, with satisfactory performance in detecting voice commands across different acoustic conditions.

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THE ROLE OF TRUST IN MEDIATING THE INFLUENCE OF PERCEIVED USEFULNESS AND PERCEIVED EASE OF USE ON REPURCHASE INTENTION IN ONLINE TRADING APPLICATIONS IN DENPASAR

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ABSTRACT

This study aims to analyze the effects of perceived usefulness and perceived ease of use on repurchase intention, with trust acting as a mediating variable, in the context of online trading applications in Denpasar. The research adopts a quantitative approach, utilizing Partial Least Squares (PLS) for data analysis. The findings indicate that both perceived usefulness and perceived ease of use significantly influence repurchase intention. These factors enhance user trust, which in turn encourages users to repurchase via online trading applications. The results suggest that online trading platforms should focus on improving the perceived usefulness and ease of use of their applications, as well as building customer trust to increase user loyalty and repurchase intention. This research contributes valuable insights for developing marketing strategies and managing customer relationships in the financial technology sector, particularly for online trading applications.

Keywords: *Perceived Usefulness, Perceived Ease of Use, Repurchase Intention, Online Trading Applications, Customer Loyalty*

1. INTRODUCTION

Significant growth in the financial sector, particularly in the capital market, has been achieved through the merging of finance and technology, resulting in investment applications that attract public attention, especially among millennials (Siregar & Nasution, 2020). Interest in investing surged dramatically during the Covid-19 pandemic, particularly among young people aged 20 to 30. This trend was driven by conditions in the Indonesian stock market that indicated a phenomenal rise in stock prices, commonly known in the industry as a rebound (Catriana & Movanita, 2020)

The number of investors in the Indonesian capital market surpassed 10 million as of November 3, 2022, according to PT Kustodian Sentral Efek Indonesia (KSEI, 2022). This growth can be attributed to increasing public awareness of investment and the digitalization of financial services. Online trading applications have become popular among investors for their ease of use, speed, and security (Yulisetiarini et al., 2024). this context, repurchase intention in online trading applications is a critical aspect, as retaining users and ensuring their continuous use of the platform for stock purchases is essential. Companies must enhance customer trust, improve service quality, ensure user satisfaction, and provide a positive user experience. This involves offering accurate information, responsive customer service, and features that increase perceived value (Nurjanah et al., 2023).

Perceived usefulness is a belief about whether a system provides benefits; individuals are more likely to use a system they find useful (Oktavia Kartikasari & Trisnawati, 2019). This belief influences repurchase intentions, as users who see tangible benefits—such as improved performance and efficiency—tend to return to the platform (Tan et al., 2021). However, (Mulyani & Rukminingsih, 2020) notes that perceived usefulness does not always directly lead to purchasing behavior, as consumers often delay decisions due to uncertainty.

Perceived ease of use, another influential factor, affects customer trust and their likelihood of repurchasing. An accessible and user-friendly online platform

encourages repeat usage (Dutta, 2016). However, (Suryani & Ramdhani, 2022) argues that ease of use alone does not guarantee repurchase intentions. Enhancing both perceived usefulness and ease of use in online trading applications can strengthen customer trust, thereby boosting repurchase intentions.

This study investigates how trust mediates the effects of perceived usefulness and ease of use on repurchase intentions in online trading applications, focusing on users in Denpasar City.

2. RESEARCH METODOLOGY

This study employs a quantitative approach with an associative research design, which aims to analyze the influence and relationships between variables (Sugiyono, 2019). The research investigates the role of trust in mediating the influence of perceived usefulness and perceived ease of use on repurchase intention in online trading applications in Denpasar. The subsequent steps involve data preparation and hypothesis testing to draw conclusions based on the research findings.

The sample size for this study is 165 respondents, selected using a non-probability sampling method, specifically purposive sampling, which involves selecting participants based on specific criteria relevant to the study (Sugiyono, 2019). Data collection was conducted through a survey method using questionnaires distributed directly by the researcher. Each questionnaire item is designed to measure respondents' attitudes, opinions, and perceptions using a Likert Scale, which assigns scores to five response options as follows:

Table 1. Respondents' Alternative Answers

Alternative Answer	Code	Score
Strongly agree	S	5
Agree	S	4
Quite Agree	N	3
Disagree	TS	2
Strongly Disagree	STS	1

(*Source:* (Sugiyono, 2019)

In a preliminary survey involving 30 respondents from Denpasar City, participants were asked about their perceptions and experiences with online trading applications. This survey included questions to assess the perceived usefulness, ease of use, and trust in these applications. The results are summarized as follows:

Table 2. Pre-Survey of Customers Using Online Trading Applications in Denpasar City

No.	Introductory Interview Questions	Agree	Disagree
1	I often use online trading applications to buy back shares.	26	4
2	I believe in using online trading applications to make stock purchases.	25	5
3	I feel the ease of use in making stock purchases again through the application.	24	6
4	The usefulness that I feel, such as making a profit, will influence my intention to buy back shares through the application.	24	6

(Source: Primary data processed, 2024)

This data demonstrates that the majority of respondents find online trading applications useful and easy to use, fostering trust and influencing their intention to repurchase stocks.

Inferential statistics were applied using Partial Least Square (PLS) analysis, a component- or variance-based Structural Equation Modeling (SEM) technique. PLS

was selected for its effectiveness in analyzing complex relationships between variables, especially latent constructs that cannot be directly measured. The SEM approach is particularly suitable for testing hypotheses and explaining the interrelationships among variables.

3. RELATED RESEARCH

The Technology Acceptance Model (TAM) is a framework used to understand how users accept and adopt technology. TAM was developed in 1986 by Fred Davis in his paper titled "A Technology Acceptance Model for Empirically Testing New End-User Information Systems." The basic concept of TAM is a framework that helps understand and predict technology adoption by users. TAM posits that technology adoption is influenced by two main factors: perceived usefulness (persepsi kegunaan) and perceived ease of use (persepsi kemudahan penggunaan) (Fitriyani & Wicaksana, 2024)

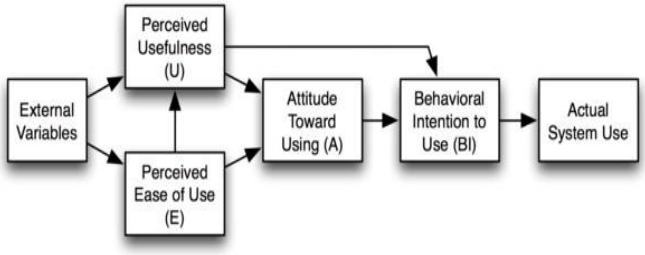


Figure 2. *Technology Acceptance Model*
Source. David et al., (1989)

Over time, the Technology Acceptance Model (TAM) has evolved to reflect the characteristics of technology, initially focused on software, but now extending to other technologies such as mobile technology, social media, the Internet of Things (IoT), and more (Prabawa et al., 2024). Additionally, according to (Miandari et al., 2021), companies in the online retail sector are increasingly targeting consumers worldwide, as both developed and emerging markets have embraced online shopping to purchase products. This shift has also changed global and specifically Indonesian consumer behavior, influencing their daily activities and interactions in new ways.

4. RESULTS AND DISCUSSION

Perceived usefulness and repurchase intention have a significant relationship. According to (Daffa & Praswati, 2023), when consumers receive useful information from online shopping services that increase their knowledge of the product, this increases the intention to repurchase. When using online shopping sites, people look for benefits such as time efficiency, quick access to the site, and ease of purchasing products (Faradila & Soesanto, 2016). Perceived usefulness positively affects repurchase intentions because if consumers feel that online shopping applications provide benefits, they are encouraged to continue shopping online (Laora et al., 2021). This is in line with the research of (Tan et al., 2021) which states that the perceived usefulness of online shopping services increases the likelihood of users to repurchase.

Perceived ease of use also has an important role in repurchase intentions. (Chandra & Santoso, 2022) found that people are more likely to buy products when they feel comfortable and easy to use the application. If a site provides a clear transaction flow guide, from ordering to product delivery, this encourages users to shop online (Udayana & Ramadhan, 2020). Ease of use is a key factor influencing online purchasing behavior, such as searching for product information and completing transactions (Pangestu & Setiyaningrum, 2023). Consumers who find shopping online easy (perceived ease of use) tend to have the intention to buy again online (Nurmalia & Wija, 2018).

Perceived usefulness is also related to trust. According to (Daffa & Praswati, 2023), perceived usefulness is based on the extent to which customers believe that e-commerce sites will provide facilities for shopping for brands. Perceived usefulness has a significant positive influence on trust. The greater the perceived usefulness, the higher the trust in using technology (Aryani et al., 2018). (Wati et al., 2024) state that the greater the perceived benefits of a product or service, the higher the trust in the product or service. Technology that increases value, efficiency, and company performance builds trust among customers (Nurjanah et al., 2023)

Perceived ease of use also affects trust. Perceived ease of use is an important variable for online businesses because it affects customer trust (Dachyar & Banjarnahor, 2017). When customers find websites easy to understand and navigate, trust is built (Putri & Iriani, 2021). Easy-to-use technology indicates a high-quality product, and the simpler a technology is to use, the greater the trust in it (Syahrina & Christiana, 2023). Perceived ease of use has a significant positive effect on trust, so that increasing ease of use directly increases customer trust (Kurniawan et al., 2022).

Trust affects repurchase intentions in e-commerce. According (Uviyanti et al., 2022), the higher the level of trust, the more likely someone is to repurchase. Trust is a positive expectation of future online shopping behavior, which contributes to long-term relationships between customers and sellers (Asri et al., 2022). High trust in a site, which is built through accurate information and services, encourages customers to repurchase and increase customer loyalty (Suleman et al., 2021). (Alfian et al., 2023) also found that trust significantly affects purchase preferences. The higher consumers' trust in online shopping sites, the more likely they are to repurchase.

Trust also acts as a mediator between perceived usefulness and repurchase intention. According to (Keni, 2020), the greater the perceived usefulness of an electronic system or technology, the less uncertainty of the transaction, thereby increasing trust between the parties involved and encouraging repurchase intentions. Trust acts as a positive and significant mediator between perceived usefulness and repurchase intentions (Nurjanah et al., 2023). (Sawitri, 2023) also stated that trust mediates the relationship between perceived usefulness and online repurchase intentions. The benefits perceived by consumers directly affect repurchase intentions, with trust as a mediator (Fauzi, 2021)

Trust also mediates the relationship between perceived ease of use and repurchase intentions. Trust partially mediates the relationship between perceived ease of use and repurchase intentions in e-commerce (Uviyanti et al., 2022). A high level of trust in the ease of use of a platform like Shopee increases the likelihood of repurchase intentions (Miandari et al., 2021). According to (Yudiarti & Puspaningrum, 2022), trust positively and significantly influences online repurchase intentions through perceived ease of use. When consumers find it easy to shop, this builds trust which then increases repurchase intentions (Deborah, 2019).

5. CONCLUSION

The conclusion of this study shows that perceived usefulness and perceived ease of use have a significant influence on repurchase intentions through the mediation of trust. Perceived usefulness and ease of use of e-commerce applications directly increase consumer trust, which in turn encourages loyalty and repurchase intentions. Trust plays an important role in reducing transaction uncertainty and building long-term relationships between consumers and service providers. Therefore, the development of online shopping applications should focus on increasing perceived benefits and ease of use to strengthen user trust. E-commerce service providers should continue to enhance relevant features and provide clear guidance on transaction flow. In addition, it is important to provide responsive customer service and maintain data security to maintain customer trust. Further research can explore additional factors such as user experience and service personalization to better understand online consumer behavior

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UNDERSTANDING SOUND DESIGN AND FILM SCORING THROUGH A HERMENEUTIC APPROACH

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ABSTRACT

In film, sound design and scoring are often seen as merely complementary to the visuals. Due to the highly technical manipulation of sound, it is often assumed to be a purely technical element. However, sound is an integral part of human life and reality, also carries its own impression and meaning. Gadamer's philosophical hermeneutics offers a potential framework for interpreting the broader and richer meanings of sound in film. In addition, Murray's soundscape theory, which posits that sound is an integral part of the environment, supports this view. Through the approaches of hermeneutics and soundscape theory, the study of sound in film can be divided into three perspectives: (1) sound as a common understanding, (2) sound in the context of film, and (3) the subjective (biased) meaning of sound as perceived by the audience. The philosophical hermeneutic aims to consider sound design and music in film not just as technical elements, but as media rich in symbolic, emotional, and narrative meaning. This study is qualitative and uses an exploratory method. The exploration is based on Gadamer's hermeneutics and Murray's soundscape theory.

Keywords: *Sound, Sound Design, Music Scoring, Hermeneutics, Film*

1. INTRODUCTION

Hermeneutics, a branch of the philosophy of interpretation, has been widely applied to various fields of art and literature. However, in the field of sound - which includes sound design and film scoring as elements that shape emotions - it is rarely interpreted by audiences. Philosophical hermeneutics offers an opportunity to deepen our understanding of sound beyond its technical aspects. Through a hermeneutic approach, audiences can construct an emotional narrative by integrating the context of the film with their personal perceptions. These perceptions are shaped by the individual's life processes, experiences and environment (subjective), not just by common interpretations (objective).

The construction of understanding within a framework of emotional narrative, historical context and personal perception can be achieved through Gadamer's philosophical hermeneutics. This approach opens possibilities for considering sound in film as a language or text, rich in symbols, emotions, and meanings.

2. RESEARCH METODOLOGY

This research uses film elements that incorporate sound design and film scoring as subjects of study. Primary literature sources include R. Murray Schafer's work on soundscape and Hans-Georg Gadamer's philosophical hermeneutics. The application of philosophical hermeneutics, as proposed by Gadamer in his book

"Truth and Method" (Gadamer, 2013), allows for the interpretation of the meaning behind artistic elements. This approach allows us to understand that sound is not just a technical matter, but also involves the realities of human life.

Similarly, R. Murray Schafer's work*, "The Soundscape: Our Sonic Environment and the Tuning of the World"* (Schafer, 1994), sees sound as an integral, inseparable part of the environment that shapes the audience's perception and experience. Schafer explores the concept of soundscape and how sound influences human perception of the environment. He sees sound as an environmental element capable of shaping human perception and experience, similar to the role of sound design in film. This research examines how soundscape in film immerses audiences in a narrative experience, guiding them emotionally and shaping their interpretation of scenes.

This study uses an exploratory research method that applies Gadamer's hermeneutic philosophy. The exploratory method relies on the imagination of the researcher (Mudjiyanto, 2018), in which sound elements are analogised to language. This assumes that sound elements in sound design and music scoring are expressions of emotions, similar to words that convey the realities of life. A crucial aspect of this research is personal perception and context, which can serve as tools for interpreting sound, in line with Gadamer's philosophical hermeneutics.

3. RELATED RESEARCH

A French film theorist and composer named Michel Chion introduced the concept of "audio-vision". Chion's work explores the relationship between sound and image. His book *"Audio-Vision: Sound on Screen*" (Chion, 1994), discusses the roles of diegetic, non-diegetic and acousmatic sound, emphasising that sound in film is not merely added to the visual; rather, each sound can create a sensory experience and carry new emotional meaning for the audience. However, the book places less emphasis on the philosophical hermeneutics that allow viewers to personally interpret music and sound.

Claudia Gorbman, in her book *"Unheard Melodies: Narrative Film Music"* (Gorbman, 1987) presents a semiotic approach to understanding music in film. She explores how film music functions as a text that helps the audience interpret narrative meaning. Gorbman also examines how the conventions of classical Hollywood film music can be deciphered. Through semiotic interpretation, audiences are assisted in their search for meaning within the film's narrative.

An article titled Ideology in the Film *"Uang Pannai Mahal from a Hermeneutic Perspective by Habermas"* highlights an effort to understand the ideology of the Bugis-Makassar community through a qualitative descriptive method (Herlina & Rasyid, 2019). In this study, Habermas' hermeneutic approach is applied to examine how the Bugis community perceives dignity *(siri)* and *uang pannai* through film. However, this study does not use the hermeneutic approach suggested by Gadamer.

Another study that uses hermeneutics to analyse sound is *"The Interpretation of the Lyrics "New Generation" by The S.I.G.I.T. in Schleiermacher's Hermeneutic Perspective"*. Wati Purnama Sari explains that the song "New Generation" uses declarative statements to highlight issues of poverty and education through sarcasm and hyperbole (Sari, 2023). The lyrics reveal a sense of disappointment on the part of the songwriter. This study adopts Schleiermacher's hermeneutic approach and categorises the interpretation into grammatical and psychological interpretation.

4. RESULTS AND DISCUSSION

In Aesthetic Theory, translated by Robert Hullot-Kentor, Theodor W. Adorno posits that art represents an antithesis to social conditions, yet it cannot be directly translated to fit existing social contexts (Adorno, 2002). This suggests that art necessitates a comprehensive and nuanced interpretation. Similarly, sound and music scoring have the potential to exist as autonomous forms of art. The social and personal contexts of a film's audience can exert an influence on their interpretation of the film's sound and music.

Gadamer, a student of Heidegger, offered a novel interpretation of hermeneutics that differed from those put forth by his predecessors Schleiermacher and Dilthey. In his work, F. Budi Hardiman outlines Gadamer's objective to liberate his hermeneutics from the constraints of prior interpretations, thereby reinvigorating it for application within the social and human sciences (Hardiman, 2015). He introduced the concept of the "fusion of horizons," which entails the integration of the interpreter's perspective with the historical context of the work.

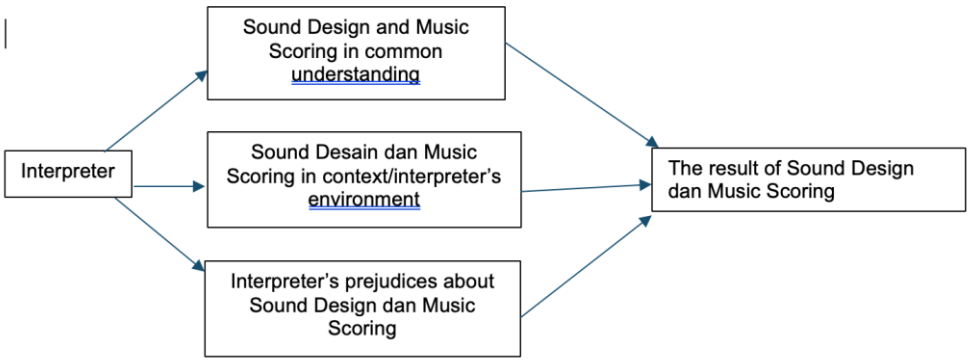


Figure 1. Interpretation scheme based on Gadamer's Hermeneutic and Schafer's Sound Theory

The philosophical hermeneutics proposed by Gadamer can be applied to the interpretation of sound design and music scoring, which allow for subjective interpretation. Gadamer permits interpreters to contribute their own preconceptions while also considering established interpretations and contextual factors. The following is a schematic of Gadamer's hermeneutic framework for interpreting sound, which is closely aligned with Schafer's view of soundscape as an integral part of the environment.

In this framework, the experience of sound is conceptualised as a language or text that can be interpreted based on a universal consensus. Furthermore, the interpretation of sound is contingent upon the narrative context or the environmental context of the interpreter. Concurrently, the interpreter is empowered to incorporate their subjectivity or preconceptions, shaped by personal experiences, into their interpretation. The role of sound can be described as follows:

4.1 Hermeneutics and Sound Design

a. Sound Experience as Language

The role of sound in film is not merely to enhance realism; rather, it can convey symbolic meaning that is open to interpretation by the audience. For instance, the sound of a ticking clock in a tense scene may symbolise the passage of time, anxiety, or an impending threat. In hermeneutics, each sound can be regarded

as a form of 'text' open to interpretation, where certain sounds evoke profound cultural or emotional contexts.

b. Contextualisation of Sound

The hermeneutic approach underscores the significance of contextualisation in comprehending meaning. In the field of sound design, the manipulation of sound can be used to create a specific ambience and to influence the emotional responses of the audience. The effectiveness of this approach is contingent upon the context of the film in question. To illustrate, the sound of trickling water may evoke disparate meanings in a scene of character reflection as opposed to one depicting a natural disaster. The meaning perceived by the audience is contingent upon the narrative context.

c. Dialogue between Audience and Sound

Furthermore, hermeneutics elucidates the significance of prejudices or preconceptions in interpretation. It is erroneous to assume that audiences enter a film with a blank slate; they inevitably bring their own experiences, culture, and knowledge to their film experience. For example, the sound of rain may evoke nostalgia or calmness, depending on the audience's personal experiences. This illustrates that sound interpretation is always subjective and shaped by social and psychological factors.

4.2 Hermeneutics and Film Music

As an emotional enhancer in film, music acts as part of the narrative, providing emotional context to specific scenes. Melancholic music in a farewell scene, for example, creates a dialogue between image and sound, guiding the audience to understand the emotional intensity of the moment. Hermeneutics allows us to see how music 'speaks' to the audience, adding layers of interpretation that are not directly conveyed through dialogue or visuals. Film music can be seen as a form of text that conveys the emotions of the events in the film.

a. Musical intertextuality

Film music often refers to previous genres, styles or compositions, creating a rich intertextuality. Audiences respond to film music based on their familiarity with these references. For example, classical music in a battle scene can create an ironic contrast, adding complex meaning by juxtaposing musical tradition with the violence on screen. Hermeneutics helps us to understand how music works as a "text within a text", building visual depth within the film.

b. Ambiguity and musical interpretation

Music often conveys messages that are ambivalent or ambiguous. Hermeneutics encourages the audience to actively interpret musical compositions. Viewers are free to interpret the relationship between musical elements and emotions within the narrative, with interpretations varying according to individual and cultural backgrounds. This creates a unique viewing experience, allowing each viewer to engage with the film in their own way.

5. CONCLUSION

Gadamer's philosophical hermeneutics allows the audience the freedom to openly interpret the film. Key aspects to consider in this interpretive process include: (1) the

meaning of sound design and film scoring (sound) within the narrative or cultural context of the film, (2) the meaning of sound design and film music (sound) within a general understanding, and (3) the subjective meaning of sound design and film music influenced by each viewer's individual background.Philosophical hermeneutics shows that sound design and film music not only serve technical purposes, but also act as symbolic media that enrich the meaning, narrative and emotion of film. Sound and music are not merely supplementary elements, but integral parts of the audience's cinematic experience, allowing viewers to engage in an open dialogue with the sounds within a film.Hermeneutics creates a space to understand how sound design and scoring in film are not only representations of reality, but also fields of interpretation where meaning continues to expand indefinitely. This expansion occurs through the complex interaction between sound, music, visuals, and the audience's experience.

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BUSINESS STRATEGY FORMULATION AND ITS IMPACT ON DIGITAL MARKETING (CASE STUDY ON WARUNG PETANI'S AND CATERING)

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ABSTRACT

Warung Petani's and Catering is a restaurant located in the Karangasem area which was built with the concept of simplicity, namely a restaurant that prioritizes simple dishes with high quality. This restaurant has experienced a decline in the number of visits in recent years but always trying to survive amidst quite tight competition. This business needs to analyze the threats, opportunities, strengths and weaknesses that exist to deal with the problem of decreasing number of visits. This study aims to design a business strategy by analyzing the internal and external environmental conditions of the Warung Petani's and Catering business. Located on Jl. Veteran, Padang Kerta Village, Karangasem District, Karangasem Regency. The analysis technique used is the IFAS-EFAS Matrix. The results of the study indicate that the company's current business strategy is in quadrant V. This means that the company's correct business strategy to implement is the hold and maintain strategy by means of market penetration and product development.

Keywords: *Internal Eksternal Matrix (IE), Business Strategy, Market Penetration, Product Development, Digital Marketing*

1. INTRODUCTION

Indonesia has abundant natural resources in the plantation and agricultural sectors; these two sectors are the main gateways to the primary human needs sub-sector, namely food (Hutabarat, 2015). Culinary businesses have now emerged in society: various types of food and beverage businesses are increasingly popular among start-up businesses (Erwin et al.,2023). The development of culinary businesses has also increasingly created a tight competitive space for culinary business actors, thus requiring business actors to be more flexible and sensitive to various changes (Nasution et al., 2021). Culinary businesses that emerge from society, in addition to requiring a solid development strategy in order to survive, must also follow current trends to innovate.

Table 1. Number of Eateries/ Restaurants in Karangasem Regency 2020-2023

Year	Number of Restaurants
2020	113
2021	125
2022	127
2023	157

Source : BPS Statistics Karangasem Regency

The table above shows the increase in culinary businesses in Karangasem which can be seen from 2020-2023. This is a concern for entrepreneurs engaged in the culinary field. The development of the area has brought significant changes in the food and beverage industry, especially in terms of ideas and creations. The emergence of various new foods with unique and innovative names encourages

competition between producers to present competitive products and meet consumer needs. In addition, Bali, which is a tourism area, is closely related to culinary businesses. In the global tourism industry, culinary tourism is an important aspect, especially in the current era, because tourists are increasingly interested in experiencing and exploring the culinary richness of an area (Veronica & Facrureza, 2024). Culinary businesses indirectly encourage the development of culinary tourism, which can be a unique feature of a region. Culinary-related tourism not only considers food as its subject and medium but also uses it as a goal and means to encourage the growth of regional tourism.

Warung Petani's and Catering is one of the companies engaged in the culinary field located in Karangasem Regency. Warung Petani's and Catering was established in 2015 and has developed a business that was initially only a restaurant, but is now also engaged in catering and new restaurant branches. Warung Petani's and Catering and many companies in the culinary field Post Covid-19 experienced a drastic decline in sales. During the recovery period, now many new culinary business entrants have started to. This is a special concern for Warung Petani's and Catering.

Tabel 2. Number of visits to Warung Petani's and Catering

Year	Number of visits
2018	25.920
2019	18.640
2020	7.200
2021	11.520
2022	14.400
2023	17.550

Source : Processed Data Manager

The data above shows a decrease in the number of visits from 2018-2020 and an increase in 2021-2023, but this increase has not reached the highest point of the number of visits in the previous year. The usefulness of determining a business strategy in facing competition is to form and implement strategic steps that can improve the company's competitive position among its competitors, and can influence the company's long-term development (Kaban, 2017). The purpose of this study is to determine the IE position of Warung Petani's and determine the right strategy to face this position in developing and implementing consistent and efficient operational standards.

2. RESEARCH METODOLOGY

This study uses a conceptual approach to strategic management with the research object being the business strategy of Warung Petani's and Catering. The research method uses a qualitative descriptive method that is useful for solving actual problems and focusing on real problems. Based on the need to determine the strategy business development, EFE (External Factor Evaluation) and IFE (Internal Factor Evaluation) matrices can be effective alternative tools (Alamanda et al, 2019). Data collection is done by direct observation, interviews, and literature studies. respondents in this study were the owner and manager of Warung Petani's and Catering. In formulating strategies using the IFE matrix consisting of strength and weakness factors and the EFE matrix consisting of company opportunity and threat factor. Using IFE and EFE matrix can be one way to determine the right strategy in dealing with conditions based on the company's internal and external factors (Saputra & Alamsyah, 2023).

The decision to choose the best strategy is based on the results of the IE matrix analysis as in Table 2.

Table 3. IE Matrix Table

		IFE		
		Strong 3,0-4,0	Average 2,0 – 2,99	Weak 1,0 – 1,99
EFE	High 3,0 – 4,0	I Growth & Build	II Growth & Build	III Hold & Maintain
	Medium 2,0 – 2,99	IV Growth & Build	V Hold & Maintain	VI Harvest or Divest
	Low 1,0 – 1,99	VII Hold & Maintain	VIII Harvest or Divest	IX Harvest or Divest

Source : David *et al*., (2020:207)

3. RELATED RESEARCH

The parameters used are the company's internal parameters and external influences faced by the company. The purpose of using this model is to obtain a business strategy. According to Nawawi (2017:175) the internal matrix carried out by analysis and evaluation is useful for determining the strengths and weaknesses of resources within the organisation so that they have an impact on organizational performance. The external matrix carried out by analysis and evaluation, however, is to determine opportunities that can be utilised, and threats that must be overcome against operational, national, and global environmental conditions that are predicted as initial ideas that have a direct and/or indirect relationship to company performance.

There are several alternative strategies that can be used by companies according to David *et al* (2020:158), namely: Integration Strategies, Intensive Strategies, Diversification Strategies and Defensive Strategies. Company strategy is the company's marketing goals and objectives combined into one comprehensive plan to: increase sales, create sustainable growth for the company, understand what customers want, meet needs and exceed customer expectations, and strengthen relationships with target customers (Pandey *et* al., 2023).

Digital marketing is the application of the internet and related digital technologies to traditional communication methods to achieve marketing goals (Widodo & Oktarina, 2023). Social media and digital technology provide many new opportunities for marketers or sellers to verify marketing mix strategies, develop new channels, create new market positions, build relationships to increase innovative steps, overcome distance and time barriers, and provide access to products and services instantly and continuously. Digital marketing has revolutionized business practices globally, particularly in reaching and engaging consumers through various online platforms (Olugbenga, 2024)

4. RESULTS AND DISCUSSION

The analysis conducted in the internal environment examines the factors that exist in Warung Petani's and Catering, namely the strengths and weaknesses presented in Table 4.

Table 4. IFE Matrix of Warung Petani's and Catering

Strategic Internal Factor	Currently (2024)			The Future (2025-2029)		
	Weight	Rating	Score	Weight	Rating	Score
Strength						
Owner are directly involved in the day to day management process	0,13	4	0,52	0,13	4	0,52
Uniqueness of taste and presentation of food	0,12	3	0,36	0,13	3	0,39
Comfortable and relaxed atmosphere in enjoy food	0,11	4	0,44	0,12	4	0,48
The variety of menus offered	0,11	3	0,33	0,12	4	0,48
Adequete facilities for carry out the event	0,09	3	0,27	0,10	3	0,30
Using a system to manage company finances	0,09	3	0,27	0,12	3	0,36
Sub Total	**0,65**		**2,19**	0,72		**2,53**
Weakness						
Promotion is not optimal	0,13	1	0,13	0,07	2	0,14
Unable to apply time management	0,11	1	0,11	0,10	1	0,10
Limited number and capabilities of employees	0,06	2	0,12	0,04	1	0,04
Inadequate parking space	0,05	2	0,10	0,07	2	0,14
Sub Total	**0,35**		**0,46**	0,28		**0,42**
Grand Total IFE Matrix	1,00		**2,65**	1,00		**2,95**

Source: Processed data, 2024

The biggest weakness faced by Warung Petani's and catering is a promotion that is not optimal. Promotion has the highest score, which is 0.13. In this case, Warung Petani's and Catering are still not able to carry out the right marketing strategy. Limited team capabilities in implementing marketing strategies, advertising and promotion of Warung Petani's and Catering are still lacking. This is in line with the findings of Subaktilah *et* al., (2018), where the lack of promotion and marketing reach is an internal weakness in Bumi Asih SMEs. In Predictions for 2029, Warung Petani's biggest weakness are suboptimal promotion and inadequate parking space, namely 0.14.

The analysis conducted in the external environment examines the key factors that exist, namely opportunities and threats.

Table 5. EFE Matrix of Warung Petani's and Catering

Strategic External Factors	Currently (2024)			Future (2025-2029)		
	Weight	Rating	Score	Weight	Rating	Score
Opportunity						
The development of the tourism industry in Karangasem	0,14	4	0,56	0,14	4	0,56
There is cooperation with agencies and offices	0,14	3	0,42	0,14	4	0,56
Well- established relationships with suppliers	0,13	4	0,52	0,13	4	0,52

There is support the government in mentoring and training	0.11	3	0,33	0,11	3	0,33
Sub Total	**0,52**		**1,83**	**0,52**		**1,97**
Threats						
New Competitors in the culinary business	0,14	2	0,28	0,14	1	0,14
Rapidly changing trends in the culinary industry	0,14	1	0,14	0,12	2	0,24
Fluctuating raw material prices	0,13	1	0,13	0,11	2	0,22
There are changes in regulations or government policies that are not beneficial for managers	0,07	2	0,14	0,11	2	0,22
Sub Total	**0,48**		**0,69**	**0.48**		**0,82**
Grand Total EFE Matrix	**1,00**		**2,52**	**1,00**		**2,79**

Source : Processed data, 2024

Based on table 5, the EFE matrix value is obtained which can be used to determine the opportunities and threats that can be used to formulate the business strategy of Warung Petani's and Catering. According to Hutahaen et al., (2017) if the EFE value is more than 2.5, the company or organization has a high response in responding to external opportunities and threats. The biggest opportunity for Warung Petani's and Catering is the development of the tourism industry in Karangasem with the largest score of 0.56. This opportunity has the potential to increase visitors to Warung Petani's and Catering. Meanwhile, in 2029, Warung Petani's and Catering has great opportunity considering the rapid development of the tourism industry in Karangasem and the existence of cooperation with office institutions. The largest score value, namely 0.56.

The biggest threat to Warung Petani's and Catering is the presence of new competitors in the culinary business with a score of 0.28. This requires the management of Warung Petani's and Catering to think about the right business strategy to achieve competitive advantage. While it is predicted that in 2029, Warung Petani's and Catering will have the biggest threat, namely rapid changes in trends in the culinary industry with a score of 0.24.

Table 6. Company Position and Strategy Options in 2024 and 2029

		IFE		
		Strong	Average	Weak
		3,0-4,0	2,0 – 2,99	1,0 – 1,99
EFE	Tall	I	II	III
	3,0 – 4,0	*Growth & Build*	*Growth & Build*	*Hold & Maintain*
	Currently	IV	V	VI
	2,0 – 2,99	*Growth & Build*	*Hold & Maintain* (2,65 ; 2,52) (2,95 ; 2,79)	*Harvest or Divest*
	Low	VII	VIII	IX
	1,0 – 1,99	*Hold & Maintain*	*Harvest or Divest*	*Harvest or Divest*

Source : David et al., (2020:207)

Based on the IFE and EFE matrix tables, the IFE scores are known as well. The EFE in 2024 is located in the medium quadrant with a quarter value between 2.0 to 2.99 which can then be used to formulate a business strategy that can be a reference or guideline for companies to run their businesses in the future; thus the hold and maintain strategy and the position of the future Warung Petani's and Catering business in 2029 is still in the same position, namely in quadrant V with a quarter value between to 2.99 which means it is still in Hold and Maintain.

These results are in line with research conducted by Mahfud & Yogiana (2017), Heningnurani (2019), Qanita (2020).

The IFE and EFE matrices that have complete weight values can be combined into the IE Matrix so that the position of Warung Petani's and Catering can be known. Based on this, the right strategy to be carried out by Warung Petani's and Catering in quadrant V is Hold and Maintain business strategies that can be carried out such as Market Penetration and Product Development strategies. Referring to these results, Warung Petani's and Catering should try to carry out several business strategies as follows:

1) Market Penetration is a market penetration strategy that seeks to increase market share for existing products or services in the current market through greater marketing efforts (Suhendah et al, 2022). This strategy is widely used alone or in combination with other strategies. Market penetration includes increasing the number of sales forces, increasing advertising expenditures, offering extensive sales promotions or increasing publicity efforts

   Things to do at Warung Petani's and Catering :

   a. Increase promotion through social media such as Instagram, Facebook, Tiktok and create a website.
   b. Hold promotions in the form of discounts on food purchases.
   c. Collaborate with travel agents and companies to expanding the market share of foreign tourists.
   d. Recruiting qualified workers to manage the restaurant

   Rai and Chauhan (2023) said thet technological advancements, businesses are increasingly incorporating digital marketing strategies to broaden customer reach and enhance sales. Digital marketing significantly expands market reach by allowing businesses to connect with a global audience. The internet's vast and borderless nature means that businesses are no longer confined to their local markets (Olugbenga, 2024). The digital marketing strategies that can be implemented are as follows:

   a. Paid Ads: using advertising platforms such as Google Ads, Facebook Ads, or Instagram Ads to reach a wider audience.
   b. SEO (Search Engine Optimization): optimizing a website to make it easier to find from Google search results
   c. Email Marketing: sending newsletters or special offers to existing customers to encourage more or more frequent purchases. Especially to offices and travel communities.
   d. Referral Program: encourage existing customers to recommend a product to friends or family in exchange for incentives, such as discounts or free products.

2) Product Development is a strategy that seeks to increase sales by improving or modifying existing products or services. Product development usually requires large research and development (R&D) expenditures.

   Thing to do at Warung Petani's and Catering:

   a. Innovating in creating food menus
   b. Using alternative raw materials in managing cooking and drinks
   c. Offer a seasonal food menu to attract customers

   The expansion of traditional marketing with digital marketing tools dramatically facilitates the task of exploring a new product, studying demand and promoting an innovative product (Robul et al, 2020). The digital marketing strategies that can be implemented areas follows:

   a. Collaboration with Food Bloggers and Influencer Marketing: in introducing a new menu, restaurants can collaborate with food bloggers and influencers who have a large relevant audience.
   b. Content Marketing : Warung Petani's Restaurant and Catering can create content such as videos or articles that show the process of

creating new menus or the ingredients used to ensure the quality and uniqueness of the product.

5. CONCLUSION

The main strength of Warung Petani's and Catering's strategy is the owner who is directly involved in the daily management process. Warung Petani's and Catering has a relatively good strategy to anticipate internal weaknesses and maximize existing strengths. Warung Petani's and Catering is able to overcome existing threats and is able to maximize the potential opportunities that exist. In the current IE matrix (2024) and the future (2025-2029), it is known that Warung Petani's and Catering is located in quadrant V, namely Hold and Maintain, which means that the company is in a period of growth and is able to make optimal efforts.The right business strategy for a company to implement is the Hold and Maintain strategy by means of market penetration and product development. Steps that can be taken the future is to increase promotion on social media, collaborate with travel agents and companies to expand market share, recruit qualified workers, innovate in creating new food menus, use alternative raw materials and offer seasonal food menus. In addition, it can also carry out digital marketing strategies with paid advertising, SEO, Email Marketing, referral programs, collaboration with food vloggers and content marketing. By integrating digital marketing with market penetration and product development strategies, Warung Petani's and Catering can expand its reach and introduce new products effectively.

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OPTIMIZATION OF C.45 ALGORITHM WITH SPLITTING METHOD FOR TODDLER NUTRITION CLASSIFICATION

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ABSTRACT

Toddler nutritional health is a critical aspect of community development, yet Indonesia continues to face significant challenges in this domain. Posyandu Manukaya Village, a village-level community health service unit, struggles with identifying toddler nutritional status due to manual record-keeping. This study addresses the issue by applying the C4.5 algorithm to classify toddler nutritional status using data from the Tampaksiring I Health Center, comprising a clean dataset of 970 entries. The research adopts the CRISP-DM (Cross Industry Standard Process for Data Mining) framework, with tailored stages including data preparation, model training, and evaluation using confusion matrix. The study identified weight (BB) as the most influential attribute for classification. Among the three attribute separation methods tested, Gain Ratio achieved the best accuracy of 89%, followed by Information Gain at 88%, and Gini Index at 86%. The resulting model was integrated into a simple website using Flask and Joblib, enabling early detection of toddler nutritional status. This research demonstrates the potential of integrating machine learning into public health initiatives and provides a strong foundation for enhancing toddler health monitoring at Posyandu Manukaya Village. Future research should use larger, balanced datasets and more attributes to enhance the model and support early toddler health interventions.

Keywords: *Nutritional status of toddlers, data mining, classification, C4.5 algorithm*

INTRODUCTION

Nutritional health in toddlers is an important aspect of community life. Inadequate nutrition in toddlers can have negative consequences for their growth and development, including intelligence and physical health (Ginting et al., 2022). Therefore, nutritional care for infants and children is a must to prepare a healthy, intelligent, high-quality generation, and reduce mortality rates in infants and children (Marniati, 2021). However, in Indonesia, the problem of nutritional health in toddlers is still a worrying issue. The results of the 2022 Indonesian Nutrition Status Survey (SSGI) showed a prevalence of stunting of 21.6%, wasting 7.7%, underweight 17.1%, and overweight 3.5% (Kementerian Kesehatan RI, 2016). These data indicate the need for further attention to steps to improve the nutritional status of toddlers in Indonesia. Providing counseling and weighing toddlers is an important step to provide information to parents about toddler nutrition and health. This aims to increase toddler resistance to disease. Efforts to improve nutritional status throughout life, especially for infants, toddlers, adolescent girls, and pregnant and lactating mothers, are regulated in Article 142 of the Health Law of the Republic of Indonesia Number 36 of 2009 (Republik Indonesia, 2009). The government is responsible for setting nutritional standards, providing nutritional services, ensuring nutritional resources, and providing accurate nutritional education to the community (Republik Indonesia, 2009). Therefore, quality health services are very important in maintaining nutrition.

Tampaksiring I Health Center assists the integrated health post in Manukaya Village, especially in stimulation, detection, and early intervention of toddler development. Currently, Tampaksiring I Health Center still uses a manual approach to determine the nutritional status of toddlers, namely by calculating the z-score of the Anthropometry index. This process takes a long time because the results are matched with the category table and thresholds set in accordance with the Regulation of the Minister of Health Number 2 of 2020. Therefore, a more efficient approach is needed. One approach is to utilize the classification method in data mining. Classification in data mining is expected to be able to optimize the process of calculating the nutritional status of toddlers more efficiently. The C4.5 algorithm can be used to build decision trees, grouping data into different categories or classes based on certain attributes (Muslim et al., 2019).

Based on the problems that have been identified, this study will focus on the implementation and analysis of the performance of the C4.5 algorithm in classifying the nutritional status of toddlers. The analysis will be conducted using a 1043 gross dataset from Tampaksiring I Health Center. This study will test several methods of selecting splitting attributes such as Information Gain, Gain Ratio, and Gini Index, in forming a decision tree. The accuracy of the model will be measured using a confusion matrix. It is hoped that this study can provide an in-depth understanding of the performance of the C4.5 algorithm in various data splitting scenarios for the classification of toddler nutritional status and improve the effectiveness of toddler health monitoring at the Manukaya Village Posyandu.

STATE OF THE ART

1. Data Mining
   Data Mining is an analysis process that aims to identify pattern relationships in big data using statistical techniques, mathematics, artificial intelligence, and machine learning. The data mining process involves processing raw data, transforming it into information, and recognizing patterns to gain useful knowledge (Muslim et al., 2019; Witten et al., 2011).
2. Dataset
   A dataset is a collection of data consisting of objects with certain attributes or variables. Each object in the dataset represents an individual with the attributes measured or observed (Muslim et al., 2019).
3. Classification
   Classification in data mining is the process of finding patterns in data to separate categories and predict the category of a class of unknown objects. This process consists of a learning stage and a classification stage (Muslim et al., 2019; Rajoub, 2020; Witten et al., 2011).
4. Decision Tree C4.5
   The C4.5 algorithm is used in data mining to design Decision trees. This algorithm selects the best attributes at each Step of Decision tree construction using metrics such as Information Gain, Gain Ratio, and Gini Index (Muslim et al., 2019; Witten et al., 2011).
5. Information Gain
   Information Gain is utilized in the Decision tree algorithm to assess which attribute is most optimal to use as a split at a node. Information Gain measures the decrease in the level of uncertainty or entropy after data splitting is done based on a particular attribute. The higher the Information Gain value, the more effective the attribute is in splitting data (Muslim et al., 2019; Witten et al., 2011).

Information Gain calculation formula:

$$Info\ (D) = -\sum_{i=1}^{m} Pi \log_2 (pi) \quad (1)$$

$$Info_A(D) = \sum_{j=i}^{v} \frac{|Dj|}{|D|} x\ info(D_j) \quad (2)$$

$$Gain(A) = Info(D) - Info_A(D) \quad (3)$$

Description:
D = The Dataset
m = The number of classes in dataset
Pi = The proportion of instances in class i relative to the total dataset.
A = An attribute used to split the dataset.
v = The number of subsets created by splitting D using attribute A.
$| Dj |$ = The number of data points in subset Dj.
$| D |$ = The total number of data points in the original dataset.
$Info\ (D)$ = The entropy of the original dataset.
$Info_A(D)$ = The weighted entropy of the subsets created by splitting the dataset on attribute A.
Dj = Subset j of the dataset after the split.
$Gain(A)$ = The amount of information gained by splitting the dataset using attribute A.

6. Gain Ratio

Gain Ratio is an enhancement of the normalized Information Gain method to handle situations where an attribute has many values or categories. When an attribute has many different values or categories, Information Gain tends to favor that attribute. Gain Ratio overcomes this bias by dividing Information Gain by Split Information. Split Information measures how well an attribute divides the data without considering the class label (Muslim et al., 2019; Witten et al., 2011).

Gain Ratio calculation formula:

$$SplitInfo_A(D) = -\sum_{j=i}^{v} \frac{|Dj|}{|D|} x\ log_2 \left(\frac{|Dj|}{|D|}\right) \quad (4)$$

$$GainRatio(A) = \frac{Gain(A)}{SplitInfo_A(D)} \quad (5)$$

Description:
$log2$ = Logarithm with base 2, used to calculate entropy.
$-\sum$ = Summing the negative entropy values of all subsets Dj gives the total entropy for the dataset split.
SplitInfoA(D) = The proportion of instances in class i relative to the total dataset.

7. Gini Index

The Gini Index measures impurity or how mixed the classes are in each section when dividing data based on an attribute. The lower the Gini Index value, the more effective the attribute is in separating the data (Muslim et al., 2019; Witten et al., 2011).

Gini Index calculation formula:

$$Gini(D) = 1 - \sum_{i=1}^{m} P^2 i \quad (6)$$

$$Gini_A(D) = \frac{|D1|}{|D|} Gini(D1) + \frac{|D2|}{|D|} Gini(D_2) \quad (7)$$

Description:
$D1, D2$ = The subsets created by splitting the dataset D using attribute A.

$|D1|, |D2|$ = The number of instances in subsets D1D and D2D, respectively.
$Gini(D)$ = Calculate the impurity level of each data partition.
$Gini_A(D)$ = Gini Index measurement.

8. Confusion Matrix
   Confusion matrix is a technique used in predictive analysis of classification models to show the correct and incorrect prediction results in a binary classification task. This matrix helps in calculating performance metrics such as accuracy, precision, recall, and F1-score (Markoulidakis et al., 2021).
9. Related Research
   This study was compiled based on previous research that has been conducted in a similar field. Several studies that are the main references include research conducted by Hajar Izzatul Islam and colleagues (2022) which revealed that the application of the C4.5 algorithm in monitoring the nutritional status of toddlers produced a classification model with 90% accuracy, precision, recall, and F1-score of 87% using the SMOTETomek technique (Islam et al., 2022).
   Previous research conducted by Marini, Heru Satria Tambuna, Zulia Almaida Siregar, Gus Perdana Windarto, and Fitri Rizki (2022) revealed that research using the C4.5 algorithm to classify the nutritional status of toddlers at the Gunung Maligas Posyandu can help identify factors that influence malnutrition and undernutrition, and support efforts to address nutritional problems in children in developing countries (Marini et al., 2022).
   Previous research conducted by Hananda Hafizan and Anggita Nadia (2020) which tested the effectiveness of the C4.5 algorithm in determining the nutritional status of toddlers at the Kenanga Posyandu, Simalungun Regency, which obtained a high accuracy of 100% from the RapidMiner software (Hafizan & Putri, 2020).
   Previous research conducted by Mahfuz, Amri Muliawan Nur, L M Samsu (2022) which highlighted the importance of the C4.5 Algorithm in monitoring the nutritional status of toddlers at the Posyandu and achieved an accuracy result of 97.02% with 4 attributes with an AUC value from the decision tree of 0.928 (Mahpuz et al., 2022).
   Previous research conducted by Sri Mujiyono and Novan Syaiful (2023) which tested the efficiency of the C4.5 Algorithm in producing decision trees to handle numeric and categorical attributes with an accuracy score of 84.22% and 91.40% from the RapidMiner software (Mujiyono & Syaiful, 2023).
   Referring to the literature from previous studies, it can be concluded that the C4.5 algorithm is effective in classifying the nutritional status of toddlers. The novelty of this research includes: 1) The number of datasets used; 2) Types and attribute labels used; 3) Implementation of the C4.5 algorithm model testing experiment using three data splitting techniques.

RESEARCH METHODOLOGY

The method used in this study is the Cross Industry Standard Process for Data Mining (CRISP-DM) method. CRISP-DM is a process model designed to guide and structure data mining or data science projects. This model provides guidance on the steps that should be taken in a data science project from start to finish (Data Science Process Allieance, 2021; Matthew, 2012; Schröer et al., 2021).

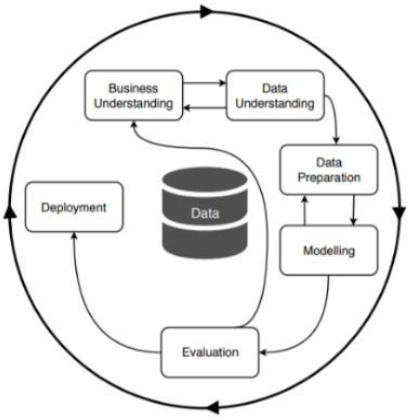


Figure 1. Research Method

For this study on toddler nutritional status classification. The detailed research flow is as follows:

1. Business Understanding
   In this phase, the author details and understands the conditions and problems found in the research object in order to determine the research objectives, identification of problems is carried out by conducting unstructured interviews with the head of the hamlet of Br. Belahan, then the author conducts a study of related literature to overcome the problems found. The results of the main problems obtained are that the posyandu cadres in Manukaya village lack the ability to calculate the Z-Score to determine the nutritional status of toddlers, so that the classification label of the results of the nutritional status of toddlers cannot be known directly in manual recording of the Anthropometric index. With these problems, the author aims to apply the data mining method with the C4.5 algorithm to produce a model that can be used to help determine the label of the results of the nutritional status of toddlers.
2. Data Understanding
   In this phase, the author collects and analyzes data to evaluate data quality. Dataset collection is carried out with documentation involving data searches available at the Tampaksiring I Health Center related to early detection of nutritional status of toddlers totaling 1043 gross datasets.
3. Data Preparation
   In this phase, the author determines the dataset, attributes, conducts data exploration, and cleaning dataset. In determining the attributes, the author first conducts an analysis of the relationship between attributes, so that it can be determined which attributes will be used, namely age, gender, weight, and height of toddlers.
4. Modelling
   In this phase, the author uses the data mining method with the C4.5 algorithm as a model in the process of searching for patterns or knowledge from the specified dataset. The model is created with the number of data splitting with a ratio of 80% training data and 20% testing data. The data mining process also includes testing several data division techniques (splitting) to determine the separation attributes in the decision tree, such as information gain, gain ratio, and gini index.
5. Evaluation
   In this phase, the model that has been created will be evaluated using a confusion matrix to identify true positive, true negative, false positive, and false negative values in a model. The results of the evaluation can be used to determine the accuracy, precision, recall, and f1-score values. The criteria set to determine whether the resulting model can be implemented are if the model's accuracy value is greater than (>) 85%. The data splitting technique with the best accuracy

will also be selected to be implemented into an information system in the form of a simple website using the Flask framework in Python.

6. Deployment
   In this phase, the best model results will be implemented into an information system in the form of a simple website using the Flask framework in Python. This implementation is expected to help Posyandu officers in Manukaya Village in conducting interventions and early detection to determine the evaluation label for the results of the classification of toddler nutritional status more efficiently.

RESULTS AND DISCUSSION

If we look at the number of each nutritional status in Table 2 below. This dataset can be called an imbalance dataset because there is a very clear dominance of the Good Nutrition category.

Table 1. Dataset Information

Column	Dataset Count	Data Type
JK	970	Categorical
Umur_Bulan	970	Numerical
BB	970	Numerical
TB	970	Numerical
Status	970	Categorical

Table 2. Dataset Information by Status Gizi Count

Status	Gizi Baik	Risiko Gizi Lebih	Gizi Lebih	Obesitas	Gizi Kurang
Total	720	176	44	16	14

Table 3 below shows that the Gain Ratio model is the best overall with the highest accuracy and good performance in most categories. The Information Gain model is also very good and almost on par with Gain Ratio, especially in weighted average precision and recall. The Gini Index model has a lower performance than the other two models.

Table 3. Model Accuration

Model	Precision	Recall	F1-Score	Akurasi
Information Gain	0,88	0,88	0,87	88%
Gain Ratio	0,89	0,89	0,89	89%
Gini Index	0,86	0,86	0,85	86%

Table 4. Decision Tree Root Node

Information Gain	Gain Ratio	Gini Index
BB <= 16,95	BB <= 16,95	BB <= 16,95
Entropy = 1.132	Entropy = 1.132	Entropy = 1.132
Samples = 776	Samples = 776	Samples = 776
Value = [13, 34, 12, 132]	Value = [13, 34, 12, 132]	Value = [13, 34, 12, 132]
Class = Gizi Baik	Class = Gizi Baik	Class = Gizi Baik

From the results of each decision tree root in Table 4, the most influential attribute is body weight (BB ≤ 16.95). Discussions with Midwives at Tampaksiring I Health Center showed that body weight has a significant influence in determining the category of nutritional status and can be used for general nutritional status evaluation on the BB/TB index or Body Mass Index (BMI).

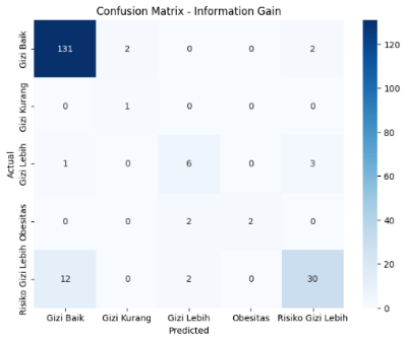


Figure 2. Confusion Matrix Information Gain

In Figure 2, the main diagonal of the Information Gain model matrix shows the number of accurate predictions for each class: 131 for Well-Nutritioned, 1 for Under-Nutritioned, 6 for Over-Nutritioned, 2 for Obese, and 30 for Risk of Over-Nutrition. Elements outside the main diagonal record the model's prediction errors.

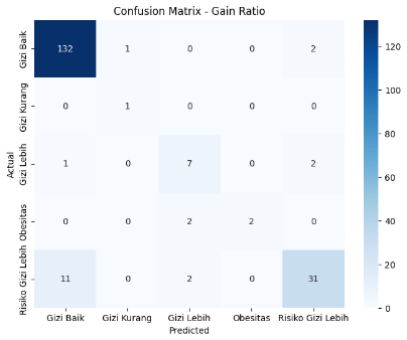


Figure 3. Confusion Matrix Gain Ratio

In Figure 3, the main diagonal of the Gain Ratio model matrix shows the number of accurate predictions for each class: 132 for Well-Nutritioned, 1 for Under-Nutritioned, 7 for Over-Nutritioned, 2 for Obese, and 31 for Risk of Over-Nutrition. Elements outside the main diagonal record the model's prediction errors.

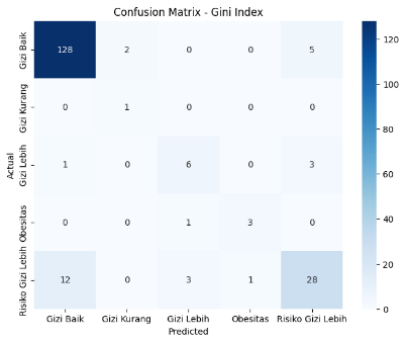


Figure 4. Confusion Matrix Gini Index

In Figure 4, the main diagonal of the Gini Index model matrix shows the number of accurate predictions for each class: 128 for Well-Nutritioned, 1 for Under-Nutritioned, 6 for Over-Nutritioned, 3 for Obese, and 28 for Risk of Over-Nutrition. Elements outside the main diagonal record the model's prediction errors.

Table 5. Model Accuration Based from Status Gizi

Status Gizi	Model	*Precision*	*Recall*	*F1-Score*	*Support*
Gizi Baik	Information Gain	0,91	0,97	0,94	135

Status Gizi	Model	*Precision*	*Recall*	*F1-Score*	*Support*
	Gain Ratio	0,92	0,98	0,95	135
	Gini Index	0,91	0,95	0,93	135
Gizi Kurang	Information Gain	0,33	1,00	0,50	1
	Gain Ratio	0,50	1,00	0,67	1
	Gini Index	0,33	1,00	0,50	1
Gizi Lebih	Information Gain	0,60	0,60	0,60	10
	Gain Ratio	0,64	0,70	0,67	10
	Gini Index	0,60	0,60	0,60	10
Obesitas	Information Gain	1,00	0,50	0,67	4
	Gain Ratio	1,00	0,50	0,67	4
	Gini Index	0,75	0,75	0,75	4
Risiko Gizi Lebih	Information Gain	0,86	0,68	0,76	44
	Gain Ratio	0,89	0,70	0,78	44
	Gini Index	0,78	0,64	0,70	44

In Table 5, it can be seen that for Good Nutrition status, all models show very good performance with high F1-score values. Although recall for Undernutrition status is high, precision remains low due to limited sample size. For Overnutrition status, model performance is consistent, but precision and recall still need to be improved. In the context of Obesity, the models show high precision but low recall except for the Gini index model, which can cause overfitting. Overnutrition Risk status shows varying performance with Gain Ratio as the best metric. Although the dataset is imbalanced, the C4.5 algorithm is effective in overcoming it. The test results show that although some nutritional status labels have low precision and recall, the model is still able to predict the labels accurately after manual testing using 14 dataset samples for each label. This shows that despite the challenges in data imbalance and performance variation, the C4.5 algorithm still provides adequate results.

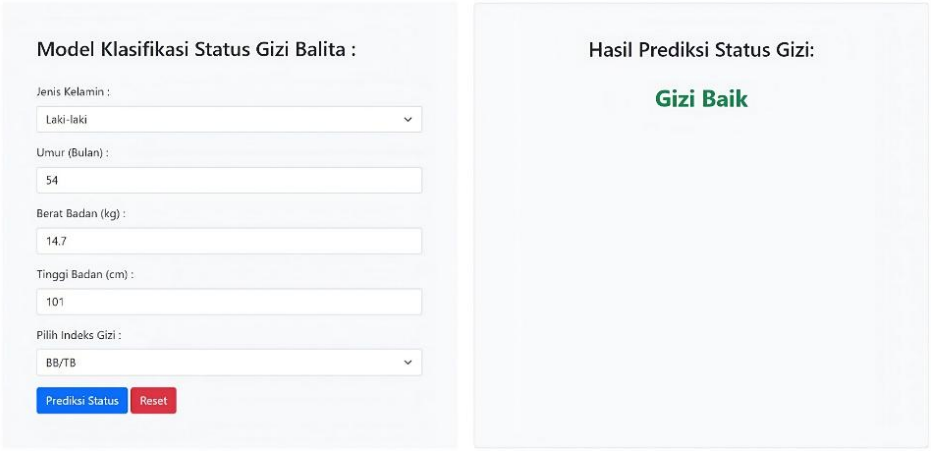


Figure 5. Website Implementation

Figure 5 shows a simple website interface for early detection of nutritional status of toddlers implemented with the Flask framework in Python. This interface is a form where users enter data such as gender (Male, Female), age (months), weight (kg), and height (cm). After the data is entered, users can click the "Predict Status" button to get the prediction results or the "Reset" button to clear the form. This website also has a feature for selecting nutritional status assessment indices. In this study, only the measurement labels for the classification of nutritional status of toddlers based

on the BB/TB index were used. However, this website was also developed to predict the nutritional status of toddlers with TB/U and BB/U indices.

CONCLUSION

Based on the results of the application of data mining with the C4.5 algorithm for the classification of nutritional status of toddlers at the Posyandu in Manukaya Village, the effectiveness of three attribute separation methods was evaluated: Information Gain, Gain Ratio, and Gini Index. The dataset used consisted of 970 data on nutritional status of toddlers from the Tampaksiring I Health Center. The conclusions of the study are as follows:

1. The C4.5 algorithm was successfully applied in the classification of nutritional status of toddlers based on the dataset from the Tampaksiring I Health Centre. Decision tree analysis showed that the weight attribute (BB) was the most influential and was used as the root. This was confirmed by the midwife at the Tampaksiring I Health Centre. This model was then applied to a simple website for early detection of nutritional status of toddlers, with model storage using the Joblib module in Google Colab and website implementation using the Flask framework in Python.
2. Of the three attribute separation methods tested, the Gain Ratio model showed the best performance with an accuracy of 89% and the highest weighted average precision, recall, and F1-score. The Information Gain model has an accuracy of 88% with performance close to Gain Ratio in the weighted average of precision, recall, and F1-score, in accordance with the theory that Gain Ratio is an improvement of Information Gain. The Gini Index model has an accuracy of 86% with a weighted average of precision, recall, and F1-score which is quite good but not as good as the other two models, especially in handling imbalanced datasets with many category labels.

Based on the results of the research and evaluation of the performance of the toddler nutritional status classification model, the following suggestions can be considered:

1. The Gain Ratio method is recommended for use in the early detection model for toddler nutritional status because it provides the best overall accuracy and performance. The Information Gain model can also be considered as an alternative. The Gini Index model can be considered for balanced datasets with fewer category labels, but further evaluation is still needed before implementing the model.
2. It is recommended to conduct model trials with larger, more balanced datasets and use more varied attributes to improve model performance in detecting and conducting early interventions for toddler nutritional health. Model development trials can also be conducted for the TB/U and BB/U indices.

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REIMAGINING MALACCA'S HERITAGE SHOPHOUSES: ADAPTATIONS FOR TOURISM SUPPORTING FACILITIES

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ABSTRACT

Malacca City, a UNESCO World Heritage Site since 2008, represents a rich tapestry of multicultural and colonial history. The city's heritage shophouses, exemplifying architectural styles influenced by Portuguese, Dutch, British, and Chinese traditions, play a vital role in preserving its identity. This study explores the adaptive reuse of these shophouses, focusing on their transformation into tourism-supporting facilities such as homestays and cafés. Case studies of Ohana House, a boutique homestay, and Ban Kheng Café highlight how minimal intervention and architectural harmony maintain historical integrity while accommodating contemporary tourism needs. The findings emphasize the balance between preservation and modernization, achieved through minimal alterations, strategic reuse of spaces, and maintaining visual compatibility. Challenges such as utility limitations and sustainability issues persist, underscoring the need for innovative solutions to enhance both operational efficiency and visitor experience. Recommendations include integrating sustainable technologies and expanding cultural offerings to enrich the heritage tourism experience while safeguarding Malacca's unique identity. Overall, this research demonstrates the potential of heritage conservation to contribute to sustainable urban development, cultural preservation, and economic growth in historic settings like Malacca.

Keywords: *Malacca city, adaptive reuse, heritage shophouse*

1. INTRODUCTION

Malacca City, Malaysia, is a vibrant repository of the nation's colonial and trading history, shaped by successive Portuguese, Dutch, and British occupations (Winstedt, 1948; UNESCO, 2009). Established in the 15th century by Prince Parameswara, it grew from a regional Malay kingdom into a melting pot of Malay, Chinese, Peranakan (Baba Nyonya), Chetti (Peranakan Indian), and Portuguese Eurasian (Kristang) cultures (Amat, 2019). The Malacca River divides the city into administrative, residential, and commercial zones, reflecting its layered history. This rich cultural and historical amalgamation earned Malacca UNESCO World Heritage status in 2008, highlighting its importance as a hub for cross-cultural exchange and trade between East and West for over five centuries (Shamsuddin, 2011).

As a region with significant historical value, Malacca possesses distinctive characteristics shaped by both tangible and intangible elements, which contribute to its place identity. According to Shamsuddin (2011), architectural heritage is a critical tangible element that plays a vital role in defining the identity of a historical site. A prominent feature of Malacca's architectural heritage is its traditional shophouses—narrow, elongated terraced buildings with commercial spaces on the ground floor and residential quarters above (Wagner, 2017). These structures, influenced by Dutch, Portuguese, and Chinese designs, reflect colonial-era

regulations and cultural traditions (Han & Beisi, 2015). This shows how Malacca is able to express its cultural traditions and the simultaneous process of adaptation.

Since gaining UNESCO recognition, the surge in tourism has driven the adaptive reuse of these shophouses into homestays, cafes, and museums. This paper examines the role of adaptive reuse in preserving Malacca's heritage while addressing the needs of contemporary tourism. Specifically, it explores the transformation of shophouses into hotels and cafes, providing insights into how the community balances the demands of tourism with efforts to maintain Malacca's unique place identity.

2. RESEARCH METODOLOGY

This study adopts a qualitative methodology to explore the adaptive reuse of heritage shophouses in Malacca, Malaysia, with a focus on their transformation into tourism-supporting facilities such as homestays and cafes. The research integrates a literature review and field observations to comprehensively analyze adaptive reuse practices within this context. The literature review examines the defining characteristics of heritage shophouses, the principles of adaptive reuse, and tourism industry perspective in historical context. Field observations are conducted on selected heritage shophouses repurposed as homestays and cafes, focusing on modifications made to accommodate modern tourism functions. Data collected through observations include photographs and plan drawings of public areas within these facilities. The findings from the literature review and field observations are then compared to identify trends and preferences in adaptations that align with community practices and tourism demands.

3. RELATED RESEARCH

The Characteristic of Heritage Shophouse in Malacca

Heritage shophouses in Malaysia trace their origins to the early 1600s, initially developed by Chinese traders in Malacca before Dutch colonization (Weebers et al., 2015; Teuling, 2010). These structures evolved significantly under British colonial rule, incorporating eclectic architectural styles influenced by Western regulations and an influx of Chinese laborers, who adapted the designs to balance commercial and residential needs (Zwain & Bahauddin, 2018). Heritage shophouse characterized by narrow, elongated layouts, shophouses were traditionally organized to accommodate both business and family life. Ground floors were used for commercial activities, while upper floors housed living quarters (Tan, 2015). Key features included courtyards for ventilation and prosperity, communal clusters, and distinctive facades with five-foot walkways, shuttered windows, and decorative motifs that often reflected feng shui principles (Zwain & Bahauddin, 2020; Tan, 2015). These design elements symbolized wealth and heritage while also serving functional purposes, such as supporting airflow and public accessibility (Tan & Fujita, 2014; Ismail & Ching, 2016).

Over time, material choices shifted from timber to masonry to improve durability and safety, with early constructions using clay bricks and tiles. By the 20th century, concrete and steel were introduced, allowing taller buildings and more intricate decorations (Baroldin & Din, 2018; Wegner, 2017). These advancements not only modernized the structural resilience of shophouses but also enhanced their aesthetic appeal, ensuring their relevance in evolving urban landscapes.

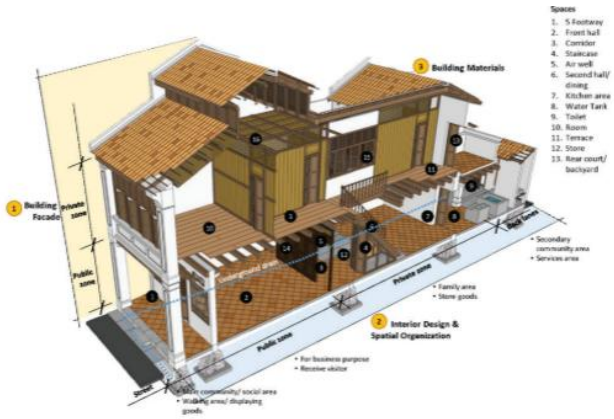


Figure 1. Heritage Shophouse Typical Features
Source: Hakim Zamri et al., 2023

Adaptive Reuse

Adaptive reuse is defined as a major change of a building with alteration of both the building and the function it accommodates. It is a process of building conversion by recycling usable components for the purpose of new use, and a strategy that can be used to preserve its cultural heritage (Abdulameer & Sati'Abbas, 2020). Based on the literature review conducted by Vafaie et al. (2023), there are several factors that impact the success of adaptive reuse from architectural (physical) perspective.

1. **Minimum intervention**: Defining suitable changing level, considering the basic structure and character of the building to be intact
2. **Potential of reversibility**: The new installations should not needlessly damage the building nor limit future adaptations
3. **Explicitness of alterations:** The architectural style after reuse should not falsify the record of the past and new changes should be distinguishable for future generations
4. **Architectural harmony & Visual compatibility:** The compatibility of contemporary extensions with the original building, considering: the contrast of new and old, replication, size and volume, colour and material harmony, the importance of location, and characteristics of surface articulations
5. **Analysis and assessment of structural layout:** The structural alterations to old buildings should be analyzed/assessed by expert consultants for conversion, level of intervention, safety indicators, and historical building envelope (integration, insertion, addition, etc)
6. **Upgrading physical characteristics around:** The reuse project should contribute to the improvement of the physical characteristics of surrounding areas, acting as a catalyst for urban upgrading
7. **Creativity:** The creativity of fitting the contemporary needs and concept of the past into what already exists in the building
8. **Age value of materials:** Considering the "Age Value" of materials and aesthetic qualities of harmony and beauty in decay, patina, disintegration
9. **Building usability:** The importance of suitable infrastructures of the building such as electricity, drainage, mechanical systems, space utilization, lighting, air quality, etc. for future changes
10. **Material durability:** The interior and exterior fabric is constructed with durable materials that could be retained for the building's future new use

Tourism Industry Perspective in Historical Context

According to Aksu et. al. (2010), tourists have their own personal expectations regarding tourist destination chosen, according to the source and attraction pull of an area. A certain expectation could be high or otherwise according to the publicity and marketing conducted in developing a particular tourism destination. Related to accommodation, according to Ab Wahab et al (2023), there are several physical elements that impact the tourist preferences in choosing hospitality facility with adaptive reuse concept:

1. Architectural design: the building façade is conserved and preserved to keep it as original as possible, as with most heritage structures
2. Interior design: the fusion of the past and current offers by the interior design and the heritage building
3. Layout: unique layout design is preserved
4. Location, nearby attraction, accessibility
5. Technology used
6. Room range
7. Leisure facilities

4. RESULTS AND DISCUSSION

This study focuses on two adaptive reuse examples in Kampung Jawa, an area central to Malacca's early urban development. The first is Ohana House, a boutique homestay brand with a "Baba Nyonya" theme celebrating the city's Peranakan heritage. Two branches, Ohana House HQ and Ohana House @31 Jawa, highlight the diversity of accommodations. Ohana House HQ offers 14 uniquely designed rooms for groups ranging from two to 40 guests, catering to varied traveler preferences. In contrast, Ohana House @31 Jawa provides a more intimate setting for up to four guests, featuring a dining area, TV lounge, and other amenities. Both properties are conveniently located near major attractions like Jonker Street, the Baba Nyonya Museum, and popular shopping centers, offering culturally immersive stays while providing practical services such as rentals and daily housekeeping.

The second example is Ban Kheng Café, situated near Ohana House HQ along the Melaka River. Known for its authentic Malaysian cuisine and vibrant atmosphere, the café reflects Malacca's multicultural heritage. Its riverside location and proximity to tourist hubs make it a favorite for visitors and locals alike, offering a blend of traditional flavors and cultural charm. Together, these adaptive reuse projects demonstrate how heritage preservation can be effectively combined with modern tourism needs, enriching the visitor experience while maintaining historical integrity.

Spatial Organization

Spatial organization represents one of the most significant modifications in adapting both the homestay and café for their current functions. Ohana House Melaka, comprising four branches located along Jalan Jawa, maintains close proximity with only a 1-2 minute walking distance between each. As a result, the reception area is centralized at its headquarters (HQ), which also houses a restaurant and souvenir shop within a single multifunctional space. This layout often leads to overcrowding during peak guest arrivals, with overflow occasionally extending to the street. Similar to traditional shophouses, the rear of the HQ contains staff or owner’s spaces and toilet, preserving the historical layout of using the back area for private functions. Meanwhile, the second floor, historically a private residence, has been repurposed into guest rooms.

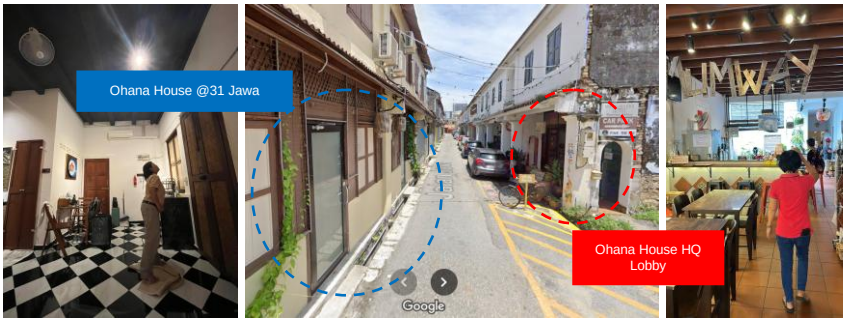


Figure 2. Spatial Connection between Ohana House HQ and @31 Jawa
Source: Modified from gmaps.com

At Ohana House @31 Jawa, there is no transitional space between the exterior wall and Jalan Jawa, creating the impression that the public street serves as the transition area for guests. This lack of an intermediary zone impacts the accommodation's exclusivity and safety, although card access doors have replaced traditional ones for enhanced security. The two-story unit features a pantry, bathroom, and living room on the first floor, while the second floor is dedicated entirely to guest bedrooms equipped with two queen-size beds.

In contrast, Ban Kheng Café utilizes the rear portion of a shophouse with a frontage on Bunga Raya Street, capitalizing on its location along the Melaka River. Access to the café is exclusively through the riverfront pedestrian path, which also doubles as an outdoor seating area, offering direct views of the vibrant riverside lined with colorful buildings and passing boats. This design approach enlivens the previously quiet pedestrian space and enhances safety, inviting passersby to explore the café's offerings displayed in the outdoor commercial area. Inside, visitors first encounter the kitchen, cashier counter, and restroom before entering a spacious seating area. Part of this seating space occupies what was historically a shophouse courtyard. A transparent roof has been installed to allow natural light, preserving the courtyard's openness. The second floor functions as a private area for the owner or staffs, consistent with the traditional zoning of shophouses.



Figure 3. Public spaces in Ban Kheng Cafe

Interior Design

The design of Ohana House Melaka draws inspiration from the Baba Nyonya theme, which embodies the rich cultural heritage of the Peranakan or Straits Chinese community, a legacy of intermarriage between Chinese immigrants and the local Malay population. This theme is prominently reflected in the furniture and décor of the lobby and guest rooms at the Ohana House Headquarters. Intricately carved wooden furniture with floral and animal motifs highlights Baba Nyonya aesthetics, merging Chinese symbolism with Malay craftsmanship. Antiques, vintage family heirlooms, and nostalgic décor elements such as old photographs, brass ornaments, and porcelain vases further enrich the interiors, preserving the cultural heritage. Exposed brick walls in the circulation areas enhance the warm and nostalgic ambiance.

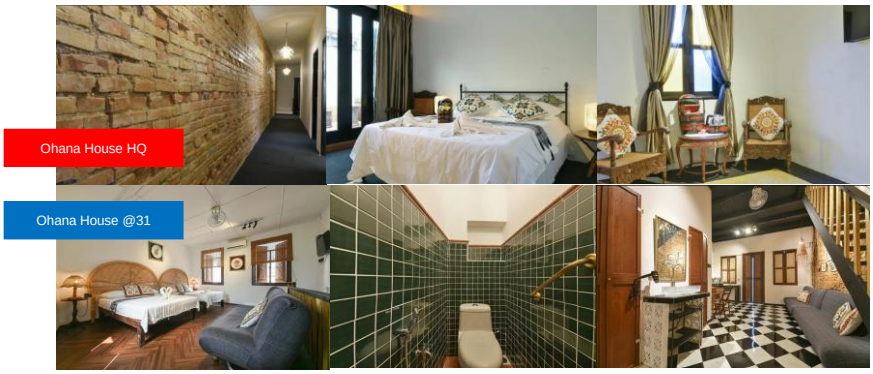


Figure 4. Interior at Ohana House HQ and Ohana House @31 Jawa
Source: https://www.ohanahousehq.com

In contrast, the interior of Ohana House @31 Jawa incorporates contemporary design elements alongside heritage features. Modern touches like rattan beds, glass countertop sinks, and green-tiled bathroom walls reflect current trends, while exposed brick walls are retained to maintain a connection with the historical aesthetic. However, the study highlights challenges in adapting old buildings to modern utilities. Issues such as electrical overloads, water seepage, and non-functional taps illustrate the complexities of balancing functionality, aesthetics, and heritage preservation in renovations.

At Ban Kheng Café, the design leans towards modern practicality while retaining elements of traditional charm. Outdoor seating features durable plastic furniture, while indoor areas utilize wooden furniture to complement the preserved wooden frames and lattices of the shophouse structure. The café emphasizes creating a spacious and airy atmosphere, retaining the courtyard's open design to promote natural ventilation and lighting. Windows on the second floor, connected to the courtyard and exterior, are kept open to facilitate airflow. Transparent roofing over the courtyard and perforated ceilings in the cashier area, paired with fans, enhance both natural and artificial ventilation, ensuring a comfortable and well-lit environment that respects the heritage structure.



Figure 6. Interior at Ban Kheng Cafe

Façade

In the homestay case study, the façade has undergone minimal architectural changes, with modifications primarily focused on space usage and openings. At Ohana House HQ, decorative doors and tinted glass have been added, while the traditional 5-foot covered walkway, originally intended for pedestrian use, is now repurposed for decorative displays and vending machines to emphasize the Baba Nyonya concept. At Ohana House @31 Jawa, the original wooden windows feature has been preserved, with only a modern card-access door installed outside the original wooden door for added security.

In contrast, Ban Kheng Café exhibits more noticeable changes to its façade. The exterior has been repainted in light green, departing from its original white, and the access door now features a mural to attract visitors. Additionally, the café has

integrated an outdoor seating area complemented by hanging lights that create an inviting ambiance, particularly at night. These adjustments align with the café's strategic orientation toward the Melaka River, leveraging its visibility and appeal to attract tourists from various vantage points.



Figure 7. Frontage of Ohana House HQ*, Ohana House @31 Jawa, Ban Kheng Cafe
Source: gmaps.com (*)

Adaptive Reuse Physical Success Factor and Tourist Preferences in Study Cases

The findings from the field observations are then analyzed to determine whether they meet the criteria for adaptive reuse and align with tourist preferences when selecting hospitality facilities in a historical context such as Malacca.

Table 1. Adaptive Reuse Physical Success Factors and Tourist Preferences in Study Cases

Factors	Homestay (Ohana House)	Café (Ban Kheng Café)
Minimum Intervention	**The interventions were minimal**. There is additional steel structure added to strengthen the wooden flooring in the second floor of the guest room, some indoor materials and utility are changed especially in the bathroom. Structure, façade, and materials are preserved	**The interventions were minimal**. Additional roof structure is added in the courtyard, but the transparent materials create the same atmosphere as the original one. Structure, openings, and materials are preserved
Potential reversibility	**There is potential of reversibility** because of the minimum changes in overall building	**There is potential of reversibility** because of the minimum changes in overall building
Explicitness of alterations	**The past and new changes are distinguishable in both interior and exterior.** The past can be felt because of minimum intervention in the façade and structure. It is also strengthen by the furniture and material choices that still refer to Baba Nyonya Style.	**The past and new changes are distinguishable in interior.** The courtyard and preserved openings play the major roles to preserve the authentic feeling of the shophouses. Meanwhile the exterior is modern and vibrant because it previously used as the back of the shophouses so there is no urge to preserve it.
Architectural harmony & visual compatibility	**Yes**, because it preserves the original façade of the shophouses	**Yes**, because most of the buildings that have orientation to the river now painted with color to create an attractive visual
Upgrading physical characteristic	The exterior contributes to maintain the overall image of the shophouses in the area, but it somehow uses public street as an in-between buildings circulation	The exterior contributes to overall riverfront landscapes
Materials	They expose the original material of the structures and maintain the original openings to create the past atmosphere in the interior and exterior.	They maintain the original opening material and form to create past atmosphere in the interior
Building usability	Issues such as electrical overloads, water seepage, and non-functional taps illustrate the complexities have to be worked on	The natural lighting and air-quality are utilized very well in indoor seating area
Location	Walkable distance from major attractions and popular shopping centers. The access road is too small,	Walkable distance from major attractions and popular shopping centers. The access road is too small,

	enough for one car to pass by but they provide parking for the guest	enough for one car to pass by and they don't provide parking site
Technology	Access card for the guest room, internet service	-
Room Range	They provide several types of room to choose, but the number of each type is very limited because the fixed area of the shophouse	They provide indoor and outdoor seating area
Leisure facilities	Restaurant and souvenir shop	-

The analysis indicates that the homestay and café case studies in Kampung Jawa effectively align with tourist preferences for adaptive reuse, particularly in maintaining minimum interventions, explicitness of alterations, architectural harmony, and material compatibility for both interiors and exteriors. These outcomes are achieved by preserving the original façade, incorporating exposed structural materials into the interior design, and enhancing the heritage ambiance with furniture and materials consistent with the historical context.

However, adaptive reuse projects must address challenges related to building utilities, especially when performance requirements differ from the original use. Integrating sustainable technologies, such as energy-efficient systems, could improve operational efficiency and attract environmentally conscious visitors. Furthermore, it is essential for accommodation and dining establishments to consider expanding leisure offerings to enhance visitor experiences. For example, Ohana House could incorporate cultural activities or heritage tours to appeal to tourists seeking immersive experiences. Similarly, Ban Kheng Café could introduce cultural programming, such as exhibitions or themed events, to strengthen its connection to Malacca's historical and cultural narrative. These enhancements could further support the balance between preserving heritage and meeting contemporary tourism demands.

5. CONCLUSION

The study highlights how adaptive reuse practices in Malacca's Kampung Jawa area successfully balance heritage preservation and contemporary tourism needs through the transformation of traditional shophouses into homestays and cafés. The examples of Ohana House and Ban Kheng Café demonstrate the application of key adaptive reuse principles, such as minimal intervention, reversibility, and architectural harmony, which preserve the historical and cultural essence of these buildings while meeting modern functional requirements.

Despite the success in maintaining architectural integrity and enhancing the visitor experience, challenges persist, particularly in adapting heritage structures for new utilities and ensuring operational efficiency. Issues such as electrical overloads, water seepage, and limited facilities underscore the need for further optimization. Sustainable technologies and additional leisure-oriented facilities could enhance both environmental and visitor appeal, addressing the evolving expectations of modern tourists.

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SENTIMENT ANALYSIS OF THE LEADERSHIP OF THE PRESIDENT OF THE REPUBLIC OF INDONESIA USING THE SUPPORT VECTOR MACHINE METHOD

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ABSTRACT

Sentiment analysis has become one of the most widely used methods to understand public opinion on various issues, including the leadership of the President of the Republic of Indonesia. The data for this study were obtained from YouTube and X platforms through data crawling techniques using Python, with the keyword #Jokowi. The methodology used in this study applies the Support Vector Machine (SVM) to categorize public views into positive and negative sentiment categories. The evaluation of the entire process in the program demonstrates the results of each step in the Support Vector Machine method. This evaluation uses metrics such as accuracy, precision, and recall. The results of the analysis obtained from the Support Vector Machine are visualized using a confusion matrix, yielding the following outcomes: True Negative 1,451, True Positive 2,600, False Positive 511, and False Negative 350. These results indicate an accuracy of 82%, precision of 83%, and recall of 88%. The confusion matrix results show that the model accurately identified 2,600 data points with an accuracy of 82%, precision of 83%, recall of 88%, and an F1-Score of 85%. Overall, this analysis demonstrates that the model performs better in recognizing positive sentiments compared to negative sentiments.

Keywords: *Analysis Sentiment, Support Vector Machine, President of the Republic of Indonesia, Leadership Sentiment*

1. INTRODUCTION

In the current era of globalization, global issues related to politics and security remain significant threats to nations. Issues concerning areas such as the South China Sea and Natuna Waters, as well as advancements in defense technology in neighboring countries, continue to play a crucial role in motivating a nation to enhance its self-defense capabilities (PERMATASARI, 2022). These types of threats need to be anticipated through flexible and adaptive national defense policies, where the preparation process remains aligned with the government's vision and mission. The implementation of these national defense policies can also serve as a guide for Ministries/Agencies in conducting national defense (Saputra et al., 2022). Defense policy is an essential element in the governmental structure of every nation, with primary goals including ensuring national security, protecting territorial integrity, and safeguarding citizens from potential external threats (Sarjito, 2023).

This enhances the ability to understand the political views of social media users. The large number of social media users allows researchers to incorporate personal status updates into emotional data to be processed and analyzed. Sentiment analysis based on the processing of status updates and tweets by users

on X reveals public opinion (Nardilasari et al., 2023). Sentiment analysis, or analisis sentimen in Indonesian, is a method or technique used to identify how sentiment is expressed using text and how it can be categorized as either positive or negative sentiment (Mahawardana et al., 2022). In the context of sentiment analysis, there is an effective method for processing data obtained on X using the Support Vector Machine (SVM) method. SVM is a technique used to analyze data and identify patterns. This method is useful in performing classification and regression in data analysis. SVM is also capable of predicting and evaluating the systems in place (Nardilasari et al., 2023). In this research, Support Vector Machine (SVM) is used as a classification method. SVM originates from statistical learning theory and provides better results compared to other methods (Darwis et al., 2020).

Thus, this research conducts sentiment analysis on the leadership of the President of the Republic of Indonesia using the Support Vector Machine (SVM) method. The study aims to provide a clearer perspective on public perception of the President's performance. By analyzing data from conversations on X, this research is expected to offer a deeper understanding of how society views current political leadership.

2. RESEARCH METODOLOGY

In text-based research or natural language processing (NLP), selecting the appropriate methods is crucial to achieve research objectives. These objectives include data collection, word cleaning, word labeling, word weighting, sentiment classification using the Support Vector Machine (SVM) method, and classification testing to achieve the desired results.

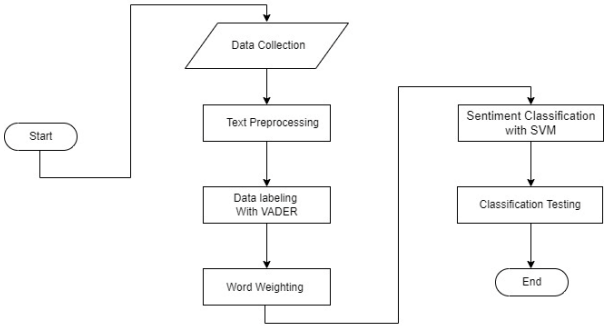


Figure 1.Research Methodology

3. RELATED RESEARCH

In this study, five previous research papers are used as references and comparisons in order to enhance and avoid plagiarism in the research. Here are the nine previous studies: (1) The first study was conducted by (Adiati et al., 2019), titled Sentiment Analysis of Public Opinion on Political Parties Participating in the 2019 Election on Twitter Using Naïve Bayes Classifier. This study applied the Naïve Bayes Classifier method to evaluate public sentiment toward political parties participating in the 2019 election. The results showed that 46.13% of sentiments were negative, while 53.87% were positive. In terms of accuracy, this approach achieved a rate of 78.03%. (2) The second study was conducted by (Firdlous et al., 2023), titled Public Sentiment Analysis on Twitter Regarding the 2024 Election Using Long Short Term Memory Model. This study used the Long Short Term Memory (LSTM) method and resulted in an accuracy of 78%, with 52.2% of identified sentiments being positive. Most positive sentiments were related to support for a successful election and information about the election process. On the other hand, 37% of sentiments were identified as negative. (3) The third study was conducted by (Farasqa et al., 2024), titled Sentiment Analysis on Anies Baswedan Using Support Vector Machine: A Case Study on Twitter. This study used the Support Vector Machine (SVM) method and concluded that public sentiment tended to be negative toward Anies Baswedan.

The SVM classification test without data balancing showed an accuracy of 77%, precision of 76%, and recall of 72%. (4) The fourth study was conducted by (Ni Made Tara Okta Adriana et al., 2023), titled Public Sentiment Analysis of Demonstrations in Indonesia Using Support Vector Machine and Random Forest. This study used both Support Vector Machine and Random Forest methods. The results indicated that the SVM algorithm had a higher accuracy rate than the Random Forest algorithm, reaching 80.3%. The classification process showed a dominance of negative sentiment at 54.98%, while about 15.86% of the public supported demonstrations, and 29.15% remained neutral. (5) The fifth study was conducted by (Sabily et al., 2019), titled Sentiment Analysis of the 2019 Presidential Election on Twitter Using the Maximum Entropy Method. This study applied the Maximum Entropy method and achieved a high Macro accuracy of 89.16%. (6) The sixth study was conducted by (Paramarta and Darmawan, 2023). It is titled "Implementation of the Support Vector Machine Method in Sentiment Analysis of Public Opinion on the 2020 Regional Elections on Twitter." This research used the Support Vector Machine (SVM) method. The study demonstrated that by applying SVM to sentiment evaluation of the 2020 regional elections, based on 6,037 tweets collected using the keyword "Pilkada 2020," it resulted in 4,864 tweets with positive sentiment and 1,173 with negative sentiment, achieving an average accuracy of 87.94%. (7) The tenth study was conducted by (Ade Dwi Dayani et al., 2024). It is titled "Sentiment Analysis on Public Opinion on Social Media Twitter Using the Support Vector Machine Method." This research utilized the Support Vector Machine (SVM) method to analyze public opinion on social media, classifying the sentiments into positive, negative, and neutral categories. The results of the SVM analysis showed an accuracy of 69.69%, recall of 45.60%, precision of 51.56%, and an F1-score of 46%. (8) The eighth study was conducted by (Asno Azzawagama Firdaus et al., 2023). It is titled "Sentiment Analysis on the Projection of the 2024 Presidential Election Using the Support Vector Machine Method." This research utilized the Support Vector Machine (SVM) method to evaluate sentiment classification regarding the projection of the 2024 presidential election. The sentiment results for three selected candidate datasets were as follows: Anies Baswedan with 65.62%, Ganjar Pranowo with 73.58%, and Prabowo Subianto with 66.34%. The accuracy of the SVM method applied to these datasets was 73% for Anies Baswedan, 79% for Ganjar Pranowo, and 79% for Prabowo Subianto. (9) The ninth study was conducted by (Sari and Kurniawan, 2024). It is titled "Sentiment Analysis on the Performance of the Mayor of Medan's Program on Social Media X Using Support Vector Machine." This research applied the Support Vector Machine (SVM) method to evaluate the sentiment of the Medan Mayor's program on the X application (formerly Twitter). The results showed an accuracy of 81%, precision of 84%, recall of 90%, and an F1-score of 87%.

4. RESULTS AND DISCUSSION

This research uses secondary data collected through crawling techniques on the YouTube and X platforms (formerly Twitter) using the keyword "Jokowi," resulting in 20,303 data points. The data includes text, user comments, interaction counts, and other information related to President Jokowi's leadership. Through text preprocessing, such as removing duplicates, normalization, eliminating irrelevant words, and filtering keywords, the data was refined into 6,140 relevant points for further analysis of President Jokowi's leadership. This study involves four stages: data collection, text preprocessing, Sentiment labeling, Tf-idf weighting, and classification using SVM :

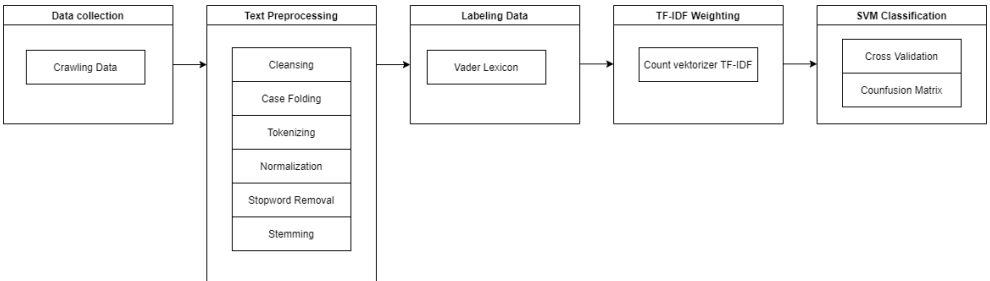


Figure 2.Research flow

a. Start Text Preprocessing

At this stage, text preprocessing begins with cleansing to remove characters such as emojis, @, #, &, and others, followed by case folding to convert all text to lowercase. Next, tokenizing breaks the text into words, then normalization corrects the form of the words. After that, stopword removal removes unimportant words, and finally, stemming returns words to their base form.

b. VADER sentiment labeling

Sentiment labeling is conducted using the VADER algorithm by analyzing the compound score of each text. Texts with a compound score greater than **0.5** are classified as **positive**, as they indicate a tendency toward supportive or positive opinions. Conversely, texts with a compound score less than **-0.5** are labeled as **negative**, as they represent opposing or negative opinions. The following are the results:

	clean data	sentiment scores	compound score	sentiment label
0	prosperous Indonesian Jokowi	{'neg': 0.0, 'neu': 0.392, 'pos': 0.608, 'comp...	0.4767	Positive
1	Jokowi's heart is sincere to the people	{'neg': 0.0, 'neu': 0.69, 'pos': 0.31, 'compou...	0.4019	Positive
2	There are doubts that Jokowi's leadership is t...	{'neg': 0.135, 'neu': 0.429, 'pos': 0.436, 'co...	0.7096	Positive
3	Poor Jokowi, his position has been ruined by h...	{'neg': 0.292, 'neu': 0.708, 'pos': 0.0, 'comp...	-0.7351	Negative
4	strongly reject dynastic politics	{'neg': 0.397, 'neu': 0.294, 'pos': 0.309, 'co...	-0.1531	Negative

Figure 3. Labeling sentiment Vader

The dataset that has been input into the program will be processed and converted into a bar chart to measure the sentiment score level of the dataset. Additionally.

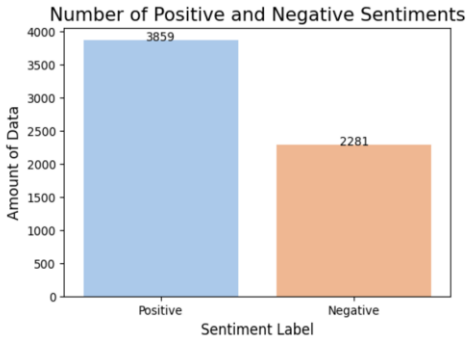


Figure 4.Bar score

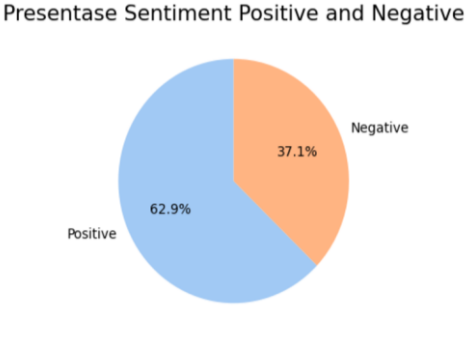


Figure 5.Presentase score

This study uses a total of 6,140 data points obtained from comments on the X platform (formerly Twitter) and YouTube through a data crawling process related to President Jokowi's leadership. As a result, the dataset contains 3,859 positive

sentiments and 2,281 negative sentiments, with a positive sentiment percentage of 62.9% and a negative sentiment percentage of 37.1%, for further analysis.

c. Data split

In this study, a total of 6,140 data points were used, and the data splitting process was carried out to divide the dataset into two parts: 80% training data and 20% test data for model training.

d. Modeling

At this stage, the text classification process will be performed using the Support Vector Machine (SVM) method. The dataset, which has gone through the previous processing steps, will be trained and tested using the 'Polynomial' kernel. Additionally, the program will predict all the data in the test set and compare it with the dataset that has been fitted on the split data.

e. Cross Validation

The validation process is an important step in research to ensure the accuracy and precision of the results. In this study, the cross-validation method is applied with a 10-fold configuration, meaning the model is tested 10 times using randomized subsets of the dataset. The analysis results show that the average value from the cross-validation is 81%.

f. Classification report

The classification results show that the model performs quite well with an accuracy of 82%, where it performs better in predicting the positive class compared to the negative class (precision and recall are higher for the positive class). The higher F1-Score for the positive class indicates a better balance between precision and recall for that class. However, for the negative class, although precision is lower (0.74), recall is quite good (0.81), meaning the model is able to recognize most of the negative data, despite some incorrect.

g. Evaluate

At this stage, the evaluation presents the entire process within the program, showcasing the results of each step of the Support Vector Machine (SVM) method. The evaluation includes metrics such as accuracy, precision, and recall. The results obtained from the confusion matrix provide details in the form of True Negative 1451, True Positive 2600, False Positive 511, and False Negative 350. This results in an accuracy of 82%, precision of 83%, and recall of 88%.

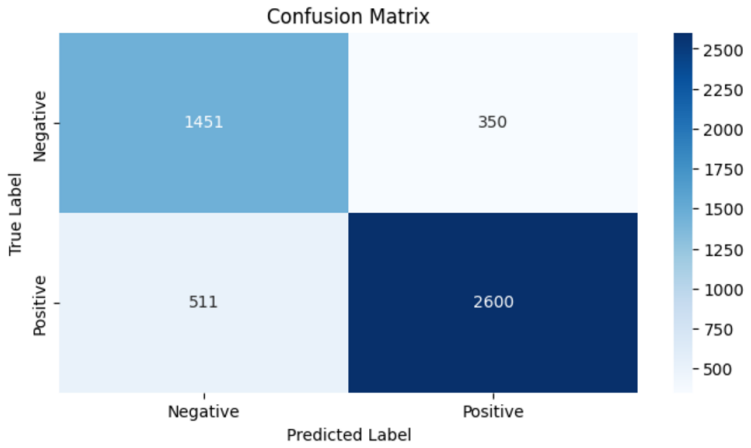


Figure 6. Confusion Matrix

5. CONCLUSION

In this study, data was obtained from sentiment analysis of comments on Platform X (formerly Twitter) and YouTube using data crawling techniques, resulting in a total of 20,303 data points. Subsequently, text preprocessing was conducted through six stages: Cleansing, Case Folding, Tokenizing, Normalization, Stopwords Removal, and Stemming. After the text preprocessing stage, the data was reduced from 20,303 to 6,140 clean data points. Based on the sentiment analysis conducted, the Support Vector Machine (SVM) model demonstrated good performance in classifying positive and negative sentiments in the dataset. The confusion matrix results showed that the model accurately identified 2,600 data points as positive sentiment (True Positive) and 1,451 data points as negative sentiment (True Negative). However, there were 511 negative data points misclassified as positive (False Positive) and 350 positive data points misclassified as negative (False Negative). The model evaluation produced key metrics: an accuracy of 82%, precision of 83%, recall of 88%, and an F1-Score of 85%. Overall, this analysis indicates that the model performs better at recognizing positive sentiments compared to negative sentiments, as evidenced by the higher precision and recall values for the positive class.

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INTRODUCTION TO BALINESE MASKS AS A VIRTUAL REALITY BASED CULTURAL HERITAGE PRESERVATION EFFORT

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ABSTRACT

Indonesia has an incredible wealth of culture, including the Balinese mask art which is not only aesthetically beautiful but also rich in spiritual values and symbolism. However, this culture is facing major challenges due to the influence of modern culture that has reduced the younger generation's interest in traditional arts. Based on the data, most of the younger generation agrees that the dominance of modern culture has affected their appreciation of traditional cultural heritage such as Balinese masks. To address this challenge, this research proposes the use of Virtual Reality (VR) technology as an alternative solution in introducing and preserving Balinese masks. VR technology enables an immersive visual experience so that users can explore the details of Balinese masks, understand their meanings, as well as experience the Balinese atmosphere virtually. This research uses the Multimedia Development Life Cycle (MDLC) method. The VR application designed presents a visual reconstruction of Balinese masks, interactive features, and simulation of a traditional atmosphere. This experience is designed to be accessed using the Oculus Quest 2 device, allowing users to experience the virtual environment to the fullest through immersive VR standalone technology. By doing so, VR can be a relevant alternative solution to introduce Balinese masks to the younger generation, while maintaining cultural values amid the development of the digital era.

Keywords: *Balinese Mask, Virtual Reality, Cultural preservation, Digital Technology, Multimedia Development Life Cycle (MDLC)*

PRELIMINARY

Indonesia is the largest archipelago in the world consisting of 17,508 and is inhabited by at least 360 ethnic groups. Due to this wealth, Indonesia has an extraordinary diversity of customs and cultures (Mahdar Ernita 2023). The Ministry of Education and Culture (MoEC) has recorded more than 67,273 cultural heritages in Indonesia. Of these, there are 11,627 immovable cultural heritage, 53,538 are movable objects, and 2,108 are intangible cultural heritage. Every region in Indonesia has a distinctive culture that reflects its identity. Many of these cultures have been recognized by UNESCO (Salwa Syafiqoh 2024). One example of Indonesia's proud cultural heritage is the traditional mask performance art on the island of Bali. This mask performance art has a long history from a simple form to a complex art form and is spread throughout the island of Bali.

Balinese masks are one of the art objects worn on the face of Balinese dancers, usually masks are used to accompany Balinese musical instruments during

religious ceremonies or during performances. Masks as one of the arts of the island of Bali are generally used to honor ancestors or clarify characters in accompanying cultural arts. In the life of modern society today, masks are placed as a form of art that has a high appeal, not only because of its aesthetic beauty, but the mystery side that is stored on the face of the mask is still able to exude magical powers that are difficult to explain (Wirawan 2021).

As a cultural heritage rich in meaning and symbolism, Balinese masks face serious challenges in maintaining their sustainability. Physical damage and limited access to live performances or museum collections are obstacles that hinder understanding and appreciation of the beauty of this art. In addition, the ease of obtaining information has changed the mindset of the younger generation to become more modern. This can affect the interest of the younger generation in preserving traditional Indonesian arts, especially Bali, based on the results of the questionnaire show that 54.9% of 51 respondents with an age range of 20 years to 23 years agreed that the dominance of modern culture has reduced the interest of the younger generation in traditional cultural heritage such as Balinese masks, 33.3% strongly agreed, 9.8% expressed doubt, and 2% disagreed. Without realizing it, traditional art continues to erode over time. Many teenagers or young people prefer modern art such as western pop, Korean pop, and so on (Bintang Panduraja Siburian 2021). As an ancestral heritage, these masks not only hold artistic value, but are also rich in deep cultural and spiritual meaning for the Balinese people.

In an effort to preserve and introduce Balinese cultural heritage to the younger generation, digitization of cultural heritage can be interpreted as a form of utilization of digital technology in carrying out management on cultural heritage objects. The utilization of digital technology will provide effectiveness and efficiency in cultural heritage preservation efforts. In this case, digital media can be utilized in collecting data, documenting, storing, managing, and disseminating cultural heritage information (Agustinova 2022). The utilization of modern technology such as virtual reality (VR) is an interesting choice. Virtual reality is an interactive technology that allows users to experience a digitally created environment (Fitria 2023). In the context of Balinese masks, the use of virtual reality can be an effective educational medium to introduce and understand the history of Balinese masks. The utilization of virtual reality also helps in the learning process and strengthens the process of simulating situations and information (Zulherman 2020). Questionnaire results from 51 respondents stated 62.7% strongly agreed that the ability of VR technology to present information about Balinese masks virtually can expand public reach and attract wider interest from various groups, including the younger generation. The advantages of using virtual reality as a medium for education and information on Balinese masks include: First, it creates an interactive experience, by utilizing virtual reality, users can directly experience the Balinese Mask content in an interactive visual way. They can feel the atmosphere of Bali deeply, including the sounds of nature, traditional music, and spiritual atmosphere. Second, experiential learning, the use of virtual reality also helps in the learning process and strengthens the process of simulating situations and information. In the design stage, the design of the application to be built is carried out. The user interface (UI) design includes a splash screen and Museum display. Finally, Visual Reconstruction, through virtual reality technology, users can see a visual reconstruction of the Balinese Mask, including the fine details and carvings in it. They can zoom, rotate, and see every angle clearly, making the experience more immersive and detailed (Putu Wirayudi Aditama 2023).

Virtual reality is a new media in the Industrial Revolution 4.0 which is growing rapidly at this time. Before the existence of virtual reality, information delivery media usually only utilized audio and visual media with limited interaction, and had not utilized various sensors in maximizing user interaction. The development of advanced technology now allows a better and more real interaction simulation

between media and humans. Virtual reality allows a user to enjoy receiving more real information. The utilization of various kinds of sensors makes virtual reality the best media in simulating something close to the real world without damaging the system that has been running. Seeing from the ability that virtual reality can do, virtual reality has the potential to be utilized as an introduction media. This is because by using virtual reality, the introduction is more efficient than theoretical explanations because there is direct visualization (Vasiliki Liagkoua 2018).

Through the utilization of virtual reality technology as a means of education and information for the Bali Mask Museum, the author conducted a research seminar entitled “Introduction to Balinese Masks as an Effort to Preserve Cultural Heritage Based on Virtual reality” which aims to present an alluring and different experience in introducing the cultural heritage of masks to the younger generation. By utilizing virtual reality, this museum is expected to be able to convey the information contained in each mask in a more interesting and memorable way. Virtual visitors can directly engage in the learning process, understanding the meaning and story behind each mask in an interactive way. Through this technology, users can gain a deeper understanding of Balinese culture and appreciate the values contained in mask art in a direct and interactive way.

RESEARCH METHODOLOGY

Several relevant previous studies support the development of a Virtual Reality (VR) based Balinese mask recognition application. (I Made Ochlan Pramana Putra 2021) used the Multimedia Development Life Cycle (MDLC) method in the development of VR-based museum artifact recognition applications, which were adopted in the process of data collection and UI/UX development for Balinese mask applications. (Putu Wirayudi Aditama 2023) showed that VR can create interactive and immersive experiences in cultural introductions, which inspired this application's interactive and immersive features. (I Wayan Andika Raditya 2020) used the Waterfall method for interactive 3D visual development, which was adapted to create a detailed view of Balinese masks in this application. Finally, (Rayyan Hanugrah 2021) developed an Android-based VR application with interactive features, such as 3D views and motif guessing games, which inspired the development of interactive elements in the Balinese mask recognition application.

Based on references from previous research, the system development method used to build the digitization of Balinese mask culture through a Virtual Reality-based Museum follows the Multimedia Development Life Cycle (MDLC) method. This method consists of structured stages that ensure the systematic development of interactive applications. The first stage, Concept, involves determining the purpose, target audience, and goals of the application, with the aim of creating an immersive VR museum to introduce Balinese masks. Next, in the Design stage, the system functionality, interface, and database structure are outlined. The system design includes features such as interactive exploration of the museum space and hotspot-based mask information in Indonesian and English. At the Material Collecting stage, resources such as 3D mask models, historical data, and cultural descriptions are collected. The Assembly stage is carried out with application development using Blender for 3D modeling and Unity to create VR experiences. The app was designed to be compatible with the Oculus Quest 2 device, ensuring a high level of interactivity and immersion. Testing was done with black-box testing to verify the functionality of the system, focusing on navigation and content accuracy. Finally, in the Distribution stage, the VR museum application was used

for user evaluation and engagement, showcasing its potential as a cultural preservation tool.

Data Collection Techniques

During the research on the introduction of Balinese masks through a Virtual Reality-based Museum as an effort to preserve cultural heritage, data collection was conducted to gather the necessary information for the preparation of this report. The data collection techniques used are as follows:

1) Primary Data
   Primary data was collected directly from the field by the researchers. In this study, primary data collection methods included interviews and observations. Interviews were conducted with key figures such as Bagus Santoso, the manager of Setia Darma House of Masks and Puppets, These interviews provided insights into the types of Balinese masks, their cultural significance, and perspectives on utilizing Virtual Reality for cultural preservation. Observations were carried out at Rumah Topeng dan Wayang Setia Darma and I Wayan Muka Mask Product to document mask collections and obtain an understanding of the cultural and historical context.

2) Secondary Data
   Secondary data was gathered through documentation techniques and literature studies from scientific journals, books, and reliable online sources. This included gathering information on Balinese mask traditions, their classification, and cultural roles. Additionally, 3D asset references, historical descriptions, and relevant multimedia development frameworks were reviewed to support the design and development of the Virtual Reality Museum application.

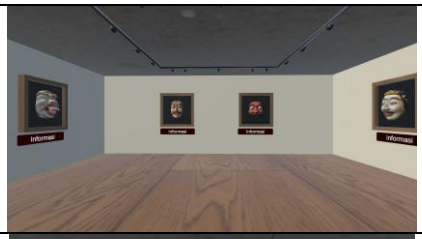
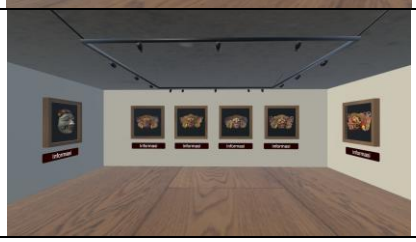
This combination of primary and secondary data collection ensured a comprehensive approach to capturing the essential aspects of Balinese mask culture and its preservation through modern technology.

RESULTS AND DISCUSSION

The result of this research is the creation of a Virtual Reality Museum of Balinese Mask for the Introduction of Balinese Mask as an Effort to Preserve Cultural Heritage for the younger generation, which can be seen in Table 1.

Table 1. The Results Of Balinese Mask Virtual Reality Museum

No	User Interface	Description
1.		The Main Menu page is the initial display when just starting the Bali Mask Museum *virtual reality* . On this page displays several buttons, namely Explore Mask Museum, Wali Mask Room, Calonarang Mask Room, and Ramayana Mask Room which if clicked will enter the respective pages of the Bali Mask Museum.
2.		On the Explore Topeng Museum page, visitors can walk around the Bali Topeng Museum area, and can directly enter each room in the Bali Topeng Museum area.

3.		In the Topeng Wali room there are several masks, namely: Hard Mask, Old Mask, Dalem Mask, Sidakarya Mask, Wijil Mask, and Penasar Mask. On each mask there is an information button which, if clicked, will bring up information about each mask.
4.		In the Calonarang Mask room there are several masks, namely: Rangda Mask, Rarung Mask, Barong Mask, Weksiksa Mask, Gandi Mask, Lendi Mask, Rangda ing Dirah Mask, Celuluk Mask, and Patih Mask. On each mask there is an information button which, if clicked, will bring up information about each mask.
5.		In the Prembon Ramayana Mask room there are several masks, namely: Rama Mask, Sita Mask, Hanoman Mask, Jatayu Mask, Sugriwa Mask, Ravana Mask, Sempati Mask, Anggada Mask, Patih Prahasta Mask, and Kumbakarna Mask. On each mask there is an information button which, if clicked, will bring up information on each mask.

Analysis of Test Results

The test results here are in the form of an assessment of the application using the User Experience Questionnaire (UEQ), in the form of filling out a Google form that has been created. The following are the assessment results related to the Balinese Mask Virtual Reality Museum application filled in by 52 respondents with an age range of 20 years to 23 years to support introducing and preserving the Balinese Mask cultural heritage to the younger generation.

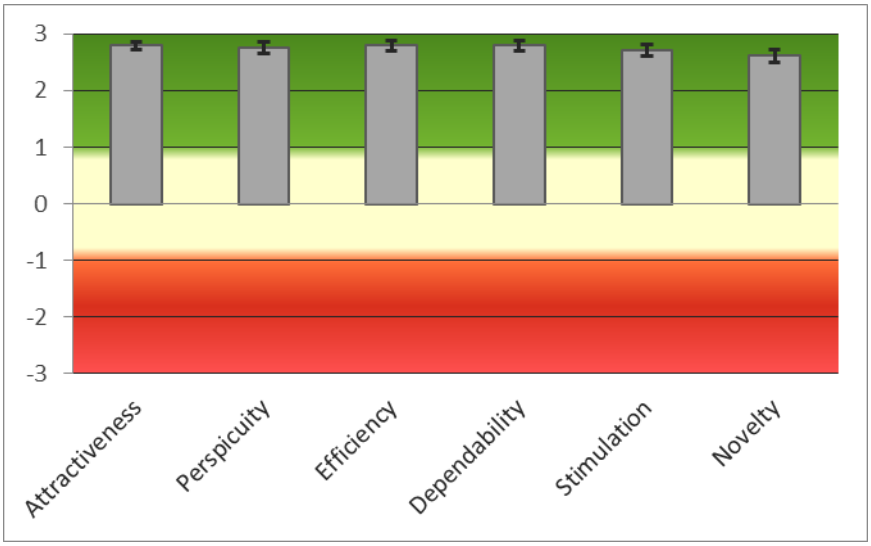


Figure 1. Graph of the average impression of respondents based on variables

Based on Figure 2, it can be concluded that the Topeng Bali virtual reality museum application based on the results of the investigation on the Image scale consistently falls into the “excellent” impression category with a minimum value of 2.6, then it can be concluded that the Topeng Bali virtual reality museum application based on the results of the investigation on the efficiency scale consistently falls into the “excellent” impression category with a maximum value of 2.7.

CONCLUSION

Based on the research, it can be concluded that the digitization of Balinese cultural arts through a Virtual Reality (VR) based virtual museum to introduce Balinese masks has successfully supported the preservation of cultural heritage, especially for the younger generation. This application was developed using the Multimedia Development Life Cycle (MDLC) method, utilizing Blender and Unity software, and optimized for Oculus Quest 2. Test results using the User Experience Questionnaire (UEQ) showed that the app received consistent ratings in the "excellent" category from 52 respondents, especially in the aspects of efficiency and interactive impression. Respondents appreciated features such as virtual exploration, interactive information about mask details and symbolism, and immersive cultural experiences. With this approach, VR-based virtual museums play an important role in educating and increasing appreciation of Balinese traditional arts in the digital era.

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HERMENEUTICS IN UNDERSTANDING PHOTOS "REJANG FOR SALE" BY PUTU DUDYK

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ABSTRACT

Photography has the term photographer, namely the person who carries out the recording. For a professional photographer, the photo object is not just a mere recording, but must provide an aesthetic touch to various compositions. Photographers are now so creative, they are not only experts in using a camera but also have to be experts in preparing photo themes and final processing to give an aesthetic impression in the feel of the photo. Photographer Putu Dudyk, as he is usually called, is a photography practitioner and lecturer. He has been involved in the world of photography for a long time, he has produced many works, including documentation and art photographs. The method used in this research is a descriptive qualitative method. dialogical hermeneutics, for him correct understanding is understanding that leads to the ontological, not methodological, level. This means that truth can be achieved not through methods, the photographic work entitled Rejang For Sale by Dudyk visualizes three rejang dancers, each of whom has their own expression according to the desired concept and theme, the addition of plastic as a symbol of packaging for a product that can be sold. bought, with a black background as an impression of sadness, as well as the dancers' sad expressions and blank stares depicting the lack of sincerity in something that is sacred being commercialized.

Keywords: *Commercialization, Hermeneutics, Photo Rejang For Sale*

1. INTRODUCTION

In photography there is the term photographer, namely the person who carries out the recording. For a professional photographer, the photo object is not just a mere recording, but must provide an aesthetic touch to various compositions. Photographers are now so creative, they are not only experts in using a camera but also have to be experts in preparing photo themes and final processing to give an aesthetic impression in the feel of the photo. A photographer is essentially a person who has expertise in maintaining and expressing optical sensitivity so that the results of the object shot can develop into an aesthetic experience for humanity. The results of his camera shots are visual art that can imply the order of life or have a touch of culture. Apart from that, photographers are also required to understand the rhetorical triangle which has elements as mentioned by Wendy Hesford and Brenda Jo Brueggemann (in Illahi, 2017), namely if photography analysis involves images in terms of subject/content, audience/context, and perspective.

Photographer Putu Dudyk, as he is usually called, is a photography practitioner and lecturer. He has been involved in the world of photography for a long time, he has produced many works, including documentation and art photographs. As a photographer, Dudyk is very astute in seeing current phenomena expressed in photographic works, from the naturalistic to the critical nuances, current phenomena are related to Balinese culture, especially many of the commercialized traditions. This phenomenon was one of the targets of Putu Dudyk's photographs which received awards and exhibitions in China. The work is entitled "Rejang For Sale".

2. RESEARCH METODOLOGY

The method used in this research is a descriptive qualitative method. The qualitative method is research that does not carry out calculations such as additions, numbers, percentages and statistics in carrying out epistemological justification (Kaelan, 2012: 5). Not using calculations and additions, the qualitative method places more emphasis on the natural aspect of quality because it involves understanding, the concept of value and the characteristics inherent in the research object. This research is descriptive in nature, where descriptive research is research that attempts to describe events and happenings that are currently occurring, and focuses attention on actual problems as they exist at the time the research takes place (Noor, 2012: 34). This research will describe the research object, namely the interpretation of the photo work Rejang For Sale by Putu Dudyk, the interpretation will be carried out on stories and visuals.

3. RELATED RESEARCH

Hans-Georg Gadamer (1900-2002), a figure in dialogical hermeneutics, for him correct understanding is understanding that leads to the ontological, not methodological, level. This means that truth can be achieved not through methods, but through dialectics by asking many questions. Thus, language becomes a very important medium for dialogue to occur.

Hermeneutic methodology is a building block of epistemology that has been studied by many philosophers, one of whom is Hans Georg Gadamer (1900-2002). His famous book was entitled Truth and Method, but Gadamer did not intend to make hermeneutics a method. According to Gadamer, hermeneutics is not just a matter of interpretive methodology, but rather an ontological interpretation, namely that understanding itself is an effort to interpret a text, whether religious or other texts such as art and history.

Photography basically means a method for producing images or photos of an object by recording the reflection of light hitting the object using light-sensitive media, namely a camera (Sukarya, 2009:10). Sukarya also added that the art of photography is the art of seeing. A photographer is required to be able to see everything in a unique way. The ability to process feelings, ideas/concepts and control light is something that is the basis of photography. Every form of work produced from photography has nothing but a goal and concept of creation which starts from a basic idea which develops into a practical implementation with the support of equipment and techniques expressed through visual language. Basic shooting techniques are something that must be mastered in order to produce good photos. The criteria for a good photo are actually different for each person. However, there is a common opinion that can be used as a reference. A good photo has shooting techniques, lighting (Exposure), composition, shooting angle (Angle).

4. RESULTS AND DISCUSSION

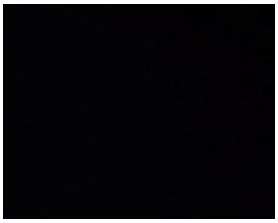
This research will be divided into several interpretive stages so that it is easy to interpret the photo work "Rejang For Sale" by Putu Dudyk.
This is a consideration in selecting this photographic work, seen from the perspective of the work which has a very strong meaning towards social criticism related to phenomena currently occurring in society, an academic lecturer and professional photographer who is also a member of the Bali Photographers Association, and has had many photographic works produced. produced, he also won several awards, and was invited to be a resource person at national and international activities. From this biography, the researcher is interested in discussing one of Putu Dudyk's works, the most recent work this year which is the focus of the research is a photographic work entitled "Rejang For Sale". beautiful but can also be used as a medium for criticism. The concept of this work is very strong in determining the character and emotions of each model so that it can convey what it wants to be conveyed to viewers of photographic works.



Figure 1: Photo of Rejang For Sale
(Source: Author)

Apart from the concept of art, it is further discussed from the perspective of the interpreter (writer) from existing knowledge and understanding. Interpreters focus more on the main object of Dudyk's photographic work, namely Rejang For Sale, and the title attached to the photographic work for cultural criticism which has been sold commercially, where something that was once sacred is now simply sold, judging by its beauty and beauty. attractiveness to be commercialized. Photography is known for many genres, and in studio photography there are several types of photos to differentiate one style from another. Dudyk's photo can be categorized as a conceptual artistic photo. Where making a photo always starts with determining the concept and idea so that the work you want to create is exactly what you want and can represent the photographer's own feelings (Dudyk).

Table 1. Photo Work Result

Figure	Karya
	The overall photo shows three dancer models as objects, each has a role that is set according to the concept of the photo work, the three dancers use the attributes and decorations of rejang dancers, one dancer poses beautifully dancing the rejang movement, two dancers are packaged with plastic like a the work that will be sent to consumers, with different poses emphasizes the overall packaging
	Black is used in the background to emphasize the disapproval or sadness that occurs in current phenomena that commercialize culture, especially sacred dances which previously were only performed or danced during religious ceremonies.

	The addition of plastic bags is interpreted as packaging which is usually used to wrap goods or works that are bought and sold
	The expressions displayed are very flat and full of meaning.

1. Rejang Dance

Rejang dance is a traditional dance in Bali which is danced by women in groups or en masse. There are several types of Rejang dance, namely: Rejang Renteng, Rejang Bengkel, Rejang Ayodpadi, Rejang Galuh, Rejang Pelak, Rejang Membingin, Rejang Makitut, Rejang Haja, Rejang Negara and Rejang Dewa. For the last one, namely the Rejang Dewa dance, which has special features compared to the others. Because this dance cannot be performed in any place, but can only be performed in places that are considered sacred by Hindus. Namely in the jero (inner) or jabe (outer) middle courtyard of a temple and during religious ceremonies. For example, during the peak ceremony of *Ngenteg Linggih*.

The Rejang Dewa dance is a sacred dance to complete Hindu ritual activities in Bali, performed in groups by women who have never experienced menstruation. The Rejang Dewa dance is called a sacred dance or offering dance because it is a symbol of the angels who lead Bathara/Gods down to earth to reside in sacred objects (*pratima*) in the temple. (disbud.bulelengkab.go.id)

The dancers are generally women of elementary school (SD) age, wearing traditional Balinese clothing in white and yellow with head jewelry made from coconut leaves. They dance to complete religious ceremonies, whether held in family holy places (*merajan)* or in temples within traditional villages (*pekraman*).

2. Balinese culture

Balinese art and culture is an identity that makes Bali well known to the outside world, therefore the government and Balinese people have an interest in protecting and preserving Balinese art and culture so that it remains intact and is not polluted by external cultural influences. Identity will refer to the image or image of a nation (Tilaar, 2007:35). The Balinese identity that has been formed as an image that is understood by outsiders towards Bali,

Balinese culture then became popular culture since 1930, which in simple terms, mass culture is popular culture produced through mass production industrial techniques and marketed to gain profits to the mass consumer audience (Strinati, 2010: 36). This has been done since 1930 with the development of the men's choir in the Sang Hyang dance into Kecak performance art by Walter Spies and Baryl de Zoete together with the art scene in Bedulu, Gianyar, Bali (Bandem, 1983: 42). Kecak then became a commercial art that could bring in money, thus Kecak was mass produced and had its own standards.

Interpretation of Indonesian Culture. Indonesia, which has more than 1500 ethnic groups, is a paradise for the development of understanding culture. Therefore, cultural diversity and cultural plurality are consequences that bring benefits to enrich culture. With hermeneutics, cultural traditions are not erased, but are maintained and even stimulated to be inspired and reintegrated, both in the context of ethnic cultural encounters within national culture and in the context of cultural encounters between nations (Poespoprodjo, 2004: 143).

5. CONCLUSION

An academic photographer who in the process of creating a work always determines the concept for creating a photographic work, where Putu Dudyk packages problems that occur in society into photographic works. Taking into account technical and photographic elements. The work entitled "Rejang For Sale" is full of meaning and outbursts of disagreement with the increasingly commercialization of Balinese culture, where the rejang dance was once very sacred and was only performed at sacred religious events. It can be seen from the visuals that the photographs created are full of meaning, where the rejang dancer's object is chosen by determining the composition in a row with each model acting out an expression that is full of meaning. So the work "Rejang For Sale" received an award following an exhibition in China. With hermeneutics, Hans-Georg Gadamer can interpret photographic works in detail and clearly what a photographer wants to convey in his work.

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IDENTIFYING FAKE ACCOUNTS IN SOCIAL MEDIA COMMERCIAL VIDEOS USING SUPPORT VECTOR MACHINE METHOD

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ABSTRACT

In today's society, many fake accounts actively comment on commercial videos on social media, especially Instagram. These fake accounts are often used to manipulate public perception of certain products or services, either to improve the product image and the image of the influencer, to damage the reputation of competitors. Therefore, this research applies the Support Vector Machine (SVM) method to detect and classify fake accounts based on characteristics such as number of followers, interactions, and activity patterns. SVM was chosen because of its ability to handle classification problems with a high degree of accuracy and the ability to separate complex data. The results showed that the SVM model was able to achieve 71% accuracy, with 68% precision, 84% recall, and 75% f1-score. These numbers indicate that SVM is quite effective in detecting fake accounts. The SVM model successfully identified a number of fake accounts with uniform interaction patterns and unusual activity, suggesting that most fake accounts tend to make repetitive and inauthentic comments. This research successfully contributes to the development of techniques to tackle the abuse of fake accounts on social media, thereby reducing the negative impact on consumer perception of commercial videos on the Instagram platform.

Keywords: Fake Account, Commercial Video, Social Media, Instagram, Support Vector Machine

1. INTRODUCTION

In today's society, social media plays an important role in our daily lives as a means of communicating and sharing information. Many businesses also use social media as a marketing tool or as a platform to listen to customer feedback, criticism, and opinions (Sahputri et al., 2023). Content marketing is recommended as the most effective online marketing approach (Hikmah Nur Karimah & Fadillah, 2021). Content that contains advertisements or promotions is commonly referred to as commercial videos. One of the social media that is often used to promote businesses through commercial videos is Instagram. Businesses engaged in products and services in Indonesia today have realized the potential of Instagram social media as a means to increase sales by marketing and promoting through product/service uploads wrapped in creativity so that it will attract an Instagram audience that has never been reached before (Adawiyah & Boer, 2023). Where Indonesia itself is the 4th largest Instagram user country in the world, with a total of 104.8 million users in October 2023 (Moh. Fatur Gifahri et al., 2024). However, based on observations that have been made on one of the commercial videos on Instagram, many comments are found that contain the same sentence but are given by different

accounts with criteria that refer to fake accounts on the accounts that give these comments. This can be done to increase the credibility of the business brand or to enhance the image of the influencer in the commercial video. This is one of the biggest challenges for businesses in influencer marketing to ensure that the selected influencer has a relevant and authentic audience (Adellia, 2024). In the creation of bots or fake accounts, often the creation of fake accounts uses false or stolen identity information such as names or photos of other people. This is regulated in Article 35 of Law Number 11 of 2008 concerning Electronic Information and Transactions which reads "Every person intentionally and without rights or against the law manipulates, creates, changes, removes, destroys Electronic Information and / or Electronic Documents with the aim that the Electronic Information and / or Electronic Documents are considered as authentic data" (Louis Paskalis Dwinanto, Diana RW Napitupulu, 2024). Therefore, researchers conducted research to identify fake accounts contained in social media commercial videos on Instagram to find out how to identify fake accounts in a commercial video, and find out what criteria are more valid for classifying fake accounts and real accounts on Instagram.

In this study, researchers used the Support Vector Machine method algorithm for the classification process. Support Vector Machine is one of the classification methods using machine learning (supervised learning) methods that predict classes based on patterns from the results of the training process (Siti Aisah et al., 2024). The SVM algorithm model is one of the algorithms of the classification method, which works by finding a line (hyperplane) to separate two groups of data (Yanti & Asana, 2023). The results of the study are expected to reduce the number of spam and fake comments by fake accounts on Instagram and add references for further research in the future.

2. RESEARCH METHODOLOGY

2.1 Research Flow

In this research , researchers take several steps or processes to get the results and conclusions of the research conducted. The following is the research flow that will be carried out:

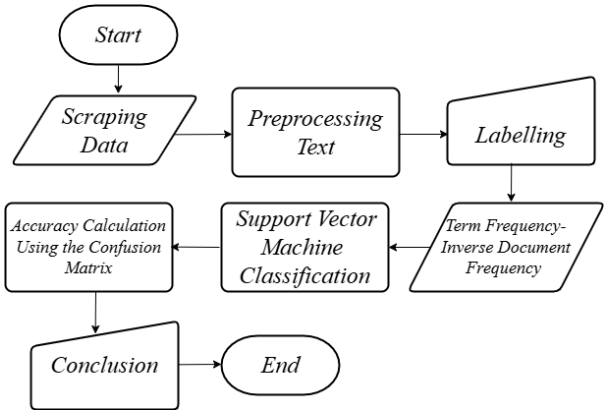


Figure 1. Research Flow

Data from Instagram accounts that comment on commercial videos is scraped for the research. After data collection, preparation comprises text cleaning, case folding, followers following ratio, and bio word count. Next, classify the data to detect false and real accounts using preset criteria. TF-IDF converts text data into numerical features. It then undergoes SVM classification. Next, confusion matrix evaluates model performance. A confusion matrix shows the number of true positives, true negatives, false positives, and false negatives to assess method accuracy (Aditya et al., 2022; Armaeni et al., 2024). Then precision, recall, f1-score, and accuracy may be determined to evaluate the model.

2.2 Data Scraping

The activity of processing data, or rather extracting data from the web or social media to find out the patterns hidden in it is called scraping, the advantage of the scraping process is that it can quickly collect data (Yuniar et al., 2022). This data scraping process was carried out from September 15, 2024 to October 20, 2024. The data consists of 335 account records, representing the total number of accounts that commented on the commercial video.

Table 1 Data Scraping

User name	Bio	Followers	Following	Mentions in last 10 posts	Total Posts	Total Likes in Last 10 Posts	Total Comments in Last 10 Posts
fittrimaulyda	Kunfayakun Always be grateful	15	55	0	7	1	0
dheiz_is	I'm just an ordinary woman 🤦 - Iis nurhasanah 🧥	424	517	0	119	35	5
adelianurfafiza	ESFP ↗️🐯💗🌹 Mom of double R Fashion - Beauty - Lifestyle - Kpop 💚💜	21	29	0	29	7	1
tanti.ynti	tanti ajah	10	290	0	6	7	0
yund_adian	I from Probolinggo - East Java	16	93	0	4	6	0

2.3 Preprocessing

The preprocessing stage is the initial stage to prepare documents to make them easier to process (Alamsyah et al., 2023). Preprocessing is one of the steps in eliminating problems that can interfere with the results of the data classification process (Purbolaksono et al., 2021). The first step is the cleaning process, which involves removing special characters, punctuation, and irrelevant elements to prepare the data for further analysis. Next, a case folding step converts all text to lowercase, eliminating discrepancies caused by uppercase and lowercase variations. The process continues by calculating the Followers-to-Following Ratio, often used as an indicator to identify fake accounts. Additionally, the number of words in the user profile bio (Bio Word Count) is calculated, as fake accounts often have very short or empty bios. The analyzed data is then saved in .csv format to facilitate further processing.

2.4 Labelling

The labeling process is carried out to label the data which will then be stored in the dataset for the Data Splitting process (Duei Putri et al., 2022). In social media fake account identification, data labeling involves marking accounts as "fake" or "real" based on various features or patterns found in the account's behavior.

Table 2 Data Labeling

User name	Bio	Followers	Following	Mentions in last 10 posts	Total Posts	Total Likes in Last 10 Posts	Total Comments in Last 10 Posts	Followers Following Ratio	Bio Word Count	Label
melisa_ajeee		44	343	0	1	9	0	0	0	Fake
anastawury	1 Corinthians 2 9 Im not lucky im blessed	8868	632	4	201	276	4	1	9	Real
mikaylalala08	Updating yourself	17	29	0	0	0	0	0	4	Fake
ndaa_1915	brass west java	103	676	0	0	0	0	0	3	Fake
henriefranko		486	392	0	84	0	0	1	0	Real

The result of the labeling process is visualized in the following graph:

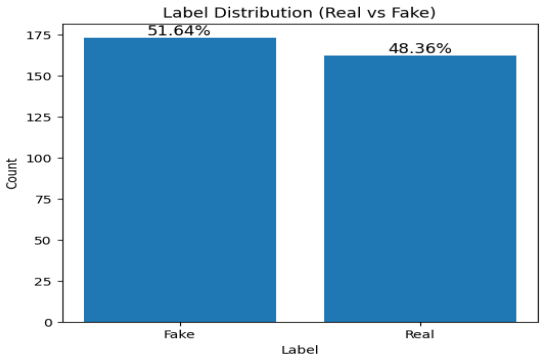


Figure 2. Labeling Data Graph

The figure above shows the distribution of fake and real labels on the Instagram account dataset after the labeling process. The percentage of accounts labeled as Fake is 51.64% which is a total of 173 accounts, while accounts labeled as Real is 48.36% which is 164 accounts. This graph provides a visual representation of the proportion of fake and real accounts in the data, with Fake accounts slightly outnumbering Real accounts.

2.5 Data Splitting

In this research, data is divided into 2, namely as training data and test data. Training data is used to train and model the hidden features/patterns in the data. While test data is separate data that is used to test the performance of the model after completing training(Ernianti Hasibuan & Elmo Allistair Heriyanto, 2022). A total of 100 account records were designated as training data, while the remaining 235 account records were automatically assigned as testing data. Increasing the amount of data, particularly in the training data set, allows the model to learn from more information, thereby enhancing its potential to improve accuracy in identifying fake accounts.

2.6 Term Frequency Inverse Document Frequency

TF-IDF (Term Frequency Inverse Document Frequency) is a method for calculating the weight of each word in a document and also a set of documents, the weight being an important presentation for a word in a document. The greater the weight, making the word's role more important in the presentation of a document. (Danu, 2021). In this research, TF-IDF aims to convert text data into numeric in order to enter the classification process. It converts the text in the bio column into numerical features that represent the frequency of words in the text.

3. RELATED RESEARCH

Research conducted by (Putra et al., 2019) found that the SVM algorithm detected bogus Twitter accounts with 93.42% accuracy utilizing tweet characteristics, geolocation, and account status. SVM outperformed Naïve Bayes in detecting false reviews on Tokopedia (91.57%) with 94.38%) accuracy (Alamsyah et al., 2023). On Instagram, (Gunawan et al., 2022) explained how to spot fraudulent accounts. These criteria are description length, #post, the ratio of followers to followings, and #followers. (Wanda et al., 2021) investigates using the Recurrent Neural Network (RNN) method to detect bogus OSN accounts. This research found that RNN fake account classification can achieve high accuracy with little losses. According to research (Yunianto & Mada, 2021) using Bayesian Inference to calculate the probability of a fake Instagram account, parameters like the length of the biography description, accounts without profiles, non-private accounts, and accounts with few media increase the likelihood of a fake account. Dewi (2021) used SMOTE-NC and CatBoost to classify Instagram phony accounts with 98.04% accuracy.

4. RESULTS AND DISCUSSION

4.1 Model Prediction Results

After the model is trained and tested on the test data, predictions are made using the SVM model on the test data. After obtaining the prediction results, the number of predictions classified as fake and real is calculated. These results are then visualized in the form of a bar graph to show the distribution of model predictions between the two classes.

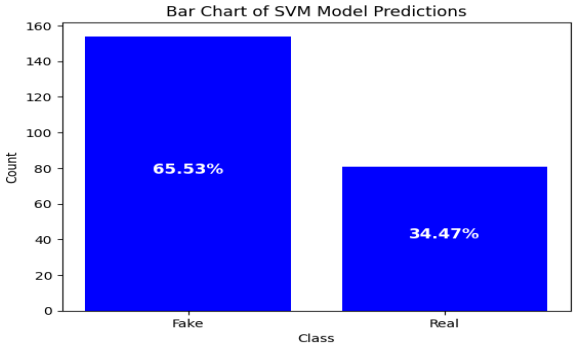


Figure 3. Graph of Model Prediction Results 1

From the picture above, we can see the results of the model prediction on the test data. Predictions in the "Fake" class are 65.53%, namely a total of 154 account data, while for the "Real" class there is a percentage of 34.47%, namely a total of 81 account data. The classification report illustrates how well the support vector machine model is able to distinguish between fake and real classes in the test data.

4.2 Model Evaluation

Evaluate the performance of the SVM classification model on test data using several evaluation metrics commonly used in classification model evaluation, namely accuracy, precision, recall, and F1-score.

Table 3. Model Evaluation

Accuracy	71%
Precision	68%
Recall	84%
F1-score	75%

The results of the model performance evaluation using the Support Vector Machine method are presented in Table 3, showing a fairly good performance in predicting fake and real labels on Instagram accounts. With an accuracy of 0.71, the model is able to correctly predict the label in about 71% of all observed cases. The precision of 0.68 indicates that about 68% of the examples predicted as "fake" by the model are indeed "fake." Recall of 0.84 indicates that the model successfully identified about 84% of all "fake" accounts. Furthermore, the F1-score of 0.75 illustrates a good balance between precision and recall, showing consistent performance in both aspects for the identification of "fake" accounts.

4.3 Model Evaluation with Confusion Matrix

The evaluation process is carried out after the classification process, where the goal is to measure the performance of a model in data classification. The following confusion matrix shows the results of true positive, false positive, true negative, and false negative.

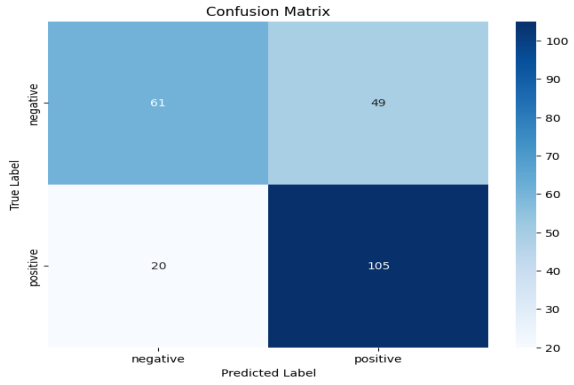


Figure 4. Confusion Matrix

The confusion matrix above shows the performance of the SVM model in classifying Instagram accounts as fake (positive) or "real" (negative). From these results, the model successfully classified 105 "fake" accounts correctly as "positive" (True Positive) and 61 "real" accounts correctly as "negative" (True Negative). However, there were 49 "real" accounts that were incorrectly classified as "fake" (False Positive) and 20 "fake" accounts that were incorrectly classified as "real" (False Negative).

5. CONCLUSION

From the results of the conducted research, the following conclusions were drawn:

1. This study demonstrates that the Support Vector Machine (SVM) method is effective in detecting fake accounts in commercial video comments on Instagram, achieving an accuracy of 71%.

2. Evaluation metrics indicate good model performance, with a precision of 68%, recall of 84%, and an F1-score of 75%, although some errors in identifying genuine accounts as fake were observed.
3. Fake accounts in commercial video comments generally exhibit specific characteristics, such as a low number of followers, short or empty bio word counts, and low activity and interaction levels.
4. The SVM method can identify uniform and invalid comment patterns frequently used by fake accounts to manipulate the image of a product or influencer.
5. This research contributes to reducing the negative impact of fake accounts on social media, particularly in product promotion contexts, while protecting users from potential fraud and manipulation on the Instagram platform.

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DESIGNING VISUAL COMMUNICATION MEDIA ABOUT EDUCATION WITH THE CONCEPT OF FUN LEARNING TO TRAIN FINE MOTOR SKILLS IN EARLY CHILDHOOD

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ABSTRACT

ICT in the classroom can enhance learning resources for teachers by providing access to nonverbal and verbal presentation modes, enabling teachers to use various media to help students develop their fine motor abilities. Early childhood education, which prepares children for further education, often struggles with sensitive motor development elements. This study explores the value of visual communication media about education in video tutorials with fun learning concept, such as making shapes with plasticine and telling folk stories, to train fine motor skills and cultivate good character in early childhood. The process is divided into three stages: pre-production, production, and post-production. Observations showed that students could determine shapes and colors without video, but needed to focus on softening the plasticine. After the video was shown and with teacher assistance, students succeeded in making apple and turtle shapes. The teacher also emphasizes the moral messages of the story. Testing on material and media experts concluded that this educational media can be used or recommended as a learning media for early childhood.

Keywords: Early childhood*, educational media, fine motor skills, fun learning.*

1. INTRODUCTION

A child's early years are a time of rapid development essential to their future existence. Children in their early years enjoy movement (do not want to be quiet), are distinct, active, curious, enjoy trying new things, can express themselves creatively, have imagination, and want to converse. Additionally, early infancy exhibits impulsive behaviour, is still easily irritated, acts carelessly, has a short attention span, is enthusiastic about learning, gains much knowledge from experience, and becomes more interested in friends. Children's early years are sometimes called the "golden age" because this is when their intelligence begins to develop. According to Harefa et al. (2022) and Hasanah & Deiniatur (2018), children require extra care from their environment during this era of prosperity. Early childhood education must be appropriate for the child's development and traits since if the golden age is missed, their growth and development will not be at their best.

Early childhood education is a level of education that comes before primary education to prepare children for further education, which is offered through formal, non-formal, and informal channels. It is one of the coaching efforts designed for children from birth to age six. It provides educational stimuli to help children grow and develop physically and spiritually (Nuraeni & Gunawan, 2022). Early childhood education aims to foster all facets of a child's development, including their religious beliefs, moral principles, motor skills, language, cognitive abilities, artistic abilities, and social-emotional skills. Together, these six facets of action need to be developed and enhanced in a sustainable and well-balanced way. Since these six factors are

connected, this premise is accurate. The physical and fine motor skills of children are vital to their development.

Nonetheless, many kids still struggle with sensitive motor development elements that aren't sufficiently stimulated. This is still not the best way to learn youngsters' motor skills in the "starting to develop" developmental stage. These include a youngster who has trouble holding a pencil correctly, struggles to write letters and numbers, and struggles to understand what they write. This occurs due to students being disinterested in the media and teaching strategies employed in the classroom. Using engaging and enjoyable media to grow and encourage children's development properly is preferable. According to Agustina et al. (2018), children's fine motor skills can be divided into four categories: pinching, holding, focus, and hand-eye coordination. Finely controlled movements are a component of fine motor abilities. Fine motor abilities are demonstrated by having a toy, buttoning a blouse, or performing any other task requiring dexterity. Children's ability to establish and execute elegant muscular movements in coordination and agility, as well as talent using hands and fingers, is a component of their development of fine motor skills.

Play can help to improve and stimulate fine motor skills. Among these is the use of educational media. The Latin medius, which signifies the midst of an introduction or intermediary, is where the word media originates. Known as distributors or liaisons for teaching messages, instructional media are learning resources created or held by educators in a planned way that are not instructors. In a nutshell, the media are material, human occurrences that create circumstances that allow students to acquire information, abilities, or attitudes. Children's sensory organs are significantly impacted when media is used in teaching and learning activities. Using media will ensure that the lesson's topic is better understood.
Additionally, educational media can elicit and immerse pupils in a joyful and contented environment where they are emotionally and cognitively engaged. The efficacy of the learning process and the dissemination of messages and learning materials during the learning orientation stage will be greatly enhanced by using instructional media. Learning media can assist students in growing in all areas of their development and igniting their enthusiasm and interest (Sari, 2015).

Teachers can use a variety of media to assist students in developing their fine motor abilities. For kids with bodily-kinesthetic intelligence, fine motor abilities also serve as a bridge. These include children's play activities, their ability to manage and coordinate their body motions, and their use of particular equipment. Furthermore, from a social perspective, children who have developed fine motor abilities are better able to confidently engage with others and their surroundings, which fosters a positive self-image. Installing and unfastening buttons and zippers, cutting paper with scissors, and handling a form in one hand are all activities that need coordination of finger motions, which is a component of fine motor abilities. On the other hand, it is used for writing, drawing, and other tasks. Others can create shapes by folding paper, mixing beads, using plasticine or a vase, and inserting a thread into a needle (Nurwita, 2019).

Media for learning must be based on a child's developmental stage. The foundation for the development of other components is motor physical development. Assume that the child's ability to grow physically and motor skills is impaired. Given that children's physical development is adequate to define their motor activity, which influences their everyday activities and behavior, this will impact growth in the following areas. Similarly, the development of motor skills will result in more intricate social movements, namely play activities, that become the early childhood learning environment (Komaini et al., 2021). Children's world is the realm of play; they spend most of their time engaging in play activities. Children learn through play.

In this project, we will test a research methodology for kindergarten in the Denpasar region of Bali, Indonesia. The research object is a school that falls under the early childhood education category, which refers to all educational initiatives aimed at supporting children's learning and development from birth to age six by offering a variety of comprehensive, integrated, and developing experiences and stimuli that promote positive growth and development. Healthy and ideal are based on the chosen values and way of life (Sutedjo & Prilosadoso, 2016). Breakthroughs in science and technology positively impact improvements in education. According to Yelland (2001), the use of ICT (information and communication technology) in the classroom can enhance the learning resources available to teachers by giving them access to resources and questions that would be impossible without ICT, giving students access to more engaging learning materials, and benefiting the teacher as well. It will make learning more comfortable (Schiller & Tillett, 2004).
One aspect of technology and communication is the rise of visual communication-based learning, such as video, which is now utilized in primary and preschool education.

Technology and information advancements have made it possible to combine nonverbal presentation modes—such as graphics, video, animation, and sound—with verbal presentation modes, such as different narratives and texts on a monitor screen, all within a single device—computers, gadgets, and other devices (Moreno & Mayer, 1999). The best way to support early childhood learning strategies is through optical media in the form of video tutorial media. According to Olsen's (1994) presentation, information and communication technology's (ICT) potential is crucial today and serves as the primary basis for educational reform, particularly initiatives to accomplish student-centered learning objectives (Schiller & Tillett, 2004). Therefore, this study will discuss the value of educational media in video tutorials making various shapes by plasticine with fun learning concepts while telling folk stories to train fine motor skills and cultivate good character for early childhood.

2. DATA COLLECTION METHOD

This study was made based on research from observation, interview, research literature, and documentations. Observation is “a data collection method in which a person (usually trained) observes subjects of phenomena and records information about their characteristics”. (Sproull, 1988) Science starts with observation and validates discoveries by observation. Observation was made at Widya Kumara Sari Kindergarten, Denpasar, Bali, Indonesia by recording how learning activities train fine motor skills and cultivation of good character.

Interviews are qualitative research methods that acquire data through questions. Two or more individuals interview, with one asking questions. Different types of interviews differ in structure. Data collection through interviews was carried out with the Principal of kindergarten.

This research employs a literature review methodology by analyzing various scholarly journals pertinent to fine motor skills and educational media. The employed data-gathering strategy is documentation, specifically utilizing literature such as papers and scientific publications relevant to the research themes. Literature studies will be utilized to determine fine motor skills using educational media. Meanwhile, documentation techniques complement the use of observation and interview methods. Data obtained through documentation methods is in the form of a photo of the semester program document, RPPM (Weekly Learning Implementation Plan) and Widya Kumara Sari Denpasar Kindergarten school atmosphere. For media testing, researchers use observation and interview to gather data from respondents. Written or oral questions are asked in an interview-style setting.

3. RELATED RESEARCH

In this section, we briefly introduce some related works in literature.

In (Hendraningrat et al, 2021), This study uses 2009 ADDIE development research paradigm. This study involves one instructor and 18 3- to 4-year-olds. Data from the efficacy test shows that digital media improves children's fine motor skills. Video tutorials boost children's fine motor skills, according to studies. In class action research, 81.25% of children had complete fine motor abilities.

In (Tadoranggi et al, 2022), This study included 5-6-year-olds at GKST Kindergarten in Poso Regency. The child's fine motor abilities improve 50-70% during the first encounter. The child's ability grew to 80.00% in the second meeting and 90.00% at the third. This study concludes that playing with plasticine can improve children's fine motor skills.

In (Fitroh et al, 2015), This study investigates whether fairytales help early childhood pupils develop character. Legends are fictional stories that teach character and create good character traits that set them apart. The sample was 15 students ages 2.5–3.5 from PAUD Kasih Ibu, Murukan Mojoagung Jombang's group A-2. Qualitative research including file observation and interviews was performed. This research suggests that fairytales are beneficial character-building material for early childhood students. To develop students' character, accustomed and example are essential.

In (Dini, 2022), In this study, they develop scientific literacy learning videos for children learning from home early 5-6 years with the theme of the universe and subthemes of shadows and inner wind. The use of learning videos can increase children's knowledge about shadows and wind. Thus, the development of this learning video stated to be very feasible, very practical, and very effective.

4. RESULTS AND DISCUSSION

The following process which is divided into 3 stages, namely pre-production stage, production stage, and post-production stage. In pre-production, research, design, concept, storyboard, and determine the audio. The second stage is production, where there are shooting, work areas, and voice-over. The final stage is post-production, namely merging all the images that have been taken unification voice over to rendering. After the realization of video media, testing will be carried out to find out the feasibility of the video so that later, it can be used as teaching material by teachers at school for children's learning process.

Pre-production

In pre-production, research, design, concept, storyboard, and determine the audio. The concept of this learning media is starting from an introduction to fine motor training, how to maintain it and the benefits of fine motor learning using plasticine media, which is packaged with fun learning concepts, as well as in language that is easy for early childhood to understand. We chose plasticine media because it is easy to use and fun to make to resemble the original shape (3 dimensions), where early childhood want to hone their motor skills by touching and squeezing objects with their ten fingers. This study used the shapes of fruits and animals because those shapes are related to learning at school, are easy to make, and are easy to remember.

In this case, we are present the learning media design in an innovative, creative way that meets the criteria of interactive multimedia. So that later learning media can be

realized as acceptable and able to provide benefits for teachers and students. So, the educational media that will be designed is learning videos to form animals and fruit, which will then be made into educational stories. The story is taken in the form of a story entitled "Turtle and Monkey", an adaptation of a tantric story, namely a folk tale that contains learning and educational concepts and a moral message for early childhood learning.

In the work visualization, the video consists of 15 scenes. Figure 1 shows an example of visual scenes.

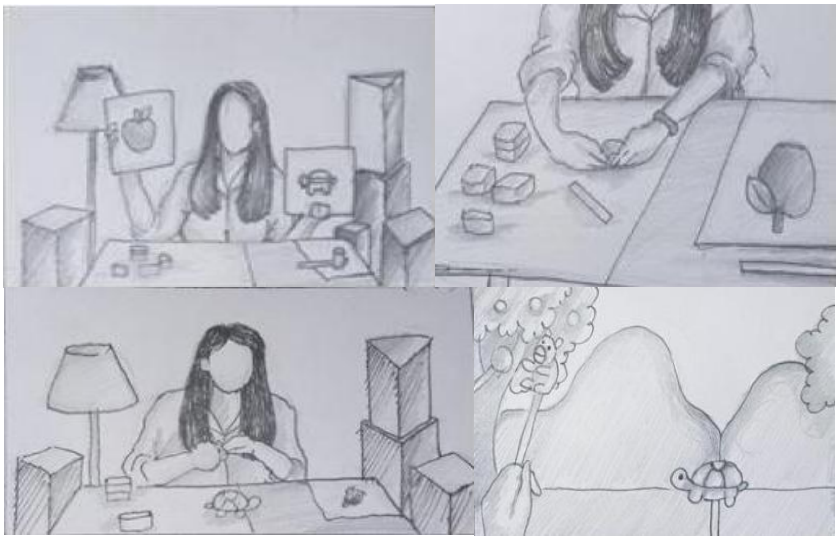


Figure 1. An example of visual scenes.
(Source: Personal, 2024)

Production

The production stage is the stage for producing videos. The following are several stages of the production process carried out:

a. Preparing the camera. The camera will use a video setting with 1080p resolution with a frame rate of 60fps.
b. The shooting technique involves taking pictures with the camera lens and camera head in a static position.
c. Record voiceovers, change soundtracks, as well fonts for video purposes.
d. Take videos at the specified studio location.

Post-production

At this stage, all recorded footage and audio are edited using Adobe Premiere Pro 2022 software.

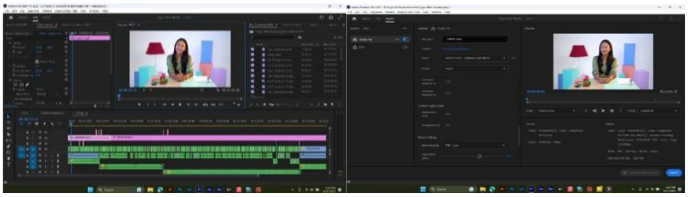


Figure 2. An editing and rendering process.
(Source: Personal, 2024)



Figure 3. Visualization of works.
(Source: Personal, 2024)

Distribution and Media Testing

Educational media was distributed to Widya Kumara Sari Kindergarten by showing it at school and watching it to 18 early childhood students. Before the video aired, we conducted interviews with several students. Most of the students are familiar with plasticine media. We ask students to make various shapes according to their creations. From the observation results, most of them could determine what shape to make and choose the color of the plasticine. However, most of them still need to focus on softening plasticine, so they often fail to make shapes. Children still need guidance and direction from the teacher to focus on softening the plasticine and making the desired shape.

After the video was shown and directed by the teacher, most of the students began to be able to focus and concentrate on the plasticine softening process, so they were able to produce apple and turtle shapes successfully. After the video was shown and directed by the teacher, most of the students began to be able to focus and concentrate on the plasticine softening process, so they were able to produce apple and turtle shapes successfully. Apart from that, when the video was shown, the children seemed enthusiastic and entertained by the story of the monkey and turtle. The teacher emphasizes the moral messages of the story to students.



Figure 4. Distribution and media testing.
(Source: Personal, 2024)

5. CONCLUSION

The fun learning concept or the fun education concept of using plasticine as a media was chosen as a method for training fine motor skills and cultivate good character in early childhood. The fun learning concept is a learning concept to develop children's creativity. The benefit of fun learning is that it makes it easier for early children to understand and express it because the learning media used in this research is visual/video based. The use of plasticine media was chosen because it is a medium that is easy to shape according to the imagination of an early children. In this educational media, early childhood children are trained to be able to learn while playing with plasticine, and character education is included through folklore told by

the speaker. From the results of observations when the video had not been shown, most of the students could determine what shape they wanted to make and choose the color. However, most students needed to focus and concentrate on softening the plasticine. After the video was shown and assistance from the teacher, most of the students could focus and concentrate on softening the plasticine. They succeeded in making apple and turtle shapes. The students seemed enthusiastic and entertained when they showed a video showing a story about a monkey and a turtle. The teacher also emphasizes the moral messages of the story. Testing of this work was also carried out on material experts and media experts, and it can be concluded that this learning video can be used or recommended as a learning media for early childhood.

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EXPLORATION OF CONVERTIBLE FASHION STYLES WITH BATIK PATTERN COMBINATION TECHNIQUE

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ABSTRACT

The increasing consumerist lifestyle of society has led to a surge in fashion waste and the proliferation of fast fashion production. This is driven by the societal need to present different styles on various occasions. Additionally, there is an issue where people are reluctant to use batik fabric for daily activities due to its perceived outdated design or the notion that it is only suitable for formal events. Therefore, the author conducted research using industrial visits, literature studies, interviews, and Google Forms questionnaires to find solutions to the issues of fashion waste, equal distribution, and cultural preservation. This research aims to merge sustainability and cultural preservation by creating convertible clothing that combines batik motifs with casual ready-to-wear fashion. The hope is that the products created by the author can educate the public and benefit various stakeholders, particularly local batik artisans, emphasizing the importance of preventing and reducing fashion waste without adopting a consumptive lifestyle. The goal is to enable individuals to maintain a comfortable and fashionable appearance on various occasions.

Keywords: *fashion waste, cultural preservation, convertible clothing, batik combination, ready to wear*

1. INTRODUCTION

Indonesia, as a country with abundant cultural wealth and a very valuable cultural heritage. One of the cultures that is a source of pride for the Indonesian nation is batik. Batik is a traditional cloth adorned with distinctive Indonesian patterns and motifs. Batik not only serves as a symbol of Indonesian national identity but also as one of the fashion trends that continue to evolve. Batik was designated as an Indonesian Cultural Heritage (intangible cultural heritage) by UNESCO (United Nations Educational, Scientific and Cultural Organization) on October 2, 2009 (Ari Wulandari- 2011). Since then, every October 2nd has been commemorated as National Batik Day.

Batik comes from the Javanese words "amba" and "titik," which mean to write dots. Batik is closely tied to Javanese culture, although it also interacts with other cultures. Javanese batik has various motifs that are rich in life philosophy. [2] (Yunus & Tulasi,-2012)

Among the various types of batik, one of them is Combination Batik. This batik is made using a writing technique with a canting and wax to form the desired motif details, then in the design completion process, stamps or seals are used. This batik is produced with the hope of creating more attractive motifs. However, there are still many people who are reluctant to use batik cloth as everyday clothing due to

its old-fashioned design, or because they consider its purchase to be "half-hearted" since it can only be used for formal events. Thus, this leads to a consumerist lifestyle where people buy many clothes intended for different occasions. Currently, more and more people are interested in fashion trends that successfully blend batik fabric into modern clothing and combine it with other materials. With the creation of designs that are more functional in the eyes of the public. The term for such clothing is convertible ready-to-wear fashion. According to Bernard in the foundational article on fashion style and trends, fashion style is the understanding of one's personality and using clothing according to personal taste. [3]

Ready-to-wear clothing is clothing that can be purchased and worn immediately without the need for body measurements and ordering the design in advance. [4] (Hana – 2011 ‘online article Ready to-wear) This type of clothing is commonly referred to as ready-to-wear. Meanwhile, convertible clothing according to Felicia Setiawan & Paulina Tjandrawibawa in the article (Designing Convertible Clothing for the Volatile Brand) [5] is practical clothing created by making multifunctional convertible garments. Clothes that are easily convertible can provide more than one look, allowing consumers to change their appearance in a short amount of time. The creation of this convertible fashion is based on the consumerist lifestyle of society. And it is aimed at reducing fashion waste. In an online news article titled "Fast Fashion Waste, The Forgotten Waste" (itsojt November 2022), it was reported that the clothing industry has contributed as the second-largest polluter in the world. He also added that as much as 1.2 billion tons of greenhouse gas emissions are produced by the textile industry worldwide. [6] With the hope that this combination of convertible batik fashion can make people fall in love with local products again, and can use clothes with various explored modes so that they do not need to buy many different clothes.

2. RESEARCH METODOLOGY

In the process of creating styles and convertible clothing with the technique of combining batik motifs into visual forms. So that it aligns with the desires of the community and the existing market target, without eliminating the elements or principles of the batik fabric itself. Therefore, based on the type and analysis, a Mixed Research Method combining quantitative and qualitative research, as well as case studies and field research, is used. Quantitative Method According to Robert Donmoyer (in Norjanah: 2014) [7], quantitative research is an approach to empirical studies to collect, analyze, and present data in numerical (number) form rather than narrative. This research is usually conducted when accurate results are desired because it relies on calculations. Meanwhile, the Qualitative Method in the form of narratives is obtained from interviews with several fashion designers who apply hand-drawn and stamped batik in their creations, batik craftsmen, and the community who appreciate fashion styles. In the data collection and analysis, a descriptive analysis method was used in the form of questionnaire completion with the help of the Google Form platform, which was carried out by elaborating on several questions related to batik fabric, convertible clothing, and combined batik motifs to respondents regarding their application in Ready-to-wear clothing. So that we can understand the public's response regarding the use, as well as suggestions and hopes for producers in the fashion industry, whether they are fashion designers, batik cloth artisans, or those who will eventually impact fashion trends themselves. The second data collection method is through observation methods such as interviews, as well as literature studies or visits to industries or fashion practitioners with the aim of accurately collecting data and understanding market demand or target market. Which can then be strengthened by conducting field observations related to observing convertible fashion styles with a combination technique of batik motifs between hand-drawn batik and stamped batik, thus producing abstract motifs through the application of both techniques. The data processing from the combined research method and observation uses the Batch Processing method, which involves periodic or simultaneous data processing

in "batches" or large groups. The data processing is carried out on the collected data and is not done in real-time. Batch processing is often used for large and complex processing tasks [8]. Where the aim is to explore previously unknown aspects, identify patterns and trends in the research, and ensure the alignment between findings and the information discovered. The data generated by the respondents will be sorted first, which will later produce interest percentages, starting from interest in the use of batik fabric, public interest in convertible ready-to-wear clothing, to the extent of public interest in the motifs of batik fabric with the combination technique that is expected to be produced later.

3. RELATED RESEARCH

According to Saputra, Batik is one of Indonesia's local cultural heritages that currently also needs preservation to maintain and sustain its existence amidst the rapid waves of modernization and globalization. Through the existence and preservation of batik amidst the rapid modernization, it is undeniable that the fashion industry has experienced rapid development driven by the consumerist lifestyle of society. The phenomenon of fast fashion has negative impacts such as increased textile waste and the exploitation of natural resources. On the other hand, cultural heritage such as batik faces challenges in acceptance within modern society, especially among the younger generation who tend to consider batik less flexible for everyday use. Therefore, innovative solutions are needed to address these two major issues: sustainability in fashion and the preservation of local culture..

4. RESULTS AND DISCUSSION

Literature study, also known as literature review, is the process of investigating and analyzing literature, research papers, and other written works relevant to a specific topic. The purpose of a literature study is to understand, evaluate, and synthesize information that already exists in the scientific or professional literature related to a particular subject or research question. In the process of creating this Final Project, the author conducted a literature study on several fashion designers and batik fabric artisans, including:

a. The Dwico brand, created by fashion designer Mr. Dwi Iskandar, who is quite well-known in Bali and even in Indonesia. The Dwico brand has been developing since 2001 until now, and has a studio located at Komplek Ruko Puri Gading Block B 01/ No. 1a – 1b in the Jimbaran Bali area. Starting with a modest beginning in 2001 with a small boutique in Sanur, Mr. Dwi Iskandar has embarked on an impressive journey, developing his studio into an entity that currently involves a team of 12 staff members. Known for his sophisticated designs, he combines modern and traditional fabrics in styles influenced by ethnic elements, creating colorful and unique results. In 2005, Dwi Iskandar launched dwico, focusing on the retail aspect, and dwico smart for uniforms. His knowledge of design and expertise in the hospitality field made him the top choice for leading hotel design projects in Bali and various countries. His love for Indonesian culture, art, and traditional fabrics is clearly reflected in his work. Currently, her dedication is not limited to the fashion world, but also encompasses a deep concern for principles such as reuse, reduction, and recycling.

His works have gained recognition through his participation in various fashion shows in different locations, including Indonesia, San Francisco, Hong Kong, Vietnam, and Seychelles. Dwi Iskandar also has experience designing dresses for contestants from Malta and Georgia in the Miss World 2013 event in Bali. Active in the fashion industry, he previously led APPMI Bali and IFC Bali, and currently serves as the Chairman of BEDO (Business and Export Development Organization), contributing to the growth and improvement of individuals and small

businesses in the fashion sector, promoting a spirit of learning and enhancement for their own benefit.

The data obtained by the author from literature studies and interviews with Mr. Dwi Iskandar indicate that the Dwico brand has several advantages, namely designs using zero waste techniques, showing concern for the environment, the use of batik or traditional Indonesian woven fabrics, providing a local identity, and the disadvantage of only using batik fabric with geometric patterns in most products. The author concludes that Dwico Fashion Studio characterizes itself as a pioneer of zero waste techniques with a focus on local materials, especially batik and woven fabrics. Although geometric patterns dominate, the studio has the potential to combine zero waste techniques with the uniqueness of hand-drawn batik patterns or combinations.

b. Batik Popiler was founded in 1962 by Mr. Wayan Matra and Mrs. Made Tunjung. In the fifties, Mrs. Tunjung made a living by trading spices. Her work brought her into regular contact with farmers in remote areas of Bali who always requested batik from the neighboring island, Java. Ibu Tunjung would make regular visits there, personally selecting the best samples, including very beautiful antique items, which were easier to obtain at that time. Her business was doing well, and she opened a batik store in Bali's capital, Denpasar – the first on the island. By 1976, the business had grown significantly, and a larger location was found in Tohpati, east of Denpasar. Mrs. Tunjung's daughter, Putu Arnany, took over the business in 1983 by adding bold contemporary designs and expanding the business into batik painting and various types of products. Currently, Batik Popiler II continues to set the standard for superior batik quality, with the same focus on tradition and design innovation.

We can not only buy beautiful batik at the Batik Popiler Headquarters, but they can also see many rare antique textiles that Mrs. Tunjung and her daughter have collected over the years and even gain insight into the intricate process of hand-making these beautiful textiles.

The data obtained by the author from literature studies and interviews with Mrs. Putu Arnany indicate that Batik Popiler has several advantages, namely the production of high-quality batik with a focus on tradition and design innovation while adhering to traditional values. However, there are also limitations, namely the absence of batik clothing that incorporates modern designs. The author can then conclude that Batik Popiler II maintains high quality and traditional values in its batik production. Nevertheless, design innovation is necessary to reach a broader market, especially by introducing batik clothing with modern designs.

Survey Data Results

Here are some questions included by the author related to this scientific article research, aimed at the community aged 15 – 55 years with various genders and occupations:

Table 1. Questionnaire Column

No	Question
1.	Name Respondent's
2.	Gender
3.	Respondent's Origin
4.	Respondent's Age

5.	Respondent's Occupation
6.	Did you know that Indonesia produces 2.3 million tons of clothing waste, and only 0.3 million tons of that waste can be recycled?
7.	If the author creates Convertible Clothing or multifunctional clothing made from batik fabric as shown in the picture below, aimed at reducing fashion waste and promoting Indonesia's cultural heritage, would the respondents be interested?
8.	From the multifunctional design above, where the clothing can be transformed into different shapes, do the respondents agree that this can reduce fashion waste?
9.	If viewed from the aesthetic composition, which design motif is the most attractive and most suitable to be applied to everyday clothing?
10.	According to your choice above, is that fashion style suitable for use on a resort vacation?

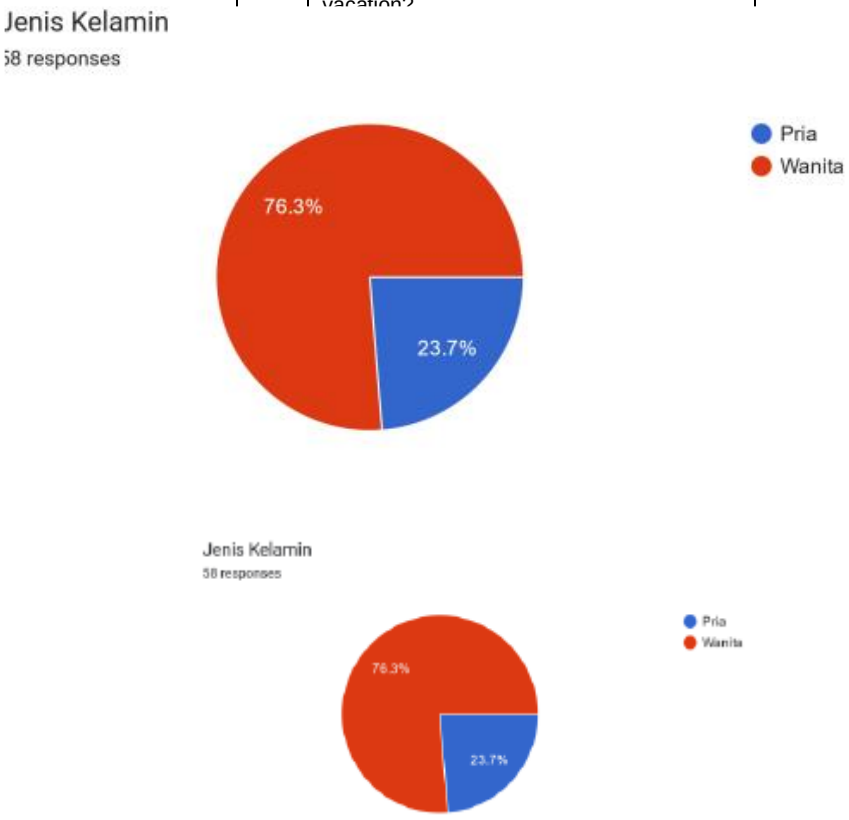


Figure 1. Percentage Diagram of the Questionnaire Respondents' Gender
(Source : Writter, 2024)

From the diagram above, it can be concluded that 76.3% of the respondents are women, and 23.7% are men.

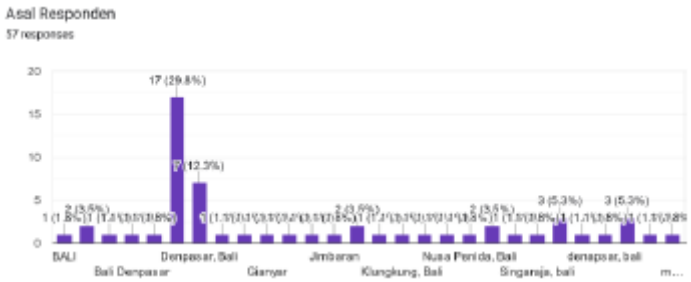


Figure 2. Questionnaire Percentage Diagram
Respondent Origin
(Source: Writter, 2024)

From the diagram above, it can be concluded that the majority of respondents are from the city of Denpasar and from the Bali region.

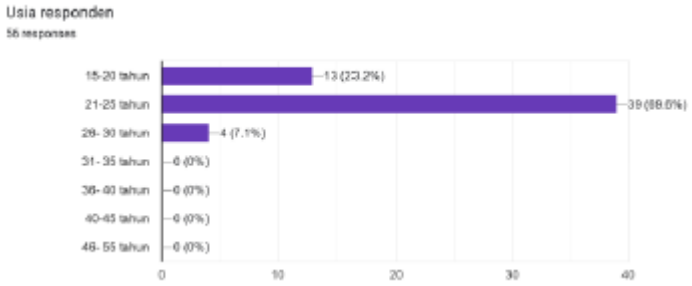


Figure 3. Percentage Diagram of Respondent Age
(Source : Writter, 2024)

From the diagram above, 69.6% (39 people) of the respondents are aged 21-25 years, 23.2% (13 people) of the respondents are aged 15-20 years, and 7.1% (4 people) of the respondents are aged 26-30 years. It can be concluded that the majority of the respondents are teenagers aged 20-25 years.

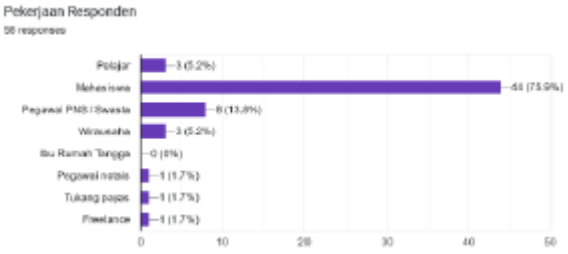


Figure 4. Percentage Diagram of Respondent Job Questionnaire
(Source: Writter, 2024)

The respondents' occupation as students has a total percentage of 75.9% (44 people), followed by respondents working as civil servants/private employees at 13.8% (8 people), and then respondents working as entrepreneurs at 5.2% (3 people). According to the data, the conclusion from the above data is that the average respondents from the questionnaire are individuals who have a need for fashion according to their field of work. In this data, the majority are teenagers who are still students.



Figure 5. Percentage Diagram of Clothing Waste Knowledge Questionnaire
(Source : Writter, 2024)

In the first question, it can be concluded that respondents who have knowledge about clothing waste amount to 48.3% (28 people), then 27.6% (16 people) of respondents may have only heard about it without knowing further data for sure, and 25.9% (15 people) of respondents do not yet know that Indonesia produces 2.3 million tons of clothing waste. It can be concluded that education about waste and awareness in the community may have increased, but it needs to be continuously educated so that the entire community is aware of the importance of knowledge about waste, how to reduce it, and how to prevent it.



Figure 6. Percentage Diagram of the Convertible Fashion Creation Opinion Questionnaire
(Source : Writter,2024)



Figure 7 Illustration of Convertible Fashion
(Source : pintterest.com)

Regarding the question about convertible clothing, 87.9% (51 people) of the respondents are interested in the clothing and agree that it is attractive, while

13.8% (8 people) of the respondents might be interested and agree with the convertible clothing that will be produced by the author. It can be concluded that convertible clothing has its own unique appeal, making it suitable for production by the author.



Figure 8. Percentage Diagram of the Multifunctional Design Opinion Questionnaire that can reduce fashion waste
(Source : Writter, 2024)

From the above percentage, 87.9% of respondents agree that the construction design can reduce fashion waste, and 12.1% of respondents said they might agree with this. It can be concluded that the majority of respondents agree with the author's opinion, and the author can apply this multifunctional construction design to the products that will be created.



Figure 9. Percentage Diagram of the Aesthetic Composition Motif Opinion Questionnaire
(Source : Writter, 2024)



Figure 10. Illustration of the Motif with points in certain areas, and the size of the motif adjusts accordingly.
(Source :Pinterest.com)



Figure 11. Illustration of a fairly large-sized motif
(Sumber :Pinterest.com)



Figure 12. Illustration of full motif design with a single center point
(Source :Pinterest.com)



Figure 13. Illustration of a full motif design with the same size
(Source :Pinterest.com)

From the diagram above, 77.6% (45 people) of respondents were more interested in designs where the motifs were placed only in certain parts with size-adjusted

motifs, 27.6% (16 people) were interested in designs with full motifs of the same size, then 20.7% (12 people) were interested in designs with full motifs with one center point on the material or garment, and 8.6% (5 people) were interested in designs with fairly large motifs. It can be concluded that the majority of respondents preferred designs with motifs only in certain parts and size-adjusted motifs.

Discussion

1. The Process of Batik Fabric Production

In the process of batik fabric production, there are several stages, including:

a. Selection of raw materials. In this selection process, there are also two steps: choosing the main material, which is usually made from silk or other natural fibers, and ensuring the quality of the materials, which must be of high quality to achieve good batik results.



Figure 14. Main material selection process
(Source: Writter, 2024)

b. Then, it is continued with the application of the previously designed pattern onto the fabric using carbon or drawing it directly onto the fabric.



Figure 15. Drawing The Patterns
(Source: Writter, 2024)

c. The waxing process or "menyembelit" begins with the application of hot wax on the fabric according to the design pattern. The wax then acts as a protector, preventing the dye from adhering to certain areas.



Figure 16. Candle application
(Source: Writter, 2024)

d. First Dyeing Process (Ngalam): Base Color: The fabric is dyed in the desired base color. Washing: After dyeing, the fabric is washed to remove the wax and achieve a clean base color.
e. The Next Night Process (Re-waxing): Wax Addition: Wax is reapplied to protect areas that should not be affected by the next color.
f. The Next Dyeing Process (Nglorot): Additional Color Application: The fabric is dyed with an additional color, according to the desired design. Rewashing: After the dyeing is complete, the fabric is washed to remove the wax and provide color clarity.
g. Final Washing and Drying: Final Process: The fabric is carefully washed to remove any remaining dye and wax. Drying: The fabric is dried appropriately to ensure the color remains durable.
h. Finishing Process: Detail Completion: The final process involves adding any necessary details or finishing touches. Quality Inspection: The fabric is inspected to ensure the quality and accuracy of the design.

2. Conceptualization of Motifs and Designs

a. Description of the "Mother Earth" Concept

Ibu Pertiwi is a term in Indonesian that can literally be translated as "Mother Earth" or "Motherland" in English. The definition of Ibu Pertiwi encompasses a profound symbolic concept that depicts the homeland or earth as a "mother" that provides life, fertility, and protection to humanity. It symbolizes the close relationship between humans and nature, as well as our responsibility to protect, nurture, and preserve the environment and natural resources for the well-being of current and future generations. Mother Earth also reflects love and care for the homeland and the culture of a country. This term is often used in the context of nationalism, patriotism, and environmental preservation.

b. Concept Mind Mapping

There are several sub-sections within the concept of "Mother Earth," including:

1. The Origin of Mythology

In this section, it is explained how Mother Earth is known and believed in worldwide.

Namely:

Due to the influence of Hinduism in Indonesia, where people began to worship deities, one of which is Dewi Pertiwi, which became the origin of the term "Mother Earth."

2. Other Names

Mother Earth also has other names besides Ibu Pertiwi, such as dhara, dhart, and dhrthri, which mean the center that holds everything.

3. Symbol

Mother Earth is believed to be a symbol of life, fertility, protection, and balance.

4. Representing

Mother Earth also represents several relationships, including the relationship between humans and nature, as well as the responsibility to care for, nurture, and preserve the environment.

5. Colors

Mother Earth is associated with several colors and their philosophies, including brown, which signifies natural, conventional, and humble; green, which represents natural stability, wealth, and renewal; and black and white.

c. Keywords of the concept to be implemented in fashion

- The relationship between humans and nature is implemented through the design of asymmetrical curved geometric ornaments that resemble interconnected waves and the application of sustainable design.
- Balance is represented by the lotus flower flora, symbolizing balance.
- Fertility is symbolized by the dispersion of seeds, implemented in the form of dots to make the design appear more complex.
- Color: brown - implemented as the base color of the fabric.
- Black and white are implemented in the motif color and outline.

Mission of the work

1. Sustainable design

Sustainable design is a clothing design that considers the sustainability of life and the environment in terms of materials, dyeing techniques, and minimizing production waste.

2. Zero waste technique

Zero waste in fashion creation refers to a design and production approach aimed at reducing or even eliminating textile waste throughout the entire product lifecycle. This approach prioritizes efficiency in the use of fabrics and materials, resulting in little to no waste generated during the production process. Some principles and techniques generally associated with the zero waste approach that the author will apply are:

A. Zero-Waste Pattern: Designers strive to create fabric cutting patterns in such a way that no unused material remains. These patterns are usually meticulously designed to minimize leftover pieces and maximize fabric usage.
B. Modular Design: Clothing is designed with components that can be easily assembled and disassembled. This allows for extending the product's lifespan and updating certain parts without having to replace the entire garment.
C. Material Efficiency: Carefully selecting materials and optimizing their use. Reducing excessive cutting and maximizing the yield from each roll of fabric.

Application of Motifs and Production Techniques in Fashion Design



Figure 17. Manual sketch of the batik motif to be applied to the clothing
Source: Writter, 2024)



Figure 18. Digital sketch of the batik motif to be applied to the clothing
Source: Writter, 2024)

In accordance with the survey results and the concept presented by the author, which is "mother earth," a design featuring lotus flower motifs combined with geometric ornaments was created. Additionally, the placement of the motifs will be positioned at specific points on the garments, with sizes adjusted accordingly.



Figure 20. Digital fashion design to be produced
(source : writer, 2024)

According to the survey results and analysis conducted, the majority of respondents prefer a casual yet stylish fashion appearance. Therefore, the author created a convertible outfit consisting of a top designed like a halter top, covering the body and crossing over the neck and shoulders. The bottom of the outfit is designed like a drawstring skirt tied at the waist, creating draped folds. Of course, it is complemented with detailed batik motifs, a combination of hand-drawn and stamped patterns, which will be placed in several sections with motifs created by the author.

Market, Business and Concrete Strategies To Increase Public Awareness And Education

1. Market Analysis

Target Audience:

- Demographics: Young adults to middle-aged consumers (18-45 years old), particularly those with an interest in cultural heritage and sustainable fashion.
- Geographics: Urban areas with a strong appreciation for art, culture, and innovation. International markets can be explored, especially countries with existing interest in Batik and cultural textiles (e.g., Japan, Netherlands, and the USA).
- Psychographics: Consumers who value versatility, tradition, sustainability, and unique design in their wardrobe.

Market Trends:

- Increasing interest in sustainable fashion and slow fashion movements.
- Growing appreciation for multifunctional clothing that can be styled in different ways.

- Rising global awareness and demand for cultural heritage-inspired designs.
- Strong emphasis on customization and unique patterns in high-value markets.

2. Business Model

Product Offering:

- Convertible fashion items, such as dresses, skirts, tops, and jackets, that can be styled or worn in multiple ways.
- Incorporation of Batik patterns using traditional and innovative techniques (e.g., eco-friendly dyes or digital Batik printing).

Value Proposition:

- Versatility: One garment, multiple looks—ideal for travel, minimalist wardrobes, and mix-and-match styles.
- Cultural Pride: Integration of Batik as a unique, meaningful pattern that highlights cultural heritage.
- Sustainability: Use of eco-friendly materials and techniques to align with environmental concerns.

Revenue Streams:

- Direct sales through e-commerce platforms and physical stores.
- Collaborations with designers or brands for exclusive collections.
- Workshops or kits for DIY Batik combination techniques.

3. Marketing Strategy

Brand Positioning:

- Highlight the fusion of modern fashion with cultural heritage.
- Emphasize sustainability and craftsmanship.

Promotion Channels:

- Social Media Campaigns: Instagram, TikTok, and Pinterest for showcasing styling versatility and storytelling.
- Fashion Events: Participation in cultural and sustainable fashion shows to reach niche audiences.
- Collaborations: Partner with influencers and cultural organizations to boost visibility.
- Content Marketing: Blog posts and videos about Batik's cultural significance and styling ideas.

Pricing Strategy:

- Competitive pricing for middle-tier consumers while offering premium options for high-end markets.
- Seasonal promotions and subscription models for loyal customers.

4. Production and Distribution

Production:

- Collaborate with local Batik artisans to support communities and ensure authentic patterns.
- Use a mix of handmade and digital production techniques to balance cost and scalability.

Distribution:

- E-commerce platforms for global reach.
- Pop-up stores and partnerships with boutique retailers.
- Direct-to-consumer approach for a personal shopping experience.

5. Sustainability and Social Responsibility
1) Adopt zero-waste cutting techniques for efficiency.
2) Source from ethical suppliers and use biodegradable packaging.
3) Collaborate with Batik-making communities to preserve traditional techniques and empower artisans economically.
4) 6. Challenges and Solutions

Challenges:

1) Misappropriation concerns for traditional Batik patterns.
2) Higher production costs due to artisan collaborations and sustainability practices.
3) Educating the market on Batik's cultural and artistic value.

Solutions:

1) Obtain proper certifications and collaborations with Batik organizations to ensure authenticity and respect.
2) Efficient supply chain management to reduce costs.
3) Strong storytelling and educational marketing campaigns to build appreciation.

7. Growth Opportunities
1) Expand product lines to include accessories and home décor with Batik elements.
2) Enter the global luxury market with exclusive, handcrafted collections.
3) Explore tech-based innovations like AR styling apps to show garment versatility in real-time.
4) This approach positions Convertible Fashion Styles with Batik Pattern Combination Technique as a sustainable, culturally rich, and innovative brand ready to captivate modern consumers.

Technology And Innovation That Can Be Used In The Production Of Transformable Fashion.

1. Fabric Technologies

Sustainable and Recycled Materials
- Use of biodegradable or recycled fabrics to align with eco-conscious consumers.
- Innovative fibers like Tencel, which are versatile for multiple styling purposes.

2. Design Innovations
   1) Modular Design Techniques
      - Garments constructed with detachable components (e.g., sleeves, collars, panels) that can be reassembled for new styles.
      - Snap, zipper, or Velcro systems for easy transformation without compromising aesthetics.
   2) Convertible Mechanisms
      - Reversible Construction: Double-sided fabrics to allow inside-out transformation.

- Adjustable Drawstrings and Ties: To modify garment shapes or sizes.

3) 3D Printing in Garment Construction
   - Use of 3D-printed accessories or panels that can be snapped onto garments for added versatility.
   - Lightweight and customizable 3D elements for unique designs.

3. Advanced Production Methods
1) Laser Cutting and Engraving
   - High precision for creating modular parts or intricate patterns that fit together seamlessly in transformable designs.
2) Digital Fabric Printing
   - Use of on-demand digital printing for customized and reversible patterns, such as reversible Batik-inspired designs.
   - Eliminates waste from traditional dyeing processes.
3) Seamless Knitting Technology
   - Techniques like WHOLEGARMENT by Shima Seiki for garments that adapt naturally to different forms without seams.

4. Technology-Driven Functional Enhancements
1) IoT-Enabled Garments
   - Wearable technology: Incorporate sensors to monitor body metrics, allowing garments to adapt to user needs (e.g., expanding when detecting movement).
   - Smart controls for LED or thermo-reactive embellishments for aesthetic transformations.
2) Self-Healing Materials
   - Fabrics that repair themselves after small tears, enhancing the longevity and versatility of transformable designs.

5. Digital Design and Development Tools
1) 3D Fashion Design Software
   - Tools like CLO 3D, Browzwear, or Optitex to prototype transformable garments and visualize their adaptability virtually before production.
   - Enables simulations for testing functionality, fit, and transformation mechanisms.
2) AI-Assisted Pattern Making
   - AI-powered systems to generate multi-functional garment patterns efficiently and optimize for minimal waste.

6. Consumer-Centric Innovations
1) Augmented Reality (AR) Styling Apps
   - Allow users to visualize different ways to style or transform garments before purchase.
   - Enhances the shopping experience and helps consumers maximize usage.
2) Customization Platforms
   - Interactive systems where users can choose modular elements, fabrics, or patterns to design their transformable pieces.

7. Sustainability-Focused Innovations
1) Zero-Waste Cutting Techniques
   - Algorithms to optimize fabric usage for modular designs, ensuring minimal leftover materials.
2) Closed-Loop Recycling Systems
   - Enable worn-out transformable garments to be disassembled into raw materials for new designs.

By integrating these technologies and innovations, the production of transformable fashion can meet the demands for functionality, sustainability, and modern aesthetics.

5. CONCLUSION

Batik, as a cultural heritage of Indonesia, holds immense value. Although recognized as Indonesian Cultural Heritage by UNESCO on October 2, 2009, there are still challenges in encouraging the community to adopt batik as everyday clothing. Some people are still reluctant to wear it because they consider it outdated or only suitable for formal events. However, the new fashion trend that combines batik with modern designs, such as in the ready-to-wear convertible fashion style, is starting to attract a lot of attention. This clothing, designed to reduce fashion waste and support a more sustainable consumer lifestyle, can provide a different look in a short time. This aligns with efforts to change public perception of batik and support local products.
The author also emphasized the negative impact of the fashion industry on the environment, highlighting the role of the clothing industry as the second-largest contributor to pollution in the world. By promoting convertible batik combination fashion styles, it is hoped that the community can return to loving local products and reduce the need to buy many different clothes. Thus, awareness of environmental impact can be increased while still preserving Indonesia's cultural wealth. Data collection used the batch processing method, which is a combination of qualitative and quantitative methods conducted through literature study, interviews, and filling out Google Form questionnaires. Based on the survey results, it can be seen that the majority of respondents are interested in the convertible clothing that the author will produce, so the author is determined to create a unique convertible clothing line. Additionally, the respondents have also suggested to the author that the majority prefer casual clothing styles with motifs placed only in certain areas, with sizes that will be adjusted by the author.

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CULTURAL HERITAGE PRESERVATION A CERAMIC FUSION DESIGN INSPIRED BY EAST JAVA COFFEE DRINKING CUSTOM

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ABSTRACT

The primary objective of this research is to safeguard and enhance awareness surrounding the abundant cultural legacy of East Java by amalgamating facets of its varied traditions, less familiar to external audiences, such as the Remo dance and distinctive coffee-drinking practices of its inhabitants. Employing the intricate craft of ceramic carving, this investigation aims to encapsulate the robust, resolute, and fervent nature inherent in East Java. The study relies on the acquisition of data from historical and cultural sources, employing the IMO (inner, middle, outer) method for cultural identification, supplemented by interviews, observations, and exploration. The ultimate outcomes of this exploration yield two coffee sets that reflect the local customs of East Java, notably the unique practice of pouring coffee into the saucer—an increasingly rare phenomenon in urban areas. The design incorporates elements of the Remo dance and employs carving techniques, fusing visual, ideational, and auditory aspects of the dance into the coffee sets. This endeavor successfully melds both cultures into ceramic design, contributing to a broader understanding of East Java's traditions, as evidenced by user reviews.

Keywords: *design, ceramic, tradition, coffee, culture of East Java*

1. INTRODUCTION

Since the pandemic ebbed in 2021 people worldwide have exhibited growing interest in spending time doing activities at home, and one of the popular choices chosen are pottery ceramics. From global ceramic demand analytics, it is reasonable to expect this trend will continue on an upward trajectory through 2028 with a predicted compound annual growth rate(CAGR) of around 4.4%(Grand View Research, 2022). Additionally, ceramic products that embody a strong identity are more in demand, given that a strong identity can enhance the product's existence in the global market and enhance individual user experience. The identity can be by applying cross pollination design strategies that combine various cultural influences into the product, which lead to new opportunities for local area ceramic artists seeking ways to strengthen locally made products. Indonesia has many regions with vast amounts of culture. However only few in number are prominent enough to be recognized by others. By looking back into its history and to the people's behavior that intermixed into many of its cultures and arts, it’s apparent that East Javanese people proclaim the value of solidarity and heroism. One of East Java arts and culture is the opening of the Ludruk performance, Remo dance that portrays the story of a warrior defending their nation, which is now used to welcome visitors. Another custom is the way East Java peoples’ drink their coffee which is already uncommon to find in the central city, but can be easily located in street food stalls and street side restaurants for common folks. With this in mind, this study aims to create a ceramic art inspired by Remo dance and incorporate it with the coffee drinking custom from East Java

which not only increase the number of East Java designs but also help broaden outsiders' knowledge of East Java cultures.

2. RESEARCH METODOLOGY

This research will be conducted with secondary research followed by primary research through data collection from the historical and cultural sources, the identification of culture using IMO (inner-intangible level proclaiming the spiritual or ideal side, middle-behavioral level proclaiming the function and usability side, outer-tangible level proclaiming the physical or visual side) method in 3 cultural levels (Lin, 2007), interviews, observations, exploration and experimentations, as well as collections of user reviews and prototypes.
Secondary research was used to collect data starting from ceramics orpottery basics for introducing the way pottery is made, an in-depth research about the culture of East Java by looking for their similarity of value especially on the cultures chosen for this study - Remo dance and coffee-drinking custom - beginning from their history, values, aspects, forms, and others that filled up the design identification method of IMO (Inner, Middle, and Outer). Other than that, there was also the study of Carl Jung's Color Energy theory —about how personality can be depicted as colors on how it represents oneself and how others perceive them—and the study of shapes psychology to support the transformation of Remo dance into the design later on.
**While in primary research, the study was done first handedly by identifying the process in ceramic handbuilding technique of slabbing and ceramic surface decoration in carving firstly. It was followed by diving through a series of experimenting the basic shape formed by Remo dance forms, the carving technique, how the surface depth affected the picture shown by the poured liquid, how a shape impacted the draping process, and on how, if possible, a locking system can be introduced to the design or what new shape can be used but still stable enough to use. In deciding the best one this study used the QFD (Quality Function Deployment) method and grading 1-4 for each indicator to be looked for on each piece, such as the ergonomic, the smoothness in dripping, has the least residue, the timeto cool down, and the best volume in the saucer shape. In this phase, the study also interviewed some East Java coffee lovers by asking some coffee drinking habits and their preferences. Like, what type of coffee they drink, where they usually did it, the routine or course of action in making and drinking coffee, the usage of cup's saucer to the East Java people, and some suggestions. It helps in giving insight about the coffee-drinking custom and habits to tackle any inconvenience or what feature to be added or removed. Afterward, some observation about the coffee-drinking custom of pouring it into the saucer rather than drinking it from the glass was done to fill in the "why's" that was not quite answered through the interview. From the collected data and by merging them following the moodboard, some prototypes were made to test out the material, pictures from the carvings, the color scheme, the forms and ergonomics, weight, and the auditive aspect. Which was graded and chosen to be developed as the final product using QFD (Quality Function Deployment) method. Finally, when the final product was ready, it went through 5 users to be tested out directly where 2 users are local from East Java and the others are not, thus finding out the different impacts it can give to the locals and to the outsiders. The user review was closed with the filling of some questionnaires to gradethe product starting from the concept ideas, the delivery of the planned vibe, the delivery of education on East Java cultures, the function, the uniqueness, the carving, and the quality of the product.

3. RELATED RESEARCH

3.1 Secondary Research Result

From the data collected from the secondary research it shows that East Java upholds the value of heroism and fellowship to live as a pact in quite a high esteem with their traditional arts implementing the value of freedom, simplicity, and the usage of their

flora and fauna (Mahalia, 2023)(Tri Wedawati et al., 2022). They also use carving techniques to almost all their designs in order toconserved this art until now. These values can be seen in one of their cultures, which is Remo dance that this study used as one of the concepts. Remo first started as a collective dancing form of entertainment for the people. It started to have the theme of heroism when it merged with Ludruk performance and the start of colonialism in Indonesia as a show of criticizing the invaders plus a way to encourage the locals. Nowadays, it has become another form of entertainment as well as a show of welcoming non-locals. Remo dance has 4 main aspects: ideation (theme of heroism), visual (costume and makeup from the 18 centuries), physical-kinesthetic (dancing forms), and auditive (music and costume accessories such as *gongseng*, ankle band of bells that work as rhythm). With the help of IMO method, it can be identified that this study will proceed with slabbing handbuilding ceramic technique where the process used thin 3-4mm thick clay to be assembled by parts and used carving decoration technique like sgraffito and mold pressing to its surface.

Table 1. IMO Design Method

Outer	Middle	Inner
Dance form 	As in entertainment, a show of encouragement, a welcoming	Heroism, showing of strong, fast, and hard pace personality
Costume 	Characterization, theme of 18 centuries, rhythm bells	Telling a story of a knight fighting and defending their nation as a show of appreciation to those who fight and support[4].
Makeup: strong, deep, bold stroke (Apriliani & Wilujeng, 2020) 	Characterization 	
Color; red, white, black 		

Source: Hartanto, et al., 2022

The experiment on the shape formed in the dancing forms (*tancep, salam pembuka*, and *tanjak*) led into 3 basic shapes shown in figure 1 that displayed all of them using a variety of rectangles. These shapes will later be used as the basic form of the design (Designex Studio, 2020).



Figure 1. Shapes Formed from Remo Dane (Tancep Form; Salam Pembuka Form; Tanjak Form)
Source: Hartanto, et al., 2022

The carving technique, as shown in figure 2, was explored in ways:
(a) carving the outline drawing angled outward, (b) carving the outline drawing angled inward, (c) carving in the pictures, (d) carved out the background, and (e)combination of c and d (DK, 2019). Exploration a made a gradation of color outward as opposed to exploration b that has a gradation inward to the picture. Due to that exploration b has a smallerpicture than a. Exploration c carved in the picture in as opposed to exploration d that carved out the background which made the

picture pop out. Exploration has the most unique result that gives a sense of arrangement which ones at the back and the front.



Figure 2. Carving Technique & Depth Experiment (Carving in; Adding it up)
Source: Hartanto, et al., 2022

The experiment on dripping was done to some existing saucer with different depth and form. Through this experiment and the help of QFD method, the one with the best compatibility with the indicator waswith the height of 3 cm, depth of 2.5 cm, and volume of 60 mm. Lastly for the locking experiment, it was done using a dummy shown on figure 2. Though this experiment was not as accommodating or efficient as it was meant to be.



Figure 3. Dripping Experiment on Existing Saucer & Locking Experiment Dummy
Source: Hartanto, et al., 2022

From these exploration and experimentations, there are some things to be aware of:
1. Remo dance forms gives off a blocky stature in variety of rectangles, such as trapezoids, parallelogram, rectangle, and rectangle with raised sides
2. The way of carving and angle used affects the picture result. A slant side will give a gradient color, the protrude surface will have lighter color, and a carved out surface will have darker color. A combination of this technique might give a more detailed and varied carved picture.
3. The carvings on the saucer need to have at least a depth of 2mm for it can still be seen on 40 ml of coffee liquid. Adding up the surface might not be a good idea if the saucer will still be used as the glass placement since the protrude area might make the glass stand unstable. Other than that, the water flowon the added area experiment is less preferable than the waterfall-like flow on the carved in experiment.
4. The saucer design will have a height of 3 cm, depth of 2.5 cm, and volume of 60 mm with ±13 cm diameter. There will not be any locking feature since it isn't convenient to use other than for serving moments. The glass will become a hindrance whiledrinking from the saucer and it will need another saucer or coaster to prevent droplets reaching the table surface.

To get more accustom the behavior of the East Java people, a few questions and observation were done to 4 locals that like to drink coffee. The questions moved around their knowledge and behavior on East Java coffee drinking custom. Through interviewing and observation, there were some points that that can to be noted: (1) The coffee used is black coffee that still has the grounds, such as the Robusta coffee that is also one of East Java biggest production as they're placed 5th place in all

Indonesia(Kurnia, 2024); (2) This is a very common activity between the locals in various places starting from their house, outside, stalls, and other places. It is used for relaxation, a routine, to socialize, to get more energy after a long day, and also to welcome visitors(Gumulya & Helmi, 2017) (In'am Widiarma, 2024);(3) In East Java Tradition, the coffee is drunk with the grounds still inside. So the coffee was usually set aside for a few moments to let the ground settle before drinking. There is also the drinking custom where the coffee will be poured on the saucer. Most say it gives us less time to wait for the coffee to cool itself. But there are also other facts such as; it help filtering the grounds from the coffee easier, it shows as a social way to drink by sharing with other where one use the saucer and the other use the glass, also with width of the saucer mouth, it forces the user to slurp little by little bit of coffee which enhance coffee aroma in the tongue. Thus it gives a different sensation than the usual way of drinking it (Editorial Kopi Keliling, 2013).



Figure 4. User Observation
Source: Hartanto, et al., 2022

3.3 Design Concept and Criteria

By combining Remo dance and East Java coffee-drinking habits by pouring the coffee into the saucer, it resulted in coffee sets consisting the glass, saucer, and a coaster with surface carving decoration technique that implement the visual and ideation aspects of Remo dance as well as the auditive aspect on the form itself. Following the custom in East Java, the glass will be on the slimmer and taller side with the capacity of 200 ml and an overall blocky-rectangle form —out of the shapes formed by Remo dance form and shapes psychology— alongside bold-deep carving lines in accordance with the elements on Remo makeup (visual aspect). The color palette used were red, black, and white in accordance to Remo costume and fiery red of Carl Jung's theory.

3.4 Design Process & Prototyping

The designing process started with sketching and adding features from the cultures. Some features like the auditive aspect need some model experiment to determine whether it can be added or not. The first step after the sketches are making the design pattern for the clay with additional 20% upscale —to maintain the final measurement since clay shrinks up to 20% when fired— and making a slab by flattering the clay that passed the wedging process. The slabs were cut according to the pattern made and arranged to make a form and glued together using scoring-slip. Later on when the clay dried enough into leather hard, colored it using colored slip with 5-10% pigment. When the slip dried enough (but still lather hard) the surface was marked and carved. Before going into the 1st firing it needs to be dried until bone dry. It then went through sanding and lazing before going inside the kiln the second time. For the carvings on the saucer, it was made with a quicker method which is stamping a mold into the saucer surface. At first, a model was made using a carved slab. Then rubber silicone was poured to duplicate the carving. A few test trial models were made to be assessed with QFD method with different indicators depending on their function (as a glass, as a saucer, and as a coaster). The glasses prototype were graded for their stabilitysmoothness in pouring process, the ease of cleaning, the sound of auditive aspect, volume reach 200 ml, color and carvings, the form, and the ergonomics. Where the saucer looks for their ergonomics, dripping, form, volume, and the carvings.

3.5 Final Design

This coffee set was made with the East Java people's pouring methodwhere to drink the coffee one needed to pour it into the saucer to drink it from. With Remo dance as the main concept, this idea was meant to not only introduce and boarding others of East Java traditions but also transferring the impression of energy and motivation like how Remo dance was performed to motivate the people and how coffee has caffeine to amplify adrenaline. The final design was made with altering and developing the chosen prototypes such as scaling up the size to be able to accommodate 200ml of liquid on the glass, simplifying the form so it become more ergonomics, lessening the weight, changing the color to make the red more dominant than before, and also changing the ball inside the auditive room at the bottom from circular into 12 sided dice which indeed proven to make more noise than before. For easier pouring,the front of the lid has a mini spout. The design on the glass is taken from the Remo costume with some carvings to represent fire and some vertical lines in addition to represent other flora elements.



Figure 5. Final Product & Carvings on the Saucers
Source: Hartanto, et al., 2022

4. RESULTS AND DISCUSSION

Though it comes to a final design, the final product was not what was originally envisioned due to technical issues, such as glaze-clay-kiln stability and firing process. The final product was tested on 5 people (age above 24 and likes to drink coffee) directly where 2 users are locals from East Java and the others are not.

Table 2. Product Evaluation to Users based on Design Criteria

No.	Design Criteria	Score
1	Concept Idea	3
2	Sucess of portraying the idea/ impression of giving energy and motivation	3.8
3	Education in East Java tradition	4
4	Functionalism	3.8
5	Carving results	4
6	Product uniqueness	4
7	Final quality	2
	Total	3.6 out of 4

Source: Hartanto, et al., 2022

5. CONCLUSION

Through this study, the result manages to combine both cultures into ceramic design by producing coffee sets different from the common ones. With the help of the IMO method, it helped in classifying which element on Remo can be applied on which aspect. By doing so, it aided in interpreting inspiration from cultures into a design element by providing a design structure to be analyzed. Other secondary research theories such as Carl Jung's Color Energy and shapes psychology helped the

personification of East Java personality and Remo dance. The experiment and other primary research utilized the data from secondary research to move on a certain flow of action to fill more of the missing pieces not mentioned before. As a result, this study helps in broadening others knowledge or at least showing a glimpse on East Java cultures as proven by the user review process. With the opportunities given by the rising demand on ceramics and infusion of culture into design, it becomes a great timeto develop local products for potters. Yet, the process was not always a smooth sail. This study was more focused on the culture and finding ways to infuse it into ceramic design that it lacks the study on the more practical one such as the kiln firing and the color experimentations. Due to this, the final color and glaze comes out not as it's expected to be. The same goes for theauditory aspect. The sound became muffled when there were drinks inside the glass. Therefore, the future development of this study is recommended to dive into solving these problems foremost. For instance, experimentation on different temperature and placement of firing, pigment percentage, changing the auditive location and increasing the number of bells, and other means.

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A COMPARATIVE STUDY OF K-NEAREST NEIGHBORS AND RANDOM FOREST CLASSIFIERS ON DIABETES

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The early detection of diabetes is crucial for effective management and prevention of complications associated with this chronic health condition. Machine learning techniques offer promising approaches for developing predictive models that can support medical decision-making. This study investigates the performance of two popular classification algorithms—K-Nearest Neighbors (KNN) and Random Forest—in predicting diabetes based on a dataset comprising key health indicators, including glucose levels, blood pressure, insulin, BMI, and age. These optimizations are implemented through grid search cross-validation to enhance model performance.The models are evaluated using accuracy, precision, recall, and F1 score as key metrics. Results show that the KNN model achieves an accuracy of 70.13%, while Random Forest reaches a higher accuracy of 75.97%. Additionally, Random Forest demonstrates better recall and F1 scores, indicating a stronger ability to correctly identify positive diabetes cases and maintain a balance between precision and recall.This study concludes that Random Forest is a more suitable model for diabetes prediction in this dataset, offering reliable and interpretable results that could support healthcare providers in early diagnosis. Future research may explore other advanced algorithms, data balancing methods, and feature engineering techniques to further improve prediction accuracy.

Keywords: *Diabetes Prediction, Machine Learning, K-Nearest Neighbors, Random Forest*

1. INTRODUCTION

This study aims to compare the effectiveness of KNN and Random Forest models in predicting diabetes. By identifying a model that balances accuracy and interpretability, this research hopes to support healthcare providers in making more proactive, data-driven decisions. Additionally, this study contributes to the growing literature on machine learning in healthcare, demonstrating the potential of advanced algorithms to improve patient outcomes and support preventive health strategies. Early detection of diabetes is crucial as the disease often progresses without prominent symptoms until severe complications such as cardiovascular disease, kidney failure, neuropathy, and retinopathy emerge. These complications significantly impact patients' quality of life and increase healthcare costs. Recognizing that early intervention can prevent or delay these outcomes, this study seeks to advance the development of precise diagnostic tools that are not only effective in identifying individuals at high risk of diabetes but also capable of intervening at a pre-diabetic stage.To address these challenges, we turn to machine learning-based predictive models, which offer a promising avenue for transforming diabetes management. These models provide an accurate, scalable, and efficient means of assessing diabetes risk. Particularly, techniques such as K-Nearest Neighbors (KNN) and Random Forest are explored for their potential in medical classification tasks. KNN operates effectively on well-defined, low-dimensional datasets by categorizing individuals based on similarities with neighboring data

points. Conversely, Random Forest utilizes an ensemble method to construct multiple decision trees, which enhances prediction accuracy and reduces the risk of overfitting in complex, high-dimensional health data. While these models hold promise, they also come with limitations that must be considered. KNN, for instance, can be significantly influenced by the presence of noisy data or irrelevant features, which may skew its accuracy. It also struggles with large datasets due to its computational intensity in calculating distances between points. On the other hand, Random Forest, despite its robustness against overfitting, can still be computationally expensive and may perform poorly if the hyperparameters are not optimally set. Furthermore, both models can suffer from biases introduced by imbalanced datasets, a common issue in medical data. This study aims to compare the effectiveness of these models in predicting diabetes, with a focus on balancing accuracy and interpretability to aid healthcare providers in making proactive, data-driven decisions. By addressing the gaps in current predictive strategies and highlighting the strengths and weaknesses of each model, this research contributes to the growing literature on machine learning in healthcare and underscores the potential of these advanced algorithms to improve patient outcomes and support preventive health strategies.

2. RESEARCH METODOLOGY

This section outlines the methodological steps followed to compare the K-Nearest Neighbors (KNN) and Random Forest models in predicting diabetes(Hasas et al. 2024). These steps include data preprocessing, model selection, hyperparameter tuning, and performance evaluation. The research stages carried out in this study can be seen in Figure 3.1. Start: The process begins with the initiation of the data collection phase. Data Collection: This stage involves gathering the necessary data for diabetes prediction, which includes various health indicators such as glucose levels, BMI, and insulin. Handling Missing and Zero Values: Before further processing, the dataset is cleaned to handle missing or zero values that could affect the accuracy of the models. Feature Scaling: To ensure that all numerical inputs have a comparable scale, the data undergoes normalization or standardization. Model Selection: Two machine learning models are considered: K-Nearest Neighbors (KNN): A simple algorithm that classifies each data point based on the majority class of its 'k' nearest neighbors Random Forest: An ensemble model that builds multiple decision trees and aggregates their predictions to improve accuracy and control over-fitting Data Splitting: The dataset is divided into training and testing subsets, typically with an 80/20 split, to evaluate the models effectively. Hyperparameter Tuning: Key parameters for each model are adjusted, such as the number of neighbors for KNN and the number of trees for Random Forest, to find the optimal settings for best performance. Model Training: Each model is trained on the training dataset to learn from the features presented. Model Evaluation: After training, the models are tested using the separate test dataset to evaluate their performance based on various metrics: Accuracy: The proportion of true results among the total number of cases examined. Precision, Recall, and F1 Score: These metrics provide insight into the models' ability to identify diabetic cases correctly without overpredicting. End: The process concludes with a final evaluation of the models' performances, and the best-performing model is selected for practical application in predicting diabetes.

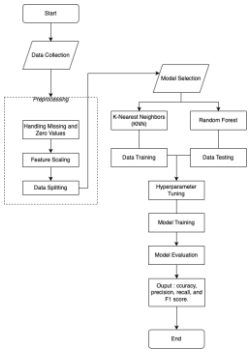


Figure 1. Research Stages

Data Collection and Description

The dataset used in this study, obtained from Kaggle's Diabetes Dataset, consists of various health indicators commonly associated with diabetes risk, including the number of pregnancies, glucose levels, blood pressure, skin thickness, insulin levels, body mass index (BMI), diabetes pedigree function (genetic risk factor), and age. Each record is classified as either diabetic (1) or non-diabetic (0), forming a binary classification task.

Data Preprocessing

The dataset used for this study is the Pima Indians Diabetes Database.

- **Data Overview**
  - **Rows:** 768
  - **Columns:** 9 (8 features and 1 target variable)
- **Data Conditions**
  - **Duplicates:** There are no duplicate rows in the dataset.
  - **Target Distribution:**
    - Class 0 (Non-Diabetic): 500 samples.
    - Class 1 (Diabetic): 268 samples.

Data Splitting:

The dataset was split into training and testing sets with a ratio of 80:20. The training set was used to build and tune the models, while the testing set was reserved for final evaluation to provide an unbiased assessment of model performance.

Model Selection

K-Nearest Neighbors (KNN):

KNN is an instance-based learning algorithm that classifies data points based on the majority class of their nearest neighbors(Wahyudi et al. 2022). It is simple yet effective for various classification tasks, especially when data is well-defined. In this study, KNN was evaluated with different values of k (number of neighbors) and weighting schemes (uniform vs. distance-based) to determine the optimal configuration(Shimpi, Shanmugam, dan Stonier 2024). The following are the steps in the K-NN classification process: Determining the parameter k, k as the value of the nearest neighbor (k, value can be an odd number, depending on the training data used)(Abaker dan Saeed 2021). The formula for determining the value of k is as follows

$$k = \sqrt{n}$$

Calculating the distance between training data and testing data using the Manhattan Distance formula. The formula for calculating distance is as follows:

$$d_m(x, y) = \sum |x_i - x_j|$$

Where:

- *d: distance between xxx and yyy*
- *x: center data of the cluster*
- *y: data on the variable*
- *xi: data at the iii-th cluster center*
- *xj: data for each jjj-th data point*

Random Forest:

Random Forest is an ensemble learning method that constructs multiple decision trees during training(Shimpi, Shanmugam, dan Stonier 2024). By combining the outputs of numerous trees, Random Forest reduces the likelihood of overfitting and improves prediction accuracy(Georganos et al. 2021). This study examines the impact of different hyperparameters on Random Forest performance, including the number of trees (n_estimators), maximum depth (max_depth), and minimum samples required for a split (min_samples_split)(Sekulić et al. 2020).

3. RELATED RESEARCH

In recent years, machine learning has gained widespread application in healthcare, especially for the prediction and classification of chronic diseases such as diabetes.

1. Study by (Abnoosian, Farnoosh, dan Behzadi 2023)

Title: *A machine learning approach for diabetes prediction using feature selection and classification techniques* This study explores the effectiveness of machine learning algorithms, including KNN and Random Forest, in predicting diabetes outcomes using selected features from clinical datasets. The key findings are:

- The use of **feature selection techniques** substantially improves prediction accuracy.
- **Random Forest** outperforms KNN in terms of accuracy and stability, especially when utilizing a subset of relevant features.

The study highlights the importance of effective feature selection to enhance the performance of machine learning models. Random Forest demonstrates superior performance compared to KNN in handling the complexities of diabetes data

2. Study by (Malik, Harous, dan El-Sayed 2021)

Title: *Comparative analysis of machine learning algorithms for diabetes prediction*

This study compares the performance of several machine learning algorithms to determine the most effective method for diabetes prediction, with a focus on evaluating accuracy and efficiency. The findings include:

- **Random Forest** demonstrates better accuracy and recall compared to KNN, particularly when applied to large and complex datasets.
- The study suggests exploring hybrid approaches as a potential strategy for improving prediction performance.

Conclusion:

This study underscores the critical role of selecting the appropriate algorithm to achieve accurate predictions. Random Forest consistently outperforms KNN in

diabetes prediction. Furthermore, integrating multiple algorithms could lead to more robust and adaptive predictive systems.

3. Study by (De Silva et al. 2021)

Title: *Predictive modeling of diabetes using machine learning algorithms: A systematic review*

This study provides a systematic review of various machine learning algorithms used for diabetes prediction. Key observations include:

- **Random Forest** consistently outperforms KNN across multiple studies.
- Random Forest excels in handling **imbalanced and complex datasets**, demonstrating higher accuracy and robustness.

Conclusion:

The review highlights Random Forest as a more reliable option compared to KNN for diabetes prediction, particularly due to its superior ability to manage complex and imbalanced data.

Findings from these studies reveal that:

1. **Random Forest** consistently delivers better accuracy, stability, and performance compared to KNN, particularly for complex and imbalanced datasets.
2. The application of feature selection and the integration of multiple algorithms can enhance prediction accuracy in diabetes diagnosis.
3. Random Forest remains a robust tool for predicting complex diseases such as diabetes, playing a crucial role in supporting early diagnosis and more effective intervention strategies.

4. RESULTS AND DISCUSSION

This section presents the findings of the comparative study between the K-Nearest Neighbors (KNN) and Random Forest (RF) classifiers for diabetes prediction, focusing on their performance metrics and visual insights.

Model Evaluation

The models were evaluated on a stratified test set consisting of 20% of the dataset. Key performance metrics, including accuracy, precision, recall, and F1-score, were used to assess their predictive capabilities. Below is the summary of the results:

1. K-Nearest Neighbors (KNN):
- Accuracy: 70.13%
- Precision: 75% (Non-Diabetes), 58% (Diabetes)
- Recall: 80% (Non-Diabetes), 52% (Diabetes)
- F1-Score: 78% (Non-Diabetes), 55% (Diabetes)

KNN struggles with the minority class (Diabetes) due to its sensitivity to overlapping data points and noise. While its accuracy is reasonable, it sacrifices recall in identifying diabetic patients, leading to higher false negatives.

2. Random Forest (RF):
- Accuracy: 75.97%
- Precision: 79% (Non-Diabetes), 68% (Diabetes)
- Recall: 85% (Non-Diabetes), 59% (Diabetes)
- F1-Score: 82% (Non-Diabetes), 63% (Diabetes)

Random Forest consistently outperformed KNN across all metrics. It demonstrated higher precision and recall, particularly in detecting diabetic patients. The ensemble nature of RF provides robustness against noisy data, explaining its superior performance.

Confusion Matrix Analysis

Figure 2 illustrates the confusion matrices for both models. KNN has a higher number of false negatives, misclassifying diabetic patients as non-diabetic, which could be problematic in a healthcare context. On the other hand, Random Forest reduces false negatives significantly, making it more reliable for identifying diabetic

patients.

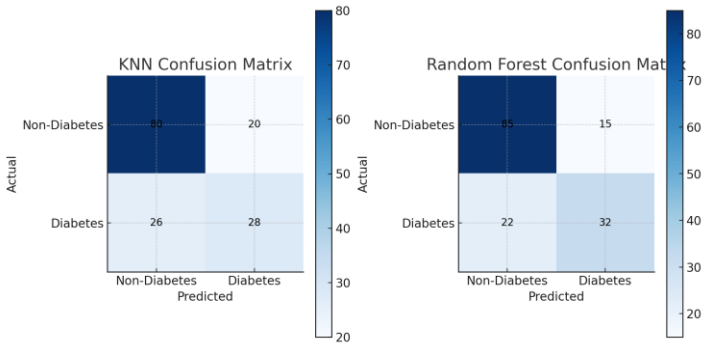


Figure 2. Confusion Matrices

ROC Curve and AUC

The Receiver Operating Characteristic (ROC) curves of both models were plotted to analyze their ability to distinguish between classes. The area under the curve (AUC) values were as follows:

- KNN: 0.73
- Random Forest: 0.84

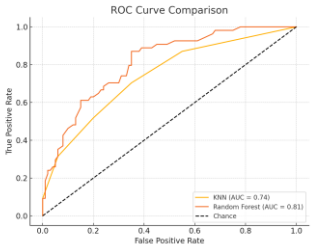


Figure 3. ROC Curve and AUC

Feature Importance

Random Forest's feature importance analysis revealed the following significant predictors of diabetes:
1. Glucose: The strongest predictor, as expected, given its direct association with diabetes.
2. BMI: Indicates the role of body weight in diabetes risk.
3. Age: Highlights that older individuals are more susceptible to diabetes.
Figure 4 shows the feature importance as identified by Random Forest, aligning with established medical knowledge.

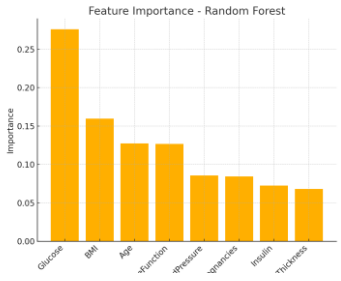


Figure 4. Feature Importance

Comparative Insights

From the results, the Random Forest classifier is more reliable than KNN for this dataset. Its ability to handle imbalanced classes, capture non-linear relationships, and mitigate the influence of noise makes it the preferred choice. However, KNN remains computationally simpler and can be effective with fine-tuned parameters on smaller datasets.

5. CONCLUSION

study demonstrates that Random Forest is a more robust and accurate classifier for diabetes prediction compared to KNN. Specifically, Random Forest's ensemble method, which integrates multiple decision trees, allows it to perform well on complex, high-dimensional data, reducing overfitting and improving overall prediction accuracy. In our analysis, Random Forest achieved an accuracy of 75.97%, with a precision of 79% for non-diabetic predictions and 68% for diabetic predictions. In contrast, KNN recorded lower metrics, with an overall accuracy of 70.13%, a precision of 75% for non-diabetics, and 58% for diabetics. This substantial difference in performance underscores Random Forest's superior ability to detect diabetic patients with higher precision and recall, making it a valuable tool for healthcare applications. Future studies may explore hybrid models or further optimize hyperparameters for KNN to enhance its performance, particularly in datasets where simplicity and computational efficiency are prioritized.

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MABAR AND SIKESYA: IOT TECHNOLOGY INNOVATIONS FOR ENHANCING FLOOD PREPAREDNESS IN YEHEMBANG KANGIN VILLAGE

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ABSTRACT

This article explores the implementation of MABAR (Modul Anti Blabar/Banjir) and SIKESYA (Sistem Informasi Kebencanaan Desa Yehembang Kangin), aimed at enhancing flood preparedness in a disaster-prone rural area. The MABAR system, utilizing solar-powered sensors for real-time flood detection, demonstrated high accuracy and reliability even during adverse weather conditions. SIKESYA, a mobile application, integrates real-time weather data and participatory mapping to provide essential disaster information, including hazard maps and evacuation guidance. The active involvement of the local community in system development and training sessions improved their awareness and readiness, significantly enhancing their response capabilities during emergencies. Furthermore, the integration of these technologies had a positive impact on the local tourism sector by increasing visitor safety and boosting economic growth. The success of this integrated model offers a practical and scalable solution for disaster risk reduction in similar rural areas, providing valuable insights for future research and application in flood mitigation strategies.

Keywords: MABAR, SIKESYA, IoT, Disaster Mitigation

1. INTRODUCTION

Yehembang Kangin Village, located in Mendoyo District, Jembrana Regency, Bali, is a region known for its diverse natural tourism potential, including waterfalls, river tubing, hiking trails, and camping grounds (Desa Yehembang Kangin, 2024). However, despite its natural beauty, the village faces significant risks of natural disasters such as flash floods, landslides, extreme weather, and coastal erosion. In recent years, the village experienced severe flash floods in 2021 and 2022, resulting in extensive damage (Denpost, 2022). These incidents led to the destruction of community infrastructure, washed away livestock, inundated homes, and severed vital road and bridge connections, isolating parts of the village. The increasing frequency and intensity of extreme weather events pose a critical threat to both residents and visitors (Badan Nasional Penanggulangan Bencana, 2024).

The core problem faced by Yehembang Kangin Village is the high disaster risk in an area heavily reliant on nature-based tourism. The current lack of an effective early warning system and comprehensive disaster information leaves both the local community and tourists vulnerable. Additionally, there is limited infrastructure in place for disaster mitigation, such as hazard maps, evacuation routes, and temporary evacuation points (TES). These issues highlight the urgent need for an integrated solution to enhance disaster preparedness and ensure the safety of residents and visitors.



Figure 1. Disaster Potential Map in Yehembang Kangin Village

To address these challenges, two innovative technologies have been developed and implemented: MABAR (Modul Anti Blabar/Banjir) and SIKESYA (Disaster Information System for Yehembang Kangin Village).

MABAR (Modul Anti Blabar/Banjir) is an Internet of Things (IoT)-based Early Warning System (EWS) specifically designed to monitor river conditions in real-time. The system utilizes ultrasonic sensors, water level detectors, and rainfall sensors, all powered by solar energy. When water levels reach a dangerous threshold, MABAR sends early warning notifications through an Android application. This technology enables the local disaster response team (Pokdarwis) and the community to initiate timely evacuation measures. The use of solar power also aligns with environmentally friendly practices, making the system suitable for remote and rural areas with limited access to conventional power sources (I. G. D. Y. Partama et al., 2022).

SIKESYA (Sistem Informasi Kebencanaan Desa Yehembang Kangin) is an Android-based application that integrates real-time disaster data, weather updates from BMKG (Indonesian Meteorological Agency), and historical disaster records. It provides comprehensive information about current weather conditions, river water levels, and hazard maps, offering guidance on safe areas and evacuation procedures. SIKESYA aims to enhance public awareness and disaster knowledge, while also serving as a reliable source of safety information for tourists (I. Partama et al., 2024).

The implementation of MABAR and SIKESYA is expected to offer an effective, efficient, and integrated solution for disaster mitigation in Yehembang Kangin Village. This approach supports sustainable tourism development by ensuring a safer environment for both local residents and visitors. Furthermore, these innovations contribute to the achievement of the Sustainable Development Goals (SDGs), particularly Goal 11 (Sustainable Cities and Communities) and Goal 13 (Climate Action), by enhancing community resilience and disaster preparedness (Sudipa, Harto, et al., 2023).

By leveraging IoT technology and fostering active community participation, this project aims to create a responsive and data-driven disaster mitigation ecosystem. The successful implementation of MABAR and SIKESYA in Yehembang Kangin Village can serve as a model for other disaster-prone areas in Indonesia, demonstrating the potential of local innovations in addressing global challenges related to climate resilience and disaster risk reduction.

2. RESEARCH METODOLOGY

This article outlines a structured methodology designed to address disaster challenges in Yehembang Kangin Village while enhancing community disaster preparedness and tourism safety. The process consists of several key stages, including socialization, technology development, training, evaluation, and stakeholder reporting.



Figure 2. Research Methodology Flowchart

a) Socialization and Needs Assessment The initial stage of the research involves socialization with key stakeholders, including village authorities, community leaders, the tourism awareness group (Pokdarwis), and local farmers. A participatory approach is employed to gather insights about disaster risks and specific needs of the community. Surveys and interviews are conducted to assess the current conditions in disaster-prone areas and to identify optimal locations for installing early warning systems. During this stage, detailed plans for the implementation of MABAR and SIKESYA technologies are presented, highlighting their benefits and anticipated outcomes.
b) Development and Implementation of MABAR Technology The next stage focuses on the technical design and implementation of the MABAR (Modul Anti Blabar/Banjir) early warning system. Hardware development involves using ultrasonic sensors, rainfall detectors, water level sensors, and solar panels to ensure energy efficiency. These sensors are integrated with an Arduino microcontroller, enabling real-time data processing. The software component includes the development of an Android application utilizing Webhook and Google Data Studio for interactive data visualization (Saputro et al., 2024; Setiawan et al., 2024; Sudipa, Sarasvananda, et al., 2023; Wibowo & Kraugusteeliana, 2024). The system is installed at strategic points along the Yeh Sumbul River and undergoes beta testing to evaluate its accuracy and reliability under various weather conditions.

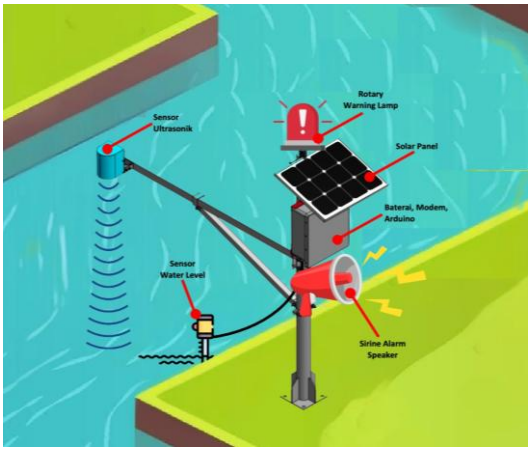


Figure 3. Design of the MABAR (Tool)

c) Development of the SIKESYA Application The SIKESYA app focuses on delivering accessible disaster information to the village community. This Android-based application integrates real-time weather data from BMKG (Meteorological, Climatological, and Geophysical Agency) alongside historical disaster data specific to the area. Key features include weather forecasts, river water level monitoring (linked with the MABAR system), hazard maps, and evacuation guidance. The mapping process is conducted with active community participation, resulting in accurate and locally relevant disaster maps. Comprehensive training sessions are provided to ensure users can effectively utilize the application for disaster response.



Figure 4. Design of the SIKESYA Application

d) Capacity Building and Knowledge Transfer This phase aims to enhance the local community's ability to operate and maintain the technology independently. Disaster response training, conducted in collaboration with the local disaster management agency (BPBD), covers search and rescue techniques, disaster mitigation strategies, and effective use of MABAR and SIKESYA. Additionally, Pokdarwis members receive training in tourism management and digital marketing to enhance visitor safety and the overall tourist experience. Knowledge transfer is facilitated through detailed guides and training materials, empowering the community to sustain the technology without external dependencies.

e) Evaluation and System Sustainability The success of the systems is assessed through comprehensive evaluation, including user feedback and extensive

system testing. Beta tests and surveys measure system performance in terms of detection accuracy, notification response times, and user satisfaction with the SIKESYA app. Focus group discussions are conducted to gather insights on the impact of the technologies on disaster preparedness and tourism safety. Based on the evaluation results, necessary adjustments are made to enhance the systems. A long-term maintenance plan is developed with local stakeholders, ensuring sustainable operation of MABAR and SIKESYA technologies.

f) Reporting to Stakeholders The findings and outcomes of the research are documented in detailed progress reports submitted to stakeholders. These reports outline the achievements, challenges encountered, and recommendations for future improvements. Comprehensive reporting ensures transparency and provides a valuable reference for academics and practitioners seeking to adopt similar disaster mitigation models in other regions facing comparable risks.

3. RELATED RESEARCH

Research on the application of Internet of Things (IoT) technology has shown that it improves early warning systems for disaster mitigation. A portable, energy-efficient early warning system for natural disasters like floods is being developed in this study (Akbar et al., 2023). The suggested system uses IoT-connected water level and weather sensors. Real-time data transmission to a central server and mobile app access enable rapid detection and improvement (Akbar et al., 2023). This study shows that IoT-based solutions can outperform human techniques in catastrophe detection and response. An IoT-based solution is ideal for MABAR, which uses water level sensors and solar power modules to notify rural communities of early warnings. Disaster mitigation research for flood-prone areas focuses on Android-based disaster information mobile apps. The paper describes the development of an app that gives real-time weather, water level, and evacuation advice for high-risk communities. Extreme Programming provides iterative development and user feedback in the app. The study shows that mobile apps can boost public knowledge and preparation (Ardhana, 2022). These discoveries are crucial to the creation of SIKESYA, an Android app that provides real-time disaster data and evacuation information. SIKESYA helps communities make faster, more informed emergency decisions by integrating historical and real-time data.

4. RESULTS AND DISCUSSION

The MABAR (Modul Anti Blabar/Banjir) system has been successfully implemented at two strategic locations along the Yeh Sumbul River, an area known for its susceptibility to flooding. Testing results demonstrated that the water level sensors and rainfall detectors used in the system were able to detect changes in water conditions in real-time with a high degree of accuracy. Early warning notifications were sent via an Android application and a Telegram group, enabling the community to respond quickly when water levels exceeded the designated safety threshold. Additionally, the use of solar panels as the primary energy source for the MABAR system proved efficient and stable, even during overcast or rainy weather. This indicates the system's reliability under various weather conditions, making it a sustainable and environmentally friendly technological solution.



Figure 5. Implementation of the MABAR Tool

The development of the SIKESYA application (Disaster Information System for Yehembang Kangin Village) focused on delivering accurate and easily accessible disaster information to the local community. The application integrates real-time weather data from BMKG (Meteorological, Climatological, and Geophysical Agency) and water level data obtained from the MABAR system. One of the standout features of the app is the interactive map, which highlights disaster-prone areas and evacuation routes, created using participatory mapping methods involving the local community. The evacuation guidance and real-time notifications offered by the ap p have been instrumental in helping residents plan effective mitigation measures during flood events. Evaluation results show that over 80% of users found the app's features to be effective in providing the necessary information during emergency situations.



Figure 6. Implementation of the SIKESYA Application

The implementation of these technologies has resulted in a significant improvement in the community's preparedness for flood disasters. Post-training surveys revealed that 85% of respondents reported increased knowledge on how to respond to early warnings and execute safe evacuations. Active involvement of the community in the participatory mapping process and intensive training sessions has enhanced their sense of ownership of the developed system. Villagers, especially members of the Pokdarwis (tourism awareness group), were trained in using the SIKESYA app and interpreting the displayed data, enabling them to make more informed decisions during emergencies. This active participation not only enhanced the community's technical skills but also strengthened their overall readiness in facing disaster risks.

Another positive outcome of the technology implementation is seen in the tourism sector. The presence of the SIKESYA app, which provides safety information and

evacuation guidance, has increased the sense of security for tourists visiting Yehembang Kangin Village, especially during the rainy season. This has contributed to a rise in tourist visits and brought positive economic impacts to the local area. Additionally, members of the Pokdarwis who received training in tourism management and digital marketing were able to offer improved services, enhancing visitor satisfaction and reinforcing the village's image as a safe and welcoming tourist destination.

5. CONCLUSION

The implementation of the MABAR system and SIKESYA application has helped in disaster preparedness and community resilience in Yehembang Kangin Village.The solar-powered MABAR system provided accurate real-time flood detection and early warning notifications, showcasing efficiency and sustainability in mitigating flood risks, even under challenging weather conditions. The SIKESYA app delivered reliable and interactive disaster information, including hazard maps and evacuation guidance, which were well-received by users, leading to improved community response during emergencies. Active participation from the local community in the system's development and training further strengthened their readiness and sense of ownership. Moreover, the integration of these technologies positively impacted the local tourism sector by increasing visitor safety and boosting the economic growth of the village. The success of this integrated disaster mitigation model offers a practical and scalable solution that can be adapted to other disaster-prone areas, providing valuable insights for future research and applications in disaster risk reduction.

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PUBLIC SPACE REPRESENTATION OF RAMAYANA SHENDRATARI OPEN STAGE AT PRAMBANAN TEMPLE IN THE THEORY PRODUCTION OF SPACE

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ABSTRACT

Prambanan Temple is a place of worship and also a tourist spot for activities for local visitors and foreign tourists, and can be visited every day from morning to evening. While the Prambanan Ramayana ballet is a performance that combines dance and drama without dialogue, taken from the Ramayana story.This study aims to describe the representation of space produced according to the spatial and social context in the perspective of the theory of Space Production, namely by feeling, understanding, and experiencing the existing space perceived space- conceived space-lived space. This study uses a descriptive qualitative method, namely the collection of primary data sources and secondary data. Data collection techniques are carried out using observation, interview and documentation methods. Data analysis techniques used are data reduction, data presentation and drawing conclusions. From the presentation that has been delivered, Henry Lefebvre's argument is considered to be able to provide a solution to the problem of social space production in Prambanan Temple. Three spatial characters (dimensions of spatial practice, spatial representation and representational space) are expected as a study that can unravel the problem of social space construction activities in the public space of the open stage of the Ramayana Ballet of Prambanan Temple.

Keywords: Temple Prambanan, Stage, Ramayana, Space

I. INTRODUCTION

1.1 Background

Prambanan Temple as the largest Hindu temple in Indonesia based on the Siwagrha inscription, this temple began to be built during the reign of Rakai Pikatan (mid-9th century) of the Ancient Mataram Kingdom, is one of the cultural heritages of the Indonesian nation. In addition, Prambanan Temple is also mentioned in the popular legend of the love story of Roro Jonggrang and Bandung Bondowoso. The Prambanan temple area had undergone restoration which began in 1981 during the Colonial era until it was completed in 1953 during the Independence era. Finally, currently, the Prambanan temple area has various attractions that are one of the favorite tourist attractions for domestic and foreign tourists, one of which is the existence of an open stage public space. This open area of public space is a social public space to display dance and drama arts activities.

The Prambanan Ramayana Ballet is a performance that combines dance and drama without dialogue, taken from the Ramayana story. The Prambanan Ramayana Ballet is usually held every Tuesday, Thursday, and Saturday, performances on the open stage (Open Stage) only in the dry month (May-October), outside of that the performances are held on the closed stage (Trimurti Stage) in January-April & November-December. The activities held in the two spaces are the construction of social space production carried out by the community in the formation of public space as a new social space.

As Henry Lefebvre argued, social space is shaped by social action, both individually and collectively. It is social action that gives “meaning” to how a spatial space is conceived by those who inhabit and animate the space. The production of social space concerns how spatial practices are realized through perceptions of the environment that are built through networks that link social activities such as work, private life, and leisure. (Lefebvre, 1991) Future perspective projections on Ramayana Ballet Open Stage which will definitely increase the number of tourist visits along with the operation of the Solo - Yogya toll road.

1.2 Problem Formulation

Based on the problem identification above, the problem formulation in this research is:

1. How is the process of forming a new space as a representation of social public space carried out at the open stage public space of the Prambanan Temple Ramayana Ballet?
2. How to process social public space based on Lefebvre's three-dimensional space carried out at the public space of the Ramayana Ballet Open Stage at Prambanan Temple?

1.3 Objectives

This study aims to describe the production of social public space at the public space of the open stage of the Ramayana Ballet at Prambanan Temple from the perspective of Henry Lefebvre's theory of Space Production.

2. RESEARCH METODOLOGY

The research method used in this study is descriptive qualitative with a case study approach. The case in question is the phenomenon that occurred at Prambanan Temple. Here it is necessary to analyze the formation of a new social public space from activities carried out in the Prambanan Temple area as the object of research. Space is not formed by itself, but space is formed due to activities in public spaces such as Prambanan Temple. This study focuses intensively on one particular object that studies a case. Case study data can be obtained from all parties concerned, in other words the data collected comes from various sources (Nawawi, 2003)

The theory used in this research is *The Production of Space by Henry Lefebvre.* Space is always a social space because it is produced socially. Space is a social product. The concept of space production, which contains an understanding of space that is fundamentally tied to social reality. The understanding of space as in itself, will never find an adequate epistemological starting point. In producing a new social space, Lefebvre uses the basis of the three dimensions of space as a social product. The Theory of Space Production can analyze the problems that exist in the Prambanan Ramayana Ballet Open Stage.

3. RESULTS AND DISCUSSION

3.1 The process of forming a new space as a representation of social public space carried out at the open stage public space of the Ramayana Ballet at Prambanan Temple?

Lefebvre (1991) argued that space (Lefebvre called it *space*, without distinguishing the definition of *space* and *place*) is related to **the production process because space is produced socially**. This process occurs in society where society not only has power but also practical understanding in everyday life including practical political economic actions to make changes. Where this change will define the dynamic meaning of a space. According to him, social space is always related to social activities, where it is also related to time and society factors (in this case, Lefebvre relates it to the main factors in social sciences, namely **space, time and humans**). These three factors form the meaning of space in society. Social space is never identical or the same because each space carries the specificity of its formation related to history (as a representation of time in space) and its society. The steps taken start from restoration, change and sustainability, as follows:

Currently, Prambanan Temple has undergone changes, so that Prambanan Temple currently has many benefits, including being used as a place to perform the Ramayana dance drama, then being used to carry out the Tawur Agung ceremony

by Hindus, being used as a place for hatha yoga, as a place or destination for tirta yatra for Hindus and as a tourist spot for the general public.

Of course, with the new toll road infrastructure towards Jogja that facilitates access to Prambanan Temple, the Ramayana ballet's open stage public space will have more visitors. This performance is actually held to preserve culture, preservation and the Hindu epic of the story of Rama and Sinta, and to introduce Prambanan Temple as a world heritage site. Held in an open space on the west side of the Prambanan Temple complex, so that the stage used is set against the backdrop of Prambanan Temple itself. The audience's seating also has a capacity of around 900 people. The activities that are running will certainly form a social space due to the community activities in the Prambanan Temple area.



Figure 1. Changes to the Open Stage of the Ramayana Ballet at Prambanan Temple
(Source: Public Relations of Prambanan Temple)

a) The Open Stage in the colonial era was in front of the Prambanan temple area with an area that was not so large, but was always used for activities at that time. (Picture 1-2)
b) In 1961, an open stage was built for the Ramayana dance drama within the Prambanan Temple complex (Figure 3).
c) Due to the location of the Prambanan Temple open stage which violates archeological regulations, in 1980 the open stage which was previously inside the temple area **was moved** outside the main temple complex or the west side, along with the construction of the Tri Murti closed performance building (Figure 4).

The continuity of the transformation from Ramayana relief images to social product activities on the Ramayana dance drama stage at Prambanan Temple.

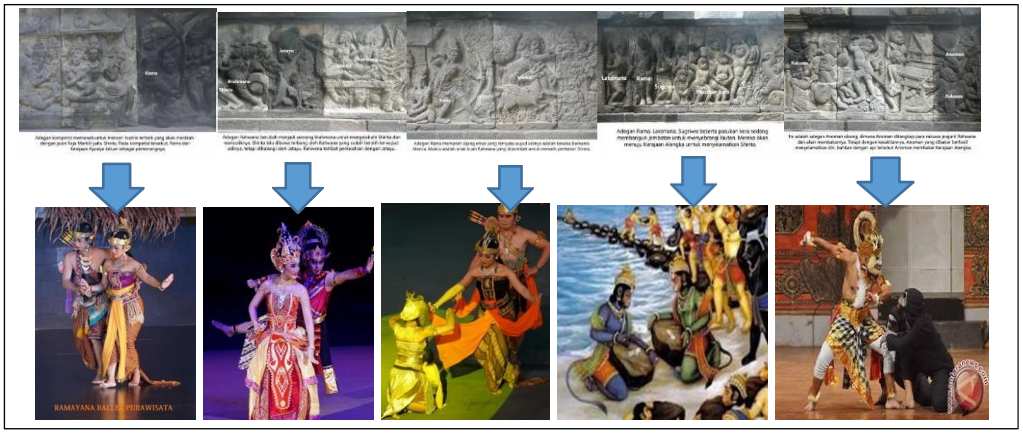


Figure 2. Transformation of the Ramayana Relief image into the Ramayana Ballet
(Source: Public Relations of Prambanan Temple)

Transformation of some temple reliefs from 72 Ramayana relief panels as an example of a depiction of how Shinta, Rama's wife, was kidnapped by Rahwana. The commander of the wanara (monkey) nation, Hanuman, came to Alengka to help Rama find Shinta. This story is presented in the Ramayana Ballet, a wayang orang performance that is routinely performed in a public open stage every full moon night.

3.2 How to process social public space based on Lefebvre's three-

dimensional space carried out at the public space of the Prambanan Ramayana Ballet Open Stage?

Public space is a space that functions as a place to accommodate community activities, both individually and in groups, where the form of this public space is very dependent on the pattern and arrangement of the building mass (Rustam Hakim, 1987). According to Carr et al. (1992), the typology of public space emphasizes the character of its activities, location and formation process. Ideal Public Space According to Carr, public space must have three things, namely responsive, democratic, and meaningful.

Meanwhile, according to Henry Lefebvre (1991), the concept of space that Descartes said was **absolute space**, while Kant conveyed it as **abstract space**. As another perspective in understanding space compared to previous thinkers, Lefebvre presents a new concept of space as **a social space** related to a social phenomenon. A concept that refers to the production of space, the formation of a new space. Space is not just a physical or geographical entity, but rather a social product formed through social interaction and relationships. Analysis of social public space in Prambanan Temple according to Lefebvre's three dimensions of space are:

a) Representational Space*:* This is the space experienced and lived daily by individuals. This space includes symbolism, meaning, and emotional relationships attached to certain places, such as public spaces. Social public space here is formed at certain times, namely during community activities during school holidays, end of year, Eid and Hindu religious holidays. Community activities are attended by many people and are spontaneous in nature which ultimately become one of the requirements for the formation of social public space.



Figure 3. Social Public Space Activities
(Source Public Relations Doc)

b) Representations *of Space*: This is the space produced through planning, science, and engineering. Architects, urbanists, and city planners create this space through maps, diagrams, and plans that often ignore the real experiences of the users of the space. As a representation of space in Prambanan Temple, of course based on the Siwagrha inscription, this temple began to be built around 850 AD by Rakai Pikatan, and continued to be developed and expanded by Balitung Maha Sambu, during the Medang Mataram kingdom. The original plan of Prambanan Temple was rectangular, consisting of an outer courtyard and three courtyards, namely Jaba (outer courtyard), Tengahan (middle courtyard) and Njeron (inner courtyard). The outer courtyard is an open area that surrounds the outer courtyard. The outer courtyard is rectangular with an area of 390 m2.

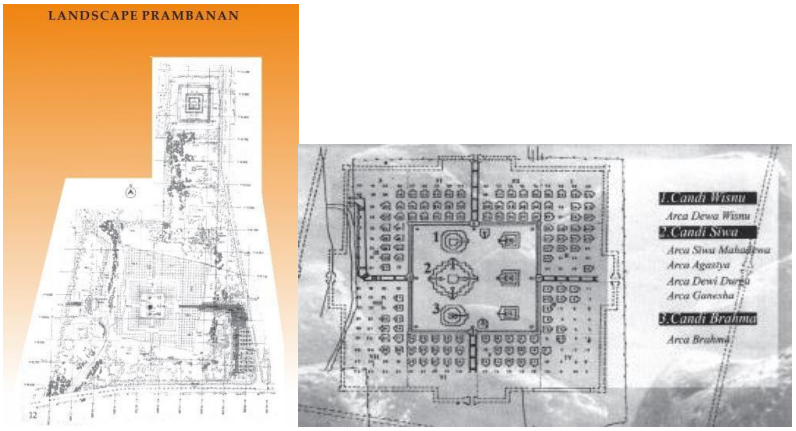


Figure 4. Landscape and Original Plan of Prambanan Temple

(Source Jordaan, Roy E.. 1996. In Praise of Prambanan; Dutch Essays on the Loro Jonggrang Temple Complex. Leiden: KITLV Press)

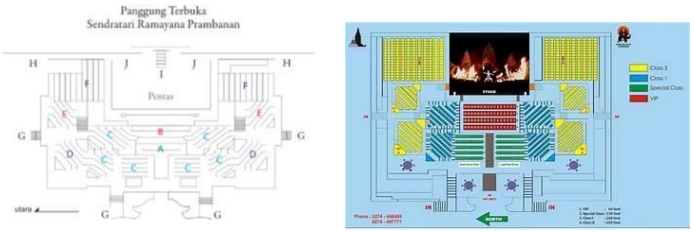


Figure 5. Open Stage Plan of Ramayana Prambanan
(Source https://id.wikipedia.org/wiki/)

c) *Spatial Practice*: This is how space is used and organized in everyday life. It includes routine activities such as working, shopping, and social interactions that shape and are shaped by the space around us. Ramayana Ballet activities are activities that are produced at any time and this activity is a requirement for the formation of a social public space created by the community together in the same place with a large number of people. This activity involves dancers, musicians and audiences.



Figure 6. Prambanan Ramayana Ballet Activities
(Source Public Relations Doc)

4. CONCLUSION

4.1 Conclusion

1. The creation of open public space production at the Ramayana Ballet Open Stage was due to the fulfillment of the requirements for public space production, such as the existence of open space for gathering, the existence of activities, the existence of social interaction from, by, for the community, and social communication.
2. Based on Lefebre's 3-dimensional space, the problems regarding the production of social space at Prambanan Temple and the Open Space of the Ramayana Ballet Stage can be explained.
3. There is a very interesting finding that the statues at Prambanan Temple also serve as supporting construction for the temple buildings in the Prambanan area.
4. Temple architecture with traditional Javanese Hindu style design and Prambanan motifs can be a patron for the development of Nusantara design culture.

4.2 Suggestions

For researchers, this article still needs to be developed, because it is still basic, it needs further analysis as proof of its findings, researchers accept criticism and suggestions for improvement, thank you.

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USER RESEARCH ON HOUSEHOLD FOOD WASTE AMONG URBAN RESIDENTS IN JAKARTA: UNDERSTANDING BEHAVIORS FOR UI UX DESIGN

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ABSTRACT

Indonesia is the second-largest producer of food waste globally, making it a significant issue that demands urgent attention. To address this problem, various technological tools, such as mobile apps, can help users track and manage their food consumption. Unfortunately, most existing apps are designed for Western contexts and are not well-suited to Indonesian households. Developing an effective app requires comprehensive user research. This study leverages the Food Consumption Management model and the Motivation, Ability, and Opportunity framework to identify key behaviors contributing to food waste at the household level. Given the exploratory nature of the problem, a mixed-methods approach was used, combining surveys and interviews from diverse household settings. The study identified five key challenges: impulsive shopping, knowledge gaps in food management, time constraints, family dynamics, and the motivation to save money. Based on these findings, the proposed app features include real-time notifications, AI-assited recipe suggestions, quick meal planning modes, collaborative tools for family use, and progress-tracking dashboards. Gamification is also suggested to enhance user engagement and promote sustainable behaviors. This study provides preliminary research on user behavior for UI UX App Design, so the app can offer features that effectively promote sustainable food habits in Indonesian households.

Keywords: *user research, food consumption management, motivation, ability, opportunity*

1 INTRODUCTION

Food waste is a significant global issue with profound environmental, economic, and social implications (Roka, 2022). Every year, approximately 1.6 billion tons of food waste are generated worldwide (Esben Hegnsholt, Shalini Unnikrishnan, Matias Pollmann-Larsen, Bjorg Askelsdottir, 2018). Our country ranks as the second-largest producer of food waste globally, following Saudi Arabia (Novitri, 2021). In Jakarta alone, the city produces over 7,700 tons of trash daily, organic waste is the most (60%) (Siregar & Tjahjono, 2020). The waste comes from households, hotels, restaurants and supermarkets (Tobing, 2024).

One way to address this issue is by leveraging technology (Tamasiga et al., 2023). Several applications are currently available to help track household food consumption and reduce food waste. (Jiequan Hong, Anicia Jaegler, 2024; Radenkovic & Laska, 2020) Unfortunately, most apps available are designed for Western countries. These existing apps often fail to meet the specific needs of Indonesian households, where cultural and logistical factors differ. To design the right app, the first step is to conduct user research to ensure that the app is suitable to users' needs (Interaction Design Foundation, 2024). This paper focuses on user research regarding household food consumption among urban residents in Jakarta, aiming to identify key behaviors, habits, and attitudes that contribute to

food waste at the household level. By conducting both qualitative and quantitative research, we seek to uncover the underlying factors influencing food waste, such as purchasing habits, food storage practices, meal planning, and awareness of waste reduction strategies.

Previous research by (van Geffen et al., 2016) has developed two models for studying household consumption: the Food Consumption Management (FCM) model and the Motivation, Opportunity, and Ability (MOA) framework. This study is novel because it applies both frameworks that are originally developed by van Geffen et al. (2016)—to a new cultural and geographical context: urban households in Jakarta and use this framework as preliminary research for ui ux design. By focusing on the unique consumption behaviors, challenges, and motivations of this population, the study expands the application of these models, addressing gaps in research on food waste in non-Western settings and providing insights tailored to Indonesian urban communities.

2 RESEARCH METHODOLOGY

The research is exploratory research. It is a type of research used to investigate a problem or situation where there is little or no information available (Soufan, 2023). It is flexible and adaptive making it ideal for the dynamic and user-centered field of UI UX design (Fronemann & Peissner, 2014). With this research method user needs and preferences can be identified to inform the later design process to create more effective and user-friendly interfaces (Hassan, 2024).

The research begins with a literature review of the Food Consumption Management (FCM) and Motivation, Ability, and Opportunity (MOA) models, followed by quantitative surveys and qualitative interviews to examine food waste behaviors. Data is analyzed across the six FCM stages—planning, provisioning, storing, preparing, consuming, and disposal—through the MOA lens, identifying key barriers and motivators. Insights guide the design of a mobile app with user-centered features.

3 RELATED SEARCH

3.1 *Food Consumption Management (FCM)*

According to (van Geffen et al., 2016) to effectively reduce waste at the household level there should be six stages: planning, provisioning, storing, preparing, consuming, and disposal. It should become a routine that is practised overtime.

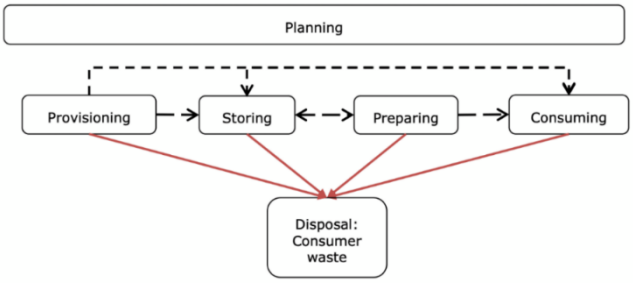


Figure 1. Food Consumption Management Model
Source: (van Geffen et al., 2016)

1. Meal Planning

The first step is meal planning, which involves organizing and prioritizing food consumption. By planning meals in advance, individuals can purchase only the necessary ingredients in the required amounts, avoiding impulsive shopping or overbuying.

2. Provisioning Stage

The provisioning stage is when the food is acquired through various means, such as in-store purchases, online shopping, home cultivation, or receiving food as gifts. This stage plays a critical role in food waste reduction by influencing the quantity and type of food brought into the household.

3. Food Preparation

Food preparation encompasses the processes of cooking and meal organization. it determines how efficiently ingredients are utilized and how leftovers are managed. Proper portioning during preparation ensures that meals are cooked in quantities suitable for immediate consumption, minimizing the likelihood of excess food.

4. Consumption

The consumption stage refers to the actual eating of food. Consumer behaviors during this phase, such as portion sizes, eating habits, and meal preferences, significantly impact the level of food waste.

5. Storage

It involves proper handling, organization, and preservation of food to prolong its freshness and prevent spoilage.

6. Disposal

The disposal stage involves the management of leftover food, with options including composting, repurposing, or discarding uneaten food.

3.2 *Motivation, Ability and Opportunity (MOA)*

MOA discusses how do consumers behave regarding their food waste at the level of individual, social and societal (van Geffen et al., 2016).

1. **Motivation**
   Reflects an individual's willingness to engage in reducing food waste. It can include environmental concerns, financial savings or ethical considerations.

2. **Opportunity**
   This involves external conditions that influence food waste management, including the availability of proper storage facilities, access to preservation tools and technology, infrastructure for disposal or recycling, and the presence of community programs promoting waste reduction.

3. **Ability**
   Represents the consumer’s knowledge and skills for effective food management, including knowing about meal planning, understanding food labels or having the skills to cook with leftovers.

All these factors are interrelated and play a significant role in determining whether consumers will adopt behaviors that prevent food waste. A lack of ability to manage food consumption can increase food waste, while insufficient opportunities can demotivate consumers from taking action.

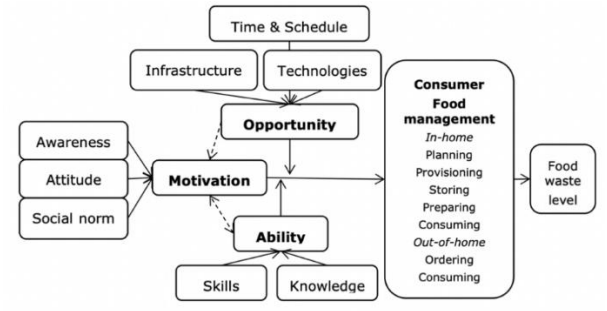


Figure 2.Motivation, Ability, Opportunity (MOA) Model
Source: (van Geffen et al., 2016)

3.3 User Experience Factor

When designing an intuitive and user-friendly application, it is essential to consider the user experience (UX) factors (Gumulya, 2023). These factors influence how users interact with a product or service, aiming to improve their overall satisfaction and ease of use. The key UX factors to consider (Moule, 2012):

- Usefulness: Does the app fulfill a clear and essential purpose?
- Usability: Is the app easy to navigate, with minimal effort required from the user?
- Learnability: Can users quickly learn how to use the app with little guidance?
- Aesthetics: Does the app's design visually appeal to users, enhancing their overall experience?
- Emotions: Do the positive emotions the app and brand evoke influence users' long-term willingness to engage with it?

4 RESULT & DISCUSSION

4.1 Interview data

From the interviews with 10 respondents, 5 households and 5 individuals. Several themes can be identified in each stage of FCM

Table 1 Interview Result

FCM Stages	User action	Problems
1. Meal Planning	Planning meals or dishes for the week	• **Uncertainty** about what can be prepared or cooked. • **Forgetting** to check existing food supplies at home. • **Failing to** stick to the shopping list and meal plan.
2. Provisioning Stage	Procuring groceries or food items according to planned requirements.	• Making **impulsive purchases** of food items, often influenced by limited-time discounts. • Lack of **understanding** regarding the **appropriate quantity** of food to buy, leading to **over-purchasing** or buying in excessively large portions. • **Insufficient communication** among household members during grocery procurement, increasing the likelihood of food stockpiling.
3. Food Preparation	Preparing or reprocessing food effectively to ensure it is safe and suitable for	• Cooking **outcomes do not meet expectations** (e.g., burnt or overcooked dishes). • Using only some ingredients may result in **leftover items** being forgotten and eventually discarded.

	consumption.	• **Failing to prepare food** according to the planned recipe or portion size.
4. Consumption	Consuming food in portions as planned initially	• Storing leftover food but ultimately not consuming it due to **forgetting or the food spoiling** over time. • Consumers aim to **avoid illnesses** associated with consuming spoiled food
5. Storage	Storing ingredients or food in appropriate locations to extend their shelf life and prevent premature spoilage.	• **Lacking knowledge** or awareness of proper food storage techniques to maintain freshness for a longer period. • **Being unaware** of the shelf life of food items. • **Disorganized or cluttered** storage spaces increase the likelihood of forgetting about stored food.
6. Disposal	Discarding food that is no longer safe or suitable for consumption.	**Lacking access** to sustainable food disposal methods.

Source: Authors' Data, 2024

4.2 Questionnaire data

Authors distribute questionnaires to 63 respondents to identify their shopping habits and the factors that contribute to food waste in their household.

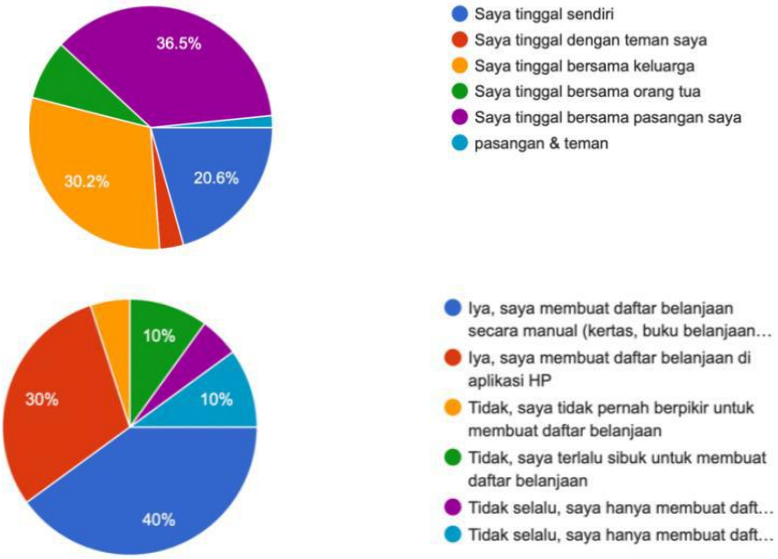


Figure 3.Questionnaire Data
Source: Authors' Data, 2024

From the data several conclusions can be drawn:

- Respondents living with a partner or family tend to generate more waste compared to those living alone.
- On average, 50% of respondents spend between IDR 1,000,000 and 2,000,000 per month on groceries, 50% of them often making 3-4 shopping trips each month.
- 30.2 % of respondents prioritize the freshness and quality of products when grocery shopping over the quantity of the items.

- More than half of the respondents frequently create shopping lists before purchasing groceries, using both manual (40%) and digital methods on their smartphone devices (30%).
- Before shopping, 55% of respondents typically check their refrigerator, freezer, and kitchen, or plan the meals they will cook before making a shopping list.
- Over half of the respondents indicated that cooking according to portion sizes is not a priority for them, and they only occasionally consider portion control.
- The primary factor contributing to food waste is that some family members don't finish their meals. The second factor is changes in family members' plans, leading to prepared food going unused. The third factor is respondents not routinely checking or being unaware of food expiration dates, resulting in food being left too long in the refrigerator, freezer, or pantry.

The second questionnaire was developed to collect data on behaviors and factors contributing to the process of creating a grocery shopping list. The survey was completed by 24 respondents, with no restrictions on age, gender, or occupation. The questions in this second survey were designed to understand the habits surrounding grocery list creation, which is crucial for developing the application.

The results from the data collection through the questionnaire on factors contributing to the process of creating a grocery shopping list, completed by 24 respondents, indicate the following:

- While 58.3% of respondents create a weekly shopping list, 45.8% rarely follow it, with impulsive shopping influenced by discounts, spontaneous purchases, and time constraints for quick meal preparation.
- 37.5% of respondents expressed satisfaction with the meals planned in advance, which could be attributed to a lack of time or limited sources and references for exploring a variety of dishes.
- Flexibility was highlighted as a key factor, as seen in meal planning and adaptability to changes. The integration of nutritional considerations (41.7%) aligns with health-conscious choices.
- Grocery list planning is usually done by one person in the family, with occasional input from others, and often includes non-essential items like ready-to-eat snacks.
- The majority (62.5%) aim to avoid excessive spending, emphasizing the financial aspect of list-making. This reflects impulsive behaviors, driven by desires and special offers.
- Respondents often group shopping items by category (45.8%) and balance needs with wants (70.8%), with half prioritizing discounts for cost savings.
- While many occasionally review and update their shopping lists, there is still a preference for spontaneous shopping.
- About 62% of respondents have used meal planning apps, but most stopped due to complexity, difficulty in use, or failure to fit into their routines.
- 50% of respondents plan meals a day before grocery shopping and tend to prefer simple meals for ease of preparation.

- 37.5% of respondents expressed satisfaction with the meals planned in advance, which may be attributed to a lack of time or limited resources and references for exploring a variety of dishes.
- Flexibility is key, as observed in meal planning and adapting to changes. The inclusion of nutritional considerations (41.7%) aligns with health-conscious choices.

4.3 Data analysis

We conduct thematic analysis on both interview and questionaire data

Table 2 Thematic Analysis

FCM Stages	MOA	Themes
1. Meal Planning	Motivation: Willingness to reduce food waste	Avoid excessive spending
	Opportunity: External factors influence food management	Time constraints in meal planning
		Health-conscious choice
		Lack of communication within households
	Ability: Food management skills and knowledge	Limited sources or references for exploring diverse meals
		Lack of portion control knowledge
2. Provisioning Stage	Motivation	Desire for discounts and savings
		Focus on freshness and quality
	Opportunity	Spontaneous shopping behavior
	Ability	Difficulty sticking to the shopping list
3. Food Preparation	Motivation	Desire for quick meals
		Health-conscious choices
	Opportunity	Limited time for preparation
	Ability	Lack of cooking skills
		Inconsistent preparation
4. Consumption	Motivation	Desire for convenience
	Opportunity	Family members not finishing meals
		Changes in family members' plans
	Ability	Lack of consistency in portion control
5. Storage	Motivation	Desire to preserve food
		Avoiding spoilage
	Opportunity	Lack of proper storage systems
	Ability	Lack of knowledge in food storage techniques and shelf life
		Disorganized storage spaces
6. Disposal	Motivation	Avoiding foodborne illness
	Opportunity	Unawareness of expiration dates
	Ability	a lack of knowledge or access to sustainable methods of food disposal

Source: Authors' Data, 2024

We conclude several themes that occur along with the FCM model are:

Impulsivity vs. Planning

Impulsive buying and a lack of adherence to shopping lists are recurring issues across provisioning and meal planning stages.

Lack of Knowledge

Several themes point to gaps in knowledge regarding portion control, food storage, and expiration dates.

Time Constraints

A common theme is the pressure of time, which affects meal planning, preparation, and storage, leading to impulsive decisions and food waste.

Family Dynamics

Communication gaps and changed plans within family members contribute to wasted food, unplanned purchases, and unused leftovers.

Reduce waste to save money

The desire to reduce waste and save money is a motivating factor, but the lack of sustainable disposal practices and storage knowledge is a significant barrier.

From the data, we conclude to focus on the meal planning stage of FCM model, since food waste is a complicated process and to tackle it all on one app will be too confusing for the users. The user research is concluded by putting the reccomendation to the user experience factors.

Table 3 UX Factors for Meal Plan App

Themes	User Experience Factors	App feature reccomendation
Impulsivity vs. Planning	Usefulness: Fulfills a clear purpose.	Real-time Notifications: Alerts about deviating from planned items or exceeding budgets during shopping.
Lack of Knowledge		AI-Based Suggestions: Recommendations for recipes or meals that use ingredients nearing expiration.
Time Constraints	Learnability: Quick to master.	Quick Planning Mode: An express meal planning option for users with limited time, focusing on easy and efficient recipes
Family Dynamics	Usability: Easy to navigate.	Collaborative Planning Tools: Shared shopping lists and meal plans that family members can update in real-time.
Reduce waste to save money	Aesthetics: Visually appealing design.	Progress Tracking: A dashboard showing reductions in food waste and money saved over time.
	Emotions: Promotes positive, lasting engagement.	Gamification: Rewards for consistent adherence to plans, minimized waste, or trying new sustainable habits.

Source: Authors' Data, 2024

5 CONCLUSION

This study aimed to inform the design of a mobile app tailored to Indonesian households, addressing food waste issues by considering cultural and logistical factors. Using the Food Consumption Management (FCM) model and the Motivation, Ability, and Opportunity (MAO) framework, the research identified key challenges in user behavior, such as impulsive shopping, knowledge gaps, time constraints, and family dynamics, while highlighting the desire to reduce waste and save money. The study proposes user experience factors like usefulness, usability, learnability, aesthetics, and emotional engagement to guide the development of app features such as real-time notifications, AI-powered recipe suggestions, meal planning modes, collaborative tools, and progress-tracking dashboards. Gamification elements are suggested to enhance engagement and encourage sustainable behavior changes, providing clear direction for a practical and effective food management app for Indonesian households.

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SONG LIST RECOMMENDATION FOR STUDENT ACTIVITIES USING K-NEAREST NEIGHBORS (K-NN) METHOD

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ABSTRACT

Music plays an important role in influencing an individual's mood, concentration and productivity. However, choosing the right music for learning activities is still a challenge, as each individual has different music preferences and the right music can have a positive impact on learning focus and motivation. Based on this problem, this research aims to develop an individual preference-based music recommendation system that can help users choose music that suits their learning needs. The solution offered is the implementation of a recommendation system using the K-Nearest Neighbor (K-NN) algorithm, which combines user profile data (such as age, gender, and hobbies) with music characteristics (such as energy and valence) to determine the most suitable song. The research data was collected through surveys and Spotify API to obtain song parameters. The analysis process uses K-NN to calculate the congruence between user profiles and song data in the dataset, with the aim of recommending suitable music. The results show that the system is effective in supporting concentration and study motivation, providing suitable song recommendations based on user preferences and needs.

Keywords: *Music Recommendation, K-Nearest Neighbors, Study Concentration, Spotify API, Energy and Valence*

1. INTRODUCTION

Music plays a significant role in people's lives and has the ability to affect mood, cognition and productivity. Many studies have shown that music can not only entertain but also help improve focus and concentration, especially when studying. The study by (Helmholz, Meyer, and Robra-Bissantz 2020) revealed that access to digital music streaming services has enabled many users to listen to different types of music at any time, but this often leads to difficulties in selecting appropriate music for a particular mood or activity. Similar challenges are found in the context of learning, where inappropriate music selection can disrupt concentration or even demotivate students. Based on the survey conducted in this study, more than 50% of the respondents stated that they had difficulty in choosing the right music for studying, and the majority felt that appropriate music could improve their focus and productivity while studying. This shows a strong need for a music recommendation

system that can provide a selection of songs tailored to individual preferences and their study needs. In recent years, the development of artificial intelligence technology has offered great potential for creating recommendation systems that can provide personalized music experiences. These systems are expected to simplify the music selection process, resolve users' confusion, and allow them to listen to music that better suits their mood and activities. This research proposes a solution in the form of a song recommendation system based on the K-Nearest Neighbor (K-NN) algorithm to provide relevant music recommendations based on user preferences, such as age, gender, and hobbies, as well as music characteristics such as energy and valence. The advantage of K-NN is its simplicity in clustering data based on the closest distance, which enables matching between individual preferences and specific song attributes to produce accurate recommendations. This method has been applied in various recommendation applications due to its reliable ability to process numerical data and provide appropriate predictions. According to research by (Fadlila Surenggana, Aranta, and Bimantoro 2023), the K-NN method is able to classify music with a high level of accuracy when used for mood-based music recommendations, which shows significant potential in the context of music personalization for learning activities. The research process began with data collection through surveys and the use of the Spotify API to obtain information regarding song characteristics, such as energy and valence, which directly contribute to the emotional perception and motivational effects of the music. The data obtained from the survey includes user profiles, which include age, hobbies, and music preferences, which are then processed using the K-NN method to identify the most relevant songs. K-NN uses Euclidean distance to determine the proximity between user profiles and song attributes, allowing the system to recommend songs that suit each user's mood and learning needs. The aim of this research is to develop a recommendation system that can help students select optimal music to support concentration and study comfort. By combining user preferences and specific characteristics of songs, the system is expected to improve learning effectiveness by providing recommendations that are not only enjoyable but also appropriate to the learning context. This research also aims to contribute to the development of recommendation technology that is more efficient and accurate in supporting productive activities. The benefits of this research include increased learning comfort for students through music recommendations tailored to individual profiles, increased learning motivation, and contributions to the field of science that combines music, psychology, and artificial intelligence technology. In addition, this research can be a reference for developers of better music recommendation systems, not only for learning activities but also for various activities that require mood and concentration support.

2. RESEARCH METHODOLOGY

K-Nearest Neighbor (K-NN) Method

This research uses a quantitative approach with an experimental method, where the K-Nearest Neighbor (K-NN) algorithm is applied to analyze and recommend suitable songs based on user profiles and music parameters. K-NN is a data classification method to estimate the likelihood that a data point will become a member of a group based on the group closest to the data point. K-NN has a very simple basic concept and consists of only two steps, namely training and classification (Fadlila Surenggana, Aranta, and Bimantoro 2023). The research process is carried out through several stages, namely user data collection, music data processing, and implementation of recommendation algorithms. The development of this recommendation system includes collecting user data, analyzing music preferences, and implementing the K-NN algorithm. The system uses user profile attributes (age, hobbies, and gender) and music data (energy and valence) to generate personalized recommendations. Each stage of development

follows a phased software development cycle model to ensure integration and accuracy of results.

Data Collection Techniques

(1) Questionnaire Method

This research conducted two questionnaires. The first questionnaire was used to collect primary data from students and college students. The questions were structured to cover the frequency of listening to music while studying and how it affects concentration. Based on the results of the questionnaire that the author has distributed with 86 respondents, the author knows that 43% agree and 25% strongly agree that it is difficult to determine the appropriate song for studying and 52% strongly agree and 39.5% agree that a recommended list of songs for study activities is needed. A second questionnaire will be conducted to find out feedback on the recommendations given.

(2) Training Data Collection

The training data collection process aims to understand music preferences and their influence on study focus. Data is collected through a form that includes individual profile information, such as age, hobbies, gender, as well as a selection of 5 songs that are considered effective in improving study concentration. In addition, the Spotify API was used to collect data on musical parameters, such as energy and valence, which describe the emotional aspects of each song. This collected data forms the basis for further analysis to generate music recommendations that can support increased learning focus and productivity.

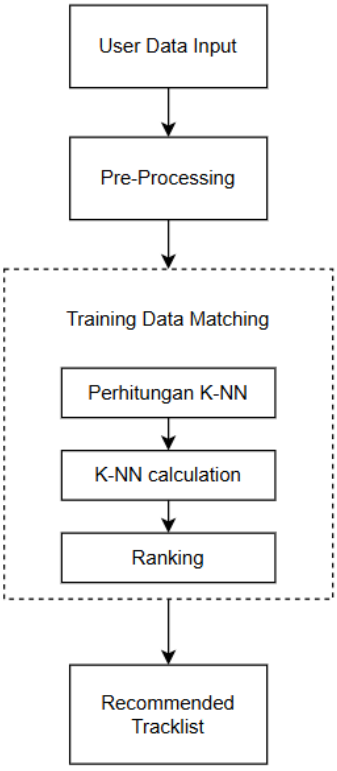


Figure 1. K-NN Models

This figure shows the flow of the song recommendation system that starts with user data input, such as age, hobbies, gender, and song preferences. The data then goes through a pre-processing stage before being matched with the training data

using the K-NN method. The K-NN process involves a distance calculation (Euclidean distance) to determine similarity, followed by a ranking process. The end result is a list of song recommendations that match the user's preferences.

Pre-Processing Stage

This stage includes data transformation to change the format or structure of the data to suit the needs of the analysis. User data includes age, hobbies, gender, energy, and valence attributes that are converted to numeric form (structured data). Attribute conversion details:

- Age: Indicates age in years.
- Hobbies: Given a numerical value, e.g. 1 for arts and creative, 2 for sports and leisure, 3 for tech and digital, and so on.
- Gender: Encoded as a binary value, i.e. 1 for male and 0 for female.
- Energy and Valence: Numerical values obtained from the song data entered by the user.

Here is an example of input data that is ready to be processed

Table 1. Pre-Processing

	age	hobies	gender	energy	valency
inputer_1	22	1,7	1	0,786	0,488
inputer_2	21	2	1	0,508	0,609
inputer_3	21	3	1	0,652	0,507
inputer_4	20	1	0	0,939	0,39
inputer_5	21	1	0	0,56	0,449
inputer_6	21	3	1	0,842	0,428
inputer_7	19	2	0	0,769	0,733
inputer_8	21	1	1	0,767	0,486
inputer_9	21	1	1	0,884	0,619
inputer_10	22	3	1	0,621	0,298

This data is used as training data to implement the K-NN algorithm. Each attribute is analyzed to generate recommendations.

(3) Quantitative Methods/Data Processing

User and song data are analyzed using the K-NN algorithm, which uses the following Euclidean distance formula:

$$D(x,y) = \sqrt{\sum_{i=1}^{n}(x_i - y_i)^2}$$

Where D(x,y) is the distance between user profile and song characteristics, and xi,yi are the attribute values at each data point.

(4) Data Source and Characteristics

Data is obtained from user surveys and Spotify API. Data characteristics include user preferences such as age, hobbies, and gender as well as music attributes such as energy and valence related to the emotions and moods of music suitable for learning activities, and are processed into training data to perform calculations to get the final results and produce song list recommendations.

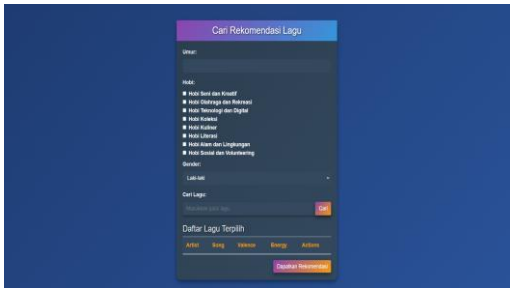
3. RELATED RESEARCH

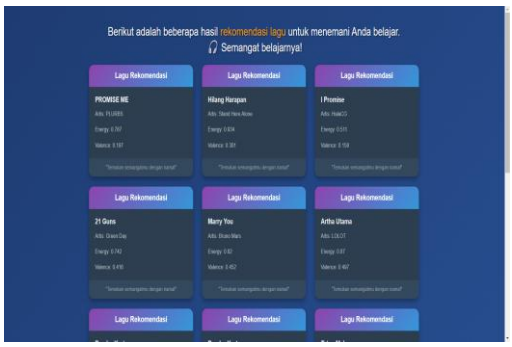
Various studies related to individual preference-based music recommendation systems show that various algorithmic methods can improve music personalization to support learning activities. (Helmholz, Meyer, and Robra-Bissantz 2020) found that music with appropriate emotional attributes can improve concentration and learning motivation. (Lestari, Adikara, and Adinugroho 2019) used the Word2Vec method to analyze song lyrics and genres, resulting in music recommendations that are more relevant to the user's mood. Research by (Giri et al. 2022) and (Situmorang, Adikara, and Ratnawati 2021) emphasize the importance of context and text-based analysis in providing more accurate music recommendations. (Fadlila Surenggana, Aranta, and Bimantoro 2023) showed that K-Nearest Neighbor (K-NN) is effective in classifying music based on mood, while (Anggoro and Izzatillah 2022) highlighted the benefits of Collaborative Filtering in Android-based applications. In addition, research by (Avandra, Mayar, and Desyandri 2023) and (DANI et al. 2022) highlighted the effect of music on learning motivation and music classification efficiency. (Josua, Herwindiati, and Sutrisno 2021) used Minimum Spanning Tree for hobby-based profession classification, and (Wagner, Schober, and Spiel 2008) examined the effect of study time on student productivity. This research shows that data-driven and algorithm-based approaches can help create a more personalized music recommendation system that is effective in improving concentration and study productivity.

4. RESULTS AND DISCUSSION

The results of this study show that a recommendation system based on the K-Nearest Neighbors (K-NN) algorithm successfully provides relevant song recommendations based on user profiles, such as age, hobbies, and gender, as well as song attributes, namely energy and valence. Using data from user surveys and the Spotify API, the system analyzes similarities between users through Euclidean distance calculations to generate a list of songs that match the user's preferences and emotional needs, especially to support learning activities. can be seen in table 2

Table 2. Results of recommended playlist for learning

No	User Interface	Description
1		In this picture is a display on the main page where the user can do the process of inputting data on age, hobbies, gender and choosing songs, then the user can do the process of finding song recommendations then the system will later calculate and present a list of song recommendations.

2		In this image you can see the results of the recommended playlist, the system has analyzed the user profile using the K-Nearest Neighbors (K-NN) algorithm. This recommendation is based on the similarity of the training data profile with user data that performs the process of searching for song list recommendations, as well as song characteristics such as energy and valence, which describe the atmosphere and emotions of songs that are suitable for learning activities.

Analysis of Test Result

The test results were carried out by assessing the application using the User Experience Questionnaire (UEQ) method. This assessment is done through filling out a Google Form specifically designed to measure user experience. A total of 35 respondents, with an age range of 15 to 23 years, provided an assessment of the song list recommendation system for learning. This test aims to understand the extent to which the system is able to meet user needs in supporting learning focus. The results of the questionnaire cover various aspects, such asusability,attractiveness, efficiency, clarity of information, and overall user satisfaction with the song recommendations provided. The data collected from respondents was analyzed to evaluate the quality of the system, correct deficiencies, and ensure that the song recommendation results are in accordance with user preferences and needs, especially in improving learning productivity. These results become an important reference for further system development.

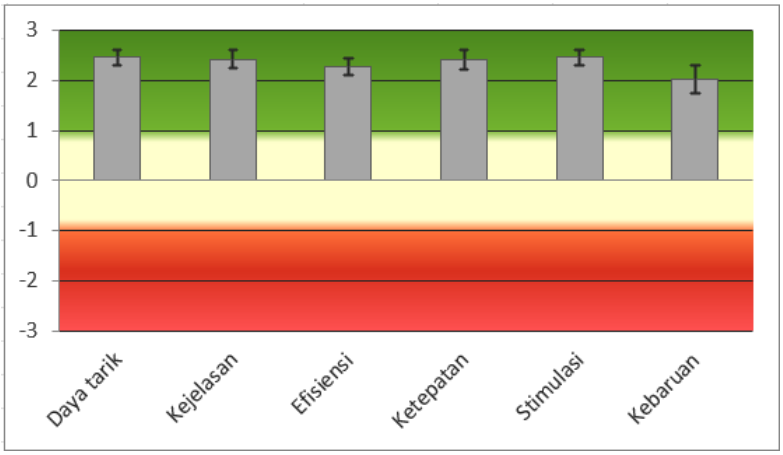


Figure 2 Graph of the average impression of respondents based on variables

Based on the results in this figure, it can be concluded that the song list recommendation system for learning consistently falls into the “very good” impression category with a minimum value of 2.0. In addition, on the efficiency scale, the system is also in the “excellent” category with a maximum score of 2.4. This shows that the system has a satisfactory and effective performance in providing song recommendations to support learning focus.

5. CONCLUSION

This K-NN-based music recommendation system makes a significant contribution in helping students select appropriate music for learning activities. The use of demographic attributes and music parameters provides recommendation results that match the user's needs, improving concentration and learning experience. Recommendations for future research include developing additional attributes as well as more complex algorithms for improved accuracy and relevance.

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IMPLEMENTATION OF A FINANCIAL REPORTING INFORMATION SYSTEM FOR SUN COMPUTER BALI STORE

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ABSTRACT

A financial reporting information system is essential for supporting the smooth operation of businesses, including Sun Computer Bali. This research aims to design a system that addresses unstructured and non-integrated income and expenditure records. The current financial reports are limited to daily summaries, lacking details on debits, credits, receivables and payables. Furthermore, store owners and employees face difficulties monitoring stock, increasing the risk of stock loss due to the absence of real-time inventory tracking. The proposed system produces comprehensive monthly financial reports, enables real-time inventory monitoring, supports decision-making, improves operational efficiency, and simplifies the tracking of profits and losses*. The system design adopts the Waterfall method, utilizing the Laravel Framework for development and MySQL for database management. System testing was conducted through user interviews to evaluate functionality, while the DeLone and McLean Information System Success Model was used for evaluation. Results indicate that the financial reporting information system effectively meets user needs, particularly in generating structured financial reports and monitoring inventory. This system significantly enhances operational management and supports the sustainable growth of Sun Computer Bali store.*

Keywords: *Information System, Financial Report, Waterfall, Transaction Recording, Stock of Goods*

1. INTRODUCTION

Business and technology have undergone significant evolution in tandem with the increasingly modern lifestyles of society. This progression is evident in various aspects of daily life, exemplified by the proliferation of retail businesses and services that streamline activities and meet human needs, which now premodinantly rely on technological advancements (Pratama and Utari, 2022). Aprianto (2021) highlights that in the real of business, whether involving the trade of goods or the provision of services, information and communication technology plays a pivotal role in facilitating transaction processes and delivering information with speed and precision. Furthermore, Riyadli and Saputra (2020) assert that information technology and systems constitute indispensable components in the management of corporate operations, particularly in the financial domain. Nevertheless, not all retail enterprises incorporate information systems into their business processes, as observed in the case of the Sun Computer Bali store located on Pejeng Tampaksiring Street, Gianyar, Bali. Sun Computer Bali is a retail business established in 2021, selling cutting-edge electronic devices to fulfill customer needs for innovative and high-quality technology. The product offered include laptops, personal computer assemblies, printers, mouse, keyboard and more. Additionally, the store provides repair services for electronic devices, covering hardware and software issues, such as system reinstallation, SSD

upgrades, keyboard repair, and similar services. The store's daily transaction volume ranges between IDR 2,000,000 until IDR 3,000,000. However, a significant issue the business faces is the lack of a systematic and integrated approach to recording income, and expenses, and generating financial reports. The second issue is that the current financial reporting system only generates daily reports without incorporating debit and credit details. Income and expenditure reports, along with profit calculations, are prepared only at the end of the month. Additionally, store owner and employees face challenges in monitoring inventory, which increases the risk of losses due to the absence of real-time stock tracking. To address these challenges, a website-based information system, titled "Implementation of Financial Reporting Information System For Sun Computer Bali Store", has been proposed. This system aims to streamline financial reporting and enhance stock management, enabling Sun Computer Bali to operate more effectively and efficiently.

2. RESEARCH METODOLOGY

2.1 Waterfall Model

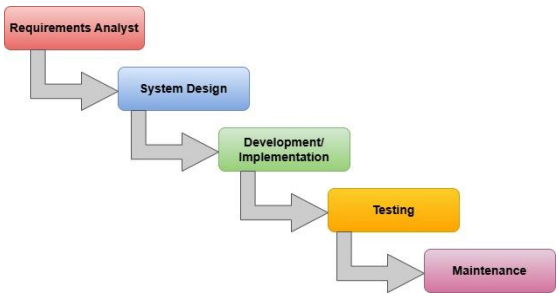


Figure 1. Waterfall Method
Source: Wahid,2020

This research applies the Waterfall system development method. This method is often refered to as the classic life cycle model or Linear Sequential Model, and describes a structure and sequential approach to software development, making it ideal for projects with clearly defined needs due to its linear and easy-to-understand characteristics, which includes the following stage (Wahid, 2020):

A. Requirements Analysis
In this analysis stage, communication is conducted with the customer, namely Sun Computer Bali, to understand the objectives to be achieved. Effective communication is crucial for obtaining project initialization, including problem analysis, data collection, and defining software features and functions (Risald and Lafu, 2021). Primary data is obtained directly from sources through interviews and observations, while secondary data is gathered from existing sources, such as documents, reports, or other references. The collected data will be analyzed to gain an in-depth understanding of the currenct needs and problems, which will serve as a strong foundation for system design.

B. System Design
At this stage, the main focus is on creating a software program design, which includes software design, data structure, user interface, and coding process (Herdiansyah, et al., 2021). Researchers compile a system design that serves to determine hardware needs and system requirements, identify functional requirements, compile system flowchart, and provide an overview of the system.

C. Development/Implementation
At this stage, the software describes how the system program works and how its functions can be used by the user (Fauziyah and Sugiarti, 2022). In this research, the code writing stage or system implementation is carried out by

coding using the Laravel Framework, and MySQL as database management by the previously designed system design.

D. Testing
After the system is designed, the next stage is to conduct a testing process to ensure that the resulting application runs well and meets predetermined expectations (Badrul and Ardy , 2021). This test aims to evaluate application or information system performance, functionality, and its ability to meet user needs. The testing method used in this research is the DeLone and McLean Model (D&M IS Success Model).

E. Maintenance
This stage is the final step in the Waterfall model, where the completed software is put into operation and maintained to ensure its performance remains optimal. Maintenance includes fixing errors that were not detected in the previous stages. According to (Listiyan and Subhiyakto, 2021) at this stage, direct testing of the applications or information systems used by the users is performed. Afterward, an analysis is conducted to identify any deficiencies that may arise. If deficiencies are found, maintenance will be carried out to correct them, as developments and changes are inevitable in the industrial world.

2.2 System Overview

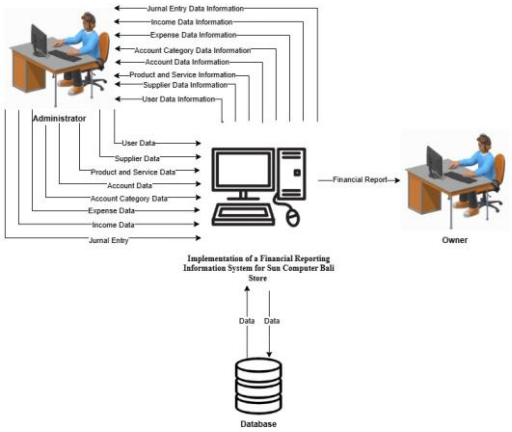


Figure 2. System Overview
Source: Personal,2024

In the implementation of the financial report information system at the Sun Computer Bali store, the administrator starts the process by logging into the information system. After successfully logging in, the administrator can input the required data, such as supplier data, goods, services, accounts and account categories. If there is an income or expense transaction at the store, the administrator will record it through the available menu, namely Income, Expenditure, and Journal Entry. Based on the inputted data, the system will process the information to produce various financial reports. These financial reports can then be accessed by the shop owner and downloaded in Excel file format for further use.

3. RELATED RESEARCH

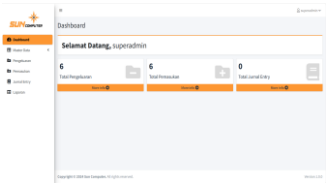
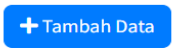
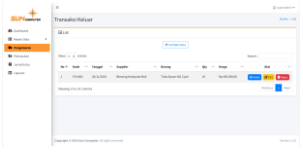
This research can be realized thanks to references from previous research results. Research with the journal title “Financial Reporting Information System at Website-Based Salon with SDLC Method” compiled by (Desmayani, et al., 2021) produces a financial reporting information system using the SDLC method and black box testing for the testing method. Another article that is relevant in this context is that researched by (Chan and Maiyana,2023), entitled “Designing a Web-Based Store Management Application”. In this study, a web-based store management application was designed that could help manage stock items and generate

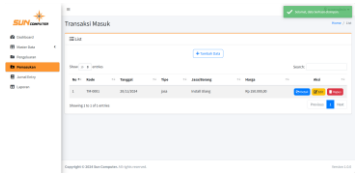
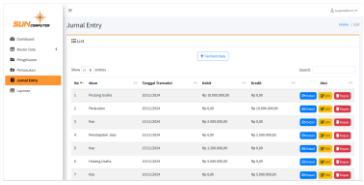
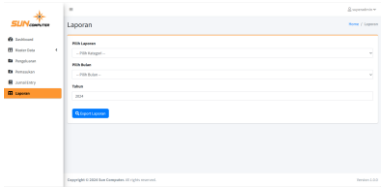
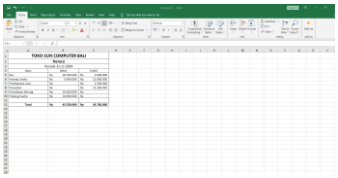
financial reports using the Codeigniter framework. Another research that also discusses information system related to financial reports and stock management is research by (Pratini, Juliharta and Wijaya, 2020) entitled "Design of a Web-Based Sales and Financial Report Information System (Case Study UD. Taru Lestari Sibetan Village, Bebandem District)". In this study, there are problems in managing financial data, stock data, and sales, therefore this study aims to present a sales information system model development with a qualitative approach and using a waterfall-based Software Development Life Cycle (SDLC) development method, as well as using the Laravel framework as the backend and the VueJs framework as the frontend. Another source that is relevant to this topic is a journal entitled "Design of a Web-Based MSME FoodyBestie Financial Report Information System" by (Alfarisi and Matondang, 2022), which produces a financial report information system and there are inventory functions to manage stock records. Another research that can be used as a references is "Designing a Financial Report Information System for Pharmacies Using the K-NN Algorithm" which was researched by (Sari and Batubara, 2021). With the design of this financial information system, pharmacy owners can easily determine whether the pharmacy is experiencing profit or loss, and users (administrator) can create reports from each data, such as reports on income data, expenses, reports on types of goods, and other reports.

4. RESULTS AND DISCUSSION

The result of this research is the implementation of a financial report information system at the Sun Computer Bali store, as shown in Table 1.

Table 1. Results of Implementation of Financial Statement Information System at Sun Computer Bali store

No.	User Interface	Description
1		The following is the Login interface for the Financial Report Information System at Sun Computer Bali. Users are required to enter their assigned username and password.
2		This dashboard menu presents important data in real-time, including total income, total expenses, and journal entries.
3		The "Add Data" field serves to enter various types of data such as suppliers, accounts, goods or services. Although each type of data has different information, the process of filling in the data in each field remains the same.
4		This menu is used to record all expenses incurred by the store, including those for purchasing stock items, operational costs, and other expenditures.

5		This feature is designed to record all income transactions received by the store. It encompasses various income sources, including revenue from product sales, service fees, and other financial inflows.
6		This feature is designed to record every financial transaction in detail, including both income and expenses. Accurate journal entries are essential records and serve as a foundation for preparing comprehensive financial statements.
7		The features on this menu allow users to select and export different types of financial reports according to their needs. Once a particular report is selected, users can download it in Excel format.
8		The following is an example of the export results of the financial statements in the form of an Excel file.

Source: Personal, 2024

4.1 Analysis of Test Results

All functions in the system must be tested so that the system can be said to be free from errors and the result obtained must be by the needs set at the previous stage (Arista and Nugroho, 2023). The results of this system test were obtained through an assessment conducted using a qualitative approach. The evaluation involved interviewing users (administrator) to gather their feedback on the system that has been developed. The success of the system trials was measured using the DeLone and McLean model framework as a reference. The DeLone and McLean Model (D&M IS Success Model) is an information system success measurement model developed by Willian H. Delone and Ephraim R. McLean (Ernawati, Hermaliani and Sulisyowati, 2021). The following are the results of the assessment related to the implementation of the financial reporting information system at the Sun Computer Bali store.

Table 2. Assessment by User

No.	Indicator	User Feedback	Percentage
1	System Quality: The extent to which the system is easy to use by its users.	The user (administrator) stated that this system is easy to use and very helpful in preparing financial reports, income and expenditure reports, and monitoring stock items.	93%
2	Information System: Refers to the quality of information that users receive from the developed system.	The information presented is easy to understand and provides features that suit user needs.	95%
3	Use: Refers to the extent to which the developed system is utilized.	The information system is used to generate financial reports, as well as income and expenditure statements.	95%
4	User Satisfaction: Represents	User provide positive feedback,	95%

	user evaluations of the information system's interface.	stating that the system's design is attractive, responsive, visually pleasing, and simple to use.	
5	Individual Impact: Highlight how the system facilitates users in performing their tasks.	The financial reporting system accelerates the creation of income, expenditure, and financial reports.	90%
6	Organization Impact: Describes the system's ability to enhance the flow of information within Sun Computer Bali, particularly in monitoring profit and loss.	The implemented system expedites the preparation of financial reports and allows real-time monitoring of stock levels.	95%

Source: Personal, 2024

5. CONCLUSION

The design and implementation of a website-based financial reporting information system were completed using the Waterfall Model, MySQL as a database management, and the Laravel framework. This system includes several features, such as stock management, recording store income and expenses, and generating financial reports. Based on the results of system testing conducted through user interviews, all features received positive feedback and functioned effectively to meet user needs. The implementation of this information system has had a significant impact on the operational efficiency of the Sun Computer Bali store. Improved recording accuracy, time efficiency, and real-time stock monitoring capabilities directly support revenue growth and reduce operating costs. The author concludes that the success of this system is that the information system is designed according to business needs and can produce accurate and integrated financial data.

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EXAMINING DIGITAL ENTREPRENEURIAL INTENTION FROM VARIOUS THEORIES

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ABSTRACT

Indonesia faces the challenge of a low number of entrepreneurs which has implications for economic growth and global competitiveness. One strategic solution to overcome this is the development of digital entrepreneurship considering the rapid digital transformation in various sectors. Efforts to increase digital entrepreneurship in Indonesia require a deep understanding of the factors that influence digital entrepreneurial intentions. This study aims to identify the theoretical basis and see the factors in it that support digital entrepreneurial intentions. This study was conducted using an explorative method by searching for previous empirical research in reputable international journals. Various theories were found such as Theory of Planned Behavior, Self-Determination Theory, Technology Acceptance Model, Social Cognitive Theory, Social Cognitive Career Theory, Entrepreneurial Event Model. The results of the study are expected to contribute to further researchers to be able to test digital entrepreneurial intentions so that they can support the growth of digital entrepreneurship in Indonesia.

Keywords: Digital Entrepreneurs, Start Up Digital, Entrepreneurial Intentions, Entrepreneurs Research Model, Entrepreneurial Intentions Theory.

1. INTRODUCTION

The increasingly developing digital technology in the world, especially in Indonesia, is changing the pattern of business creation and making digital entrepreneurship increasingly popular. Digital technology is considered to be able to open up various new options for entrepreneurs to create and develop their businesses (Darmanto, 2022). Information technology has caused local and regional markets to be replaced by global markets (Younis et al., 2020). Although there is a lot of literature on digital entrepreneurship, comprehensive information available on intentions in this context is still limited (Sahrah et al., 2023). Amid the increasingly recognized importance of digital entrepreneurship, this concept is still in its early stages of entrepreneurship research and its determinants are not widely understood (Elnadi & Gheith, 2023). The number of entrepreneurs in Indonesia remains low, accounting for only about 3.47% of the total population, which is below the 4% benchmark required for robust economic development (Pratama, 2024). This issue is primarily driven by challenges such as limited access to funding, insufficient entrepreneurship education, and inadequate support for the business ecosystem.
Digital entrepreneurial orientation has recently become an interesting research topic, as evidenced by the increasing trend of entrepreneurial orientation research in the digital field. Although research on entrepreneurial intention is extensive and comprehensive, there is a clear gap in research that focuses on digital entrepreneurial intention. There are not many previous studies that specifically discuss Digital Entrepreneurial Intention (DEI). Existing research on digital entrepreneurial intention shows that this field needs to be qualified as a whole and several factors have not been considered (A A Mir, 2023). The theory underlying the testing of digital entrepreneurial intention is deemed necessary to be mapped to make it easier for further researchers to conduct research. With this background,

this study examines in depth various theories to study digital entrepreneurial intention. The novelty of this study is that there has been no previous research that summarizes the theoretical basis that can be used to test DEI in the last 5 years published in Scopus journals.

2. RESEARCH METODOLOGY

The research was conducted using an explorative method. A literature review was conducted to find previous research results related to the antecedents of Digital Entrepreneurial Intention. The search focused on reputable international journals Q1-Q4 with publication years 2019-2024. 68 related articles were filtered by producing articles related to quantitative research and were empirical findings. From the filtration process, 19 articles were finally found which were analyzed to find the theoretical basis used. This method was carried out to be able to see the latest theories in the last 5 years that were used to test DEI.

3. RELATED RESEARCH

Theories that have generated numerous entrepreneurial studies are: Theory of Entrepreneurial Event, Theory of Planned Behavior, and Social Cognitive Theory (Susetyo & Lestari, 2014). According to the Theory of Planned Behavior, entrepreneurial intention can develop from three fundamental aspects: personal, social, and environmental (Susetyo & Lestari, 2014). Current research on digital entrepreneurship intentions suggests that this field requires extensive examination, and many factors remain to be investigated (Ajaz Akbar Mir et al., 2023). Other theories that have been analyzed to determine factors influencing digital entrepreneurial intention include Self-Determination Theory (Chang et al., 2018) and Social Cognitive Theory (Chang et al., 2020). Despite examining several theories in past research, there is a demand for more thorough studies that could support these alternative theoretical frameworks. As a result, there is an opportunity for various other theoretical models to be considered as precedents for intentions in digital entrepreneurship.

4. RESULTS AND DISCUSSION

4.1 THEORY OF PLANNED BEHAVIOR

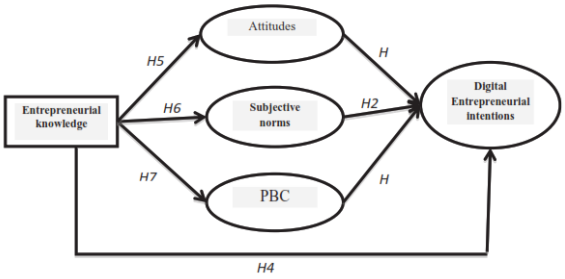


Figure 1. Sample Reserach Framework Based on Theory of Planned Behavior
Source: (Yaghoubi Farani et al., 2017)

The theory of planned behavior (TPB) assumes that the intention to perform a behavior is a good predictor of the behavior itself (Fishbein & Ajzen, 2011).Intention is defined as an internal state that influences a person's attention to a particular behavior. The planned effort to perform the behavior also reflects the intention (Siqueira et al., 2022). Previous research using this theory includes several important points. Research by (T. T. Nguyen et al., 2024) shows that personal attitudes and perceived behavioral control play a role in entrepreneurial intentions. TPB is influenced by three variables: attitudes toward behavior, subjective norms, and perceived behavioral control (Xin, 2023).

4.2 SELF-DETERMINATION THEORY

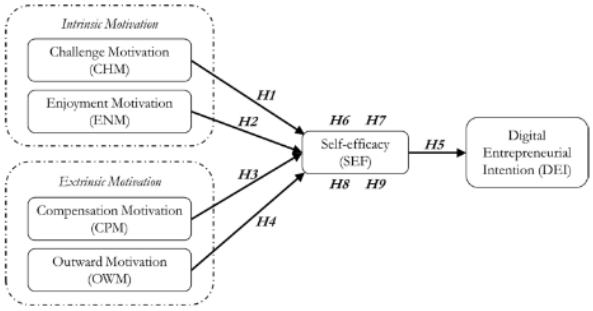


Figure 2. Sample Reserach Framework Based on Self-Determination Theory
Source: (Ridwan & Fiodian, 2024)

Self-Determination Theory (SDT), individual actions are influenced by intrinsic and extrinsic motivations as discussed by . If individuals accept challenges and believe that entrepreneurship can provide satisfaction and rewards, their entrepreneurial intentions tend to increase. Previous studies using this theory cover several important points. In particular, the study (Ridwan & Fiodian, 2024) attempts to discuss the motivations that drive individuals to pursue digital entrepreneurship, the factors that shape their intentions, and the essential requirements for success as a digital entrepreneur.

4.3 TECHNOLOGY ACCEPTANCE MODEL

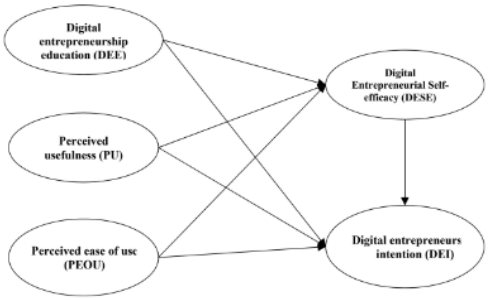


Figure 3. Sample Reserach Framework Based on Technology Acceptance Model
Source: (Wibowo, 2024)

The Technology Acceptance Model (TAM) is suitable for explaining the acceptance of technology use. Developed by (Robbins, 1964), this model is an extension of the theory of reasoned action (TRA). Perceived usefulness (pU) relates to a person's belief that technology will improve performance, while perceived ease of use (peOU) refers to a person's belief that technology will help achieve goals. Previous research using this theory includes several important points. Research from (Wibowo, 2024) explains that in principle, TAM can be applied to many domains, including digital entrepreneurship intentions and behavior.

4.4 SOCIAL COGNITIVE THEORY

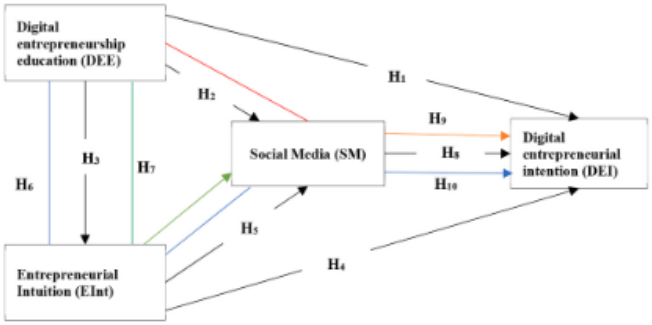


Figure 4. Sample Reserach Framework Based on Social Cognitive Theory
Source: (Wibowo, 2023)

Social Cognitive Theory (SCT) explains how digital entrepreneurship education influences digital entrepreneurial intentions, with a focus on social media and entrepreneurial intuition. SCT emphasizes the importance of observational learning, self-efficacy, and reciprocal determinism in human behavior (Bandura, 2002). Previous research using this theory includes several important points. Research by (Wibowo, 2023) provides insight into increasing interest in digital entrepreneurship through digital entrepreneurship education. According to research (Xin, 2023) self-efficacy is influenced by four aspects: direct experience, emotion, indirect experience, and verbal persuasion, indicating the use of SCT to discuss the mediating role of digital entrepreneurship self-efficacy.

4.5 SOCIAL COGNITIVE CAREER THEORY

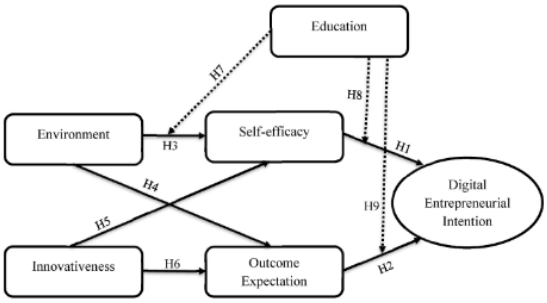


Figure 5. Sample Reserach Framework Based on Social Cognitive Career Theory
Source: (Pham, 2024)

Social Cognitive Career Theory (SCCT) is a motivational framework for career decision-making and has been adapted to explain the dynamics of career choice in diverse contexts. The theory states that career interests or intentions are shaped by the interaction of multiple factors in the environment, personal attributes, and behaviors (Lent et al., 2017). Previous studies using this theory include several important points. The relationship between various theories and the influence of social media on the entrepreneurial intentions of business graduates in digital ventures found that several factors such as competence, self-efficacy, and subjective norms significantly influenced their attitudes toward DEI (Gangadhara & Kumar, 2024).

4.6 Entrepreneurial Event Model

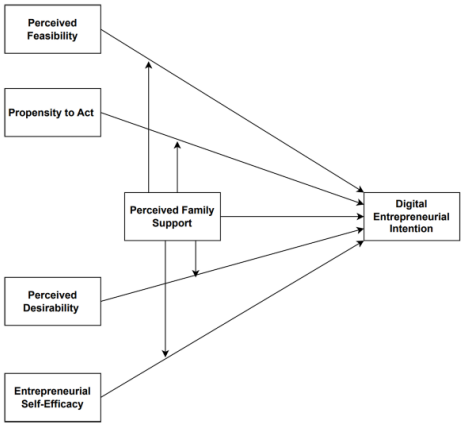


Figure 6. Sample Reserach Framework Based on Entrepreneurial Event Model
Source: (P. N. D. Nguyen, 2024)

The Entrepreneurial Event Model (EEM) is an integral part of the theoretical foundation for empowering digital entrepreneurs (Usman & Sun, 2022). Previous studies using this theory cover several important points. The study (P. N. D. Nguyen, 2024) makes a significant contribution to the entrepreneurship literature by applying and extending the EEM model to digital entrepreneurship in developing countries. This study also promotes societal development goals by highlighting the transformative power of digital entrepreneurship for inclusive and sustainable growth.

4.7 DISCUSSION

Based on a search of reputable international journals Q1-Q4 with a publication year range of 2019-2024, 68 articles discussed related topics. The articles were then filtered to identify research with a quantitative approach and empirical findings. The screening process resulted in 19 articles which were further explained to determine the basic theories used in studies related to Digital Entrepreneurial Intention. The purpose of this analysis is to reveal the main theories that are the basis for studying this phenomenon. The results of the analysis found six theories that are often used to test Digital Entrepreneurial Intention. First, the Theory of Planned Behavior (TPB) involves three direct variables: attitude, subjective norms, and perceived behavioral control (PBC). TPB can be the main reference for research that utilizes this third variable. Second, Self-Determination Theory (SDT) has one direct variable, namely self-efficacy. Third, the Technology Acceptance Model (TAM) relies on two direct variables: perceived usefulness and ease of use. Fourth, Social Cognitive Theory (SCT) uses one direct variable, namely social media. Fifth, Social Cognitive Career Theory (SCCT) includes four direct variables: environment, self-efficacy, innovation, and outcome expectations. Finally, the Entrepreneurial Event Model (EEM) has four direct variables, namely perceived feasibility, propensity to act, perceived desire, and entrepreneurial self-efficacy.

5. CONCLUSION

This study found 6 theories used to test Digital Entrepreneurial Intention. The theories are the theory of Planned Behavior, Self-Determination Theory, Technology Acceptance Model, Social Cognitive Theory, Social Cognitive Career Theory, and Entrepreneurial Event Model. In conducting a literature review, several other theories were found that could be used such as Personality trait theory and capital theory but in the last 5 years, they have not been used in research

published in reputable international journals Q1-Q4. The results of this study are expected to help further researchers to test variables that can increase DEI.

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SENTIMENT ANALYSIS OF PUBLIC OPINION ON THE IMPACT OF DEEPFAKE TECHNOLOGY USING THE NAIVE BAYES METHOD ON PLATFORM X

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ABSTRACT

The development of deepfake technology, a digital manipulation tool powered by artificial intelligence, has posed significant challenges in the modern era, particularly concerning individual privacy and reputation. This technology enables the creation of highly realistic visual content, making it vulnerable to misuse, as seen in the case of Taylor Swift, who faced the unauthorized dissemination of fake explicit content on the social media platform X (Twitter). This study aims to analyze public sentiment regarding the incident using the Naive Bayes method, chosen for its reliability in text classification, low complexity, and accuracy. The research process includes data crawling, preprocessing (cleansing, case folding, tokenizing, stopword removal, and stemming), sentiment labeling with the Vader Lexicon, and TF-IDF weighting to build the classification model. The results indicate that the Naive Bayes model achieved an accuracy of 76%, precision of 79%, recall of 73%, and an F1-score of 75%. It also revealed that the majority of public sentiment was negative (60.88%), while positive sentiment accounted for 30.12%, reflecting widespread concern over the potential misuse of deepfake technology. This study offers valuable insights into public perception and provides a foundation for developing policies to mitigate the risks associated with deepfake misuse.

Keywords: *Deepfake, Sentiment Analysis, Naive Bayes, X (Twitter), Artificial Intelligence*

1 INTRODUCTION

The development of technology has now permeated various aspects of life, including artificial intelligence (AI), which has become a global phenomenon and is utilized in daily activities. AI is in the process of transforming many aspects of human life (Mahira et al., 2023). According to (Putra and Wijaya, 2023), robots are now beginning to replace human jobs due to advancements in AI. Technology not only provides information, communication, education, and entertainment but also helps meet various needs (Ramadhan et al., 2024). While AI brings positive impacts, it also triggers negative consequences, such as the spread of deepfake-based pornographic content (Novera and Z, 2024). Deepfakes offer both benefits and risks in entertainment, such as digitally resurrecting actors or seamlessly swapping faces, but they raise ethical concerns about using people's faces without consent. The technology blurs the line between real and fake, making it difficult for viewers to distinguish truth, which challenges the entertainment industry to rethink how content

is presented in order to maintain public trust (Debroy et al., 2024). Deepfake also poses a threat to businesses and the economy. Fraudsters are now using programs to impersonate CEOs by training algorithms with speeches, YouTube videos, and TED Talks. This tactic has already been used to steal from companies, and given the influence of CEO statements on stock prices, deepfake may be used to manipulate the stock market (Yamaoka-Enkerlin, 2020). The first deepfake case emerged in 2017, featuring the face of actress Gal Gadot in a pornographic video. AI is often misused for harmful deepfake content (Situmeang et al., 2024). A relevant example is the viral deepfake photo of Taylor Swift circulating on various digital platforms. The photo depicted Taylor Swift in a fabricated yet realistic scenario due to AI manipulation. Discussions about this case are widely found on Platform X, one of the key sources of public opinion data. Twitter (X) has been a popular text-based social media platform among Indonesians for a long time (Fauziah et al., 2024). Platform X is well-known as a primary medium for discussing current topics, including deepfake technology, due to its speed in disseminating information and gathering user responses. As of October 2023, Platform X had approximately 27.5 million active users in Indonesia, making it one of the most popular social media platforms. Public sentiment regarding the use of deepfake technology is a crucial indicator in assessing its social impact. Sentiment analysis is effective in understanding public views on the risks and opportunities of technology on social media. Therefore, this study aims to examine the Taylor Swift deepfake case as a primary case study, using data from Platform X to explore public perceptions of this technology.

This research focuses on analyzing public sentiment regarding deepfakes using the Naive Bayes method. Naive Bayes is a machine learning method that uses probability and statistical calculations, introduced by British scientist Thomas Bayes (M. I. Santoso and Dzikrillah, 2024). The Naive Bayes method was chosen for this study due to its various advantages in sentiment analysis. The Naive Bayes classification method is used to make decisions by predicting a case based on the classification results obtained (Ningsih et al., 2024). The findings of this study aim to uncover public perceptions of deepfake technology.

2. RESEARCH METODOLOGY

2.1 Research Flow

In this study, the researcher conducted several steps or processes to obtain the results and conclusions of the research. The research flow to be carried out is illustrated in Figure 1.

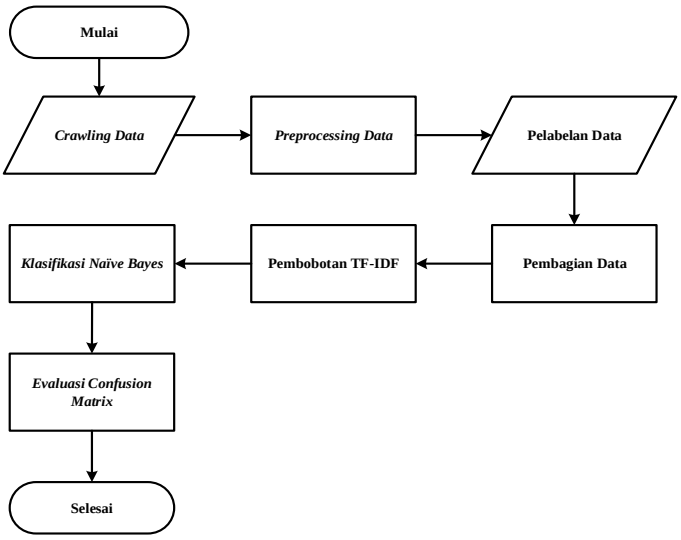


Figure. 1. Research Flow

This study begins by collecting data from X (Twitter) through data crawling, where the collected data includes the tweet's posting date (created_at), the tweet's content (full_text), and the username. Once the data is gathered, the next stage involves several preprocessing steps, including cleansing, case folding, tokenizing, stopword removal, and stemming. After the text preprocessing, the data is labeled using the VADER Lexicon method. VADER Lexicon is specifically designed to analyze microblogs, with sentiment determination based on the weight of a sentence: if the weight exceeds 0.05, it is categorized as positive sentiment; if it is less than -0.05, it is categorized as negative sentiment (Muhammad Fernanda Naufal Fathoni et al., 2024). Next, the data undergoes the TF-IDF (Term Frequency-Inverse Document Frequency) process, a weighting method used in text processing to assess the importance of a word in a document relative to a corpus. Term weighting assigns a weight to each term in a document (Ridwan et al., 2024). Subsequently, the data is divided into two sets: a training set and a testing set. The training set is used to train the Naive Bayes classification model, which is probability-based and classifies data into appropriate categories. After training the model, evaluation is performed using a confusion matrix to measure the model's performance, calculating evaluation metrics such as accuracy, precision, recall, and F1-score.

2.2 Naïve Bayes

Naive Bayes is a classification method based on Bayes' theorem with the naive assumption that each feature in the data is conditionally independent of the others given the class. This method is highly popular in text analysis and pattern recognition, particularly in applications involving text classification based on content or sentiment (Permana Putra and Farrah Syafira, 2023).

2.3 Crawling Data

Data crawling is the process of extracting information from various sources on the internet. It is used to gather data from different websites for specific purposes (Riskiyah et al., 2024). In this study, crawling was conducted using a Twitter token and the tweet-harvest tool version 2.6.1 to collect tweets from Twitter. The crawling process resulted in 2,013 data points, and after the removal of duplicate data, the cleaned dataset contained 1,375 data points.The data crawling process was carried

out from January 2024 to July 2024. The results of the data crawling are presented in Table 1.

Table 1. Crawling Data Result

created_at	full_text	username
1/29/2024	Deepfake explicit images of Taylor Swift spread on social media Her fans are fighting back Yahoo News	Security_Sleuth
1/29/2024	A Canadian man hoped his identity would remain hidden from the world despite joining in on an online campaign that circulated explicit deepfake images of They ll Never Find Me Explicit AIGenerated Photos of Taylor Swift Land X User In Hot Water	ATLBlackStar
1/29/2024	Social media platform X has temporarily blocked Taylor Swift s name from being searched after AIgenerated deepfake pornography images of the singer went viral last week	euronewsculture
1/30/2024	Deep Fake Images of Taylor Swift Taken Down Explicit AIgenerated images of Taylor Swift have been removed from X Twitter in the latest example of the proliferation of fake pornography	CyberSecInt
1/30/2024	Social media platform X has blocked searches for Taylor Swift as pornographic deepfake images of the singer have circulated online	AM800CKLW
1/31/2024	I found this on NewsBreak Taylor Swift AI pictures highlight the horrors of deepfake porn Will we finally care	worldhabbits

2.4 Preprocessing

Preprocessing is the initial stage in preparing data before further processing. The dataset will go through a series of text preprocessing steps, including cleaning, case folding (converting uppercase to lowercase), tokenizing, stopword removal, and stemming (Saputra et al., 2024). The method used to transform unstructured research data into structured data is called preprocessing (H. Santoso dkk., 2022).

2.5 Labelling

Labeling is the process of assigning labels or classifications to the collected data. In this stage, data is labeled to determine whether each sentence in the dataset has a positive or negative meaning (Muhammad Daffa Al Fahreza et al., 2024). The authors used the Vader Lexicon method to perform the labeling process. The Vader Lexicon method is a lexicon-based sentiment analysis technique specifically designed to identify sentiment in English texts, both in the context of social media and other text formats.

Table 2. Data Labeling

Full_text	Sentiment_label
Deepfake explicit images of Taylor Swift spread on social media Her fans are fighting back Yahoo News	Negative
Taylor Swift deepfakes spark calls in Congress for new legislation ltlt While many of the images appear to have been removed at the time of publication one photo of Swift was	Positive

viewed a reported 47 million times before being taken down	
You cant stop the future Deepfake is here to stay Fuck Taylor Swift soon in 3D	Negative
Easiest way to decipher this Taylor Swift deepfake thing is to ask yourself one question Does she look sexy If yes it s fake If no you ve found yourself a genuine Taylor Swift photograph Be well	Positive
If you re serious Twitter blocked search functionality for Taylor Swift due to AI deepfake porn If not	Negative

The results of the labeling process are visualized in the diagram in Figure 2 below.

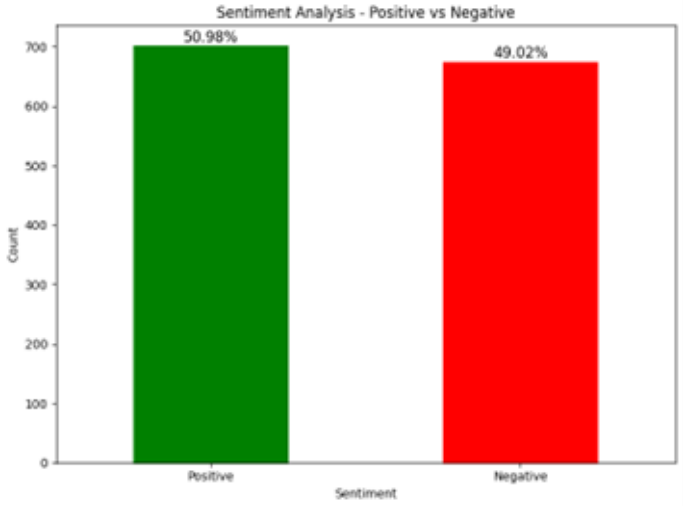


Figure 2. Labeling Result Diagram

Based on the sentiment analysis results, the diagram above shows that positive sentiment has a higher percentage, 50.98%, with a total of 701 tweets. Meanwhile, negative sentiment accounts for 49.02%, with a total of 674 tweets. This difference indicates that there are more comments classified as positive sentiment compared to negative sentiment.

2.6 Data Splitting

Splitting data serves to divide the dataset into two parts: the training data and the testing data, with a specified proportion (Sholekhah et al., 2024). In this study, the dataset is split with a ratio of 80:20, where 80% is used for training data and 20% for testing data.

2.7 TF-IDF (Term Frequency Inverse Document Frequency)

Term Frequency and Inverse Document Frequency (TF-IDF) are statistical measures that describe the importance of a term in a document within a corpus. Term Frequency (TF) refers to the frequency of a term's occurrence in a document. The more frequently a term appears, the higher its TF value. On the other hand, Inverse Document Frequency (IDF) measures the rarity of a term in a collection of

documents. The less frequently a term appears, the higher its IDF value (Syafrizal et al., 2023).

2.8 Confusion Matrix

A Confusion Matrix is a table that visualizes the performance of a model or algorithm. Specifically, each row of the matrix represents the actual class of the data, while each column represents the predicted class of the data, or vice versa (Ariqoh et al., 2023).

3. RELATED RESEARCH

The first study conducted by (Alexander et al., 2023) used the Naïve Bayes algorithm and achieved an accuracy of 82% in analyzing public sentiment about Deepfake on the YouTube social media platform. The second study by (Pratmanto et al., 2024)) also used the Naïve Bayes algorithm for their research, and found that Naïve Bayes outperformed KNN, with an accuracy of 79.96%, recall of 87.76%, and AUC of 96.40%, compared to KNN's accuracy of 78.34%, recall of 75.32%, and AUC of 92.20%. The study concluded that Naïve Bayes is more effective in providing accurate classification and distinguishing between positive and negative classes, while KNN is more accurate in predicting the positive class. The third study, conducted by (Ramadhani et al., 2024)), also used the Naïve Bayes algorithm. The results showed that the Naïve Bayes method successfully classified user sentiment using a Confusion Matrix, with an accuracy of 94.05%, precision values of 95% for positive and 81.25% for negative, and recall values of 98.84% for positive and 48% for negative. The fourth study by (Krisdiyanto, 2021) aimed to analyze public sentiment towards the implementation of the PPKM policy in Indonesia through tweets and comments on Twitter. The study found that 99% of public opinions on the PPKM policy were classified as positive, while 1% were classified as negative. Finally, the fifth study by (Syarifuddinn, 2020) compared the Naïve Bayes and KNN algorithms. The study focused on comparing the classification results of both methods and understanding public opinion trends on Twitter. The results revealed that the Naïve Bayes method performed better, with an accuracy of 63.21%, compared to KNN's 58.10%. The analysis also showed a higher number of positive opinions (610) compared to negative opinions (488), supported by the higher precision for positive opinions in Naïve Bayes (66.40%) compared to negative opinions (58.94%).

4. RESULTS AND DISCUSSION

4.1 Model Prediction Results

After the model has been trained and tested on the testing data, predictions are made using the Naïve Bayes model on the test data. Once the predictions are obtained, the next step is to count the number of predictions classified as negative and positive. These results are then visualized in the form of a bar chart to display the distribution of the model's predictions across the two classes.

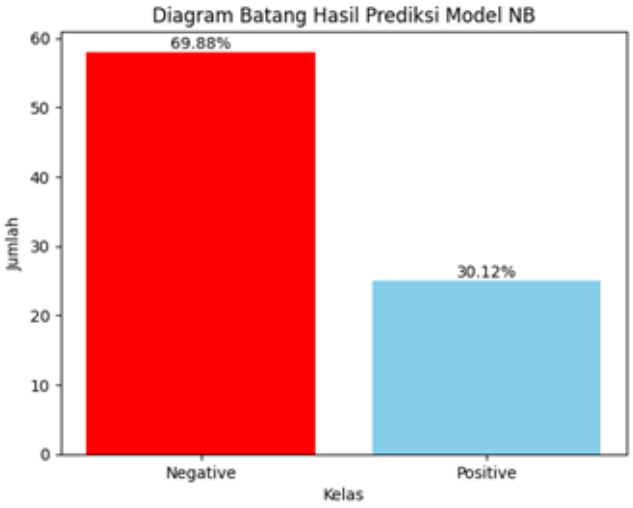


Figure 3. Diagram Of Model Prediction

Based on the diagram above, the results of the model's predictions on the test data can be observed. The prediction for the sentiment "Negative" has a percentage of 69.88%, while the sentiment "Positive" has a percentage of 30.12%. This diagram shows the distribution of the model's predictions, with a higher number of predictions for "Negative" sentiment compared to "Positive" sentiment. Based on the results in the diagram, it provides an overview of how well the Naive Bayes classification model is able to distinguish between "Negative" and "Positive" sentiments in the test data.

4.2 Model Evaluation

The performance evaluation of the Naive Bayes classification model on the test data is conducted using several commonly used evaluation metrics for classification models: accuracy, precision, recall, and F1-score. The results of the evaluation can be seen in Table 3.

Table 3. Evaluasi Model

Accuracy	76%
Precision	79%
Recall	73%
F1-score	75%

The performance evaluation results of the Naive Bayes model can be seen in Table 3, which shows that the model achieved an accuracy of 76%. This indicates the model's relatively good ability to predict sentiment based on the available data. In addition to accuracy, other metrics provide more detailed insights into the model's performance. With a precision of 79%, the model ensures that 79% of its positive predictions are correct. Furthermore, a recall value of 73% indicates that the model successfully detected 73% of the actual positive data. The combination of precision and recall results in an F1-score of 75%, reflecting the balance between the model's precision and sensitivity.

4.3 Evaluasi Model dengan *Confusion Matrix*

The evaluation process is conducted after the classification process, with the goal of measuring the performance of a model in classifying data. Below is the confusion matrix, which shows the results of true positives, false positives, true

negatives, and false negatives. The results of the confusion matrix can be seen in Figure 4.

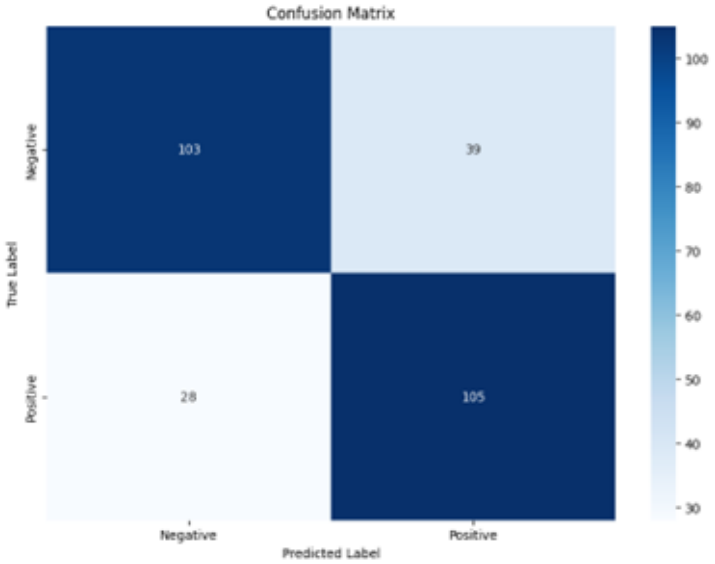


Figure 4. Confusion Matrix

The confusion matrix above shows the performance of the Naive Bayes model in classifying sentiment as either positive (Positive) or negative (Negative). The model successfully classified 105 positive data points as Positive (True Positive) and 103 negative data points as Negative (True Negative). However, there were 39 negative data points incorrectly classified as Positive (False Positive) and 28 positive data points incorrectly classified as Negative (False Negative). These results reflect the model's relatively good ability to differentiate between positive and negative sentiments.

5. CONCLUSION

This study shows that the Naive Bayes method can be effectively used to analyze public sentiment regarding the impact of deepfake technology on Platform X, with an accuracy rate of 76%. In addition, the precision value of 79%, recall of 73%, and F1-score of 75% indicate that the model performs well in classifying positive and negative sentiments, although there are still some errors in predicting certain sentiments. The model test results show that 30.12% of the data has a positive sentiment, while 60.88% (as seen in Figure 4.20) of the data reflects a negative sentiment. Positive sentiment tends to appreciate public awareness of deepfake technology misuse, while negative sentiment emphasizes the dangers and privacy violations caused by the technology. The case study of the viral Taylor Swift deepfake video on Platform X highlights how this technology can influence public perception, both positively and negatively, depending on its use context. Using Platform X as a data source is highly relevant, given the significant number of active users in Indonesia, which reached 27.5 million users. This platform is also known as the primary medium for discussions on current technological issues. Through the Naive Bayes method, this study makes an important contribution to understanding public perception of deepfake technology and its implications in the future. It is hoped that the findings from this research can serve as a foundation for the development of deepfake technology regulations and public education, so that its negative impact can be minimized, and its benefits can be maximized ethically.

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THE DEVELOPMENT OF AUGMENTED REALITY-BASED POCKET BOOKS ON LEARNING STRAIGHT LINE 3D SHAPES USING THE MARKER BASED TRACKING METHOD

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ABSTRACT

Augmented Reality (AR) is a technology that combines 2 dimensions and 3 dimensions at the same time. Augmented Reality allows a 2-dimensional object to change into 3 dimensions with the help of devices such as cameras and smartphones. Augmented Reality has many applications, one of which is in the world of education. One example of the application of augmented reality that can be done is in the Straight Line 3D shapes topic. In this topic, Augmented Reality is used to display the spatial object in the book that was previously 2-dimensional into 3 dimensions. Markers are used as objects to be scanned via a smartphone camera. From the results of the experiment in determining the ideal distance between the camera and the marker, the ideal distance was found to be between 8 - 77 cm. This depends on the size of the marker to be scanned. The following Augmented Reality applications can run well in helping mathematics learning, especially in the topic of straight line 3D shapes.

Keywords: *Augmented Reality, 3D Shapes, Learning Media*

1. INTRODUCTION

One of the trends in the world of education is to utilize technology as a learning medium. The use of technology in learning has a positive impact on learning outcomes (Sarnoto et al, 2023). This is because technology can simulate learning in 3 dimensions. So that students can see a problem from another perspective that cannot be seen in reading books.

The teaching and learning process will be of higher quality if combined with technology used as a learning medium. Learning media is needed as an intermediary for teachers to minimize failure during the learning process. In addition, interesting and interactive learning media can help students absorb the material being taught, because in the learning process many students have difficulty understanding learning with conventional methods. One of the technologies that is currently popular and developing is Augmented Reality (Indra and Idramsa, 2022).

Augmented Reality is a technology that can integrate the real world with the virtual world, allowing users to see the real world that has been added with virtual elements in 3 dimensions (Indahsari et al, 2023). Based on research conducted by Surani and Fricticarani (2023), it shows that the use of Augmented Reality in learning has a positive impact, especially on Biology learning with human digestive system material. One of the materials that can be assisted by the use of 3D Augmented Reality technology is geometry material in mathematics subjects. The use of 3D technology greatly helps students in understanding the shape, angles, and contents of geometric shapes that cannot be seen in 2 dimensions in textbooks (Wahyudin et al,

2022). Learning geometric shapes is learning that uses spatial abilities. Spatial ability is the ability possessed by a person to be able to create, store, understand, and remember mental images of space and shape (Sudirman, 2020). Spatial ability is an important ability because according to research conducted by Nasution (2023), spatial ability is one of the variables that influences students' problem-solving abilities.

Marker Based Tracking is one of the methods in the application of Augmented Reality. Based on research conducted by Putra (2023), Marker based tracking can be applied well to learning Lampung script using Augmented Reality technology. In this study, Lampung script writing can be scanned using a smartphone camera that has been installed with an augmented reality application. Based on black box testing, the application is free from functional errors and is included in the "Very Good" category. Thus, this method can be applied to pocket books to study straight line geometric shapes.

Based on the previous explanation, it can be shown that it is important to apply technology that can simulate 3 Dimensions in geometry learning, especially in spatial geometry material such as Augmented Reality technology. So the main objective of the following research is to develop a pocket book on learning Spatial Geometry, especially straight line spatial geometry using Augmented Reality assistance using the Marker Based Tracking method. The pocket book integrated with the following augmented reality application can be an alternative learning media that can improve the quality of learning about straight line spatial geometry material. So that it can improve the quality of learning both in class and outside the classroom. The pocket book integrated with the following augmented reality application will also help improve students' problem-solving abilities. So that it will provide good learning outcomes.

2. RESEARCH METODOLOGY

Research methodology is a scientific process or method that discusses the procedures for collecting data needed in the research process starting from data collection, data analysis, and designing procedures that will be used in the development of pocket books and applications (Haryanto, 2019). This research is an R&D (Research and Development) study using the ADDIE model (Analyze, Design, Develop, Implement, and Evaluate). ADDIE is a dynamic instructional model consisting of the stages of analysis, design, development, implementation, and evaluation (Mulyasari et al, 2023). The steps that will be taken based on the ADDIE model are

a. Analysis

In the following stage, the analysis conducted is related to seeing the needs and conditions that occur in classroom learning in general. In the analysis stage, interviews were also conducted with teachers and students to conduct an in-depth analysis of the needs that must be met.

b. Design

In the following stages, the Augmented Reality application is designed using a mockup application such as Figma. In the design stage, the needs obtained from the analysis process will be the basis for designing the application interface. In the design stage, the pocket book is also worked on using the Canva editing application.

c. Development

Development is done using the Unity 2021 editor application. Development is done based on design results that have met the needs. At the development stage, the logic of an application and the required 3-dimensional assets are also worked on. At the development stage, the

marker-based tracking method will also be applied to the application as a method of detecting references.

d. Implementation Phase

After the application is developed, the next step is to try or implement the application that has been created to the book that has been designed. In addition, the application will be tested with several student samples to collect data related to the feasibility and performance of the application.

e. Evaluation Phase

Evaluation or testing is done based on data collected from the implementation results. At the evaluation stage, it will also be seen whether there are bugs or errors that occur in the application. The evaluation process that will be used is Technical Performance Testing which assesses the performance of the application when it is run.

3. Related Search

Tabel 1. Story Board

Nama	Deskripsi
Marker	2-dimensional image that is used as a reference in the application
Camera	For scanning the marker
Smartphone	Devices used to run the application
Laptop	For developing the application
Unity 2021	Editor for developing the augmented reality
Vuforia	Marker's Database
Canva	Editing software for developing the book
Figma	Software for mockuping the application

4. RESULTS AND DISCUSSION

The developed application is then tested to see the possibility of bugs and room for improvement. Testing of the application is also carried out to ensure that the application can be used properly. The results of the application test can be seen in the following image:



Figure 1. Splash Screen



Figure 2. Main Menu



Figure 3. Usage Guidelines

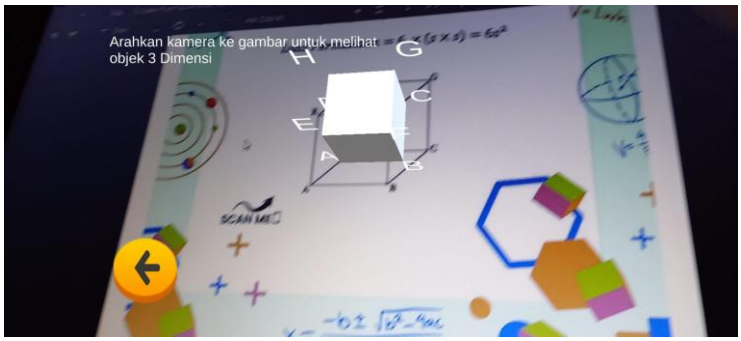


Figure 4. Augmented Reality Features (1)

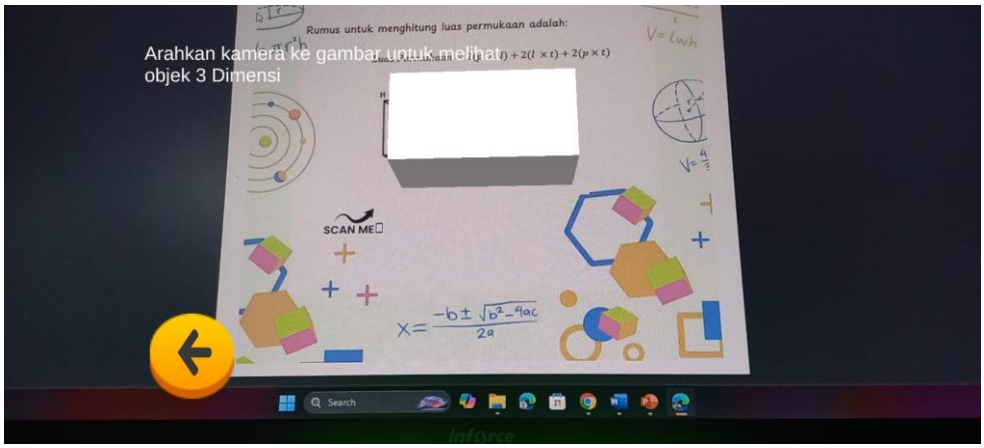


Figure 5. Augmented Reality Features (2)

Evaluation of the developed application is in the realm of Technical Performance Testing. The metrics or measuring tools used in measuring its performance include Accuracy, Latency, Frame Rate, Device Compatibility, and Distance between the camera and the marker.

Accuracy or precision is how precise the augmented reality application is in capturing references or markers. Based on testing using three different devices, the application can capture and determine what 3D objects should appear. There are no markers or references that cannot be detected by the camera. This shows that the application developed and the selected markers are very precise.

Latency, especially in displaying 3D objects, is greatly influenced by the specifications of the device used. Based on testing using devices with minimum specifications, namely Android devices with version 7.0, 2 GB memory, and dual core processors, the resulting latency ranges from 1000ms - 2000ms. Latency is also influenced by the intensity of light in the room. The brighter the light captured by the camera, the lower the latency will be. Based on testing for latency, the application that has been developed is still included in the good category and can be used without any problems.

Frame rate is the number of images displayed in a certain time unit. Frame rate is usually shown in seconds so it is called Frame Rate per second. The higher the frame rate produced, the smoother the image will look and will not experience any stuttering. Based on testing using the minimum device owned, the frame rate obtained is 15-30 fps. Frame rate is also influenced by the specifications of the device used and the intensity of light received. The higher the light intensity, the higher the frame rate produced. The following test shows that the application developed is still in the good category and is suitable for use.

The compatibility of the devices that can be used to run the following applications is very feasible. By using the minimum device, the application can be run properly. The application developed supports the use of smartphones with a minimum Android version of version 7. This version was first released in 2016. So for device compatibility, the application developed is very feasible and can be used for almost all Android devices currently available.

The distance between the device and the marker to be detected is worthy of attention so that the developed application can be used comfortably. The developed application can detect markers with a closest distance of 8 cm. While the furthest distance that can be detected is 77 cm. This shows that the developed application is very feasible. Especially its use with pocket books only requires a distance of 8 cm - 30 cm to read it.

Based on the results of technical testing to see the performance of the application, it can be concluded that the application developed is suitable for use. Because there are no obstacles in its use for various devices.

5. CONCLUSION

The developed application can be run well on the smartphone device used. The developed application can also scan pocket books that have been made to be used simultaneously. 3D objects are also clearly visible when the marker is detected on the camera. The application can be practiced perfectly both in class and outside the classroom. Based on technical testing by looking at the performance aspects of the application, it can be concluded that the application that has been developed is suitable for use in learning. Both in class and outside the classroom.

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INTEGRATED TOURISM DEVELOPMENT OF GENGGELANG VILLAGE THROUGH SIGADis APPLICATION AND WEB VIRTUAL TOUR

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ABSTRACT

The development of digital-based tourism is increasingly needed to reach tourists who are looking for virtual experiences before visiting in person. This community service aims to develop the potential of natural tourism in Genggelang Village through the application of digital technology in the form of the Si Gadis application and virtual tour website. Si Gadis application is designed as an interactive platform that presents complete information about Genggelang tourism, including maps, routes, and destination descriptions. Meanwhile, the virtual tour website provides a visual tour experience that allows prospective tourists to explore the natural beauty and facilities available online. The methods used in this community service activity include field observations, interviews with local tourism managers, and the development of a digital-based system carried out by the team. The expected results of this community service are an increase in the number of tourist visits to Genggelang Village and an increase in local people's understanding of the importance of adapting technology in tourism development. In addition, Si Gadis application and virtual tour website are expected to be a model for tourism development in other villages with similar natural potential.

Keywords: *Nature Tourism, SIGADis Application, Web Virtual Tour*

1. INTRODUCTION

In recent years, digitalization has brought significant changes in the tourism sector, especially in promoting natural tourism destinations. Tourism development is a flagship program in regional development (Suta & Mahagangga, 2018). Tourism development that is planned and managed in a sustainable manner based on the community will be able to provide economic value to the community and the local government (Nurhadi et.al, 2020). Tourism is one of the objects of local cultural sustainability and the preservation of natural beauty that provides a source of income (Lestari & Suharyanti, 2020). In addition to the material benefits that can be achieved from tourism development, it should also be noted that this will of course

have an impact on creating a challenge in several other things including the economy, environment and society (Wafik et al., 2023).

North Lombok Regency is an area with very abundant natural wealth potential. This is very supportive of business use in the tourism sector. Some of North Lombok's tourism outlites include Gili Trawangan, Gili Meno, and Gili Air with stunning natural panoramas. In addition, there are other tourist spots that support additional destinations, namely Sendang Gile, Tiu Kelep, Sekeper, Tiu Teja, Kerta Gangga, Gangga Murmas Tree House, Chocolate Village and others. In addition to tourism potential, North Lombok Regency also has the potential for agro-tourism development. One of the villages with quite good agro-tourism potential is Genggelang Village, Gangga District.

Genggelang Village has abundant natural tourism potential. It offers interesting natural beauty, such as mountain views, beautiful forests, and waterfalls. However, geographical constraints and lack of access to information have resulted in the suboptimal tourism potential of Genggelang to reach a wider range of tourists. According to Atiko et al., (2016) that tourism can have a positive impact on the sustainability and economic progress of the community, it is necessary to have the intensity and creativity of digital-based promotion. Looking at the development of information technology, especially mobile applications and Virtual Tour web-based, Genggelang Village has the potential to increase tourist visits through a digital approach. SIGADis Application and Web Virtual Tour is proposed as an interactive and easily accessible means of tourism promotion. The SIGADis app offers complete information about tourist attractions, travel routes, and local facilities. Meanwhile, Virtual Tour web-based allows prospective visitors to explore the natural beauty of Genggelang digitally before they come to the location in person.

This digitalization is important because it can help tourists plan trips, increase the attractiveness of natural tourism, and strengthen the local economy. In addition, the existence of virtual applications and web tours also provides opportunities for local communities to be involved in technology-based tourism management. This is expected to be a solution to increase tourist visits to Genggelang as well as introduce the potential of the village to a wider market. The results of previous research and service explained that application-based tourism promotion provides benefits for producers and consumers by providing current tourism information that will be targeted (Desika et al., 2022). Mobile applications are one of the most effective strategies today to support the progress and sustainability of tourism (Yanti et al., 2024). The mobile application allows tourists to access information about travel routes, the location of tourist attractions, activity schedules, and facilities available at the destination location (Dewi et al., 2023; Nurhadi et.al, 2020). This can enhance the tourist experience and encourage tourists' decision to visit the place. Apps like SIGADis, which focuses on local tourist destinations, are in line with this need, efficiently connecting tourists with specific information about the attractions of Genggelang Village.

Meanwhile, web-based virtual tours are increasingly popular as a tourism promotion tool that can be accessed by prospective visitors from anywhere. Virtual tour Helping travellers visualize their experience at their destination, thereby increasing interest in making an in-person visit (Moniaga et al., 2022; Nihayah et al., 2023). In the context of natural tourism, Virtual Tour allowing potential visitors to explore the beauty of the location without having to be in the place, providing an initial picture that often builds enthusiasm for further visits.

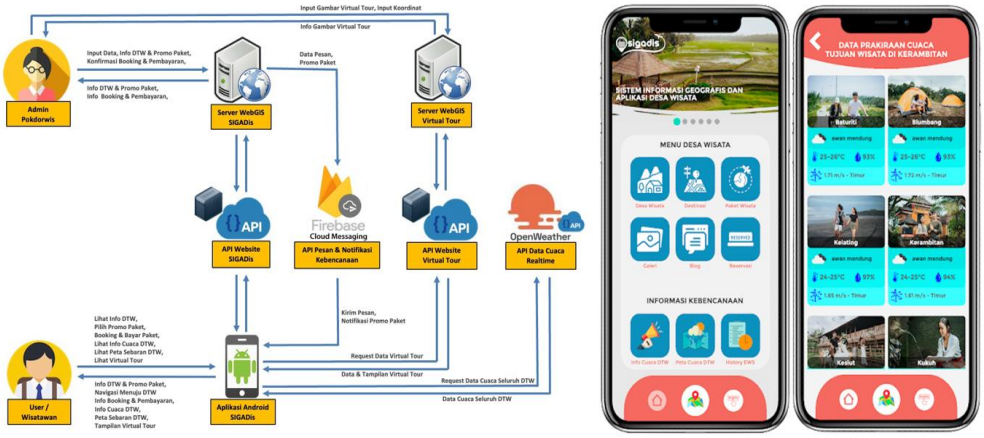


Figure 1. SIGADIs Android Architecture and Applications

The purpose of this service is to optimize the use of the SIGADis application and Virtual Tour Web in promoting natural tourism in Genggelang Village and empowering the local community to be actively involved in the tourism industry. The results of this activity are expected to support the achievement of increased tourist visits and sustainable economic growth in Genggelang Village.

2. RESEARCH METHOD

The parties involved in this Kosabangsa Program activity are 1) the implementation team (UGR), 2) the companion team (UNMAS Denpasar), 3) five students, 4) all members of the Bunga Mekar Farmers Group 5) Field Agricultural Extension from the UPTD Office of Gangga District, North Lombok Regency, and 6) the Genggelang Village Government, and NGO cooperation partners from Coastal Environmental & Fisheries. Some of the approaches taken by the implementation team in order to provide solutions to the problems faced by partners are the Knowledge Transfer approach, and Technology Transfer (TT). The work step is the first stage of socialization, at this stage the implementation team holds socialization of service activities to partners to provide an explanation of the scope of activities, the rights and obligations of group members, and post-program governance. Furthermore, the stage of implementing activities, designing and developing the SIGADis application and Web Virtual Tour. All data is collected related to tourist attractions, MSMEs, lodging facilities and others to support application features. **Transfer Technology** At this stage, the service implementation team will design and build the SIGADis application and Web Virtual Tour. **Knowledge Transfer**: The next stage will be socialization and training for members of the Gangga Murmas Tree House Pokdarwis as target partners on how to use the SIGADis application and Web Virtual Tour. **Activity Evaluation**: where at this stage it is carried out based on the improvement of the knowledge and skills of pokdarwis partner members in utilizing the SIGADis application and Web Virtual Tour which is measured using pre-test and post-test instruments.

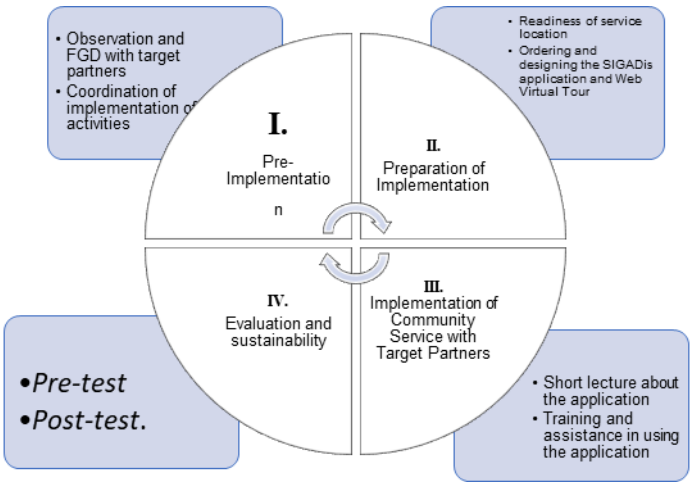


Figure 2. Stages of Community Service Activities at the Gangga Murmas Genggelang Tree House Pokdarwis

3. RELATED RESEARCH

The results of previous research and service explained that application-based tourism promotion provides benefits for producers and consumers by providing current tourism information that will be targeted (Desika et al., 2022). Mobile applications are one of the most effective strategies today to support the progress and sustainability of tourism (Yanti et al., 2024). The mobile application allows tourists to access information about travel routes, the location of tourist attractions, activity schedules, and facilities available at the destination location (Dewi et al., 2023; Nurhadi et.al, 2020). Virtual tour helping travellers visualize their experience at their destination, thereby increasing interest in making an in-person visit (Moniaga et al., 2022; Nihayah et al., 2023). Another service result explains that promotions to increase the volume of digital-based visits are still not intensively carried out by tourist attraction managers. So that tourist attractions that visitors should know about before visiting can reduce interest in tourist attractions (Yanti, 2019).

4. RESULTS AND DISCUSSION

This service was carried out in November-December 2024 located in Genggelang Village, Gangga District, North Lombok Regency. The Partner Group involved in this activity is the Gangga Murmas Tree House Tourism Awareness Group as one of the managers of the Tree House tourist destination in Genggelang Village. This Pokdarwis was established on December 3, 2022 with a total of 29 members chaired by Alan Budi Kusuma. The problem of Pokdarwis to date is that the volume of visits has decreased and even tends to be less in demand even though previously the intensity of visits was high. Therefore, the service team tried to design a mobile application in the form of SIGADis and Web Virtual Tour for online promotion.

SIGADis is a Geographic Information System and Android Application for Tourism Villages (SIGADis) with several additional features that can support business activities and tourism transactions. The goal is to support the tourism digitalization program in Indonesia. This feature includes data management for Tourism Villages, Tourist Accommodations, Tour Packages, MSMEs, as well as a reservation feature for users who want to book tour packages. SIGADis facilitates data management (insert, update, delete) and allows tourists to book tour packages and make payments. In addition, this feature is integrated with the virtual tour website of each tourist destination (DTW), allowing tourists to get an

immersive experience before visiting the location directly. This integration with virtual tours provides a 360-degree overview of the available facilities, assists tourists in planning their visits, and increases their interest and engagement. With the addition of this feature, it is hoped that it can facilitate the reservation process, help tourism village managers and related parties to monitor the development and popularity of tourist destinations, and accelerate the process of tourism digitalization. The SIGADis architecture to be built has several entities consisting of hardware, software, and brainware. As brainware, it is the operator of Pokdarwis who will add tourism potential data, news, and information on tourism promotions, and online bookings, and tourists who will get information related to DTW and tour packages. WebGIS and android applications are software entities, while hardware entities are devices used to access WebGIS or android applications, as well as servers as data processors and storage. A system architecture that describes the relationships between its entities.

The initial information done to support the SIGADis application and Web Virtual Tour collects all DTWs and then inputs them into the application. Such as tourist spots, MSMEs, lodging, local culture and so on. After the design and development of the SIGADis application and the Genggelang Village Virtual Tour Web are as follows.

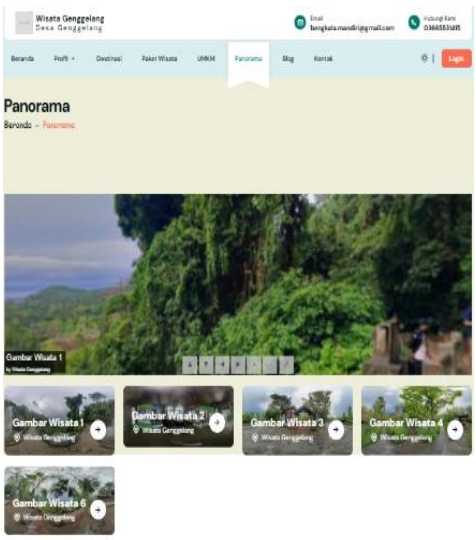


Figure 3. Web Virtual Tour Genggelang Figure

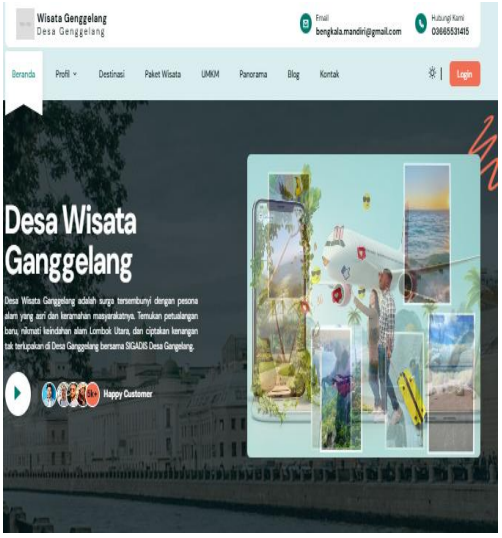


Figure 4. SIGADis Genggelang Application

Features on the Genggelang Virtual Tour Web and SIGADis Application are in the form of homepages, profiles, destinations, tour packages, MSMEs, panoramas, blogs and contacts. All of these features provide ease of hospitality and institutional governance of tourism in Genggelang Village. The hope is that visitors before going to the location can find existing tourist information. The most interesting thing about this application is that the tour package has been integrated with all tourism support sectors of Genggelang Village. So that it provides comfort and good facilities to visitors.

After designing and building the SIGADis application and the Genggelang Virtual Tour Web, training and assistance in using the application are then carried out to improve the skills and knowledge of partners in using the application. This training was carried out in the Flower Bloom Farmers group and the Gangga Murmas Tree House Tourism Awareness Group attended by all group members. According to the partner group, this application is very helpful in increasing the volume of tourism visits. Where before the earthquake and covid-19 occurred, tourism visits were very high. After the earthquake and covid-19, tourism visits dropped drastically, even more ironically, the Gangga Murmas Tree House Pokdarwis was

completely paralyzed. Meanwhile, Kampung Coco Senara is running, but the volume of visits has decreased.

With the SIGADis application and Web Virtual Tour given to partners, it is a new spirit to run and revive tourism. The most important thing in addition to the physical improvement of tourism, the most important thing is online promotion through applications so that marketing is more widespread. Visitors can immediately check the available tour packages with the views offered on the SIGADis application and the existing Web Virtual Tour. The tour packages available in the application are the result of the development of DTW Genggelang Village. From the results of training and mentoring members of the partner group, it was stated that this application is important for the development of tourism that has not been in operation for a long time. With the ease of application built, it provides technical convenience to partners. The hope is to get a high volume of visits.

The results of the Pre-Test and Post-Test of the partner empowerment level showed that the Gangga Murmas Tree House Pokdarwis had an increase in skills and understanding related to the use of the SIGADis Genggelang application and the Web Virtual Tour. The partner's ability before using the application is 50%, while after the training the level of understanding is 90%. This means that the implementing partners are skilled in using SIGADis Genggelang and Web Virtual Tour. However, further assistance is needed for further application development and partner skills.

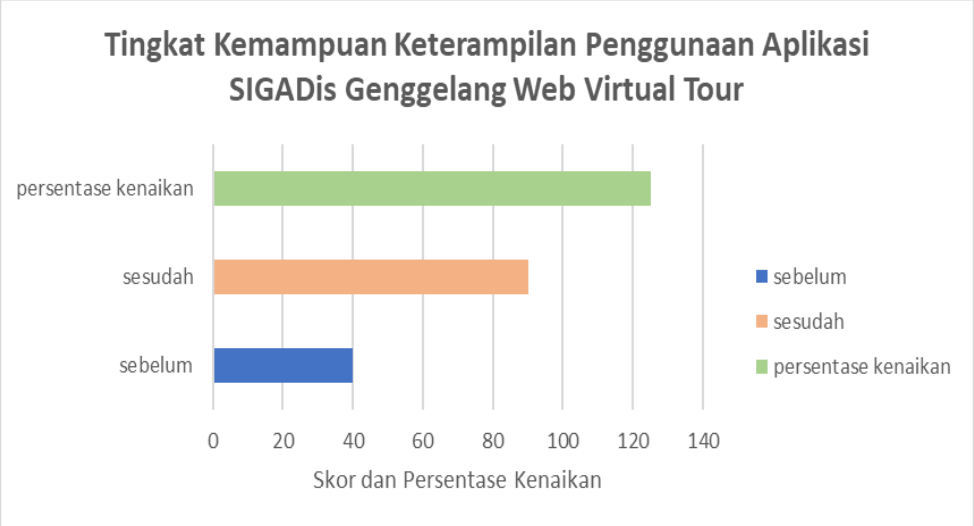


Figure 5. Results of Post Test and PreTest of Partner Empowerment Level Towards SIGADis Application and *Web Virtual Tour Genggelang*

5. CONCLUSION

SIGADis and Web Virtual Tour Genggelang is a Geographic Information System and Android Application for Tourism Villages (SIGADis) with several additional features that can support business activities and tourism transactions. The goal is to support tourism digitalization programs in Indonesia, especially Genggelang Village, Gangga District. The results of the implementation of the activity show that the design of SIGADis and the Genggelang Virtual Tour Web has been 95%, the rest is development for the sustainability of the application and the ability of partners to use the application. In terms of skills and understanding of the design, construction and operation of the SIGADis application and Web Virtual Tour Genggelang, more than 85% of the target partners understand and are skilled. However, further assistance is needed for the sustainability and development of partner group applications.

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A CNN-BASED VOICE COMMAND SYSTEM FOR SLIDE CONTROL TO ENHANCE ACCESSIBILITY FOR USERS DISABILITIES

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ABSTRACT

This study presents a robust CNN-based model for real-time voice command recognition, specifically designed to recognize "right" and "left" commands. The dataset, derived from the Speech Commands Dataset, includes audio samples augmented with additional noise, yielding hundreds of thousands of data points to enhance model performance under noisy conditions. Each audio sample, approximately 1 second in length, is transformed into a spectrogram to facilitate pattern recognition by the CNN. The model was trained over 20 epochs, achieving a training accuracy of 96.5% and a validation accuracy of 97.6%, indicating strong generalization without overfitting. Testing on real-world noisy audio further demonstrated the model's effectiveness, recording an overall accuracy of 97.7% and an AUC of 1.0 for both classes. The results underscore the model's potential for reliable deployment in noisy environments, with low false positives and rapid response times, as indicated by CPU and memory performance metrics. These findings contribute valuable insights into designing voice-controlled systems for real-world applications, especially for users in challenging auditory environments.

Keywords: *CNN, Voice Recognition, Disabilities*

1. INTRODUCTION

Presentations play a crucial role in disseminating information across diverse professional and educational settings. However, for people with physical disabilities, managing presentations can present considerable difficulties, especially when it involves direct control over devices (Lv, Poiesi, Dong, Lloret, & Song, 2022). In Indonesia, the workforce participation of individuals with disabilities has been steadily rising, with around 720,000 people entering the labor market in 2022, many of whom are involved in entrepreneurial ventures (Agnes Z. Yonatan, 2023; Cindy Mutia Annur, 2023).

Previous studies have explored various methods for developing voice-controlled systems to enhance accessibility. For instance, Muhammad Asad *et al* (Asad et al., 2018) introduced an AdaBoost-based algorithm for head movement detection, enabling hands-free control of personal computers. This system combined head movements and voice commands to facilitate interaction but primarily focused on general computer control. Similarly, Muhammad Azlan Alim *et al* (Alim, Setumin, Rosli, & Ani, 2021) developed a voice-controlled intelligent wheelchair system utilizing Raspberry Pi and Google Assistant. This system allowed users with physical limitations to navigate wheelchairs through voice commands while ensuring high accuracy and responsiveness. While these studies highlight the robustness of assistive technologies, they do not address the specific needs of managing presentation slides, especially in real-world noisy environments.

This study aims to develop a voice-command-based slide control system for presentations using Convolutional Neural Network (CNN), focusing on classifying voice commands with strong noise resilience. CNN was chosen for its ability to recognize patterns in visual data; in this case, audio data will be converted into spectrograms so that they can be analyzed as images (Peng et al., 2020). This

approach has proven effective in applications like environmental sound classification. By utilizing CNN, this system is expected to offer a more efficient and robust solution for recognizing basic voice commands such as “next” or “back” to control presentation slides. Additionally, the system is designed to operate effectively in various real-world conditions, including noisy environments, making it a more inclusive technology for individuals with physical disabilities (Xu et al., 2023).

2. RESEARCH METODOLOGY

This study develops a CNN-based slide control system using voice commands, designed to classify commands in noisy environments and assist users with physical disabilities in controlling presentations independently. The methodology includes data collection, model training, and evaluation. The Speech Commands Dataset, containing basic commands like “right” and “left” (adapted to “next” and “back”), is used, with additional noise added to simulate real-world backgrounds. Each audio file is converted into a spectrogram as input for the CNN.

2.1 Data Preprocessing

Audio files are converted into spectrograms or mel-spectrograms, visually representing frequency distribution over time for CNN analysis. Each audio sample, with a duration of 1 second, is resampled to a sample rate of 16,000 Hz. The mel spectrograms are computed using 128 mel bins (*n_mels*=128) to represent the frequency domain, while the time domain is segmented into approximately 32 frames based on a hop length of 512 samples. This results in spectrograms with dimensions of (128, ~32), representing frequency and time, respectively.
To ensure uniform size and model stability during training, each spectrogram is normalized, and an additional channel dimension is added, yielding a final input shape of (128, ~32, 1) for the CNN model. This dimensionality allows the model to effectively learn spectral and temporal features essential for accurate voice command recognition, even in noisy environments (De J. Velásquez-Martínez et al., 2023; Kumar, Renuka, & Priya, 2023; Qian, Bi, Tan, & Yu, 2016).

2.2 Model Architecture

The CNN model in this study consists of interconnected layers designed to recognize visual patterns in spectrogram data from voice commands. Each layer extracts and abstracts features for classification, as shown in the process flow in Figure 1 (Boulal, Hamidi, Abarkan, & Barkani, 2024; Lakshmi et al., 2023; Telmem, Laaidi, Ghanou, Hamiane, & Satori, 2024).

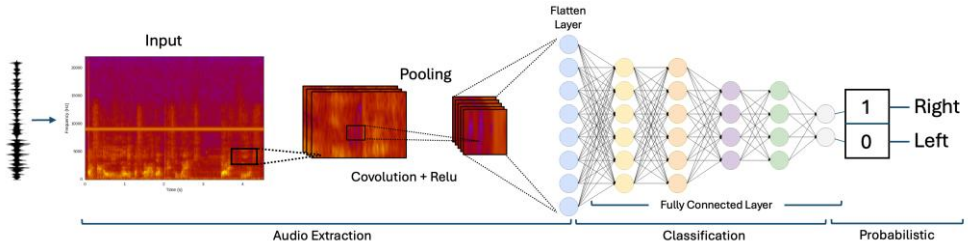


Figure 1. Model Procces

- ***Model Architecture***: The CNN model comprises interconnected layers to recognize visual patterns in spectrogram data from voice commands. Each layer extracts and abstracts features for classification, as shown in Figure 1.

- ***Convolutional Layers***: The convolutional layer applies filters to spectrogram images, extracting key patterns like frequency changes and sound intensity variations. This operation across frequency and time enables the CNN to capture unique audio features such as amplitude changes.

- ***Activation Function (ReLU)***: ReLU, applied after each convolution, introduces non-linearity by mapping negatives to zero, enhancing model convergence.

- ***Pooling Layers***: Max pooling reduces feature map dimensions and parameter count, retaining essential information while lowering the risk of overfitting.

- ***Fully Connected Layers***: The fully connected layer consolidates extracted features, linking patterns to specific classes like “next” and “back.”

- ***Output Layer (Softmax)*****:** *Softmax in the output layer converts outputs to probabilities for each class, allowing classification based on the highest probability.*

The dataset is split into training (70%), validation (15%), and testing (15%) sets, using the Adam optimizer and categorical cross-entropy loss. Early stopping is employed to prevent overfitting, and performance is measured with accuracy, precision, recall, and F1-score. To improve noise resilience, noise augmentation is applied to the training data, simulating typical background sounds (e.g., office or traffic noise), which enhances the model’s ability to classify commands accurately in real-world noisy environments.

2.3 System Implementation

The implementation of this voice recognition system begins with the collection and augmentation of voice data for two main labels, “right” and “left,” to increase data variability. The data is then converted into spectrograms to facilitate the CNN model’s ability to recognize voice patterns. Next, the CNN model is trained and evaluated using test data under different conditions (e.g., clean and noisy audio) to measure accuracy, false positive rate, error rate, and response time. The system is then tested in real-world conditions to assess performance in actual environments, including monitoring CPU usage, memory usage, and response time to ensure efficiency and reliability.

3 RESULTS AND DISCUSSION

3.1 Model Training and Validation

The data used in this study was sourced from the Speech Commands Dataset and consists of two main classes: “right” and “left.” Each audio file has an average duration of 1 second and has been augmented with additional noise, simulating real-world conditions. The noise includes common background sounds, such as office ambiance, traffic, and casual conversations, to mimic the types of auditory interference that could be present during real-world usage. This augmentation process generated tens of thousands of audio samples for each class, enhancing the model’s ability to detect voice commands even in noisy environments.

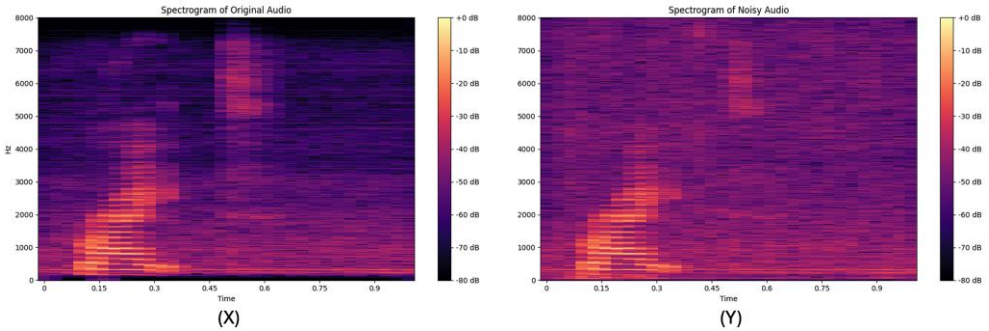


Figure 2. Audio Augmented Data Set

Figure 2 illustrates a comparison of spectrograms between the original audio (X) and the noisy audio (Y = X + Noise). The noisy version introduces additional distortions, particularly in lower and middle frequency ranges, where background noise often overlaps with the vocal frequency range.

Table 1. Data Set

Label	File Audio
Right	22301
Left	22086
TOTAL	**44387**

The CNN model was trained to recognize “right” and “left” voice commands over 20 epochs. The evaluation results demonstrate excellent performance, as detailed below:

1) Training and Validation Accuracy
The model achieved a training accuracy of 96.5% and a validation accuracy of 97.6%, as shown in Figure 3. The accuracy and loss curves indicate that the model did not experience overfitting.

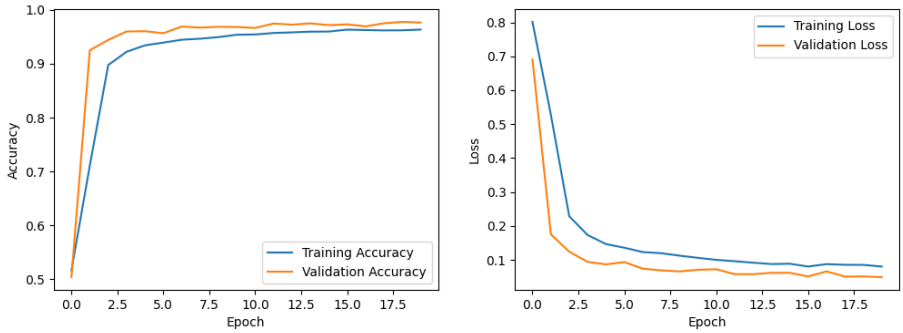


Figure 3. Accuracy and Loss Curves

2) Evaluation on Test Data
On the test data, the model recorded an overall accuracy of 97.7%. This result is supported by precision, recall, and F1-score values of 0.98 for both classes, as shown in Table 2. The Confusion Matrix in Figure 2 demonstrates that classification errors are minimal.

Table 2. Model Performance

Kelas	Precision	Recall	F1-Score
Right	0.98	0.98	0.98
Left	0.98	0.98	0.98

3) ROC
The ROC Curve in Figure 4 shows an AUC of 1.0 for both classes, indicating that the model has optimal classification capability.

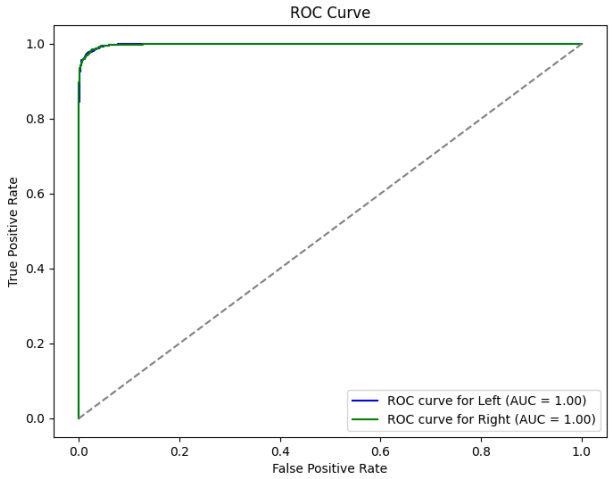


Figure 4. ROC Curve

3.2 Real-World Implementation

Each model was evaluated using 400 real-time audio samples divided into four conditions: Left Clean, Left Noise, Right Clean, and Right Noise, with 100 trials for each condition. The noise conditions were consistent with the data processing conditions and included common background sounds, such as office ambiance and traffic, simulating real-world auditory interference.

Table 3. Model Performance

Condition	Metric	CNN	RNN (LSTM)	KNN	Random Forest
Left Clean	Akurasi (%)	100.00	99.27	97.81	94.89
	False Positive Rate (%)	0.00	0.73	2.19	5.11
	Error Rate (%)	0.00	0.73	2.19	5.11
	Average Response Time (ms)	54.04	59.72	145.48	2.93
Left Noise	Akurasi (%)	96.03	94.44	88.10	82.54
	False Positive Rate (%)	3.97	5.56	11.90	17.46
	Error Rate (%)	3.97	5.56	11.90	17.46
	Average Response Time (ms)	48.70	56.50	146.99	3.00
Right Clean	Akurasi (%)	99.20	92.00	56.00	43.20
	False Positive Rate (%)	0.00	0.00	0.00	0.00
	Error Rate (%)	0.80	8.00	44.00	56.80
	Average Response Time (ms)	49.84	55.98	134.27	4.34
Right Noise	Akurasi (%)	97.60	65.60	39.20	85.60
	False Positive Rate (%)	0.00	0.00	0.00	0.00
	Error Rate (%)	2.40	34.40	60.80	14.40
	Average Response Time (ms)	49.31	51.46	136.39	3.99

The test results shown in Table 3 indicate that CNN and RNN/LSTM deliver more stable and accurate performance across various conditions compared to KNN and Random Forest. Although KNN and Random Forest achieve satisfactory results in the Left Clean and Left Noise conditions, both experience a significant performance drop in the Right Clean and Right Noise conditions. In contrast, CNN and RNN/LSTM maintain high accuracy and resilience to noise, with CNN demonstrating an advantage in response time.

This table confirms the robustness and validity of the proposed CNN model, particularly in noisy audio conditions, making it more suitable for real-world applications compared to other models. The software implementation also performs well, as shown in Figure 5, with a prediction confidence threshold set at 0.8. The application and model can be accessed and downloaded via GitHub at *https://github.com/carliapriansyahh/AI-.git.*



Figure 5. User Interface for Model Implementation

This testing also evaluates CPU performance, memory usage, and response time. The following is a summary of the highest and lowest values, as presented in Table 4.

Table 4. System Performance

Performance	CPU	Memory	Reponse Time
Highest	61%	86.1%.	354.85 ms
Lowest	25.8%	80.8%	33.88 ms

This summary indicates that CPU and memory usage show moderate variation, while response time has a wide range, suggesting an opportunity for optimization to achieve a more consistent response time.

4 CONCLUSION

In this study, a Convolutional Neural Network (CNN)-based voice recognition system was successfully developed to recognize the voice commands “right” and “left” with high accuracy, both in clean and noisy conditions. The training and validation process demonstrated that the model achieved 96.5% accuracy on the training data and 97.6% on the validation data, indicating that the model did not experience overfitting. On the test data, an overall accuracy of 97.7% was recorded, with precision, recall, and F1-score values consistently at 0.98 for both classes. Further evaluation of the system’s performance in real-world conditions revealed that the model maintained high accuracy with minimal variation in false positive rate and error rate. Additionally, the system’s CPU and memory usage showed moderate variation, with response times that still have room for improvement. The highest response time was recorded at 354.85 ms, and the lowest at 33.88 ms, suggesting potential for optimization to achieve more consistent response times.Overall, this system demonstrates robustness and adaptability across various conditions, though further improvements in reducing response time could enhance its efficiency and reliability in real-world applications. This implementation shows that the applied CNN model meets the needs of a voice recognition application for users with physical limitations, with satisfactory performance in detecting voice commands across different acoustic conditions.

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THE ROLE OF TRUST IN MEDIATING THE INFLUENCE OF PERCEIVED USEFULNESS AND PERCEIVED EASE OF USE ON REPURCHASE INTENTION IN ONLINE TRADING APPLICATIONS IN DENPASAR

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ABSTRACT

This study aims to analyze the effects of perceived usefulness and perceived ease of use on repurchase intention, with trust acting as a mediating variable, in the context of online trading applications in Denpasar. The research adopts a quantitative approach, utilizing Partial Least Squares (PLS) for data analysis. The findings indicate that both perceived usefulness and perceived ease of use significantly influence repurchase intention. These factors enhance user trust, which in turn encourages users to repurchase via online trading applications. The results suggest that online trading platforms should focus on improving the perceived usefulness and ease of use of their applications, as well as building customer trust to increase user loyalty and repurchase intention. This research contributes valuable insights for developing marketing strategies and managing customer relationships in the financial technology sector, particularly for online trading applications.

Keywords: *Perceived Usefulness, Perceived Ease of Use, Repurchase Intention, Online Trading Applications, Customer Loyalty*

1. INTRODUCTION

Significant growth in the financial sector, particularly in the capital market, has been achieved through the merging of finance and technology, resulting in investment applications that attract public attention, especially among millennials (Siregar & Nasution, 2020). Interest in investing surged dramatically during the Covid-19 pandemic, particularly among young people aged 20 to 30. This trend was driven by conditions in the Indonesian stock market that indicated a phenomenal rise in stock prices, commonly known in the industry as a rebound (Catriana & Movanita, 2020)

The number of investors in the Indonesian capital market surpassed 10 million as of November 3, 2022, according to PT Kustodian Sentral Efek Indonesia (KSEI, 2022). This growth can be attributed to increasing public awareness of investment and the digitalization of financial services. Online trading applications have become popular among investors for their ease of use, speed, and security (Yulisetiarini et al., 2024). this context, repurchase intention in online trading applications is a critical aspect, as retaining users and ensuring their continuous use of the platform for stock purchases is essential. Companies must enhance customer trust, improve service quality, ensure user satisfaction, and provide a positive user experience. This involves offering accurate information, responsive customer service, and features that increase perceived value (Nurjanah et al., 2023).

Perceived usefulness is a belief about whether a system provides benefits; individuals are more likely to use a system they find useful (Oktavia Kartikasari & Trisnawati, 2019). This belief influences repurchase intentions, as users who see tangible benefits—such as improved performance and efficiency—tend to return to the platform (Tan et al., 2021). However, (Mulyani & Rukminingsih, 2020) notes that perceived usefulness does not always directly lead to purchasing behavior, as consumers often delay decisions due to uncertainty.

Perceived ease of use, another influential factor, affects customer trust and their likelihood of repurchasing. An accessible and user-friendly online platform

encourages repeat usage (Dutta, 2016). However, (Suryani & Ramdhani, 2022) argues that ease of use alone does not guarantee repurchase intentions. Enhancing both perceived usefulness and ease of use in online trading applications can strengthen customer trust, thereby boosting repurchase intentions.

This study investigates how trust mediates the effects of perceived usefulness and ease of use on repurchase intentions in online trading applications, focusing on users in Denpasar City.

2. RESEARCH METODOLOGY

This study employs a quantitative approach with an associative research design, which aims to analyze the influence and relationships between variables (Sugiyono, 2019). The research investigates the role of trust in mediating the influence of perceived usefulness and perceived ease of use on repurchase intention in online trading applications in Denpasar. The subsequent steps involve data preparation and hypothesis testing to draw conclusions based on the research findings.

The sample size for this study is 165 respondents, selected using a non-probability sampling method, specifically purposive sampling, which involves selecting participants based on specific criteria relevant to the study (Sugiyono, 2019). Data collection was conducted through a survey method using questionnaires distributed directly by the researcher. Each questionnaire item is designed to measure respondents' attitudes, opinions, and perceptions using a Likert Scale, which assigns scores to five response options as follows:

Table 1. Respondents' Alternative Answers

Alternative Answer	Code	Score
Strongly agree	S	5
Agree	S	4
Quite Agree	N	3
Disagree	TS	2
Strongly Disagree	STS	1

(*Source:* (Sugiyono, 2019)

In a preliminary survey involving 30 respondents from Denpasar City, participants were asked about their perceptions and experiences with online trading applications. This survey included questions to assess the perceived usefulness, ease of use, and trust in these applications. The results are summarized as follows:

Table 2. Pre-Survey of Customers Using Online Trading Applications in Denpasar City

No.	Introductory Interview Questions	Agree	Disagree
1	I often use online trading applications to buy back shares.	26	4
2	I believe in using online trading applications to make stock purchases.	25	5
3	I feel the ease of use in making stock purchases again through the application.	24	6
4	The usefulness that I feel, such as making a profit, will influence my intention to buy back shares through the application.	24	6

(Source: Primary data processed, 2024)

This data demonstrates that the majority of respondents find online trading applications useful and easy to use, fostering trust and influencing their intention to repurchase stocks.

Inferential statistics were applied using Partial Least Square (PLS) analysis, a component- or variance-based Structural Equation Modeling (SEM) technique. PLS

was selected for its effectiveness in analyzing complex relationships between variables, especially latent constructs that cannot be directly measured. The SEM approach is particularly suitable for testing hypotheses and explaining the interrelationships among variables.

3. RELATED RESEARCH

The Technology Acceptance Model (TAM) is a framework used to understand how users accept and adopt technology. TAM was developed in 1986 by Fred Davis in his paper titled "A Technology Acceptance Model for Empirically Testing New End-User Information Systems." The basic concept of TAM is a framework that helps understand and predict technology adoption by users. TAM posits that technology adoption is influenced by two main factors: perceived usefulness (persepsi kegunaan) and perceived ease of use (persepsi kemudahan penggunaan) (Fitriyani & Wicaksana, 2024)

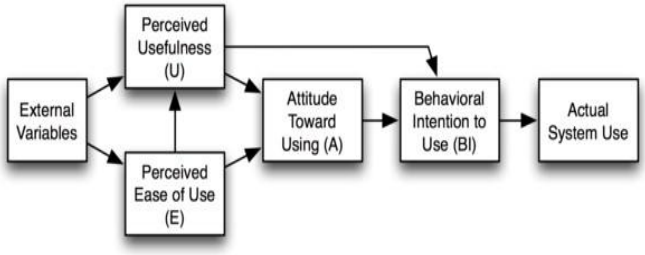


Figure 2. *Technology Acceptance Model*
Source. David et al., (1989)

Over time, the Technology Acceptance Model (TAM) has evolved to reflect the characteristics of technology, initially focused on software, but now extending to other technologies such as mobile technology, social media, the Internet of Things (IoT), and more (Prabawa et al., 2024). Additionally, according to (Miandari et al., 2021), companies in the online retail sector are increasingly targeting consumers worldwide, as both developed and emerging markets have embraced online shopping to purchase products. This shift has also changed global and specifically Indonesian consumer behavior, influencing their daily activities and interactions in new ways.

4. RESULTS AND DISCUSSION

Perceived usefulness and repurchase intention have a significant relationship. According to (Daffa & Praswati, 2023), when consumers receive useful information from online shopping services that increase their knowledge of the product, this increases the intention to repurchase. When using online shopping sites, people look for benefits such as time efficiency, quick access to the site, and ease of purchasing products (Faradila & Soesanto, 2016). Perceived usefulness positively affects repurchase intentions because if consumers feel that online shopping applications provide benefits, they are encouraged to continue shopping online (Laora et al., 2021). This is in line with the research of (Tan et al., 2021) which states that the perceived usefulness of online shopping services increases the likelihood of users to repurchase.

Perceived ease of use also has an important role in repurchase intentions. (Chandra & Santoso, 2022) found that people are more likely to buy products when they feel comfortable and easy to use the application. If a site provides a clear transaction flow guide, from ordering to product delivery, this encourages users to shop online (Udayana & Ramadhan, 2020). Ease of use is a key factor influencing online purchasing behavior, such as searching for product information and completing transactions (Pangestu & Setiyaningrum, 2023). Consumers who find shopping online easy (perceived ease of use) tend to have the intention to buy again online (Nurmalia & Wija, 2018).

Perceived usefulness is also related to trust. According to (Daffa & Praswati, 2023), perceived usefulness is based on the extent to which customers believe that e-commerce sites will provide facilities for shopping for brands. Perceived usefulness has a significant positive influence on trust. The greater the perceived usefulness, the higher the trust in using technology (Aryani et al., 2018). (Wati et al., 2024) state that the greater the perceived benefits of a product or service, the higher the trust in the product or service. Technology that increases value, efficiency, and company performance builds trust among customers (Nurjanah et al., 2023)

Perceived ease of use also affects trust. Perceived ease of use is an important variable for online businesses because it affects customer trust (Dachyar & Banjarnahor, 2017). When customers find websites easy to understand and navigate, trust is built (Putri & Iriani, 2021). Easy-to-use technology indicates a high-quality product, and the simpler a technology is to use, the greater the trust in it (Syahrina & Christiana, 2023). Perceived ease of use has a significant positive effect on trust, so that increasing ease of use directly increases customer trust (Kurniawan et al., 2022).

Trust affects repurchase intentions in e-commerce. According (Uviyanti et al., 2022), the higher the level of trust, the more likely someone is to repurchase. Trust is a positive expectation of future online shopping behavior, which contributes to long-term relationships between customers and sellers (Asri et al., 2022). High trust in a site, which is built through accurate information and services, encourages customers to repurchase and increase customer loyalty (Suleman et al., 2021). (Alfian et al., 2023) also found that trust significantly affects purchase preferences. The higher consumers' trust in online shopping sites, the more likely they are to repurchase.

Trust also acts as a mediator between perceived usefulness and repurchase intention. According to (Keni, 2020), the greater the perceived usefulness of an electronic system or technology, the less uncertainty of the transaction, thereby increasing trust between the parties involved and encouraging repurchase intentions. Trust acts as a positive and significant mediator between perceived usefulness and repurchase intentions (Nurjanah et al., 2023). (Sawitri, 2023) also stated that trust mediates the relationship between perceived usefulness and online repurchase intentions. The benefits perceived by consumers directly affect repurchase intentions, with trust as a mediator (Fauzi, 2021)

Trust also mediates the relationship between perceived ease of use and repurchase intentions. Trust partially mediates the relationship between perceived ease of use and repurchase intentions in e-commerce (Uviyanti et al., 2022). A high level of trust in the ease of use of a platform like Shopee increases the likelihood of repurchase intentions (Miandari et al., 2021). According to (Yudiarti & Puspaningrum, 2022), trust positively and significantly influences online repurchase intentions through perceived ease of use. When consumers find it easy to shop, this builds trust which then increases repurchase intentions (Deborah, 2019).

5. CONCLUSION

The conclusion of this study shows that perceived usefulness and perceived ease of use have a significant influence on repurchase intentions through the mediation of trust. Perceived usefulness and ease of use of e-commerce applications directly increase consumer trust, which in turn encourages loyalty and repurchase intentions. Trust plays an important role in reducing transaction uncertainty and building long-term relationships between consumers and service providers. Therefore, the development of online shopping applications should focus on increasing perceived benefits and ease of use to strengthen user trust. E-commerce service providers should continue to enhance relevant features and provide clear guidance on transaction flow. In addition, it is important to provide responsive customer service and maintain data security to maintain customer trust. Further research can explore additional factors such as user experience and service personalization to better understand online consumer behavior

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UNDERSTANDING SOUND DESIGN AND FILM SCORING THROUGH A HERMENEUTIC APPROACH

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ABSTRACT

In film, sound design and scoring are often seen as merely complementary to the visuals. Due to the highly technical manipulation of sound, it is often assumed to be a purely technical element. However, sound is an integral part of human life and reality, also carries its own impression and meaning. Gadamer's philosophical hermeneutics offers a potential framework for interpreting the broader and richer meanings of sound in film. In addition, Murray's soundscape theory, which posits that sound is an integral part of the environment, supports this view. Through the approaches of hermeneutics and soundscape theory, the study of sound in film can be divided into three perspectives: (1) sound as a common understanding, (2) sound in the context of film, and (3) the subjective (biased) meaning of sound as perceived by the audience. The philosophical hermeneutic aims to consider sound design and music in film not just as technical elements, but as media rich in symbolic, emotional, and narrative meaning. This study is qualitative and uses an exploratory method. The exploration is based on Gadamer's hermeneutics and Murray's soundscape theory.

Keywords: *Sound, Sound Design, Music Scoring, Hermeneutics, Film*

1. INTRODUCTION

Hermeneutics, a branch of the philosophy of interpretation, has been widely applied to various fields of art and literature. However, in the field of sound - which includes sound design and film scoring as elements that shape emotions - it is rarely interpreted by audiences. Philosophical hermeneutics offers an opportunity to deepen our understanding of sound beyond its technical aspects. Through a hermeneutic approach, audiences can construct an emotional narrative by integrating the context of the film with their personal perceptions. These perceptions are shaped by the individual's life processes, experiences and environment (subjective), not just by common interpretations (objective).

The construction of understanding within a framework of emotional narrative, historical context and personal perception can be achieved through Gadamer's philosophical hermeneutics. This approach opens possibilities for considering sound in film as a language or text, rich in symbols, emotions, and meanings.

2. RESEARCH METODOLOGY

This research uses film elements that incorporate sound design and film scoring as subjects of study. Primary literature sources include R. Murray Schafer's work on soundscape and Hans-Georg Gadamer's philosophical hermeneutics. The application of philosophical hermeneutics, as proposed by Gadamer in his book

"Truth and Method" (Gadamer, 2013), allows for the interpretation of the meaning behind artistic elements. This approach allows us to understand that sound is not just a technical matter, but also involves the realities of human life.

Similarly, R. Murray Schafer's work*, "The Soundscape: Our Sonic Environment and the Tuning of the World"* (Schafer, 1994), sees sound as an integral, inseparable part of the environment that shapes the audience's perception and experience. Schafer explores the concept of soundscape and how sound influences human perception of the environment. He sees sound as an environmental element capable of shaping human perception and experience, similar to the role of sound design in film. This research examines how soundscape in film immerses audiences in a narrative experience, guiding them emotionally and shaping their interpretation of scenes.

This study uses an exploratory research method that applies Gadamer's hermeneutic philosophy. The exploratory method relies on the imagination of the researcher (Mudjiyanto, 2018), in which sound elements are analogised to language. This assumes that sound elements in sound design and music scoring are expressions of emotions, similar to words that convey the realities of life. A crucial aspect of this research is personal perception and context, which can serve as tools for interpreting sound, in line with Gadamer's philosophical hermeneutics.

3. RELATED RESEARCH

A French film theorist and composer named Michel Chion introduced the concept of "audio-vision". Chion's work explores the relationship between sound and image. His book *"Audio-Vision: Sound on Screen*" (Chion, 1994), discusses the roles of diegetic, non-diegetic and acousmatic sound, emphasising that sound in film is not merely added to the visual; rather, each sound can create a sensory experience and carry new emotional meaning for the audience. However, the book places less emphasis on the philosophical hermeneutics that allow viewers to personally interpret music and sound.

Claudia Gorbman, in her book *"Unheard Melodies: Narrative Film Music"* (Gorbman, 1987) presents a semiotic approach to understanding music in film. She explores how film music functions as a text that helps the audience interpret narrative meaning. Gorbman also examines how the conventions of classical Hollywood film music can be deciphered. Through semiotic interpretation, audiences are assisted in their search for meaning within the film's narrative.

An article titled Ideology in the Film *"Uang Pannai Mahal from a Hermeneutic Perspective by Habermas"* highlights an effort to understand the ideology of the Bugis-Makassar community through a qualitative descriptive method (Herlina & Rasyid, 2019). In this study, Habermas' hermeneutic approach is applied to examine how the Bugis community perceives dignity *(siri)* and *uang pannai* through film. However, this study does not use the hermeneutic approach suggested by Gadamer.

Another study that uses hermeneutics to analyse sound is *"The Interpretation of the Lyrics "New Generation" by The S.I.G.I.T. in Schleiermacher's Hermeneutic Perspective"*. Wati Purnama Sari explains that the song "New Generation" uses declarative statements to highlight issues of poverty and education through sarcasm and hyperbole (Sari, 2023). The lyrics reveal a sense of disappointment on the part of the songwriter. This study adopts Schleiermacher's hermeneutic approach and categorises the interpretation into grammatical and psychological interpretation.

4. RESULTS AND DISCUSSION

In Aesthetic Theory, translated by Robert Hullot-Kentor, Theodor W. Adorno posits that art represents an antithesis to social conditions, yet it cannot be directly translated to fit existing social contexts (Adorno, 2002). This suggests that art necessitates a comprehensive and nuanced interpretation. Similarly, sound and music scoring have the potential to exist as autonomous forms of art. The social and personal contexts of a film's audience can exert an influence on their interpretation of the film's sound and music.

Gadamer, a student of Heidegger, offered a novel interpretation of hermeneutics that differed from those put forth by his predecessors Schleiermacher and Dilthey. In his work, F. Budi Hardiman outlines Gadamer's objective to liberate his hermeneutics from the constraints of prior interpretations, thereby reinvigorating it for application within the social and human sciences (Hardiman, 2015). He introduced the concept of the "fusion of horizons," which entails the integration of the interpreter's perspective with the historical context of the work.

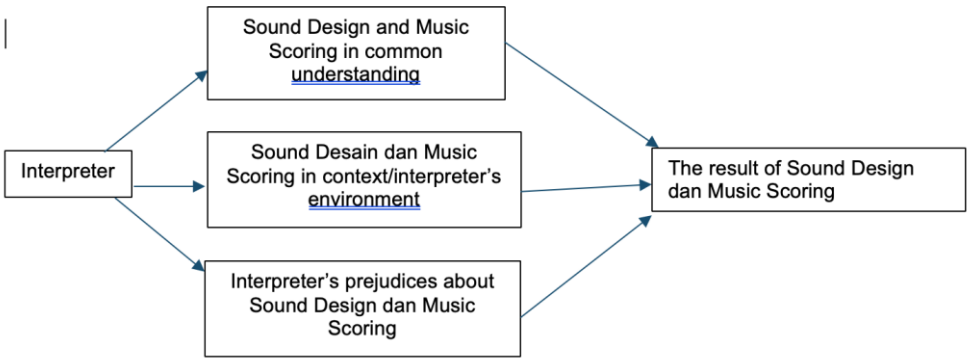


Figure 1. Interpretation scheme based on Gadamer's Hermeneutic and Schafer's Sound Theory

The philosophical hermeneutics proposed by Gadamer can be applied to the interpretation of sound design and music scoring, which allow for subjective interpretation. Gadamer permits interpreters to contribute their own preconceptions while also considering established interpretations and contextual factors. The following is a schematic of Gadamer's hermeneutic framework for interpreting sound, which is closely aligned with Schafer's view of soundscape as an integral part of the environment.

In this framework, the experience of sound is conceptualised as a language or text that can be interpreted based on a universal consensus. Furthermore, the interpretation of sound is contingent upon the narrative context or the environmental context of the interpreter. Concurrently, the interpreter is empowered to incorporate their subjectivity or preconceptions, shaped by personal experiences, into their interpretation. The role of sound can be described as follows:

4.1 Hermeneutics and Sound Design

a. Sound Experience as Language

The role of sound in film is not merely to enhance realism; rather, it can convey symbolic meaning that is open to interpretation by the audience. For instance, the sound of a ticking clock in a tense scene may symbolise the passage of time, anxiety, or an impending threat. In hermeneutics, each sound can be regarded

as a form of 'text' open to interpretation, where certain sounds evoke profound cultural or emotional contexts.

b. Contextualisation of Sound

The hermeneutic approach underscores the significance of contextualisation in comprehending meaning. In the field of sound design, the manipulation of sound can be used to create a specific ambience and to influence the emotional responses of the audience. The effectiveness of this approach is contingent upon the context of the film in question. To illustrate, the sound of trickling water may evoke disparate meanings in a scene of character reflection as opposed to one depicting a natural disaster. The meaning perceived by the audience is contingent upon the narrative context.

c. Dialogue between Audience and Sound

Furthermore, hermeneutics elucidates the significance of prejudices or preconceptions in interpretation. It is erroneous to assume that audiences enter a film with a blank slate; they inevitably bring their own experiences, culture, and knowledge to their film experience. For example, the sound of rain may evoke nostalgia or calmness, depending on the audience's personal experiences. This illustrates that sound interpretation is always subjective and shaped by social and psychological factors.

4.2 Hermeneutics and Film Music

As an emotional enhancer in film, music acts as part of the narrative, providing emotional context to specific scenes. Melancholic music in a farewell scene, for example, creates a dialogue between image and sound, guiding the audience to understand the emotional intensity of the moment. Hermeneutics allows us to see how music 'speaks' to the audience, adding layers of interpretation that are not directly conveyed through dialogue or visuals. Film music can be seen as a form of text that conveys the emotions of the events in the film.

a. Musical intertextuality

Film music often refers to previous genres, styles or compositions, creating a rich intertextuality. Audiences respond to film music based on their familiarity with these references. For example, classical music in a battle scene can create an ironic contrast, adding complex meaning by juxtaposing musical tradition with the violence on screen. Hermeneutics helps us to understand how music works as a "text within a text", building visual depth within the film.

b. Ambiguity and musical interpretation

Music often conveys messages that are ambivalent or ambiguous. Hermeneutics encourages the audience to actively interpret musical compositions. Viewers are free to interpret the relationship between musical elements and emotions within the narrative, with interpretations varying according to individual and cultural backgrounds. This creates a unique viewing experience, allowing each viewer to engage with the film in their own way.

5. CONCLUSION

Gadamer's philosophical hermeneutics allows the audience the freedom to openly interpret the film. Key aspects to consider in this interpretive process include: (1) the

meaning of sound design and film scoring (sound) within the narrative or cultural context of the film, (2) the meaning of sound design and film music (sound) within a general understanding, and (3) the subjective meaning of sound design and film music influenced by each viewer's individual background.Philosophical hermeneutics shows that sound design and film music not only serve technical purposes, but also act as symbolic media that enrich the meaning, narrative and emotion of film. Sound and music are not merely supplementary elements, but integral parts of the audience's cinematic experience, allowing viewers to engage in an open dialogue with the sounds within a film.Hermeneutics creates a space to understand how sound design and scoring in film are not only representations of reality, but also fields of interpretation where meaning continues to expand indefinitely. This expansion occurs through the complex interaction between sound, music, visuals, and the audience's experience.

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BUSINESS STRATEGY FORMULATION AND ITS IMPACT ON DIGITAL MARKETING (CASE STUDY ON WARUNG PETANI'S AND CATERING)

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ABSTRACT

Warung Petani's and Catering is a restaurant located in the Karangasem area which was built with the concept of simplicity, namely a restaurant that prioritizes simple dishes with high quality. This restaurant has experienced a decline in the number of visits in recent years but always trying to survive amidst quite tight competition. This business needs to analyze the threats, opportunities, strengths and weaknesses that exist to deal with the problem of decreasing number of visits. This study aims to design a business strategy by analyzing the internal and external environmental conditions of the Warung Petani's and Catering business. Located on Jl. Veteran, Padang Kerta Village, Karangasem District, Karangasem Regency. The analysis technique used is the IFAS-EFAS Matrix. The results of the study indicate that the company's current business strategy is in quadrant V. This means that the company's correct business strategy to implement is the hold and maintain strategy by means of market penetration and product development.

Keywords: *Internal Eksternal Matrix (IE), Business Strategy, Market Penetration, Product Development, Digital Marketing*

1. INTRODUCTION

Indonesia has abundant natural resources in the plantation and agricultural sectors; these two sectors are the main gateways to the primary human needs sub-sector, namely food (Hutabarat, 2015). Culinary businesses have now emerged in society: various types of food and beverage businesses are increasingly popular among start-up businesses (Erwin et al.,2023). The development of culinary businesses has also increasingly created a tight competitive space for culinary business actors, thus requiring business actors to be more flexible and sensitive to various changes (Nasution et al., 2021). Culinary businesses that emerge from society, in addition to requiring a solid development strategy in order to survive, must also follow current trends to innovate.

Table 1. Number of Eateries/ Restaurants in Karangasem Regency 2020-2023

Year	Number of Restaurants
2020	113
2021	125
2022	127
2023	157

Source : BPS Statistics Karangasem Regency

The table above shows the increase in culinary businesses in Karangasem which can be seen from 2020-2023. This is a concern for entrepreneurs engaged in the culinary field. The development of the area has brought significant changes in the food and beverage industry, especially in terms of ideas and creations. The emergence of various new foods with unique and innovative names encourages

competition between producers to present competitive products and meet consumer needs. In addition, Bali, which is a tourism area, is closely related to culinary businesses. In the global tourism industry, culinary tourism is an important aspect, especially in the current era, because tourists are increasingly interested in experiencing and exploring the culinary richness of an area (Veronica & Facrureza, 2024). Culinary businesses indirectly encourage the development of culinary tourism, which can be a unique feature of a region. Culinary-related tourism not only considers food as its subject and medium but also uses it as a goal and means to encourage the growth of regional tourism.

Warung Petani's and Catering is one of the companies engaged in the culinary field located in Karangasem Regency. Warung Petani's and Catering was established in 2015 and has developed a business that was initially only a restaurant, but is now also engaged in catering and new restaurant branches. Warung Petani's and Catering and many companies in the culinary field Post Covid-19 experienced a drastic decline in sales. During the recovery period, now many new culinary business entrants have started to. This is a special concern for Warung Petani's and Catering.

Tabel 2. Number of visits to Warung Petani's and Catering

Year	Number of visits
2018	25.920
2019	18.640
2020	7.200
2021	11.520
2022	14.400
2023	17.550

Source : Processed Data Manager

The data above shows a decrease in the number of visits from 2018-2020 and an increase in 2021-2023, but this increase has not reached the highest point of the number of visits in the previous year. The usefulness of determining a business strategy in facing competition is to form and implement strategic steps that can improve the company's competitive position among its competitors, and can influence the company's long-term development (Kaban, 2017). The purpose of this study is to determine the IE position of Warung Petani's and determine the right strategy to face this position in developing and implementing consistent and efficient operational standards.

2. RESEARCH METODOLOGY

This study uses a conceptual approach to strategic management with the research object being the business strategy of Warung Petani's and Catering. The research method uses a qualitative descriptive method that is useful for solving actual problems and focusing on real problems. Based on the need to determine the strategy business development, EFE (External Factor Evaluation) and IFE (Internal Factor Evaluation) matrices can be effective alternative tools (Alamanda et al, 2019). Data collection is done by direct observation, interviews, and literature studies. respondents in this study were the owner and manager of Warung Petani's and Catering. In formulating strategies using the IFE matrix consisting of strength and weakness factors and the EFE matrix consisting of company opportunity and threat factor. Using IFE and EFE matrix can be one way to determine the right strategy in dealing with conditions based on the company's internal and external factors (Saputra & Alamsyah, 2023).

The decision to choose the best strategy is based on the results of the IE matrix analysis as in Table 2.

Table 3. IE Matrix Table

		IFE		
		Strong 3,0-4,0	Average 2,0 – 2,99	Weak 1,0 – 1,99
EFE	High 3,0 – 4,0	I Growth & Build	II Growth & Build	III Hold & Maintain
	Medium 2,0 – 2,99	IV Growth & Build	V Hold & Maintain	VI Harvest or Divest
	Low 1,0 – 1,99	VII Hold & Maintain	VIII Harvest or Divest	IX Harvest or Divest

Source : David *et al*., (2020:207)

3. RELATED RESEARCH

The parameters used are the company's internal parameters and external influences faced by the company. The purpose of using this model is to obtain a business strategy. According to Nawawi (2017:175) the internal matrix carried out by analysis and evaluation is useful for determining the strengths and weaknesses of resources within the organisation so that they have an impact on organizational performance. The external matrix carried out by analysis and evaluation, however, is to determine opportunities that can be utilised, and threats that must be overcome against operational, national, and global environmental conditions that are predicted as initial ideas that have a direct and/or indirect relationship to company performance.

There are several alternative strategies that can be used by companies according to David *et al* (2020:158), namely: Integration Strategies, Intensive Strategies, Diversification Strategies and Defensive Strategies. Company strategy is the company's marketing goals and objectives combined into one comprehensive plan to: increase sales, create sustainable growth for the company, understand what customers want, meet needs and exceed customer expectations, and strengthen relationships with target customers (Pandey *et* al., 2023).

Digital marketing is the application of the internet and related digital technologies to traditional communication methods to achieve marketing goals (Widodo & Oktarina, 2023). Social media and digital technology provide many new opportunities for marketers or sellers to verify marketing mix strategies, develop new channels, create new market positions, build relationships to increase innovative steps, overcome distance and time barriers, and provide access to products and services instantly and continuously. Digital marketing has revolutionized business practices globally, particularly in reaching and engaging consumers through various online platforms (Olugbenga, 2024)

4. RESULTS AND DISCUSSION

The analysis conducted in the internal environment examines the factors that exist in Warung Petani's and Catering, namely the strengths and weaknesses presented in Table 4.

Table 4. IFE Matrix of Warung Petani's and Catering

Strategic Internal Factor	Currently (2024)			The Future (2025-2029)		
	Weight	Rating	Score	Weight	Rating	Score
Strength						
Owner are directly involved in the day to day management process	0,13	4	0,52	0,13	4	0,52
Uniqueness of taste and presentation of food	0,12	3	0,36	0,13	3	0,39
Comfortable and relaxed atmosphere in enjoy food	0,11	4	0,44	0,12	4	0,48
The variety of menus offered	0,11	3	0,33	0,12	4	0,48
Adequete facilities for carry out the event	0,09	3	0,27	0,10	3	0,30
Using a system to manage company finances	0,09	3	0,27	0,12	3	0,36
Sub Total	**0,65**		**2,19**	0,72		**2,53**
Weakness						
Promotion is not optimal	0,13	1	0,13	0,07	2	0,14
Unable to apply time management	0,11	1	0,11	0,10	1	0,10
Limited number and capabilities of employees	0,06	2	0,12	0,04	1	0,04
Inadequate parking space	0,05	2	0,10	0,07	2	0,14
Sub Total	**0,35**		**0,46**	0,28		**0,42**
Grand Total IFE Matrix	1,00		**2,65**	1,00		**2,95**

Source: Processed data, 2024

The biggest weakness faced by Warung Petani's and catering is a promotion that is not optimal. Promotion has the highest score, which is 0.13. In this case, Warung Petani's and Catering are still not able to carry out the right marketing strategy. Limited team capabilities in implementing marketing strategies, advertising and promotion of Warung Petani's and Catering are still lacking. This is in line with the findings of Subaktilah *et* al., (2018), where the lack of promotion and marketing reach is an internal weakness in Bumi Asih SMEs. In Predictions for 2029, Warung Petani's biggest weakness are suboptimal promotion and inadequate parking space, namely 0.14.

The analysis conducted in the external environment examines the key factors that exist, namely opportunities and threats.

Table 5. EFE Matrix of Warung Petani's and Catering

Strategic External Factors	Currently (2024)			Future (2025-2029)		
	Weight	Rating	Score	Weight	Rating	Score
Opportunity						
The development of the tourism industry in Karangasem	0,14	4	0,56	0,14	4	0,56
There is cooperation with agencies and offices	0,14	3	0,42	0,14	4	0,56
Well- established relationships with suppliers	0,13	4	0,52	0,13	4	0,52

There is support the government in mentoring and training	0.11	3	0,33	0,11	3	0,33
Sub Total	**0,52**		**1,83**	**0,52**		**1,97**
Threats						
New Competitors in the culinary business	0,14	2	0,28	0,14	1	0,14
Rapidly changing trends in the culinary industry	0,14	1	0,14	0,12	2	0,24
Fluctuating raw material prices	0,13	1	0,13	0,11	2	0,22
There are changes in regulations or government policies that are not beneficial for managers	0,07	2	0,14	0,11	2	0,22
Sub Total	**0,48**		**0,69**	**0.48**		**0,82**
Grand Total EFE Matrix	**1,00**		**2,52**	**1,00**		**2,79**

Source : Processed data, 2024

Based on table 5, the EFE matrix value is obtained which can be used to determine the opportunities and threats that can be used to formulate the business strategy of Warung Petani's and Catering. According to Hutahaen et al., (2017) if the EFE value is more than 2.5, the company or organization has a high response in responding to external opportunities and threats. The biggest opportunity for Warung Petani's and Catering is the development of the tourism industry in Karangasem with the largest score of 0.56. This opportunity has the potential to increase visitors to Warung Petani's and Catering. Meanwhile, in 2029, Warung Petani's and Catering has great opportunity considering the rapid development of the tourism industry in Karangasem and the existence of cooperation with office institutions. The largest score value, namely 0.56.

The biggest threat to Warung Petani's and Catering is the presence of new competitors in the culinary business with a score of 0.28. This requires the management of Warung Petani's and Catering to think about the right business strategy to achieve competitive advantage. While it is predicted that in 2029, Warung Petani's and Catering will have the biggest threat, namely rapid changes in trends in the culinary industry with a score of 0.24.

Table 6. Company Position and Strategy Options in 2024 and 2029

		IFE		
		Strong	Average	Weak
		3,0-4,0	2,0 – 2,99	1,0 – 1,99
EFE	Tall	I	II	III
	3,0 – 4,0	*Growth & Build*	*Growth & Build*	*Hold & Maintain*
	Currently	IV	V	VI
	2,0 – 2,99	*Growth & Build*	*Hold & Maintain* (2,65 ; 2,52) (2,95 ; 2,79)	*Harvest or Divest*
	Low	VII	VIII	IX
	1,0 – 1,99	*Hold & Maintain*	*Harvest or Divest*	*Harvest or Divest*

Source : David et al., (2020:207)

Based on the IFE and EFE matrix tables, the IFE scores are known as well. The EFE in 2024 is located in the medium quadrant with a quarter value between 2.0 to 2.99 which can then be used to formulate a business strategy that can be a reference or guideline for companies to run their businesses in the future; thus the hold and maintain strategy and the position of the future Warung Petani's and Catering business in 2029 is still in the same position, namely in quadrant V with a quarter value between to 2.99 which means it is still in Hold and Maintain.

These results are in line with research conducted by Mahfud & Yogiana (2017), Heningnurani (2019), Qanita (2020).

The IFE and EFE matrices that have complete weight values can be combined into the IE Matrix so that the position of Warung Petani's and Catering can be known. Based on this, the right strategy to be carried out by Warung Petani's and Catering in quadrant V is Hold and Maintain business strategies that can be carried out such as Market Penetration and Product Development strategies. Referring to these results, Warung Petani's and Catering should try to carry out several business strategies as follows:

1) Market Penetration is a market penetration strategy that seeks to increase market share for existing products or services in the current market through greater marketing efforts (Suhendah et al, 2022). This strategy is widely used alone or in combination with other strategies. Market penetration includes increasing the number of sales forces, increasing advertising expenditures, offering extensive sales promotions or increasing publicity efforts

   Things to do at Warung Petani's and Catering :

   a. Increase promotion through social media such as Instagram, Facebook, Tiktok and create a website.
   b. Hold promotions in the form of discounts on food purchases.
   c. Collaborate with travel agents and companies to expanding the market share of foreign tourists.
   d. Recruiting qualified workers to manage the restaurant

   Rai and Chauhan (2023) said thet technological advancements, businesses are increasingly incorporating digital marketing strategies to broaden customer reach and enhance sales. Digital marketing significantly expands market reach by allowing businesses to connect with a global audience. The internet's vast and borderless nature means that businesses are no longer confined to their local markets (Olugbenga, 2024). The digital marketing strategies that can be implemented are as follows:

   a. Paid Ads: using advertising platforms such as Google Ads, Facebook Ads, or Instagram Ads to reach a wider audience.
   b. SEO (Search Engine Optimization): optimizing a website to make it easier to find from Google search results
   c. Email Marketing: sending newsletters or special offers to existing customers to encourage more or more frequent purchases. Especially to offices and travel communities.
   d. Referral Program: encourage existing customers to recommend a product to friends or family in exchange for incentives, such as discounts or free products.

2) Product Development is a strategy that seeks to increase sales by improving or modifying existing products or services. Product development usually requires large research and development (R&D) expenditures.

   Thing to do at Warung Petani's and Catering:

   a. Innovating in creating food menus
   b. Using alternative raw materials in managing cooking and drinks
   c. Offer a seasonal food menu to attract customers

   The expansion of traditional marketing with digital marketing tools dramatically facilitates the task of exploring a new product, studying demand and promoting an innovative product (Robul et al, 2020). The digital marketing strategies that can be implemented areas follows:

   a. Collaboration with Food Bloggers and Influencer Marketing: in introducing a new menu, restaurants can collaborate with food bloggers and influencers who have a large relevant audience.
   b. Content Marketing : Warung Petani's Restaurant and Catering can create content such as videos or articles that show the process of

creating new menus or the ingredients used to ensure the quality and uniqueness of the product.

5. CONCLUSION

The main strength of Warung Petani's and Catering's strategy is the owner who is directly involved in the daily management process. Warung Petani's and Catering has a relatively good strategy to anticipate internal weaknesses and maximize existing strengths. Warung Petani's and Catering is able to overcome existing threats and is able to maximize the potential opportunities that exist. In the current IE matrix (2024) and the future (2025-2029), it is known that Warung Petani's and Catering is located in quadrant V, namely Hold and Maintain, which means that the company is in a period of growth and is able to make optimal efforts.The right business strategy for a company to implement is the Hold and Maintain strategy by means of market penetration and product development. Steps that can be taken the future is to increase promotion on social media, collaborate with travel agents and companies to expand market share, recruit qualified workers, innovate in creating new food menus, use alternative raw materials and offer seasonal food menus. In addition, it can also carry out digital marketing strategies with paid advertising, SEO, Email Marketing, referral programs, collaboration with food vloggers and content marketing. By integrating digital marketing with market penetration and product development strategies, Warung Petani's and Catering can expand its reach and introduce new products effectively.

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OPTIMIZATION OF C.45 ALGORITHM WITH SPLITTING METHOD FOR TODDLER NUTRITION CLASSIFICATION

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ABSTRACT

Toddler nutritional health is a critical aspect of community development, yet Indonesia continues to face significant challenges in this domain. Posyandu Manukaya Village, a village-level community health service unit, struggles with identifying toddler nutritional status due to manual record-keeping. This study addresses the issue by applying the C4.5 algorithm to classify toddler nutritional status using data from the Tampaksiring I Health Center, comprising a clean dataset of 970 entries. The research adopts the CRISP-DM (Cross Industry Standard Process for Data Mining) framework, with tailored stages including data preparation, model training, and evaluation using confusion matrix. The study identified weight (BB) as the most influential attribute for classification. Among the three attribute separation methods tested, Gain Ratio achieved the best accuracy of 89%, followed by Information Gain at 88%, and Gini Index at 86%. The resulting model was integrated into a simple website using Flask and Joblib, enabling early detection of toddler nutritional status. This research demonstrates the potential of integrating machine learning into public health initiatives and provides a strong foundation for enhancing toddler health monitoring at Posyandu Manukaya Village. Future research should use larger, balanced datasets and more attributes to enhance the model and support early toddler health interventions.

Keywords: *Nutritional status of toddlers, data mining, classification, C4.5 algorithm*

INTRODUCTION

Nutritional health in toddlers is an important aspect of community life. Inadequate nutrition in toddlers can have negative consequences for their growth and development, including intelligence and physical health (Ginting et al., 2022). Therefore, nutritional care for infants and children is a must to prepare a healthy, intelligent, high-quality generation, and reduce mortality rates in infants and children (Marniati, 2021). However, in Indonesia, the problem of nutritional health in toddlers is still a worrying issue. The results of the 2022 Indonesian Nutrition Status Survey (SSGI) showed a prevalence of stunting of 21.6%, wasting 7.7%, underweight 17.1%, and overweight 3.5% (Kementerian Kesehatan RI, 2016). These data indicate the need for further attention to steps to improve the nutritional status of toddlers in Indonesia. Providing counseling and weighing toddlers is an important step to provide information to parents about toddler nutrition and health. This aims to increase toddler resistance to disease. Efforts to improve nutritional status throughout life, especially for infants, toddlers, adolescent girls, and pregnant and lactating mothers, are regulated in Article 142 of the Health Law of the Republic of Indonesia Number 36 of 2009 (Republik Indonesia, 2009). The government is responsible for setting nutritional standards, providing nutritional services, ensuring nutritional resources, and providing accurate nutritional education to the community (Republik Indonesia, 2009). Therefore, quality health services are very important in maintaining nutrition.

Tampaksiring I Health Center assists the integrated health post in Manukaya Village, especially in stimulation, detection, and early intervention of toddler development. Currently, Tampaksiring I Health Center still uses a manual approach to determine the nutritional status of toddlers, namely by calculating the z-score of the Anthropometry index. This process takes a long time because the results are matched with the category table and thresholds set in accordance with the Regulation of the Minister of Health Number 2 of 2020. Therefore, a more efficient approach is needed. One approach is to utilize the classification method in data mining. Classification in data mining is expected to be able to optimize the process of calculating the nutritional status of toddlers more efficiently. The C4.5 algorithm can be used to build decision trees, grouping data into different categories or classes based on certain attributes (Muslim et al., 2019).

Based on the problems that have been identified, this study will focus on the implementation and analysis of the performance of the C4.5 algorithm in classifying the nutritional status of toddlers. The analysis will be conducted using a 1043 gross dataset from Tampaksiring I Health Center. This study will test several methods of selecting splitting attributes such as Information Gain, Gain Ratio, and Gini Index, in forming a decision tree. The accuracy of the model will be measured using a confusion matrix. It is hoped that this study can provide an in-depth understanding of the performance of the C4.5 algorithm in various data splitting scenarios for the classification of toddler nutritional status and improve the effectiveness of toddler health monitoring at the Manukaya Village Posyandu.

STATE OF THE ART

1. Data Mining
   Data Mining is an analysis process that aims to identify pattern relationships in big data using statistical techniques, mathematics, artificial intelligence, and machine learning. The data mining process involves processing raw data, transforming it into information, and recognizing patterns to gain useful knowledge (Muslim et al., 2019; Witten et al., 2011).
2. Dataset
   A dataset is a collection of data consisting of objects with certain attributes or variables. Each object in the dataset represents an individual with the attributes measured or observed (Muslim et al., 2019).
3. Classification
   Classification in data mining is the process of finding patterns in data to separate categories and predict the category of a class of unknown objects. This process consists of a learning stage and a classification stage (Muslim et al., 2019; Rajoub, 2020; Witten et al., 2011).
4. Decision Tree C4.5
   The C4.5 algorithm is used in data mining to design Decision trees. This algorithm selects the best attributes at each Step of Decision tree construction using metrics such as Information Gain, Gain Ratio, and Gini Index (Muslim et al., 2019; Witten et al., 2011).
5. Information Gain
   Information Gain is utilized in the Decision tree algorithm to assess which attribute is most optimal to use as a split at a node. Information Gain measures the decrease in the level of uncertainty or entropy after data splitting is done based on a particular attribute. The higher the Information Gain value, the more effective the attribute is in splitting data (Muslim et al., 2019; Witten et al., 2011).

Information Gain calculation formula:

$$Info\ (D) = -\sum_{i=1}^{m} Pi \log_2 (pi) \quad (1)$$

$$Info_A(D) = \sum_{j=i}^{v} \frac{|Dj|}{|D|} x\ info(D_j) \quad (2)$$

$$Gain(A) = Info(D) - Info_A(D) \quad (3)$$

Description:
D = The Dataset
m = The number of classes in dataset
Pi = The proportion of instances in class i relative to the total dataset.
A = An attribute used to split the dataset.
v = The number of subsets created by splitting D using attribute A.
$| Dj |$ = The number of data points in subset Dj.
$| D |$ = The total number of data points in the original dataset.
$Info\ (D)$ = The entropy of the original dataset.
$Info_A(D)$ = The weighted entropy of the subsets created by splitting the dataset on attribute A.
Dj = Subset j of the dataset after the split.
$Gain(A)$ = The amount of information gained by splitting the dataset using attribute A.

6. Gain Ratio

Gain Ratio is an enhancement of the normalized Information Gain method to handle situations where an attribute has many values or categories. When an attribute has many different values or categories, Information Gain tends to favor that attribute. Gain Ratio overcomes this bias by dividing Information Gain by Split Information. Split Information measures how well an attribute divides the data without considering the class label (Muslim et al., 2019; Witten et al., 2011).

Gain Ratio calculation formula:

$$SplitInfo_A(D) = -\sum_{j=i}^{v} \frac{|Dj|}{|D|} x\ log_2 \left(\frac{|Dj|}{|D|}\right) \quad (4)$$

$$GainRatio(A) = \frac{Gain(A)}{SplitInfo_A(D)} \quad (5)$$

Description:
$log2$ = Logarithm with base 2, used to calculate entropy.
$-\sum$ = Summing the negative entropy values of all subsets Dj gives the total entropy for the dataset split.
SplitInfoA(D) = The proportion of instances in class i relative to the total dataset.

7. Gini Index

The Gini Index measures impurity or how mixed the classes are in each section when dividing data based on an attribute. The lower the Gini Index value, the more effective the attribute is in separating the data (Muslim et al., 2019; Witten et al., 2011).

Gini Index calculation formula:

$$Gini(D) = 1 - \sum_{i=1}^{m} P^2 i \quad (6)$$

$$Gini_A(D) = \frac{|D1|}{|D|} Gini(D1) + \frac{|D2|}{|D|} Gini(D_2) \quad (7)$$

Description:
$D1, D2$ = The subsets created by splitting the dataset D using attribute A.

$|D1|, |D2|$ = The number of instances in subsets D1D and D2D, respectively.
$Gini(D)$ = Calculate the impurity level of each data partition.
$Gini_A(D)$ = Gini Index measurement.

8. Confusion Matrix
   Confusion matrix is a technique used in predictive analysis of classification models to show the correct and incorrect prediction results in a binary classification task. This matrix helps in calculating performance metrics such as accuracy, precision, recall, and F1-score (Markoulidakis et al., 2021).
9. Related Research
   This study was compiled based on previous research that has been conducted in a similar field. Several studies that are the main references include research conducted by Hajar Izzatul Islam and colleagues (2022) which revealed that the application of the C4.5 algorithm in monitoring the nutritional status of toddlers produced a classification model with 90% accuracy, precision, recall, and F1-score of 87% using the SMOTETomek technique (Islam et al., 2022).
   Previous research conducted by Marini, Heru Satria Tambuna, Zulia Almaida Siregar, Gus Perdana Windarto, and Fitri Rizki (2022) revealed that research using the C4.5 algorithm to classify the nutritional status of toddlers at the Gunung Maligas Posyandu can help identify factors that influence malnutrition and undernutrition, and support efforts to address nutritional problems in children in developing countries (Marini et al., 2022).
   Previous research conducted by Hananda Hafizan and Anggita Nadia (2020) which tested the effectiveness of the C4.5 algorithm in determining the nutritional status of toddlers at the Kenanga Posyandu, Simalungun Regency, which obtained a high accuracy of 100% from the RapidMiner software (Hafizan & Putri, 2020).
   Previous research conducted by Mahfuz, Amri Muliawan Nur, L M Samsu (2022) which highlighted the importance of the C4.5 Algorithm in monitoring the nutritional status of toddlers at the Posyandu and achieved an accuracy result of 97.02% with 4 attributes with an AUC value from the decision tree of 0.928 (Mahpuz et al., 2022).
   Previous research conducted by Sri Mujiyono and Novan Syaiful (2023) which tested the efficiency of the C4.5 Algorithm in producing decision trees to handle numeric and categorical attributes with an accuracy score of 84.22% and 91.40% from the RapidMiner software (Mujiyono & Syaiful, 2023).
   Referring to the literature from previous studies, it can be concluded that the C4.5 algorithm is effective in classifying the nutritional status of toddlers. The novelty of this research includes: 1) The number of datasets used; 2) Types and attribute labels used; 3) Implementation of the C4.5 algorithm model testing experiment using three data splitting techniques.

RESEARCH METHODOLOGY

The method used in this study is the Cross Industry Standard Process for Data Mining (CRISP-DM) method. CRISP-DM is a process model designed to guide and structure data mining or data science projects. This model provides guidance on the steps that should be taken in a data science project from start to finish (Data Science Process Allieance, 2021; Matthew, 2012; Schröer et al., 2021).

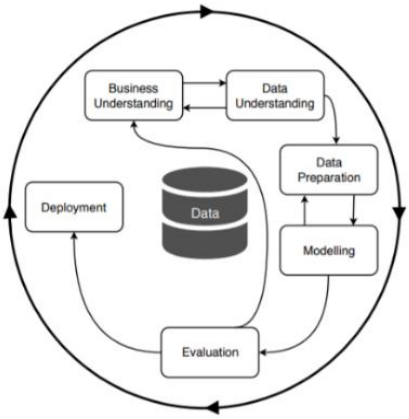


Figure 1. Research Method

For this study on toddler nutritional status classification. The detailed research flow is as follows:

1. Business Understanding
   In this phase, the author details and understands the conditions and problems found in the research object in order to determine the research objectives, identification of problems is carried out by conducting unstructured interviews with the head of the hamlet of Br. Belahan, then the author conducts a study of related literature to overcome the problems found. The results of the main problems obtained are that the posyandu cadres in Manukaya village lack the ability to calculate the Z-Score to determine the nutritional status of toddlers, so that the classification label of the results of the nutritional status of toddlers cannot be known directly in manual recording of the Anthropometric index. With these problems, the author aims to apply the data mining method with the C4.5 algorithm to produce a model that can be used to help determine the label of the results of the nutritional status of toddlers.
2. Data Understanding
   In this phase, the author collects and analyzes data to evaluate data quality. Dataset collection is carried out with documentation involving data searches available at the Tampaksiring I Health Center related to early detection of nutritional status of toddlers totaling 1043 gross datasets.
3. Data Preparation
   In this phase, the author determines the dataset, attributes, conducts data exploration, and cleaning dataset. In determining the attributes, the author first conducts an analysis of the relationship between attributes, so that it can be determined which attributes will be used, namely age, gender, weight, and height of toddlers.
4. Modelling
   In this phase, the author uses the data mining method with the C4.5 algorithm as a model in the process of searching for patterns or knowledge from the specified dataset. The model is created with the number of data splitting with a ratio of 80% training data and 20% testing data. The data mining process also includes testing several data division techniques (splitting) to determine the separation attributes in the decision tree, such as information gain, gain ratio, and gini index.
5. Evaluation
   In this phase, the model that has been created will be evaluated using a confusion matrix to identify true positive, true negative, false positive, and false negative values in a model. The results of the evaluation can be used to determine the accuracy, precision, recall, and f1-score values. The criteria set to determine whether the resulting model can be implemented are if the model's accuracy value is greater than (>) 85%. The data splitting technique with the best accuracy

will also be selected to be implemented into an information system in the form of a simple website using the Flask framework in Python.

6. Deployment
   In this phase, the best model results will be implemented into an information system in the form of a simple website using the Flask framework in Python. This implementation is expected to help Posyandu officers in Manukaya Village in conducting interventions and early detection to determine the evaluation label for the results of the classification of toddler nutritional status more efficiently.

RESULTS AND DISCUSSION

If we look at the number of each nutritional status in Table 2 below. This dataset can be called an imbalance dataset because there is a very clear dominance of the Good Nutrition category.

Table 1. Dataset Information

Column	Dataset Count	Data Type
JK	970	Categorical
Umur_Bulan	970	Numerical
BB	970	Numerical
TB	970	Numerical
Status	970	Categorical

Table 2. Dataset Information by Status Gizi Count

Status	Gizi Baik	Risiko Gizi Lebih	Gizi Lebih	Obesitas	Gizi Kurang
Total	720	176	44	16	14

Table 3 below shows that the Gain Ratio model is the best overall with the highest accuracy and good performance in most categories. The Information Gain model is also very good and almost on par with Gain Ratio, especially in weighted average precision and recall. The Gini Index model has a lower performance than the other two models.

Table 3. Model Accuration

Model	Precision	Recall	F1-Score	Akurasi
Information Gain	0,88	0,88	0,87	88%
Gain Ratio	0,89	0,89	0,89	89%
Gini Index	0,86	0,86	0,85	86%

Table 4. Decision Tree Root Node

Information Gain	Gain Ratio	Gini Index
BB <= 16,95	BB <= 16,95	BB <= 16,95
Entropy = 1.132	Entropy = 1.132	Entropy = 1.132
Samples = 776	Samples = 776	Samples = 776
Value = [13, 34, 12, 132]	Value = [13, 34, 12, 132]	Value = [13, 34, 12, 132]
Class = Gizi Baik	Class = Gizi Baik	Class = Gizi Baik

From the results of each decision tree root in Table 4, the most influential attribute is body weight (BB ≤ 16.95). Discussions with Midwives at Tampaksiring I Health Center showed that body weight has a significant influence in determining the category of nutritional status and can be used for general nutritional status evaluation on the BB/TB index or Body Mass Index (BMI).

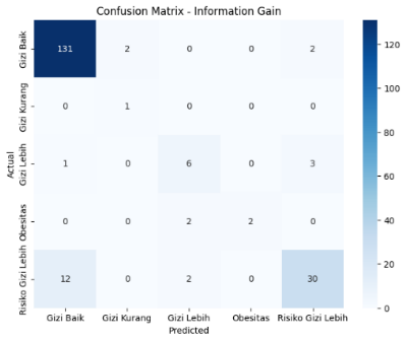


Figure 2. Confusion Matrix Information Gain

In Figure 2, the main diagonal of the Information Gain model matrix shows the number of accurate predictions for each class: 131 for Well-Nutritioned, 1 for Under-Nutritioned, 6 for Over-Nutritioned, 2 for Obese, and 30 for Risk of Over-Nutrition. Elements outside the main diagonal record the model's prediction errors.

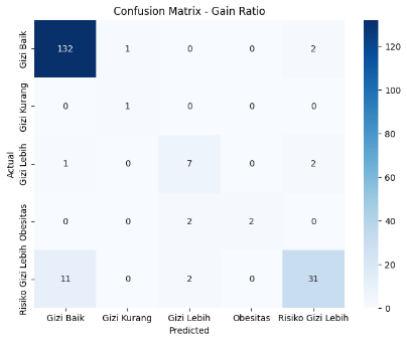


Figure 3. Confusion Matrix Gain Ratio

In Figure 3, the main diagonal of the Gain Ratio model matrix shows the number of accurate predictions for each class: 132 for Well-Nutritioned, 1 for Under-Nutritioned, 7 for Over-Nutritioned, 2 for Obese, and 31 for Risk of Over-Nutrition. Elements outside the main diagonal record the model's prediction errors.

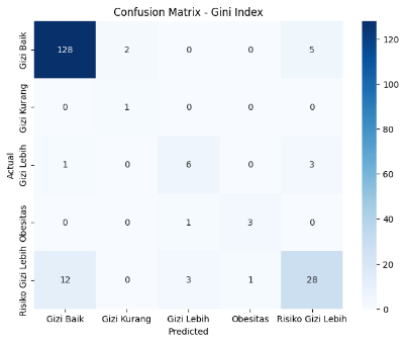


Figure 4. Confusion Matrix Gini Index

In Figure 4, the main diagonal of the Gini Index model matrix shows the number of accurate predictions for each class: 128 for Well-Nutritioned, 1 for Under-Nutritioned, 6 for Over-Nutritioned, 3 for Obese, and 28 for Risk of Over-Nutrition. Elements outside the main diagonal record the model's prediction errors.

Table 5. Model Accuration Based from Status Gizi

Status Gizi	Model	*Precision*	*Recall*	*F1-Score*	*Support*
Gizi Baik	Information Gain	0,91	0,97	0,94	135

Status Gizi	Model	*Precision*	*Recall*	*F1-Score*	*Support*
	Gain Ratio	0,92	0,98	0,95	135
	Gini Index	0,91	0,95	0,93	135
Gizi Kurang	Information Gain	0,33	1,00	0,50	1
	Gain Ratio	0,50	1,00	0,67	1
	Gini Index	0,33	1,00	0,50	1
Gizi Lebih	Information Gain	0,60	0,60	0,60	10
	Gain Ratio	0,64	0,70	0,67	10
	Gini Index	0,60	0,60	0,60	10
Obesitas	Information Gain	1,00	0,50	0,67	4
	Gain Ratio	1,00	0,50	0,67	4
	Gini Index	0,75	0,75	0,75	4
Risiko Gizi Lebih	Information Gain	0,86	0,68	0,76	44
	Gain Ratio	0,89	0,70	0,78	44
	Gini Index	0,78	0,64	0,70	44

In Table 5, it can be seen that for Good Nutrition status, all models show very good performance with high F1-score values. Although recall for Undernutrition status is high, precision remains low due to limited sample size. For Overnutrition status, model performance is consistent, but precision and recall still need to be improved. In the context of Obesity, the models show high precision but low recall except for the Gini index model, which can cause overfitting. Overnutrition Risk status shows varying performance with Gain Ratio as the best metric. Although the dataset is imbalanced, the C4.5 algorithm is effective in overcoming it. The test results show that although some nutritional status labels have low precision and recall, the model is still able to predict the labels accurately after manual testing using 14 dataset samples for each label. This shows that despite the challenges in data imbalance and performance variation, the C4.5 algorithm still provides adequate results.

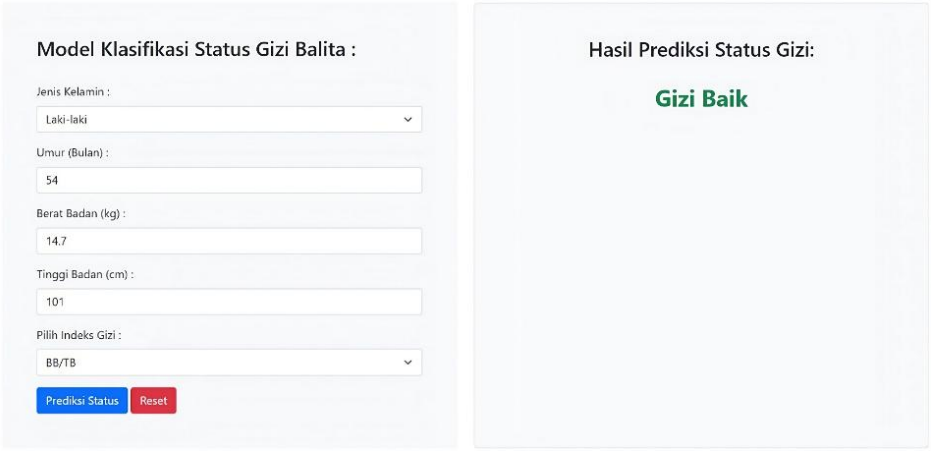


Figure 5. Website Implementation

Figure 5 shows a simple website interface for early detection of nutritional status of toddlers implemented with the Flask framework in Python. This interface is a form where users enter data such as gender (Male, Female), age (months), weight (kg), and height (cm). After the data is entered, users can click the "Predict Status" button to get the prediction results or the "Reset" button to clear the form. This website also has a feature for selecting nutritional status assessment indices. In this study, only the measurement labels for the classification of nutritional status of toddlers based

on the BB/TB index were used. However, this website was also developed to predict the nutritional status of toddlers with TB/U and BB/U indices.

CONCLUSION

Based on the results of the application of data mining with the C4.5 algorithm for the classification of nutritional status of toddlers at the Posyandu in Manukaya Village, the effectiveness of three attribute separation methods was evaluated: Information Gain, Gain Ratio, and Gini Index. The dataset used consisted of 970 data on nutritional status of toddlers from the Tampaksiring I Health Center. The conclusions of the study are as follows:

1. The C4.5 algorithm was successfully applied in the classification of nutritional status of toddlers based on the dataset from the Tampaksiring I Health Centre. Decision tree analysis showed that the weight attribute (BB) was the most influential and was used as the root. This was confirmed by the midwife at the Tampaksiring I Health Centre. This model was then applied to a simple website for early detection of nutritional status of toddlers, with model storage using the Joblib module in Google Colab and website implementation using the Flask framework in Python.
2. Of the three attribute separation methods tested, the Gain Ratio model showed the best performance with an accuracy of 89% and the highest weighted average precision, recall, and F1-score. The Information Gain model has an accuracy of 88% with performance close to Gain Ratio in the weighted average of precision, recall, and F1-score, in accordance with the theory that Gain Ratio is an improvement of Information Gain. The Gini Index model has an accuracy of 86% with a weighted average of precision, recall, and F1-score which is quite good but not as good as the other two models, especially in handling imbalanced datasets with many category labels.

Based on the results of the research and evaluation of the performance of the toddler nutritional status classification model, the following suggestions can be considered:

1. The Gain Ratio method is recommended for use in the early detection model for toddler nutritional status because it provides the best overall accuracy and performance. The Information Gain model can also be considered as an alternative. The Gini Index model can be considered for balanced datasets with fewer category labels, but further evaluation is still needed before implementing the model.
2. It is recommended to conduct model trials with larger, more balanced datasets and use more varied attributes to improve model performance in detecting and conducting early interventions for toddler nutritional health. Model development trials can also be conducted for the TB/U and BB/U indices.

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REIMAGINING MALACCA'S HERITAGE SHOPHOUSES: ADAPTATIONS FOR TOURISM SUPPORTING FACILITIES

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ABSTRACT

Malacca City, a UNESCO World Heritage Site since 2008, represents a rich tapestry of multicultural and colonial history. The city's heritage shophouses, exemplifying architectural styles influenced by Portuguese, Dutch, British, and Chinese traditions, play a vital role in preserving its identity. This study explores the adaptive reuse of these shophouses, focusing on their transformation into tourism-supporting facilities such as homestays and cafés. Case studies of Ohana House, a boutique homestay, and Ban Kheng Café highlight how minimal intervention and architectural harmony maintain historical integrity while accommodating contemporary tourism needs. The findings emphasize the balance between preservation and modernization, achieved through minimal alterations, strategic reuse of spaces, and maintaining visual compatibility. Challenges such as utility limitations and sustainability issues persist, underscoring the need for innovative solutions to enhance both operational efficiency and visitor experience. Recommendations include integrating sustainable technologies and expanding cultural offerings to enrich the heritage tourism experience while safeguarding Malacca's unique identity. Overall, this research demonstrates the potential of heritage conservation to contribute to sustainable urban development, cultural preservation, and economic growth in historic settings like Malacca.

Keywords: *Malacca city, adaptive reuse, heritage shophouse*

1. INTRODUCTION

Malacca City, Malaysia, is a vibrant repository of the nation's colonial and trading history, shaped by successive Portuguese, Dutch, and British occupations (Winstedt, 1948; UNESCO, 2009). Established in the 15th century by Prince Parameswara, it grew from a regional Malay kingdom into a melting pot of Malay, Chinese, Peranakan (Baba Nyonya), Chetti (Peranakan Indian), and Portuguese Eurasian (Kristang) cultures (Amat, 2019). The Malacca River divides the city into administrative, residential, and commercial zones, reflecting its layered history. This rich cultural and historical amalgamation earned Malacca UNESCO World Heritage status in 2008, highlighting its importance as a hub for cross-cultural exchange and trade between East and West for over five centuries (Shamsuddin, 2011).

As a region with significant historical value, Malacca possesses distinctive characteristics shaped by both tangible and intangible elements, which contribute to its place identity. According to Shamsuddin (2011), architectural heritage is a critical tangible element that plays a vital role in defining the identity of a historical site. A prominent feature of Malacca's architectural heritage is its traditional shophouses—narrow, elongated terraced buildings with commercial spaces on the ground floor and residential quarters above (Wagner, 2017). These structures, influenced by Dutch, Portuguese, and Chinese designs, reflect colonial-era

regulations and cultural traditions (Han & Beisi, 2015). This shows how Malacca is able to express its cultural traditions and the simultaneous process of adaptation.

Since gaining UNESCO recognition, the surge in tourism has driven the adaptive reuse of these shophouses into homestays, cafes, and museums. This paper examines the role of adaptive reuse in preserving Malacca's heritage while addressing the needs of contemporary tourism. Specifically, it explores the transformation of shophouses into hotels and cafes, providing insights into how the community balances the demands of tourism with efforts to maintain Malacca's unique place identity.

2. RESEARCH METODOLOGY

This study adopts a qualitative methodology to explore the adaptive reuse of heritage shophouses in Malacca, Malaysia, with a focus on their transformation into tourism-supporting facilities such as homestays and cafes. The research integrates a literature review and field observations to comprehensively analyze adaptive reuse practices within this context. The literature review examines the defining characteristics of heritage shophouses, the principles of adaptive reuse, and tourism industry perspective in historical context. Field observations are conducted on selected heritage shophouses repurposed as homestays and cafes, focusing on modifications made to accommodate modern tourism functions. Data collected through observations include photographs and plan drawings of public areas within these facilities. The findings from the literature review and field observations are then compared to identify trends and preferences in adaptations that align with community practices and tourism demands.

3. RELATED RESEARCH

The Characteristic of Heritage Shophouse in Malacca

Heritage shophouses in Malaysia trace their origins to the early 1600s, initially developed by Chinese traders in Malacca before Dutch colonization (Weebers et al., 2015; Teuling, 2010). These structures evolved significantly under British colonial rule, incorporating eclectic architectural styles influenced by Western regulations and an influx of Chinese laborers, who adapted the designs to balance commercial and residential needs (Zwain & Bahauddin, 2018). Heritage shophouse characterized by narrow, elongated layouts, shophouses were traditionally organized to accommodate both business and family life. Ground floors were used for commercial activities, while upper floors housed living quarters (Tan, 2015). Key features included courtyards for ventilation and prosperity, communal clusters, and distinctive facades with five-foot walkways, shuttered windows, and decorative motifs that often reflected feng shui principles (Zwain & Bahauddin, 2020; Tan, 2015). These design elements symbolized wealth and heritage while also serving functional purposes, such as supporting airflow and public accessibility (Tan & Fujita, 2014; Ismail & Ching, 2016).

Over time, material choices shifted from timber to masonry to improve durability and safety, with early constructions using clay bricks and tiles. By the 20th century, concrete and steel were introduced, allowing taller buildings and more intricate decorations (Baroldin & Din, 2018; Wegner, 2017). These advancements not only modernized the structural resilience of shophouses but also enhanced their aesthetic appeal, ensuring their relevance in evolving urban landscapes.

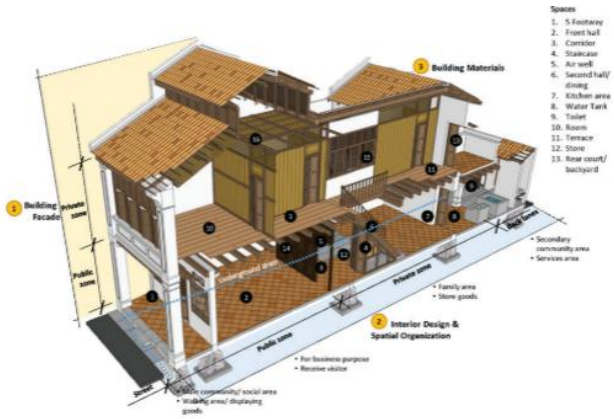


Figure 1. Heritage Shophouse Typical Features
Source: Hakim Zamri et al., 2023

Adaptive Reuse

Adaptive reuse is defined as a major change of a building with alteration of both the building and the function it accommodates. It is a process of building conversion by recycling usable components for the purpose of new use, and a strategy that can be used to preserve its cultural heritage (Abdulameer & Sati'Abbas, 2020). Based on the literature review conducted by Vafaie et al. (2023), there are several factors that impact the success of adaptive reuse from architectural (physical) perspective.

1. **Minimum intervention**: Defining suitable changing level, considering the basic structure and character of the building to be intact
2. **Potential of reversibility**: The new installations should not needlessly damage the building nor limit future adaptations
3. **Explicitness of alterations:** The architectural style after reuse should not falsify the record of the past and new changes should be distinguishable for future generations
4. **Architectural harmony & Visual compatibility:** The compatibility of contemporary extensions with the original building, considering: the contrast of new and old, replication, size and volume, colour and material harmony, the importance of location, and characteristics of surface articulations
5. **Analysis and assessment of structural layout:** The structural alterations to old buildings should be analyzed/assessed by expert consultants for conversion, level of intervention, safety indicators, and historical building envelope (integration, insertion, addition, etc)
6. **Upgrading physical characteristics around:** The reuse project should contribute to the improvement of the physical characteristics of surrounding areas, acting as a catalyst for urban upgrading
7. **Creativity:** The creativity of fitting the contemporary needs and concept of the past into what already exists in the building
8. **Age value of materials:** Considering the "Age Value" of materials and aesthetic qualities of harmony and beauty in decay, patina, disintegration
9. **Building usability:** The importance of suitable infrastructures of the building such as electricity, drainage, mechanical systems, space utilization, lighting, air quality, etc. for future changes
10. **Material durability:** The interior and exterior fabric is constructed with durable materials that could be retained for the building's future new use

Tourism Industry Perspective in Historical Context

According to Aksu et. al. (2010), tourists have their own personal expectations regarding tourist destination chosen, according to the source and attraction pull of an area. A certain expectation could be high or otherwise according to the publicity and marketing conducted in developing a particular tourism destination. Related to accommodation, according to Ab Wahab et al (2023), there are several physical elements that impact the tourist preferences in choosing hospitality facility with adaptive reuse concept:

1. Architectural design: the building façade is conserved and preserved to keep it as original as possible, as with most heritage structures
2. Interior design: the fusion of the past and current offers by the interior design and the heritage building
3. Layout: unique layout design is preserved
4. Location, nearby attraction, accessibility
5. Technology used
6. Room range
7. Leisure facilities

4. RESULTS AND DISCUSSION

This study focuses on two adaptive reuse examples in Kampung Jawa, an area central to Malacca's early urban development. The first is Ohana House, a boutique homestay brand with a "Baba Nyonya" theme celebrating the city's Peranakan heritage. Two branches, Ohana House HQ and Ohana House @31 Jawa, highlight the diversity of accommodations. Ohana House HQ offers 14 uniquely designed rooms for groups ranging from two to 40 guests, catering to varied traveler preferences. In contrast, Ohana House @31 Jawa provides a more intimate setting for up to four guests, featuring a dining area, TV lounge, and other amenities. Both properties are conveniently located near major attractions like Jonker Street, the Baba Nyonya Museum, and popular shopping centers, offering culturally immersive stays while providing practical services such as rentals and daily housekeeping.

The second example is Ban Kheng Café, situated near Ohana House HQ along the Melaka River. Known for its authentic Malaysian cuisine and vibrant atmosphere, the café reflects Malacca's multicultural heritage. Its riverside location and proximity to tourist hubs make it a favorite for visitors and locals alike, offering a blend of traditional flavors and cultural charm. Together, these adaptive reuse projects demonstrate how heritage preservation can be effectively combined with modern tourism needs, enriching the visitor experience while maintaining historical integrity.

Spatial Organization

Spatial organization represents one of the most significant modifications in adapting both the homestay and café for their current functions. Ohana House Melaka, comprising four branches located along Jalan Jawa, maintains close proximity with only a 1-2 minute walking distance between each. As a result, the reception area is centralized at its headquarters (HQ), which also houses a restaurant and souvenir shop within a single multifunctional space. This layout often leads to overcrowding during peak guest arrivals, with overflow occasionally extending to the street. Similar to traditional shophouses, the rear of the HQ contains staff or owner’s spaces and toilet, preserving the historical layout of using the back area for private functions. Meanwhile, the second floor, historically a private residence, has been repurposed into guest rooms.

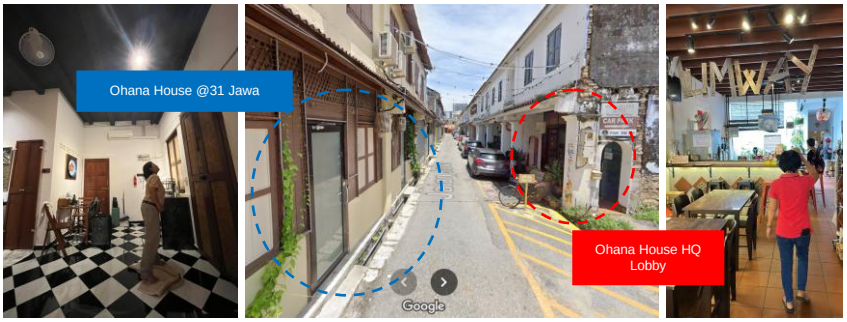


Figure 2. Spatial Connection between Ohana House HQ and @31 Jawa
Source: Modified from gmaps.com

At Ohana House @31 Jawa, there is no transitional space between the exterior wall and Jalan Jawa, creating the impression that the public street serves as the transition area for guests. This lack of an intermediary zone impacts the accommodation's exclusivity and safety, although card access doors have replaced traditional ones for enhanced security. The two-story unit features a pantry, bathroom, and living room on the first floor, while the second floor is dedicated entirely to guest bedrooms equipped with two queen-size beds.

In contrast, Ban Kheng Café utilizes the rear portion of a shophouse with a frontage on Bunga Raya Street, capitalizing on its location along the Melaka River. Access to the café is exclusively through the riverfront pedestrian path, which also doubles as an outdoor seating area, offering direct views of the vibrant riverside lined with colorful buildings and passing boats. This design approach enlivens the previously quiet pedestrian space and enhances safety, inviting passersby to explore the café's offerings displayed in the outdoor commercial area. Inside, visitors first encounter the kitchen, cashier counter, and restroom before entering a spacious seating area. Part of this seating space occupies what was historically a shophouse courtyard. A transparent roof has been installed to allow natural light, preserving the courtyard's openness. The second floor functions as a private area for the owner or staffs, consistent with the traditional zoning of shophouses.



Figure 3. Public spaces in Ban Kheng Cafe

Interior Design

The design of Ohana House Melaka draws inspiration from the Baba Nyonya theme, which embodies the rich cultural heritage of the Peranakan or Straits Chinese community, a legacy of intermarriage between Chinese immigrants and the local Malay population. This theme is prominently reflected in the furniture and décor of the lobby and guest rooms at the Ohana House Headquarters. Intricately carved wooden furniture with floral and animal motifs highlights Baba Nyonya aesthetics, merging Chinese symbolism with Malay craftsmanship. Antiques, vintage family heirlooms, and nostalgic décor elements such as old photographs, brass ornaments, and porcelain vases further enrich the interiors, preserving the cultural heritage. Exposed brick walls in the circulation areas enhance the warm and nostalgic ambiance.

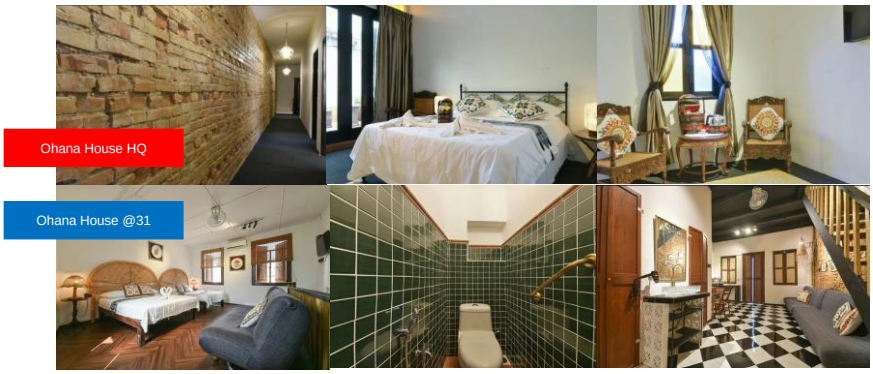


Figure 4. Interior at Ohana House HQ and Ohana House @31 Jawa
Source: https://www.ohanahousehq.com

In contrast, the interior of Ohana House @31 Jawa incorporates contemporary design elements alongside heritage features. Modern touches like rattan beds, glass countertop sinks, and green-tiled bathroom walls reflect current trends, while exposed brick walls are retained to maintain a connection with the historical aesthetic. However, the study highlights challenges in adapting old buildings to modern utilities. Issues such as electrical overloads, water seepage, and non-functional taps illustrate the complexities of balancing functionality, aesthetics, and heritage preservation in renovations.

At Ban Kheng Café, the design leans towards modern practicality while retaining elements of traditional charm. Outdoor seating features durable plastic furniture, while indoor areas utilize wooden furniture to complement the preserved wooden frames and lattices of the shophouse structure. The café emphasizes creating a spacious and airy atmosphere, retaining the courtyard's open design to promote natural ventilation and lighting. Windows on the second floor, connected to the courtyard and exterior, are kept open to facilitate airflow. Transparent roofing over the courtyard and perforated ceilings in the cashier area, paired with fans, enhance both natural and artificial ventilation, ensuring a comfortable and well-lit environment that respects the heritage structure.



Figure 6. Interior at Ban Kheng Cafe

Façade

In the homestay case study, the façade has undergone minimal architectural changes, with modifications primarily focused on space usage and openings. At Ohana House HQ, decorative doors and tinted glass have been added, while the traditional 5-foot covered walkway, originally intended for pedestrian use, is now repurposed for decorative displays and vending machines to emphasize the Baba Nyonya concept. At Ohana House @31 Jawa, the original wooden windows feature has been preserved, with only a modern card-access door installed outside the original wooden door for added security.

In contrast, Ban Kheng Café exhibits more noticeable changes to its façade. The exterior has been repainted in light green, departing from its original white, and the access door now features a mural to attract visitors. Additionally, the café has

integrated an outdoor seating area complemented by hanging lights that create an inviting ambiance, particularly at night. These adjustments align with the café's strategic orientation toward the Melaka River, leveraging its visibility and appeal to attract tourists from various vantage points.



Figure 7. Frontage of Ohana House HQ*, Ohana House @31 Jawa, Ban Kheng Cafe
Source: gmaps.com (*)

Adaptive Reuse Physical Success Factor and Tourist Preferences in Study Cases

The findings from the field observations are then analyzed to determine whether they meet the criteria for adaptive reuse and align with tourist preferences when selecting hospitality facilities in a historical context such as Malacca.

Table 1. Adaptive Reuse Physical Success Factors and Tourist Preferences in Study Cases

Factors	Homestay (Ohana House)	Café (Ban Kheng Café)
Minimum Intervention	**The interventions were minimal**. There is additional steel structure added to strengthen the wooden flooring in the second floor of the guest room, some indoor materials and utility are changed especially in the bathroom. Structure, façade, and materials are preserved	**The interventions were minimal**. Additional roof structure is added in the courtyard, but the transparent materials create the same atmosphere as the original one. Structure, openings, and materials are preserved
Potential reversibility	**There is potential of reversibility** because of the minimum changes in overall building	**There is potential of reversibility** because of the minimum changes in overall building
Explicitness of alterations	**The past and new changes are distinguishable in both interior and exterior.** The past can be felt because of minimum intervention in the façade and structure. It is also strengthen by the furniture and material choices that still refer to Baba Nyonya Style.	**The past and new changes are distinguishable in interior.** The courtyard and preserved openings play the major roles to preserve the authentic feeling of the shophouses. Meanwhile the exterior is modern and vibrant because it previously used as the back of the shophouses so there is no urge to preserve it.
Architectural harmony & visual compatibility	**Yes**, because it preserves the original façade of the shophouses	**Yes**, because most of the buildings that have orientation to the river now painted with color to create an attractive visual
Upgrading physical characteristic	The exterior contributes to maintain the overall image of the shophouses in the area, but it somehow uses public street as an in-between buildings circulation	The exterior contributes to overall riverfront landscapes
Materials	They expose the original material of the structures and maintain the original openings to create the past atmosphere in the interior and exterior.	They maintain the original opening material and form to create past atmosphere in the interior
Building usability	Issues such as electrical overloads, water seepage, and non-functional taps illustrate the complexities have to be worked on	The natural lighting and air-quality are utilized very well in indoor seating area
Location	Walkable distance from major attractions and popular shopping centers. The access road is too small,	Walkable distance from major attractions and popular shopping centers. The access road is too small,

	enough for one car to pass by but they provide parking for the guest	enough for one car to pass by and they don't provide parking site
Technology	Access card for the guest room, internet service	-
Room Range	They provide several types of room to choose, but the number of each type is very limited because the fixed area of the shophouse	They provide indoor and outdoor seating area
Leisure facilities	Restaurant and souvenir shop	-

The analysis indicates that the homestay and café case studies in Kampung Jawa effectively align with tourist preferences for adaptive reuse, particularly in maintaining minimum interventions, explicitness of alterations, architectural harmony, and material compatibility for both interiors and exteriors. These outcomes are achieved by preserving the original façade, incorporating exposed structural materials into the interior design, and enhancing the heritage ambiance with furniture and materials consistent with the historical context.

However, adaptive reuse projects must address challenges related to building utilities, especially when performance requirements differ from the original use. Integrating sustainable technologies, such as energy-efficient systems, could improve operational efficiency and attract environmentally conscious visitors. Furthermore, it is essential for accommodation and dining establishments to consider expanding leisure offerings to enhance visitor experiences. For example, Ohana House could incorporate cultural activities or heritage tours to appeal to tourists seeking immersive experiences. Similarly, Ban Kheng Café could introduce cultural programming, such as exhibitions or themed events, to strengthen its connection to Malacca's historical and cultural narrative. These enhancements could further support the balance between preserving heritage and meeting contemporary tourism demands.

5. CONCLUSION

The study highlights how adaptive reuse practices in Malacca's Kampung Jawa area successfully balance heritage preservation and contemporary tourism needs through the transformation of traditional shophouses into homestays and cafés. The examples of Ohana House and Ban Kheng Café demonstrate the application of key adaptive reuse principles, such as minimal intervention, reversibility, and architectural harmony, which preserve the historical and cultural essence of these buildings while meeting modern functional requirements.

Despite the success in maintaining architectural integrity and enhancing the visitor experience, challenges persist, particularly in adapting heritage structures for new utilities and ensuring operational efficiency. Issues such as electrical overloads, water seepage, and limited facilities underscore the need for further optimization. Sustainable technologies and additional leisure-oriented facilities could enhance both environmental and visitor appeal, addressing the evolving expectations of modern tourists.

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SENTIMENT ANALYSIS OF THE LEADERSHIP OF THE PRESIDENT OF THE REPUBLIC OF INDONESIA USING THE SUPPORT VECTOR MACHINE METHOD

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ABSTRACT

Sentiment analysis has become one of the most widely used methods to understand public opinion on various issues, including the leadership of the President of the Republic of Indonesia. The data for this study were obtained from YouTube and X platforms through data crawling techniques using Python, with the keyword #Jokowi. The methodology used in this study applies the Support Vector Machine (SVM) to categorize public views into positive and negative sentiment categories. The evaluation of the entire process in the program demonstrates the results of each step in the Support Vector Machine method. This evaluation uses metrics such as accuracy, precision, and recall. The results of the analysis obtained from the Support Vector Machine are visualized using a confusion matrix, yielding the following outcomes: True Negative 1,451, True Positive 2,600, False Positive 511, and False Negative 350. These results indicate an accuracy of 82%, precision of 83%, and recall of 88%. The confusion matrix results show that the model accurately identified 2,600 data points with an accuracy of 82%, precision of 83%, recall of 88%, and an F1-Score of 85%. Overall, this analysis demonstrates that the model performs better in recognizing positive sentiments compared to negative sentiments.

Keywords: *Analysis Sentiment, Support Vector Machine, President of the Republic of Indonesia, Leadership Sentiment*

1. INTRODUCTION

In the current era of globalization, global issues related to politics and security remain significant threats to nations. Issues concerning areas such as the South China Sea and Natuna Waters, as well as advancements in defense technology in neighboring countries, continue to play a crucial role in motivating a nation to enhance its self-defense capabilities (PERMATASARI, 2022). These types of threats need to be anticipated through flexible and adaptive national defense policies, where the preparation process remains aligned with the government's vision and mission. The implementation of these national defense policies can also serve as a guide for Ministries/Agencies in conducting national defense (Saputra et al., 2022). Defense policy is an essential element in the governmental structure of every nation, with primary goals including ensuring national security, protecting territorial integrity, and safeguarding citizens from potential external threats (Sarjito, 2023).

This enhances the ability to understand the political views of social media users. The large number of social media users allows researchers to incorporate personal status updates into emotional data to be processed and analyzed. Sentiment analysis based on the processing of status updates and tweets by users

on X reveals public opinion (Nardilasari et al., 2023). Sentiment analysis, or analisis sentimen in Indonesian, is a method or technique used to identify how sentiment is expressed using text and how it can be categorized as either positive or negative sentiment (Mahawardana et al., 2022). In the context of sentiment analysis, there is an effective method for processing data obtained on X using the Support Vector Machine (SVM) method. SVM is a technique used to analyze data and identify patterns. This method is useful in performing classification and regression in data analysis. SVM is also capable of predicting and evaluating the systems in place (Nardilasari et al., 2023). In this research, Support Vector Machine (SVM) is used as a classification method. SVM originates from statistical learning theory and provides better results compared to other methods (Darwis et al., 2020).

Thus, this research conducts sentiment analysis on the leadership of the President of the Republic of Indonesia using the Support Vector Machine (SVM) method. The study aims to provide a clearer perspective on public perception of the President's performance. By analyzing data from conversations on X, this research is expected to offer a deeper understanding of how society views current political leadership.

2. RESEARCH METODOLOGY

In text-based research or natural language processing (NLP), selecting the appropriate methods is crucial to achieve research objectives. These objectives include data collection, word cleaning, word labeling, word weighting, sentiment classification using the Support Vector Machine (SVM) method, and classification testing to achieve the desired results.

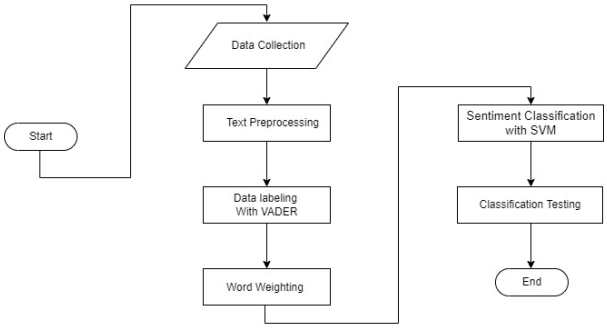


Figure 1.Research Methodology

3. RELATED RESEARCH

In this study, five previous research papers are used as references and comparisons in order to enhance and avoid plagiarism in the research. Here are the nine previous studies: (1) The first study was conducted by (Adiati et al., 2019), titled Sentiment Analysis of Public Opinion on Political Parties Participating in the 2019 Election on Twitter Using Naïve Bayes Classifier. This study applied the Naïve Bayes Classifier method to evaluate public sentiment toward political parties participating in the 2019 election. The results showed that 46.13% of sentiments were negative, while 53.87% were positive. In terms of accuracy, this approach achieved a rate of 78.03%. (2) The second study was conducted by (Firdlous et al., 2023), titled Public Sentiment Analysis on Twitter Regarding the 2024 Election Using Long Short Term Memory Model. This study used the Long Short Term Memory (LSTM) method and resulted in an accuracy of 78%, with 52.2% of identified sentiments being positive. Most positive sentiments were related to support for a successful election and information about the election process. On the other hand, 37% of sentiments were identified as negative. (3) The third study was conducted by (Farasqa et al., 2024), titled Sentiment Analysis on Anies Baswedan Using Support Vector Machine: A Case Study on Twitter. This study used the Support Vector Machine (SVM) method and concluded that public sentiment tended to be negative toward Anies Baswedan.

The SVM classification test without data balancing showed an accuracy of 77%, precision of 76%, and recall of 72%. (4) The fourth study was conducted by (Ni Made Tara Okta Adriana et al., 2023), titled Public Sentiment Analysis of Demonstrations in Indonesia Using Support Vector Machine and Random Forest. This study used both Support Vector Machine and Random Forest methods. The results indicated that the SVM algorithm had a higher accuracy rate than the Random Forest algorithm, reaching 80.3%. The classification process showed a dominance of negative sentiment at 54.98%, while about 15.86% of the public supported demonstrations, and 29.15% remained neutral. (5) The fifth study was conducted by (Sabily et al., 2019), titled Sentiment Analysis of the 2019 Presidential Election on Twitter Using the Maximum Entropy Method. This study applied the Maximum Entropy method and achieved a high Macro accuracy of 89.16%. (6) The sixth study was conducted by (Paramarta and Darmawan, 2023). It is titled "Implementation of the Support Vector Machine Method in Sentiment Analysis of Public Opinion on the 2020 Regional Elections on Twitter." This research used the Support Vector Machine (SVM) method. The study demonstrated that by applying SVM to sentiment evaluation of the 2020 regional elections, based on 6,037 tweets collected using the keyword "Pilkada 2020," it resulted in 4,864 tweets with positive sentiment and 1,173 with negative sentiment, achieving an average accuracy of 87.94%. (7) The tenth study was conducted by (Ade Dwi Dayani et al., 2024). It is titled "Sentiment Analysis on Public Opinion on Social Media Twitter Using the Support Vector Machine Method." This research utilized the Support Vector Machine (SVM) method to analyze public opinion on social media, classifying the sentiments into positive, negative, and neutral categories. The results of the SVM analysis showed an accuracy of 69.69%, recall of 45.60%, precision of 51.56%, and an F1-score of 46%. (8) The eighth study was conducted by (Asno Azzawagama Firdaus et al., 2023). It is titled "Sentiment Analysis on the Projection of the 2024 Presidential Election Using the Support Vector Machine Method." This research utilized the Support Vector Machine (SVM) method to evaluate sentiment classification regarding the projection of the 2024 presidential election. The sentiment results for three selected candidate datasets were as follows: Anies Baswedan with 65.62%, Ganjar Pranowo with 73.58%, and Prabowo Subianto with 66.34%. The accuracy of the SVM method applied to these datasets was 73% for Anies Baswedan, 79% for Ganjar Pranowo, and 79% for Prabowo Subianto. (9) The ninth study was conducted by (Sari and Kurniawan, 2024). It is titled "Sentiment Analysis on the Performance of the Mayor of Medan's Program on Social Media X Using Support Vector Machine." This research applied the Support Vector Machine (SVM) method to evaluate the sentiment of the Medan Mayor's program on the X application (formerly Twitter). The results showed an accuracy of 81%, precision of 84%, recall of 90%, and an F1-score of 87%.

4. RESULTS AND DISCUSSION

This research uses secondary data collected through crawling techniques on the YouTube and X platforms (formerly Twitter) using the keyword "Jokowi," resulting in 20,303 data points. The data includes text, user comments, interaction counts, and other information related to President Jokowi's leadership. Through text preprocessing, such as removing duplicates, normalization, eliminating irrelevant words, and filtering keywords, the data was refined into 6,140 relevant points for further analysis of President Jokowi's leadership. This study involves four stages: data collection, text preprocessing, Sentiment labeling, Tf-idf weighting, and classification using SVM :

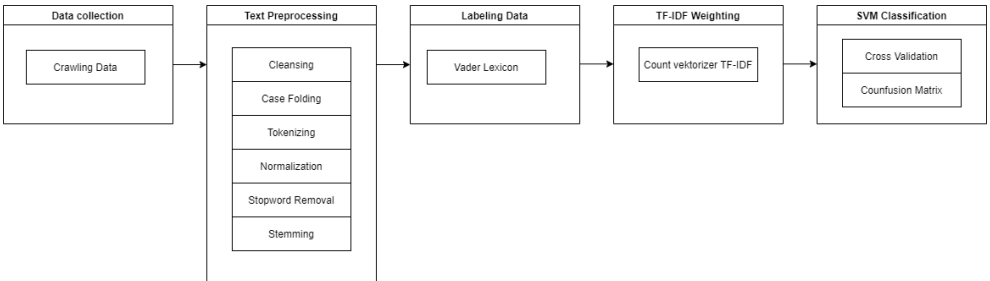


Figure 2.Research flow

a. Start Text Preprocessing

At this stage, text preprocessing begins with cleansing to remove characters such as emojis, @, #, &, and others, followed by case folding to convert all text to lowercase. Next, tokenizing breaks the text into words, then normalization corrects the form of the words. After that, stopword removal removes unimportant words, and finally, stemming returns words to their base form.

b. VADER sentiment labeling

Sentiment labeling is conducted using the VADER algorithm by analyzing the compound score of each text. Texts with a compound score greater than **0.5** are classified as **positive**, as they indicate a tendency toward supportive or positive opinions. Conversely, texts with a compound score less than **-0.5** are labeled as **negative**, as they represent opposing or negative opinions. The following are the results:

	clean data	sentiment scores	compound score	sentiment label
0	prosperous Indonesian Jokowi	{'neg': 0.0, 'neu': 0.392, 'pos': 0.608, 'comp...	0.4767	Positive
1	Jokowi's heart is sincere to the people	{'neg': 0.0, 'neu': 0.69, 'pos': 0.31, 'compou...	0.4019	Positive
2	There are doubts that Jokowi's leadership is t...	{'neg': 0.135, 'neu': 0.429, 'pos': 0.436, 'co...	0.7096	Positive
3	Poor Jokowi, his position has been ruined by h...	{'neg': 0.292, 'neu': 0.708, 'pos': 0.0, 'comp...	-0.7351	Negative
4	strongly reject dynastic politics	{'neg': 0.397, 'neu': 0.294, 'pos': 0.309, 'co...	-0.1531	Negative

Figure 3. Labeling sentiment Vader

The dataset that has been input into the program will be processed and converted into a bar chart to measure the sentiment score level of the dataset. Additionally.

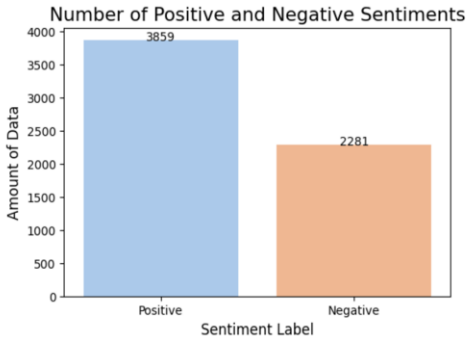


Figure 4.Bar score

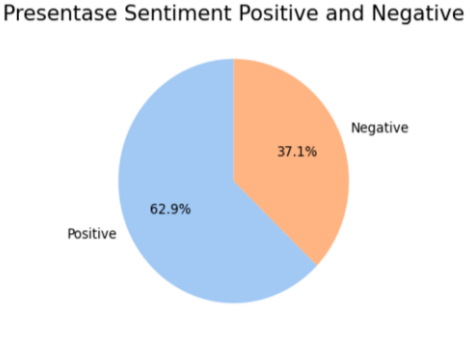


Figure 5.Presentase score

This study uses a total of 6,140 data points obtained from comments on the X platform (formerly Twitter) and YouTube through a data crawling process related to President Jokowi's leadership. As a result, the dataset contains 3,859 positive

sentiments and 2,281 negative sentiments, with a positive sentiment percentage of 62.9% and a negative sentiment percentage of 37.1%, for further analysis.

c. Data split

In this study, a total of 6,140 data points were used, and the data splitting process was carried out to divide the dataset into two parts: 80% training data and 20% test data for model training.

d. Modeling

At this stage, the text classification process will be performed using the Support Vector Machine (SVM) method. The dataset, which has gone through the previous processing steps, will be trained and tested using the 'Polynomial' kernel. Additionally, the program will predict all the data in the test set and compare it with the dataset that has been fitted on the split data.

e. Cross Validation

The validation process is an important step in research to ensure the accuracy and precision of the results. In this study, the cross-validation method is applied with a 10-fold configuration, meaning the model is tested 10 times using randomized subsets of the dataset. The analysis results show that the average value from the cross-validation is 81%.

f. Classification report

The classification results show that the model performs quite well with an accuracy of 82%, where it performs better in predicting the positive class compared to the negative class (precision and recall are higher for the positive class). The higher F1-Score for the positive class indicates a better balance between precision and recall for that class. However, for the negative class, although precision is lower (0.74), recall is quite good (0.81), meaning the model is able to recognize most of the negative data, despite some incorrect.

g. Evaluate

At this stage, the evaluation presents the entire process within the program, showcasing the results of each step of the Support Vector Machine (SVM) method. The evaluation includes metrics such as accuracy, precision, and recall. The results obtained from the confusion matrix provide details in the form of True Negative 1451, True Positive 2600, False Positive 511, and False Negative 350. This results in an accuracy of 82%, precision of 83%, and recall of 88%.

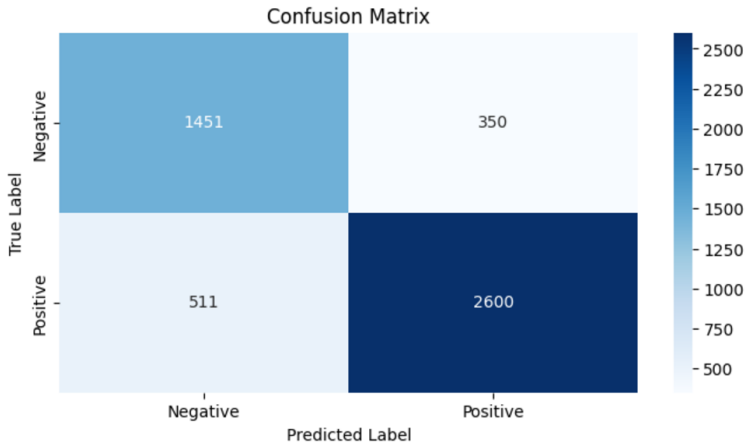


Figure 6. Confusion Matrix

5. CONCLUSION

In this study, data was obtained from sentiment analysis of comments on Platform X (formerly Twitter) and YouTube using data crawling techniques, resulting in a total of 20,303 data points. Subsequently, text preprocessing was conducted through six stages: Cleansing, Case Folding, Tokenizing, Normalization, Stopwords Removal, and Stemming. After the text preprocessing stage, the data was reduced from 20,303 to 6,140 clean data points. Based on the sentiment analysis conducted, the Support Vector Machine (SVM) model demonstrated good performance in classifying positive and negative sentiments in the dataset. The confusion matrix results showed that the model accurately identified 2,600 data points as positive sentiment (True Positive) and 1,451 data points as negative sentiment (True Negative). However, there were 511 negative data points misclassified as positive (False Positive) and 350 positive data points misclassified as negative (False Negative). The model evaluation produced key metrics: an accuracy of 82%, precision of 83%, recall of 88%, and an F1-Score of 85%. Overall, this analysis indicates that the model performs better at recognizing positive sentiments compared to negative sentiments, as evidenced by the higher precision and recall values for the positive class.

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INTRODUCTION TO BALINESE MASKS AS A VIRTUAL REALITY BASED CULTURAL HERITAGE PRESERVATION EFFORT

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ABSTRACT

Indonesia has an incredible wealth of culture, including the Balinese mask art which is not only aesthetically beautiful but also rich in spiritual values and symbolism. However, this culture is facing major challenges due to the influence of modern culture that has reduced the younger generation's interest in traditional arts. Based on the data, most of the younger generation agrees that the dominance of modern culture has affected their appreciation of traditional cultural heritage such as Balinese masks. To address this challenge, this research proposes the use of Virtual Reality (VR) technology as an alternative solution in introducing and preserving Balinese masks. VR technology enables an immersive visual experience so that users can explore the details of Balinese masks, understand their meanings, as well as experience the Balinese atmosphere virtually. This research uses the Multimedia Development Life Cycle (MDLC) method. The VR application designed presents a visual reconstruction of Balinese masks, interactive features, and simulation of a traditional atmosphere. This experience is designed to be accessed using the Oculus Quest 2 device, allowing users to experience the virtual environment to the fullest through immersive VR standalone technology. By doing so, VR can be a relevant alternative solution to introduce Balinese masks to the younger generation, while maintaining cultural values amid the development of the digital era.

Keywords: *Balinese Mask, Virtual Reality, Cultural preservation, Digital Technology, Multimedia Development Life Cycle (MDLC)*

PRELIMINARY

Indonesia is the largest archipelago in the world consisting of 17,508 and is inhabited by at least 360 ethnic groups. Due to this wealth, Indonesia has an extraordinary diversity of customs and cultures (Mahdar Ernita 2023). The Ministry of Education and Culture (MoEC) has recorded more than 67,273 cultural heritages in Indonesia. Of these, there are 11,627 immovable cultural heritage, 53,538 are movable objects, and 2,108 are intangible cultural heritage. Every region in Indonesia has a distinctive culture that reflects its identity. Many of these cultures have been recognized by UNESCO (Salwa Syafiqoh 2024). One example of Indonesia's proud cultural heritage is the traditional mask performance art on the island of Bali. This mask performance art has a long history from a simple form to a complex art form and is spread throughout the island of Bali.

Balinese masks are one of the art objects worn on the face of Balinese dancers, usually masks are used to accompany Balinese musical instruments during

religious ceremonies or during performances. Masks as one of the arts of the island of Bali are generally used to honor ancestors or clarify characters in accompanying cultural arts. In the life of modern society today, masks are placed as a form of art that has a high appeal, not only because of its aesthetic beauty, but the mystery side that is stored on the face of the mask is still able to exude magical powers that are difficult to explain (Wirawan 2021).

As a cultural heritage rich in meaning and symbolism, Balinese masks face serious challenges in maintaining their sustainability. Physical damage and limited access to live performances or museum collections are obstacles that hinder understanding and appreciation of the beauty of this art. In addition, the ease of obtaining information has changed the mindset of the younger generation to become more modern. This can affect the interest of the younger generation in preserving traditional Indonesian arts, especially Bali, based on the results of the questionnaire show that 54.9% of 51 respondents with an age range of 20 years to 23 years agreed that the dominance of modern culture has reduced the interest of the younger generation in traditional cultural heritage such as Balinese masks, 33.3% strongly agreed, 9.8% expressed doubt, and 2% disagreed. Without realizing it, traditional art continues to erode over time. Many teenagers or young people prefer modern art such as western pop, Korean pop, and so on (Bintang Panduraja Siburian 2021). As an ancestral heritage, these masks not only hold artistic value, but are also rich in deep cultural and spiritual meaning for the Balinese people.

In an effort to preserve and introduce Balinese cultural heritage to the younger generation, digitization of cultural heritage can be interpreted as a form of utilization of digital technology in carrying out management on cultural heritage objects. The utilization of digital technology will provide effectiveness and efficiency in cultural heritage preservation efforts. In this case, digital media can be utilized in collecting data, documenting, storing, managing, and disseminating cultural heritage information (Agustinova 2022). The utilization of modern technology such as virtual reality (VR) is an interesting choice. Virtual reality is an interactive technology that allows users to experience a digitally created environment (Fitria 2023). In the context of Balinese masks, the use of virtual reality can be an effective educational medium to introduce and understand the history of Balinese masks. The utilization of virtual reality also helps in the learning process and strengthens the process of simulating situations and information (Zulherman 2020). Questionnaire results from 51 respondents stated 62.7% strongly agreed that the ability of VR technology to present information about Balinese masks virtually can expand public reach and attract wider interest from various groups, including the younger generation. The advantages of using virtual reality as a medium for education and information on Balinese masks include: First, it creates an interactive experience, by utilizing virtual reality, users can directly experience the Balinese Mask content in an interactive visual way. They can feel the atmosphere of Bali deeply, including the sounds of nature, traditional music, and spiritual atmosphere. Second, experiential learning, the use of virtual reality also helps in the learning process and strengthens the process of simulating situations and information. In the design stage, the design of the application to be built is carried out. The user interface (UI) design includes a splash screen and Museum display. Finally, Visual Reconstruction, through virtual reality technology, users can see a visual reconstruction of the Balinese Mask, including the fine details and carvings in it. They can zoom, rotate, and see every angle clearly, making the experience more immersive and detailed (Putu Wirayudi Aditama 2023).

Virtual reality is a new media in the Industrial Revolution 4.0 which is growing rapidly at this time. Before the existence of virtual reality, information delivery media usually only utilized audio and visual media with limited interaction, and had not utilized various sensors in maximizing user interaction. The development of advanced technology now allows a better and more real interaction simulation

between media and humans. Virtual reality allows a user to enjoy receiving more real information. The utilization of various kinds of sensors makes virtual reality the best media in simulating something close to the real world without damaging the system that has been running. Seeing from the ability that virtual reality can do, virtual reality has the potential to be utilized as an introduction media. This is because by using virtual reality, the introduction is more efficient than theoretical explanations because there is direct visualization (Vasiliki Liagkoua 2018).

Through the utilization of virtual reality technology as a means of education and information for the Bali Mask Museum, the author conducted a research seminar entitled “Introduction to Balinese Masks as an Effort to Preserve Cultural Heritage Based on Virtual reality” which aims to present an alluring and different experience in introducing the cultural heritage of masks to the younger generation. By utilizing virtual reality, this museum is expected to be able to convey the information contained in each mask in a more interesting and memorable way. Virtual visitors can directly engage in the learning process, understanding the meaning and story behind each mask in an interactive way. Through this technology, users can gain a deeper understanding of Balinese culture and appreciate the values contained in mask art in a direct and interactive way.

RESEARCH METHODOLOGY

Several relevant previous studies support the development of a Virtual Reality (VR) based Balinese mask recognition application. (I Made Ochlan Pramana Putra 2021) used the Multimedia Development Life Cycle (MDLC) method in the development of VR-based museum artifact recognition applications, which were adopted in the process of data collection and UI/UX development for Balinese mask applications. (Putu Wirayudi Aditama 2023) showed that VR can create interactive and immersive experiences in cultural introductions, which inspired this application's interactive and immersive features. (I Wayan Andika Raditya 2020) used the Waterfall method for interactive 3D visual development, which was adapted to create a detailed view of Balinese masks in this application. Finally, (Rayyan Hanugrah 2021) developed an Android-based VR application with interactive features, such as 3D views and motif guessing games, which inspired the development of interactive elements in the Balinese mask recognition application.

Based on references from previous research, the system development method used to build the digitization of Balinese mask culture through a Virtual Reality-based Museum follows the Multimedia Development Life Cycle (MDLC) method. This method consists of structured stages that ensure the systematic development of interactive applications. The first stage, Concept, involves determining the purpose, target audience, and goals of the application, with the aim of creating an immersive VR museum to introduce Balinese masks. Next, in the Design stage, the system functionality, interface, and database structure are outlined. The system design includes features such as interactive exploration of the museum space and hotspot-based mask information in Indonesian and English. At the Material Collecting stage, resources such as 3D mask models, historical data, and cultural descriptions are collected. The Assembly stage is carried out with application development using Blender for 3D modeling and Unity to create VR experiences. The app was designed to be compatible with the Oculus Quest 2 device, ensuring a high level of interactivity and immersion. Testing was done with black-box testing to verify the functionality of the system, focusing on navigation and content accuracy. Finally, in the Distribution stage, the VR museum application was used

for user evaluation and engagement, showcasing its potential as a cultural preservation tool.

Data Collection Techniques

During the research on the introduction of Balinese masks through a Virtual Reality-based Museum as an effort to preserve cultural heritage, data collection was conducted to gather the necessary information for the preparation of this report. The data collection techniques used are as follows:

1) Primary Data
   Primary data was collected directly from the field by the researchers. In this study, primary data collection methods included interviews and observations. Interviews were conducted with key figures such as Bagus Santoso, the manager of Setia Darma House of Masks and Puppets, These interviews provided insights into the types of Balinese masks, their cultural significance, and perspectives on utilizing Virtual Reality for cultural preservation. Observations were carried out at Rumah Topeng dan Wayang Setia Darma and I Wayan Muka Mask Product to document mask collections and obtain an understanding of the cultural and historical context.

2) Secondary Data
   Secondary data was gathered through documentation techniques and literature studies from scientific journals, books, and reliable online sources. This included gathering information on Balinese mask traditions, their classification, and cultural roles. Additionally, 3D asset references, historical descriptions, and relevant multimedia development frameworks were reviewed to support the design and development of the Virtual Reality Museum application.

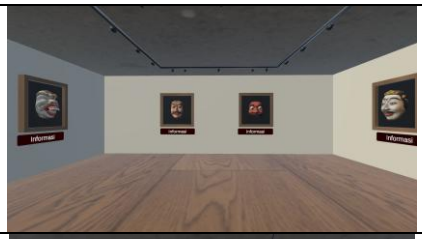
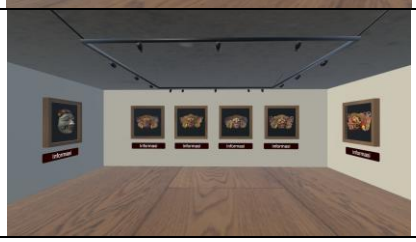
This combination of primary and secondary data collection ensured a comprehensive approach to capturing the essential aspects of Balinese mask culture and its preservation through modern technology.

RESULTS AND DISCUSSION

The result of this research is the creation of a Virtual Reality Museum of Balinese Mask for the Introduction of Balinese Mask as an Effort to Preserve Cultural Heritage for the younger generation, which can be seen in Table 1.

Table 1. The Results Of Balinese Mask Virtual Reality Museum

No	User Interface	Description
1.		The Main Menu page is the initial display when just starting the Bali Mask Museum *virtual reality* . On this page displays several buttons, namely Explore Mask Museum, Wali Mask Room, Calonarang Mask Room, and Ramayana Mask Room which if clicked will enter the respective pages of the Bali Mask Museum.
2.		On the Explore Topeng Museum page, visitors can walk around the Bali Topeng Museum area, and can directly enter each room in the Bali Topeng Museum area.

3.		In the Topeng Wali room there are several masks, namely: Hard Mask, Old Mask, Dalem Mask, Sidakarya Mask, Wijil Mask, and Penasar Mask. On each mask there is an information button which, if clicked, will bring up information about each mask.
4.		In the Calonarang Mask room there are several masks, namely: Rangda Mask, Rarung Mask, Barong Mask, Weksiksa Mask, Gandi Mask, Lendi Mask, Rangda ing Dirah Mask, Celuluk Mask, and Patih Mask. On each mask there is an information button which, if clicked, will bring up information about each mask.
5.		In the Prembon Ramayana Mask room there are several masks, namely: Rama Mask, Sita Mask, Hanoman Mask, Jatayu Mask, Sugriwa Mask, Ravana Mask, Sempati Mask, Anggada Mask, Patih Prahasta Mask, and Kumbakarna Mask. On each mask there is an information button which, if clicked, will bring up information on each mask.

Analysis of Test Results

The test results here are in the form of an assessment of the application using the User Experience Questionnaire (UEQ), in the form of filling out a Google form that has been created. The following are the assessment results related to the Balinese Mask Virtual Reality Museum application filled in by 52 respondents with an age range of 20 years to 23 years to support introducing and preserving the Balinese Mask cultural heritage to the younger generation.

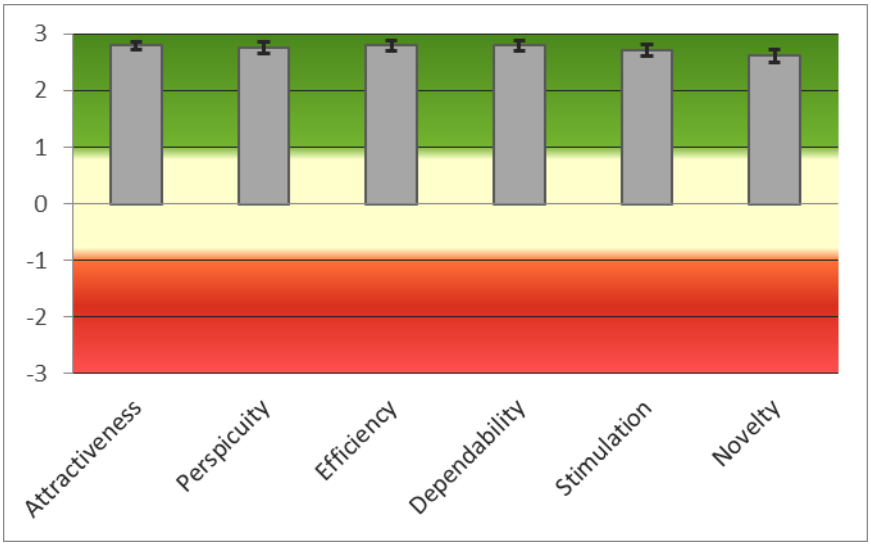


Figure 1. Graph of the average impression of respondents based on variables

Based on Figure 2, it can be concluded that the Topeng Bali virtual reality museum application based on the results of the investigation on the Image scale consistently falls into the “excellent” impression category with a minimum value of 2.6, then it can be concluded that the Topeng Bali virtual reality museum application based on the results of the investigation on the efficiency scale consistently falls into the “excellent” impression category with a maximum value of 2.7.

CONCLUSION

Based on the research, it can be concluded that the digitization of Balinese cultural arts through a Virtual Reality (VR) based virtual museum to introduce Balinese masks has successfully supported the preservation of cultural heritage, especially for the younger generation. This application was developed using the Multimedia Development Life Cycle (MDLC) method, utilizing Blender and Unity software, and optimized for Oculus Quest 2. Test results using the User Experience Questionnaire (UEQ) showed that the app received consistent ratings in the "excellent" category from 52 respondents, especially in the aspects of efficiency and interactive impression. Respondents appreciated features such as virtual exploration, interactive information about mask details and symbolism, and immersive cultural experiences. With this approach, VR-based virtual museums play an important role in educating and increasing appreciation of Balinese traditional arts in the digital era.

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HERMENEUTICS IN UNDERSTANDING PHOTOS "REJANG FOR SALE" BY PUTU DUDYK

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ABSTRACT

Photography has the term photographer, namely the person who carries out the recording. For a professional photographer, the photo object is not just a mere recording, but must provide an aesthetic touch to various compositions. Photographers are now so creative, they are not only experts in using a camera but also have to be experts in preparing photo themes and final processing to give an aesthetic impression in the feel of the photo. Photographer Putu Dudyk, as he is usually called, is a photography practitioner and lecturer. He has been involved in the world of photography for a long time, he has produced many works, including documentation and art photographs. The method used in this research is a descriptive qualitative method. dialogical hermeneutics, for him correct understanding is understanding that leads to the ontological, not methodological, level. This means that truth can be achieved not through methods, the photographic work entitled Rejang For Sale by Dudyk visualizes three rejang dancers, each of whom has their own expression according to the desired concept and theme, the addition of plastic as a symbol of packaging for a product that can be sold. bought, with a black background as an impression of sadness, as well as the dancers' sad expressions and blank stares depicting the lack of sincerity in something that is sacred being commercialized.

Keywords: *Commercialization, Hermeneutics, Photo Rejang For Sale*

1. INTRODUCTION

In photography there is the term photographer, namely the person who carries out the recording. For a professional photographer, the photo object is not just a mere recording, but must provide an aesthetic touch to various compositions. Photographers are now so creative, they are not only experts in using a camera but also have to be experts in preparing photo themes and final processing to give an aesthetic impression in the feel of the photo. A photographer is essentially a person who has expertise in maintaining and expressing optical sensitivity so that the results of the object shot can develop into an aesthetic experience for humanity. The results of his camera shots are visual art that can imply the order of life or have a touch of culture. Apart from that, photographers are also required to understand the rhetorical triangle which has elements as mentioned by Wendy Hesford and Brenda Jo Brueggemann (in Illahi, 2017), namely if photography analysis involves images in terms of subject/content, audience/context, and perspective.

Photographer Putu Dudyk, as he is usually called, is a photography practitioner and lecturer. He has been involved in the world of photography for a long time, he has produced many works, including documentation and art photographs. As a photographer, Dudyk is very astute in seeing current phenomena expressed in photographic works, from the naturalistic to the critical nuances, current phenomena are related to Balinese culture, especially many of the commercialized traditions. This phenomenon was one of the targets of Putu Dudyk's photographs which received awards and exhibitions in China. The work is entitled "Rejang For Sale".

2. RESEARCH METODOLOGY

The method used in this research is a descriptive qualitative method. The qualitative method is research that does not carry out calculations such as additions, numbers, percentages and statistics in carrying out epistemological justification (Kaelan, 2012: 5). Not using calculations and additions, the qualitative method places more emphasis on the natural aspect of quality because it involves understanding, the concept of value and the characteristics inherent in the research object. This research is descriptive in nature, where descriptive research is research that attempts to describe events and happenings that are currently occurring, and focuses attention on actual problems as they exist at the time the research takes place (Noor, 2012: 34). This research will describe the research object, namely the interpretation of the photo work Rejang For Sale by Putu Dudyk, the interpretation will be carried out on stories and visuals.

3. RELATED RESEARCH

Hans-Georg Gadamer (1900-2002), a figure in dialogical hermeneutics, for him correct understanding is understanding that leads to the ontological, not methodological, level. This means that truth can be achieved not through methods, but through dialectics by asking many questions. Thus, language becomes a very important medium for dialogue to occur.

Hermeneutic methodology is a building block of epistemology that has been studied by many philosophers, one of whom is Hans Georg Gadamer (1900-2002). His famous book was entitled Truth and Method, but Gadamer did not intend to make hermeneutics a method. According to Gadamer, hermeneutics is not just a matter of interpretive methodology, but rather an ontological interpretation, namely that understanding itself is an effort to interpret a text, whether religious or other texts such as art and history.

Photography basically means a method for producing images or photos of an object by recording the reflection of light hitting the object using light-sensitive media, namely a camera (Sukarya, 2009:10). Sukarya also added that the art of photography is the art of seeing. A photographer is required to be able to see everything in a unique way. The ability to process feelings, ideas/concepts and control light is something that is the basis of photography. Every form of work produced from photography has nothing but a goal and concept of creation which starts from a basic idea which develops into a practical implementation with the support of equipment and techniques expressed through visual language. Basic shooting techniques are something that must be mastered in order to produce good photos. The criteria for a good photo are actually different for each person. However, there is a common opinion that can be used as a reference. A good photo has shooting techniques, lighting (Exposure), composition, shooting angle (Angle).

4. RESULTS AND DISCUSSION

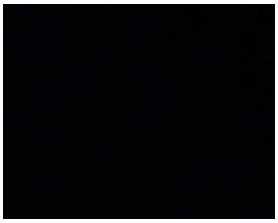
This research will be divided into several interpretive stages so that it is easy to interpret the photo work "Rejang For Sale" by Putu Dudyk.
This is a consideration in selecting this photographic work, seen from the perspective of the work which has a very strong meaning towards social criticism related to phenomena currently occurring in society, an academic lecturer and professional photographer who is also a member of the Bali Photographers Association, and has had many photographic works produced. produced, he also won several awards, and was invited to be a resource person at national and international activities. From this biography, the researcher is interested in discussing one of Putu Dudyk's works, the most recent work this year which is the focus of the research is a photographic work entitled "Rejang For Sale". beautiful but can also be used as a medium for criticism. The concept of this work is very strong in determining the character and emotions of each model so that it can convey what it wants to be conveyed to viewers of photographic works.



Figure 1: Photo of Rejang For Sale
(Source: Author)

Apart from the concept of art, it is further discussed from the perspective of the interpreter (writer) from existing knowledge and understanding. Interpreters focus more on the main object of Dudyk's photographic work, namely Rejang For Sale, and the title attached to the photographic work for cultural criticism which has been sold commercially, where something that was once sacred is now simply sold, judging by its beauty and beauty. attractiveness to be commercialized. Photography is known for many genres, and in studio photography there are several types of photos to differentiate one style from another. Dudyk's photo can be categorized as a conceptual artistic photo. Where making a photo always starts with determining the concept and idea so that the work you want to create is exactly what you want and can represent the photographer's own feelings (Dudyk).

Table 1. Photo Work Result

Figure	Karya
	The overall photo shows three dancer models as objects, each has a role that is set according to the concept of the photo work, the three dancers use the attributes and decorations of rejang dancers, one dancer poses beautifully dancing the rejang movement, two dancers are packaged with plastic like a the work that will be sent to consumers, with different poses emphasizes the overall packaging
	Black is used in the background to emphasize the disapproval or sadness that occurs in current phenomena that commercialize culture, especially sacred dances which previously were only performed or danced during religious ceremonies.

	The addition of plastic bags is interpreted as packaging which is usually used to wrap goods or works that are bought and sold
	The expressions displayed are very flat and full of meaning.

1. Rejang Dance

Rejang dance is a traditional dance in Bali which is danced by women in groups or en masse. There are several types of Rejang dance, namely: Rejang Renteng, Rejang Bengkel, Rejang Ayodpadi, Rejang Galuh, Rejang Pelak, Rejang Membingin, Rejang Makitut, Rejang Haja, Rejang Negara and Rejang Dewa. For the last one, namely the Rejang Dewa dance, which has special features compared to the others. Because this dance cannot be performed in any place, but can only be performed in places that are considered sacred by Hindus. Namely in the jero (inner) or jabe (outer) middle courtyard of a temple and during religious ceremonies. For example, during the peak ceremony of *Ngenteg Linggih*.

The Rejang Dewa dance is a sacred dance to complete Hindu ritual activities in Bali, performed in groups by women who have never experienced menstruation. The Rejang Dewa dance is called a sacred dance or offering dance because it is a symbol of the angels who lead Bathara/Gods down to earth to reside in sacred objects (*pratima*) in the temple. (disbud.bulelengkab.go.id)

The dancers are generally women of elementary school (SD) age, wearing traditional Balinese clothing in white and yellow with head jewelry made from coconut leaves. They dance to complete religious ceremonies, whether held in family holy places (*merajan)* or in temples within traditional villages (*pekraman*).

2. Balinese culture

Balinese art and culture is an identity that makes Bali well known to the outside world, therefore the government and Balinese people have an interest in protecting and preserving Balinese art and culture so that it remains intact and is not polluted by external cultural influences. Identity will refer to the image or image of a nation (Tilaar, 2007:35). The Balinese identity that has been formed as an image that is understood by outsiders towards Bali,

Balinese culture then became popular culture since 1930, which in simple terms, mass culture is popular culture produced through mass production industrial techniques and marketed to gain profits to the mass consumer audience (Strinati, 2010: 36). This has been done since 1930 with the development of the men's choir in the Sang Hyang dance into Kecak performance art by Walter Spies and Baryl de Zoete together with the art scene in Bedulu, Gianyar, Bali (Bandem, 1983: 42). Kecak then became a commercial art that could bring in money, thus Kecak was mass produced and had its own standards.

Interpretation of Indonesian Culture. Indonesia, which has more than 1500 ethnic groups, is a paradise for the development of understanding culture. Therefore, cultural diversity and cultural plurality are consequences that bring benefits to enrich culture. With hermeneutics, cultural traditions are not erased, but are maintained and even stimulated to be inspired and reintegrated, both in the context of ethnic cultural encounters within national culture and in the context of cultural encounters between nations (Poespoprodjo, 2004: 143).

5. CONCLUSION

An academic photographer who in the process of creating a work always determines the concept for creating a photographic work, where Putu Dudyk packages problems that occur in society into photographic works. Taking into account technical and photographic elements. The work entitled "Rejang For Sale" is full of meaning and outbursts of disagreement with the increasingly commercialization of Balinese culture, where the rejang dance was once very sacred and was only performed at sacred religious events. It can be seen from the visuals that the photographs created are full of meaning, where the rejang dancer's object is chosen by determining the composition in a row with each model acting out an expression that is full of meaning. So the work "Rejang For Sale" received an award following an exhibition in China. With hermeneutics, Hans-Georg Gadamer can interpret photographic works in detail and clearly what a photographer wants to convey in his work.

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IDENTIFYING FAKE ACCOUNTS IN SOCIAL MEDIA COMMERCIAL VIDEOS USING SUPPORT VECTOR MACHINE METHOD

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ABSTRACT

In today's society, many fake accounts actively comment on commercial videos on social media, especially Instagram. These fake accounts are often used to manipulate public perception of certain products or services, either to improve the product image and the image of the influencer, to damage the reputation of competitors. Therefore, this research applies the Support Vector Machine (SVM) method to detect and classify fake accounts based on characteristics such as number of followers, interactions, and activity patterns. SVM was chosen because of its ability to handle classification problems with a high degree of accuracy and the ability to separate complex data. The results showed that the SVM model was able to achieve 71% accuracy, with 68% precision, 84% recall, and 75% f1-score. These numbers indicate that SVM is quite effective in detecting fake accounts. The SVM model successfully identified a number of fake accounts with uniform interaction patterns and unusual activity, suggesting that most fake accounts tend to make repetitive and inauthentic comments. This research successfully contributes to the development of techniques to tackle the abuse of fake accounts on social media, thereby reducing the negative impact on consumer perception of commercial videos on the Instagram platform.

Keywords: Fake Account, Commercial Video, Social Media, Instagram, Support Vector Machine

1. INTRODUCTION

In today's society, social media plays an important role in our daily lives as a means of communicating and sharing information. Many businesses also use social media as a marketing tool or as a platform to listen to customer feedback, criticism, and opinions (Sahputri et al., 2023). Content marketing is recommended as the most effective online marketing approach (Hikmah Nur Karimah & Fadillah, 2021). Content that contains advertisements or promotions is commonly referred to as commercial videos. One of the social media that is often used to promote businesses through commercial videos is Instagram. Businesses engaged in products and services in Indonesia today have realized the potential of Instagram social media as a means to increase sales by marketing and promoting through product/service uploads wrapped in creativity so that it will attract an Instagram audience that has never been reached before (Adawiyah & Boer, 2023). Where Indonesia itself is the 4th largest Instagram user country in the world, with a total of 104.8 million users in October 2023 (Moh. Fatur Gifahri et al., 2024). However, based on observations that have been made on one of the commercial videos on Instagram, many comments are found that contain the same sentence but are given by different

accounts with criteria that refer to fake accounts on the accounts that give these comments. This can be done to increase the credibility of the business brand or to enhance the image of the influencer in the commercial video. This is one of the biggest challenges for businesses in influencer marketing to ensure that the selected influencer has a relevant and authentic audience (Adellia, 2024). In the creation of bots or fake accounts, often the creation of fake accounts uses false or stolen identity information such as names or photos of other people. This is regulated in Article 35 of Law Number 11 of 2008 concerning Electronic Information and Transactions which reads "Every person intentionally and without rights or against the law manipulates, creates, changes, removes, destroys Electronic Information and / or Electronic Documents with the aim that the Electronic Information and / or Electronic Documents are considered as authentic data" (Louis Paskalis Dwinanto, Diana RW Napitupulu, 2024). Therefore, researchers conducted research to identify fake accounts contained in social media commercial videos on Instagram to find out how to identify fake accounts in a commercial video, and find out what criteria are more valid for classifying fake accounts and real accounts on Instagram.

In this study, researchers used the Support Vector Machine method algorithm for the classification process. Support Vector Machine is one of the classification methods using machine learning (supervised learning) methods that predict classes based on patterns from the results of the training process (Siti Aisah et al., 2024). The SVM algorithm model is one of the algorithms of the classification method, which works by finding a line (hyperplane) to separate two groups of data (Yanti & Asana, 2023). The results of the study are expected to reduce the number of spam and fake comments by fake accounts on Instagram and add references for further research in the future.

2. RESEARCH METHODOLOGY

2.1 Research Flow

In this research , researchers take several steps or processes to get the results and conclusions of the research conducted. The following is the research flow that will be carried out:

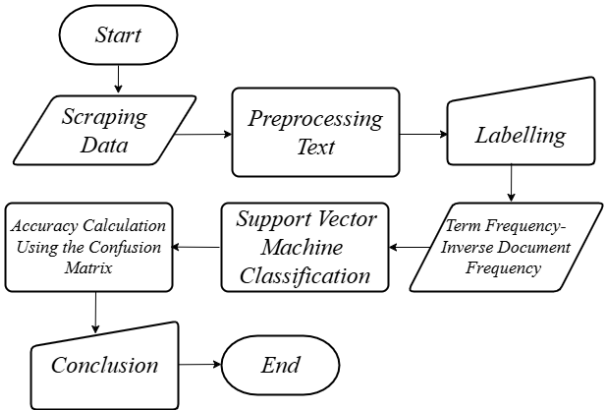


Figure 1. Research Flow

Data from Instagram accounts that comment on commercial videos is scraped for the research. After data collection, preparation comprises text cleaning, case folding, followers following ratio, and bio word count. Next, classify the data to detect false and real accounts using preset criteria. TF-IDF converts text data into numerical features. It then undergoes SVM classification. Next, confusion matrix evaluates model performance. A confusion matrix shows the number of true positives, true negatives, false positives, and false negatives to assess method accuracy (Aditya et al., 2022; Armaeni et al., 2024). Then precision, recall, f1-score, and accuracy may be determined to evaluate the model.

2.2 Data Scraping

The activity of processing data, or rather extracting data from the web or social media to find out the patterns hidden in it is called scraping, the advantage of the scraping process is that it can quickly collect data (Yuniar et al., 2022). This data scraping process was carried out from September 15, 2024 to October 20, 2024. The data consists of 335 account records, representing the total number of accounts that commented on the commercial video.

Table 1 Data Scraping

User name	Bio	Followers	Following	Mentions in last 10 posts	Total Posts	Total Likes in Last 10 Posts	Total Comments in Last 10 Posts
fittrimaulyda	Kunfayakun Always be grateful	15	55	0	7	1	0
dheiz_is	I'm just an ordinary woman 🤦 - Iis nurhasanah 🧥	424	517	0	119	35	5
adelianurfafiza	ESFP ↗️🐯💗🌹 Mom of double R Fashion - Beauty - Lifestyle - Kpop 💚💜	21	29	0	29	7	1
tanti.ynti	tanti ajah	10	290	0	6	7	0
yund_adian	I from Probolinggo - East Java	16	93	0	4	6	0

2.3 Preprocessing

The preprocessing stage is the initial stage to prepare documents to make them easier to process (Alamsyah et al., 2023). Preprocessing is one of the steps in eliminating problems that can interfere with the results of the data classification process (Purbolaksono et al., 2021). The first step is the cleaning process, which involves removing special characters, punctuation, and irrelevant elements to prepare the data for further analysis. Next, a case folding step converts all text to lowercase, eliminating discrepancies caused by uppercase and lowercase variations. The process continues by calculating the Followers-to-Following Ratio, often used as an indicator to identify fake accounts. Additionally, the number of words in the user profile bio (Bio Word Count) is calculated, as fake accounts often have very short or empty bios. The analyzed data is then saved in .csv format to facilitate further processing.

2.4 Labelling

The labeling process is carried out to label the data which will then be stored in the dataset for the Data Splitting process (Duei Putri et al., 2022). In social media fake account identification, data labeling involves marking accounts as "fake" or "real" based on various features or patterns found in the account's behavior.

Table 2 Data Labeling

User name	Bio	Followers	Following	Mentions in last 10 posts	Total Posts	Total Likes in Last 10 Posts	Total Comments in Last 10 Posts	Followers Following Ratio	Bio Word Count	Label
melisa_ajeee		44	343	0	1	9	0	0	0	Fake
anastawury	1 Corinthians 2 9 Im not lucky im blessed	8868	632	4	201	276	4	1	9	Real
mikaylalala08	Updating yourself	17	29	0	0	0	0	0	4	Fake
ndaa_1915	brass west java	103	676	0	0	0	0	0	3	Fake
henriefranko		486	392	0	84	0	0	1	0	Real

The result of the labeling process is visualized in the following graph:

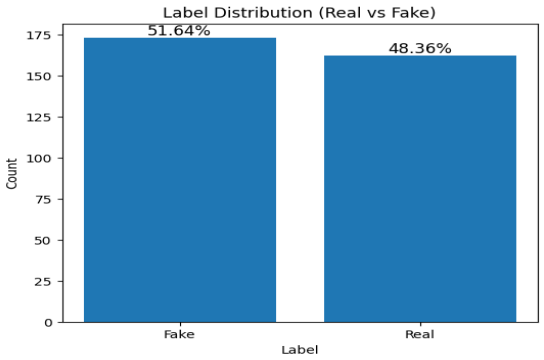


Figure 2. Labeling Data Graph

The figure above shows the distribution of fake and real labels on the Instagram account dataset after the labeling process. The percentage of accounts labeled as Fake is 51.64% which is a total of 173 accounts, while accounts labeled as Real is 48.36% which is 164 accounts. This graph provides a visual representation of the proportion of fake and real accounts in the data, with Fake accounts slightly outnumbering Real accounts.

2.5 Data Splitting

In this research, data is divided into 2, namely as training data and test data. Training data is used to train and model the hidden features/patterns in the data. While test data is separate data that is used to test the performance of the model after completing training(Ernianti Hasibuan & Elmo Allistair Heriyanto, 2022). A total of 100 account records were designated as training data, while the remaining 235 account records were automatically assigned as testing data. Increasing the amount of data, particularly in the training data set, allows the model to learn from more information, thereby enhancing its potential to improve accuracy in identifying fake accounts.

2.6 Term Frequency Inverse Document Frequency

TF-IDF (Term Frequency Inverse Document Frequency) is a method for calculating the weight of each word in a document and also a set of documents, the weight being an important presentation for a word in a document. The greater the weight, making the word's role more important in the presentation of a document. (Danu, 2021). In this research, TF-IDF aims to convert text data into numeric in order to enter the classification process. It converts the text in the bio column into numerical features that represent the frequency of words in the text.

3. RELATED RESEARCH

Research conducted by (Putra et al., 2019) found that the SVM algorithm detected bogus Twitter accounts with 93.42% accuracy utilizing tweet characteristics, geolocation, and account status. SVM outperformed Naïve Bayes in detecting false reviews on Tokopedia (91.57%) with 94.38%) accuracy (Alamsyah et al., 2023). On Instagram, (Gunawan et al., 2022) explained how to spot fraudulent accounts. These criteria are description length, #post, the ratio of followers to followings, and #followers. (Wanda et al., 2021) investigates using the Recurrent Neural Network (RNN) method to detect bogus OSN accounts. This research found that RNN fake account classification can achieve high accuracy with little losses. According to research (Yunianto & Mada, 2021) using Bayesian Inference to calculate the probability of a fake Instagram account, parameters like the length of the biography description, accounts without profiles, non-private accounts, and accounts with few media increase the likelihood of a fake account. Dewi (2021) used SMOTE-NC and CatBoost to classify Instagram phony accounts with 98.04% accuracy.

4. RESULTS AND DISCUSSION

4.1 Model Prediction Results

After the model is trained and tested on the test data, predictions are made using the SVM model on the test data. After obtaining the prediction results, the number of predictions classified as fake and real is calculated. These results are then visualized in the form of a bar graph to show the distribution of model predictions between the two classes.

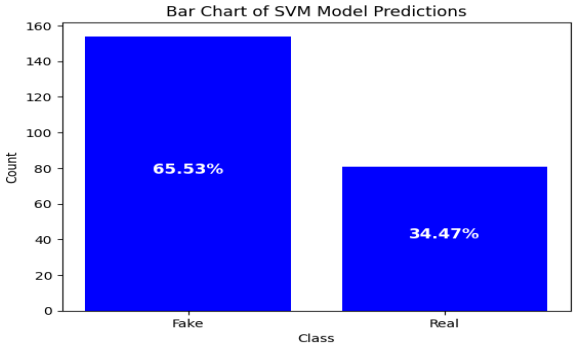


Figure 3. Graph of Model Prediction Results 1

From the picture above, we can see the results of the model prediction on the test data. Predictions in the "Fake" class are 65.53%, namely a total of 154 account data, while for the "Real" class there is a percentage of 34.47%, namely a total of 81 account data. The classification report illustrates how well the support vector machine model is able to distinguish between fake and real classes in the test data.

4.2 Model Evaluation

Evaluate the performance of the SVM classification model on test data using several evaluation metrics commonly used in classification model evaluation, namely accuracy, precision, recall, and F1-score.

Table 3. Model Evaluation

Accuracy	71%
Precision	68%
Recall	84%
F1-score	75%

The results of the model performance evaluation using the Support Vector Machine method are presented in Table 3, showing a fairly good performance in predicting fake and real labels on Instagram accounts. With an accuracy of 0.71, the model is able to correctly predict the label in about 71% of all observed cases. The precision of 0.68 indicates that about 68% of the examples predicted as "fake" by the model are indeed "fake." Recall of 0.84 indicates that the model successfully identified about 84% of all "fake" accounts. Furthermore, the F1-score of 0.75 illustrates a good balance between precision and recall, showing consistent performance in both aspects for the identification of "fake" accounts.

4.3 Model Evaluation with Confusion Matrix

The evaluation process is carried out after the classification process, where the goal is to measure the performance of a model in data classification. The following confusion matrix shows the results of true positive, false positive, true negative, and false negative.

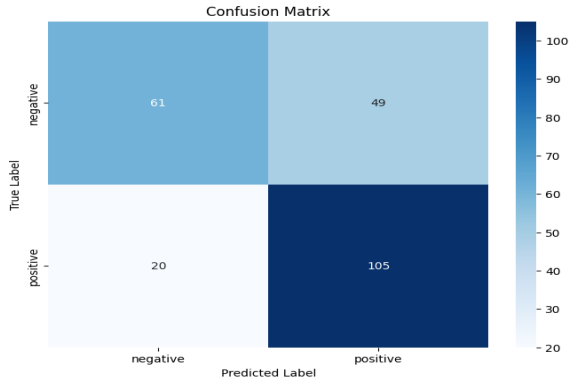


Figure 4. Confusion Matrix

The confusion matrix above shows the performance of the SVM model in classifying Instagram accounts as fake (positive) or "real" (negative). From these results, the model successfully classified 105 "fake" accounts correctly as "positive" (True Positive) and 61 "real" accounts correctly as "negative" (True Negative). However, there were 49 "real" accounts that were incorrectly classified as "fake" (False Positive) and 20 "fake" accounts that were incorrectly classified as "real" (False Negative).

5. CONCLUSION

From the results of the conducted research, the following conclusions were drawn:

1. This study demonstrates that the Support Vector Machine (SVM) method is effective in detecting fake accounts in commercial video comments on Instagram, achieving an accuracy of 71%.

2. Evaluation metrics indicate good model performance, with a precision of 68%, recall of 84%, and an F1-score of 75%, although some errors in identifying genuine accounts as fake were observed.
3. Fake accounts in commercial video comments generally exhibit specific characteristics, such as a low number of followers, short or empty bio word counts, and low activity and interaction levels.
4. The SVM method can identify uniform and invalid comment patterns frequently used by fake accounts to manipulate the image of a product or influencer.
5. This research contributes to reducing the negative impact of fake accounts on social media, particularly in product promotion contexts, while protecting users from potential fraud and manipulation on the Instagram platform.

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DESIGNING VISUAL COMMUNICATION MEDIA ABOUT EDUCATION WITH THE CONCEPT OF FUN LEARNING TO TRAIN FINE MOTOR SKILLS IN EARLY CHILDHOOD

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ABSTRACT

ICT in the classroom can enhance learning resources for teachers by providing access to nonverbal and verbal presentation modes, enabling teachers to use various media to help students develop their fine motor abilities. Early childhood education, which prepares children for further education, often struggles with sensitive motor development elements. This study explores the value of visual communication media about education in video tutorials with fun learning concept, such as making shapes with plasticine and telling folk stories, to train fine motor skills and cultivate good character in early childhood. The process is divided into three stages: pre-production, production, and post-production. Observations showed that students could determine shapes and colors without video, but needed to focus on softening the plasticine. After the video was shown and with teacher assistance, students succeeded in making apple and turtle shapes. The teacher also emphasizes the moral messages of the story. Testing on material and media experts concluded that this educational media can be used or recommended as a learning media for early childhood.

Keywords: Early childhood*, educational media, fine motor skills, fun learning.*

1. INTRODUCTION

A child's early years are a time of rapid development essential to their future existence. Children in their early years enjoy movement (do not want to be quiet), are distinct, active, curious, enjoy trying new things, can express themselves creatively, have imagination, and want to converse. Additionally, early infancy exhibits impulsive behaviour, is still easily irritated, acts carelessly, has a short attention span, is enthusiastic about learning, gains much knowledge from experience, and becomes more interested in friends. Children's early years are sometimes called the "golden age" because this is when their intelligence begins to develop. According to Harefa et al. (2022) and Hasanah & Deiniatur (2018), children require extra care from their environment during this era of prosperity. Early childhood education must be appropriate for the child's development and traits since if the golden age is missed, their growth and development will not be at their best.

Early childhood education is a level of education that comes before primary education to prepare children for further education, which is offered through formal, non-formal, and informal channels. It is one of the coaching efforts designed for children from birth to age six. It provides educational stimuli to help children grow and develop physically and spiritually (Nuraeni & Gunawan, 2022). Early childhood education aims to foster all facets of a child's development, including their religious beliefs, moral principles, motor skills, language, cognitive abilities, artistic abilities, and social-emotional skills. Together, these six facets of action need to be developed and enhanced in a sustainable and well-balanced way. Since these six factors are

connected, this premise is accurate. The physical and fine motor skills of children are vital to their development.

Nonetheless, many kids still struggle with sensitive motor development elements that aren't sufficiently stimulated. This is still not the best way to learn youngsters' motor skills in the "starting to develop" developmental stage. These include a youngster who has trouble holding a pencil correctly, struggles to write letters and numbers, and struggles to understand what they write. This occurs due to students being disinterested in the media and teaching strategies employed in the classroom. Using engaging and enjoyable media to grow and encourage children's development properly is preferable. According to Agustina et al. (2018), children's fine motor skills can be divided into four categories: pinching, holding, focus, and hand-eye coordination. Finely controlled movements are a component of fine motor abilities. Fine motor abilities are demonstrated by having a toy, buttoning a blouse, or performing any other task requiring dexterity. Children's ability to establish and execute elegant muscular movements in coordination and agility, as well as talent using hands and fingers, is a component of their development of fine motor skills.

Play can help to improve and stimulate fine motor skills. Among these is the use of educational media. The Latin medius, which signifies the midst of an introduction or intermediary, is where the word media originates. Known as distributors or liaisons for teaching messages, instructional media are learning resources created or held by educators in a planned way that are not instructors. In a nutshell, the media are material, human occurrences that create circumstances that allow students to acquire information, abilities, or attitudes. Children's sensory organs are significantly impacted when media is used in teaching and learning activities. Using media will ensure that the lesson's topic is better understood.
Additionally, educational media can elicit and immerse pupils in a joyful and contented environment where they are emotionally and cognitively engaged. The efficacy of the learning process and the dissemination of messages and learning materials during the learning orientation stage will be greatly enhanced by using instructional media. Learning media can assist students in growing in all areas of their development and igniting their enthusiasm and interest (Sari, 2015).

Teachers can use a variety of media to assist students in developing their fine motor abilities. For kids with bodily-kinesthetic intelligence, fine motor abilities also serve as a bridge. These include children's play activities, their ability to manage and coordinate their body motions, and their use of particular equipment. Furthermore, from a social perspective, children who have developed fine motor abilities are better able to confidently engage with others and their surroundings, which fosters a positive self-image. Installing and unfastening buttons and zippers, cutting paper with scissors, and handling a form in one hand are all activities that need coordination of finger motions, which is a component of fine motor abilities. On the other hand, it is used for writing, drawing, and other tasks. Others can create shapes by folding paper, mixing beads, using plasticine or a vase, and inserting a thread into a needle (Nurwita, 2019).

Media for learning must be based on a child's developmental stage. The foundation for the development of other components is motor physical development. Assume that the child's ability to grow physically and motor skills is impaired. Given that children's physical development is adequate to define their motor activity, which influences their everyday activities and behavior, this will impact growth in the following areas. Similarly, the development of motor skills will result in more intricate social movements, namely play activities, that become the early childhood learning environment (Komaini et al., 2021). Children's world is the realm of play; they spend most of their time engaging in play activities. Children learn through play.

In this project, we will test a research methodology for kindergarten in the Denpasar region of Bali, Indonesia. The research object is a school that falls under the early childhood education category, which refers to all educational initiatives aimed at supporting children's learning and development from birth to age six by offering a variety of comprehensive, integrated, and developing experiences and stimuli that promote positive growth and development. Healthy and ideal are based on the chosen values and way of life (Sutedjo & Prilosadoso, 2016). Breakthroughs in science and technology positively impact improvements in education. According to Yelland (2001), the use of ICT (information and communication technology) in the classroom can enhance the learning resources available to teachers by giving them access to resources and questions that would be impossible without ICT, giving students access to more engaging learning materials, and benefiting the teacher as well. It will make learning more comfortable (Schiller & Tillett, 2004).
One aspect of technology and communication is the rise of visual communication-based learning, such as video, which is now utilized in primary and preschool education.

Technology and information advancements have made it possible to combine nonverbal presentation modes—such as graphics, video, animation, and sound—with verbal presentation modes, such as different narratives and texts on a monitor screen, all within a single device—computers, gadgets, and other devices (Moreno & Mayer, 1999). The best way to support early childhood learning strategies is through optical media in the form of video tutorial media. According to Olsen's (1994) presentation, information and communication technology's (ICT) potential is crucial today and serves as the primary basis for educational reform, particularly initiatives to accomplish student-centered learning objectives (Schiller & Tillett, 2004). Therefore, this study will discuss the value of educational media in video tutorials making various shapes by plasticine with fun learning concepts while telling folk stories to train fine motor skills and cultivate good character for early childhood.

2. DATA COLLECTION METHOD

This study was made based on research from observation, interview, research literature, and documentations. Observation is “a data collection method in which a person (usually trained) observes subjects of phenomena and records information about their characteristics”. (Sproull, 1988) Science starts with observation and validates discoveries by observation. Observation was made at Widya Kumara Sari Kindergarten, Denpasar, Bali, Indonesia by recording how learning activities train fine motor skills and cultivation of good character.

Interviews are qualitative research methods that acquire data through questions. Two or more individuals interview, with one asking questions. Different types of interviews differ in structure. Data collection through interviews was carried out with the Principal of kindergarten.

This research employs a literature review methodology by analyzing various scholarly journals pertinent to fine motor skills and educational media. The employed data-gathering strategy is documentation, specifically utilizing literature such as papers and scientific publications relevant to the research themes. Literature studies will be utilized to determine fine motor skills using educational media. Meanwhile, documentation techniques complement the use of observation and interview methods. Data obtained through documentation methods is in the form of a photo of the semester program document, RPPM (Weekly Learning Implementation Plan) and Widya Kumara Sari Denpasar Kindergarten school atmosphere. For media testing, researchers use observation and interview to gather data from respondents. Written or oral questions are asked in an interview-style setting.

3. RELATED RESEARCH

In this section, we briefly introduce some related works in literature.

In (Hendraningrat et al, 2021), This study uses 2009 ADDIE development research paradigm. This study involves one instructor and 18 3- to 4-year-olds. Data from the efficacy test shows that digital media improves children's fine motor skills. Video tutorials boost children's fine motor skills, according to studies. In class action research, 81.25% of children had complete fine motor abilities.

In (Tadoranggi et al, 2022), This study included 5-6-year-olds at GKST Kindergarten in Poso Regency. The child's fine motor abilities improve 50-70% during the first encounter. The child's ability grew to 80.00% in the second meeting and 90.00% at the third. This study concludes that playing with plasticine can improve children's fine motor skills.

In (Fitroh et al, 2015), This study investigates whether fairytales help early childhood pupils develop character. Legends are fictional stories that teach character and create good character traits that set them apart. The sample was 15 students ages 2.5–3.5 from PAUD Kasih Ibu, Murukan Mojoagung Jombang's group A-2. Qualitative research including file observation and interviews was performed. This research suggests that fairytales are beneficial character-building material for early childhood students. To develop students' character, accustomed and example are essential.

In (Dini, 2022), In this study, they develop scientific literacy learning videos for children learning from home early 5-6 years with the theme of the universe and subthemes of shadows and inner wind. The use of learning videos can increase children's knowledge about shadows and wind. Thus, the development of this learning video stated to be very feasible, very practical, and very effective.

4. RESULTS AND DISCUSSION

The following process which is divided into 3 stages, namely pre-production stage, production stage, and post-production stage. In pre-production, research, design, concept, storyboard, and determine the audio. The second stage is production, where there are shooting, work areas, and voice-over. The final stage is post-production, namely merging all the images that have been taken unification voice over to rendering. After the realization of video media, testing will be carried out to find out the feasibility of the video so that later, it can be used as teaching material by teachers at school for children's learning process.

Pre-production

In pre-production, research, design, concept, storyboard, and determine the audio. The concept of this learning media is starting from an introduction to fine motor training, how to maintain it and the benefits of fine motor learning using plasticine media, which is packaged with fun learning concepts, as well as in language that is easy for early childhood to understand. We chose plasticine media because it is easy to use and fun to make to resemble the original shape (3 dimensions), where early childhood want to hone their motor skills by touching and squeezing objects with their ten fingers. This study used the shapes of fruits and animals because those shapes are related to learning at school, are easy to make, and are easy to remember.

In this case, we are present the learning media design in an innovative, creative way that meets the criteria of interactive multimedia. So that later learning media can be

realized as acceptable and able to provide benefits for teachers and students. So, the educational media that will be designed is learning videos to form animals and fruit, which will then be made into educational stories. The story is taken in the form of a story entitled "Turtle and Monkey", an adaptation of a tantric story, namely a folk tale that contains learning and educational concepts and a moral message for early childhood learning.

In the work visualization, the video consists of 15 scenes. Figure 1 shows an example of visual scenes.

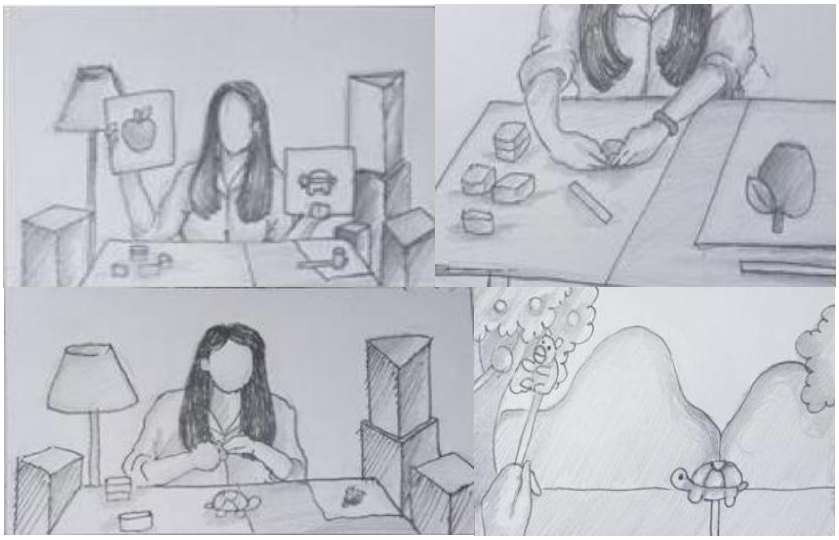


Figure 1. An example of visual scenes.
(Source: Personal, 2024)

Production

The production stage is the stage for producing videos. The following are several stages of the production process carried out:

a. Preparing the camera. The camera will use a video setting with 1080p resolution with a frame rate of 60fps.
b. The shooting technique involves taking pictures with the camera lens and camera head in a static position.
c. Record voiceovers, change soundtracks, as well fonts for video purposes.
d. Take videos at the specified studio location.

Post-production

At this stage, all recorded footage and audio are edited using Adobe Premiere Pro 2022 software.

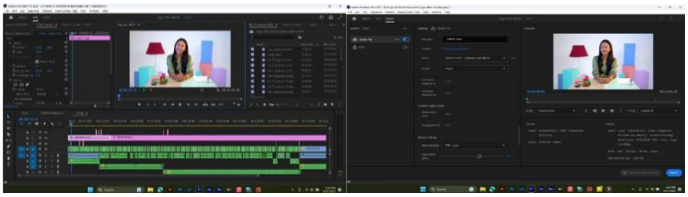


Figure 2. An editing and rendering process.
(Source: Personal, 2024)



Figure 3. Visualization of works.
(Source: Personal, 2024)

Distribution and Media Testing

Educational media was distributed to Widya Kumara Sari Kindergarten by showing it at school and watching it to 18 early childhood students. Before the video aired, we conducted interviews with several students. Most of the students are familiar with plasticine media. We ask students to make various shapes according to their creations. From the observation results, most of them could determine what shape to make and choose the color of the plasticine. However, most of them still need to focus on softening plasticine, so they often fail to make shapes. Children still need guidance and direction from the teacher to focus on softening the plasticine and making the desired shape.

After the video was shown and directed by the teacher, most of the students began to be able to focus and concentrate on the plasticine softening process, so they were able to produce apple and turtle shapes successfully. After the video was shown and directed by the teacher, most of the students began to be able to focus and concentrate on the plasticine softening process, so they were able to produce apple and turtle shapes successfully. Apart from that, when the video was shown, the children seemed enthusiastic and entertained by the story of the monkey and turtle. The teacher emphasizes the moral messages of the story to students.



Figure 4. Distribution and media testing.
(Source: Personal, 2024)

5. CONCLUSION

The fun learning concept or the fun education concept of using plasticine as a media was chosen as a method for training fine motor skills and cultivate good character in early childhood. The fun learning concept is a learning concept to develop children's creativity. The benefit of fun learning is that it makes it easier for early children to understand and express it because the learning media used in this research is visual/video based. The use of plasticine media was chosen because it is a medium that is easy to shape according to the imagination of an early children. In this educational media, early childhood children are trained to be able to learn while playing with plasticine, and character education is included through folklore told by

the speaker. From the results of observations when the video had not been shown, most of the students could determine what shape they wanted to make and choose the color. However, most students needed to focus and concentrate on softening the plasticine. After the video was shown and assistance from the teacher, most of the students could focus and concentrate on softening the plasticine. They succeeded in making apple and turtle shapes. The students seemed enthusiastic and entertained when they showed a video showing a story about a monkey and a turtle. The teacher also emphasizes the moral messages of the story. Testing of this work was also carried out on material experts and media experts, and it can be concluded that this learning video can be used or recommended as a learning media for early childhood.

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EXPLORATION OF CONVERTIBLE FASHION STYLES WITH BATIK PATTERN COMBINATION TECHNIQUE

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ABSTRACT

The increasing consumerist lifestyle of society has led to a surge in fashion waste and the proliferation of fast fashion production. This is driven by the societal need to present different styles on various occasions. Additionally, there is an issue where people are reluctant to use batik fabric for daily activities due to its perceived outdated design or the notion that it is only suitable for formal events. Therefore, the author conducted research using industrial visits, literature studies, interviews, and Google Forms questionnaires to find solutions to the issues of fashion waste, equal distribution, and cultural preservation. This research aims to merge sustainability and cultural preservation by creating convertible clothing that combines batik motifs with casual ready-to-wear fashion. The hope is that the products created by the author can educate the public and benefit various stakeholders, particularly local batik artisans, emphasizing the importance of preventing and reducing fashion waste without adopting a consumptive lifestyle. The goal is to enable individuals to maintain a comfortable and fashionable appearance on various occasions.

Keywords: *fashion waste, cultural preservation, convertible clothing, batik combination, ready to wear*

1. INTRODUCTION

Indonesia, as a country with abundant cultural wealth and a very valuable cultural heritage. One of the cultures that is a source of pride for the Indonesian nation is batik. Batik is a traditional cloth adorned with distinctive Indonesian patterns and motifs. Batik not only serves as a symbol of Indonesian national identity but also as one of the fashion trends that continue to evolve. Batik was designated as an Indonesian Cultural Heritage (intangible cultural heritage) by UNESCO (United Nations Educational, Scientific and Cultural Organization) on October 2, 2009 (Ari Wulandari- 2011). Since then, every October 2nd has been commemorated as National Batik Day.

Batik comes from the Javanese words "amba" and "titik," which mean to write dots. Batik is closely tied to Javanese culture, although it also interacts with other cultures. Javanese batik has various motifs that are rich in life philosophy. [2] (Yunus & Tulasi,-2012)

Among the various types of batik, one of them is Combination Batik. This batik is made using a writing technique with a canting and wax to form the desired motif details, then in the design completion process, stamps or seals are used. This batik is produced with the hope of creating more attractive motifs. However, there are still many people who are reluctant to use batik cloth as everyday clothing due to

its old-fashioned design, or because they consider its purchase to be "half-hearted" since it can only be used for formal events. Thus, this leads to a consumerist lifestyle where people buy many clothes intended for different occasions. Currently, more and more people are interested in fashion trends that successfully blend batik fabric into modern clothing and combine it with other materials. With the creation of designs that are more functional in the eyes of the public. The term for such clothing is convertible ready-to-wear fashion. According to Bernard in the foundational article on fashion style and trends, fashion style is the understanding of one's personality and using clothing according to personal taste. [3]

Ready-to-wear clothing is clothing that can be purchased and worn immediately without the need for body measurements and ordering the design in advance. [4] (Hana – 2011 ‘online article Ready to-wear) This type of clothing is commonly referred to as ready-to-wear. Meanwhile, convertible clothing according to Felicia Setiawan & Paulina Tjandrawibawa in the article (Designing Convertible Clothing for the Volatile Brand) [5] is practical clothing created by making multifunctional convertible garments. Clothes that are easily convertible can provide more than one look, allowing consumers to change their appearance in a short amount of time. The creation of this convertible fashion is based on the consumerist lifestyle of society. And it is aimed at reducing fashion waste. In an online news article titled "Fast Fashion Waste, The Forgotten Waste" (itsojt November 2022), it was reported that the clothing industry has contributed as the second-largest polluter in the world. He also added that as much as 1.2 billion tons of greenhouse gas emissions are produced by the textile industry worldwide. [6] With the hope that this combination of convertible batik fashion can make people fall in love with local products again, and can use clothes with various explored modes so that they do not need to buy many different clothes.

2. RESEARCH METODOLOGY

In the process of creating styles and convertible clothing with the technique of combining batik motifs into visual forms. So that it aligns with the desires of the community and the existing market target, without eliminating the elements or principles of the batik fabric itself. Therefore, based on the type and analysis, a Mixed Research Method combining quantitative and qualitative research, as well as case studies and field research, is used. Quantitative Method According to Robert Donmoyer (in Norjanah: 2014) [7], quantitative research is an approach to empirical studies to collect, analyze, and present data in numerical (number) form rather than narrative. This research is usually conducted when accurate results are desired because it relies on calculations. Meanwhile, the Qualitative Method in the form of narratives is obtained from interviews with several fashion designers who apply hand-drawn and stamped batik in their creations, batik craftsmen, and the community who appreciate fashion styles. In the data collection and analysis, a descriptive analysis method was used in the form of questionnaire completion with the help of the Google Form platform, which was carried out by elaborating on several questions related to batik fabric, convertible clothing, and combined batik motifs to respondents regarding their application in Ready-to-wear clothing. So that we can understand the public's response regarding the use, as well as suggestions and hopes for producers in the fashion industry, whether they are fashion designers, batik cloth artisans, or those who will eventually impact fashion trends themselves. The second data collection method is through observation methods such as interviews, as well as literature studies or visits to industries or fashion practitioners with the aim of accurately collecting data and understanding market demand or target market. Which can then be strengthened by conducting field observations related to observing convertible fashion styles with a combination technique of batik motifs between hand-drawn batik and stamped batik, thus producing abstract motifs through the application of both techniques. The data processing from the combined research method and observation uses the Batch Processing method, which involves periodic or simultaneous data processing

in "batches" or large groups. The data processing is carried out on the collected data and is not done in real-time. Batch processing is often used for large and complex processing tasks [8]. Where the aim is to explore previously unknown aspects, identify patterns and trends in the research, and ensure the alignment between findings and the information discovered. The data generated by the respondents will be sorted first, which will later produce interest percentages, starting from interest in the use of batik fabric, public interest in convertible ready-to-wear clothing, to the extent of public interest in the motifs of batik fabric with the combination technique that is expected to be produced later.

3. RELATED RESEARCH

According to Saputra, Batik is one of Indonesia's local cultural heritages that currently also needs preservation to maintain and sustain its existence amidst the rapid waves of modernization and globalization. Through the existence and preservation of batik amidst the rapid modernization, it is undeniable that the fashion industry has experienced rapid development driven by the consumerist lifestyle of society. The phenomenon of fast fashion has negative impacts such as increased textile waste and the exploitation of natural resources. On the other hand, cultural heritage such as batik faces challenges in acceptance within modern society, especially among the younger generation who tend to consider batik less flexible for everyday use. Therefore, innovative solutions are needed to address these two major issues: sustainability in fashion and the preservation of local culture..

4. RESULTS AND DISCUSSION

Literature study, also known as literature review, is the process of investigating and analyzing literature, research papers, and other written works relevant to a specific topic. The purpose of a literature study is to understand, evaluate, and synthesize information that already exists in the scientific or professional literature related to a particular subject or research question. In the process of creating this Final Project, the author conducted a literature study on several fashion designers and batik fabric artisans, including:

a. The Dwico brand, created by fashion designer Mr. Dwi Iskandar, who is quite well-known in Bali and even in Indonesia. The Dwico brand has been developing since 2001 until now, and has a studio located at Komplek Ruko Puri Gading Block B 01/ No. 1a – 1b in the Jimbaran Bali area. Starting with a modest beginning in 2001 with a small boutique in Sanur, Mr. Dwi Iskandar has embarked on an impressive journey, developing his studio into an entity that currently involves a team of 12 staff members. Known for his sophisticated designs, he combines modern and traditional fabrics in styles influenced by ethnic elements, creating colorful and unique results. In 2005, Dwi Iskandar launched dwico, focusing on the retail aspect, and dwico smart for uniforms. His knowledge of design and expertise in the hospitality field made him the top choice for leading hotel design projects in Bali and various countries. His love for Indonesian culture, art, and traditional fabrics is clearly reflected in his work. Currently, her dedication is not limited to the fashion world, but also encompasses a deep concern for principles such as reuse, reduction, and recycling.

His works have gained recognition through his participation in various fashion shows in different locations, including Indonesia, San Francisco, Hong Kong, Vietnam, and Seychelles. Dwi Iskandar also has experience designing dresses for contestants from Malta and Georgia in the Miss World 2013 event in Bali. Active in the fashion industry, he previously led APPMI Bali and IFC Bali, and currently serves as the Chairman of BEDO (Business and Export Development Organization), contributing to the growth and improvement of individuals and small

businesses in the fashion sector, promoting a spirit of learning and enhancement for their own benefit.

The data obtained by the author from literature studies and interviews with Mr. Dwi Iskandar indicate that the Dwico brand has several advantages, namely designs using zero waste techniques, showing concern for the environment, the use of batik or traditional Indonesian woven fabrics, providing a local identity, and the disadvantage of only using batik fabric with geometric patterns in most products. The author concludes that Dwico Fashion Studio characterizes itself as a pioneer of zero waste techniques with a focus on local materials, especially batik and woven fabrics. Although geometric patterns dominate, the studio has the potential to combine zero waste techniques with the uniqueness of hand-drawn batik patterns or combinations.

b. Batik Popiler was founded in 1962 by Mr. Wayan Matra and Mrs. Made Tunjung. In the fifties, Mrs. Tunjung made a living by trading spices. Her work brought her into regular contact with farmers in remote areas of Bali who always requested batik from the neighboring island, Java. Ibu Tunjung would make regular visits there, personally selecting the best samples, including very beautiful antique items, which were easier to obtain at that time. Her business was doing well, and she opened a batik store in Bali's capital, Denpasar – the first on the island. By 1976, the business had grown significantly, and a larger location was found in Tohpati, east of Denpasar. Mrs. Tunjung's daughter, Putu Arnany, took over the business in 1983 by adding bold contemporary designs and expanding the business into batik painting and various types of products. Currently, Batik Popiler II continues to set the standard for superior batik quality, with the same focus on tradition and design innovation.

We can not only buy beautiful batik at the Batik Popiler Headquarters, but they can also see many rare antique textiles that Mrs. Tunjung and her daughter have collected over the years and even gain insight into the intricate process of hand-making these beautiful textiles.

The data obtained by the author from literature studies and interviews with Mrs. Putu Arnany indicate that Batik Popiler has several advantages, namely the production of high-quality batik with a focus on tradition and design innovation while adhering to traditional values. However, there are also limitations, namely the absence of batik clothing that incorporates modern designs. The author can then conclude that Batik Popiler II maintains high quality and traditional values in its batik production. Nevertheless, design innovation is necessary to reach a broader market, especially by introducing batik clothing with modern designs.

Survey Data Results

Here are some questions included by the author related to this scientific article research, aimed at the community aged 15 – 55 years with various genders and occupations:

Table 1. Questionnaire Column

No	Question
1.	Name Respondent's
2.	Gender
3.	Respondent's Origin
4.	Respondent's Age

5.	Respondent's Occupation
6.	Did you know that Indonesia produces 2.3 million tons of clothing waste, and only 0.3 million tons of that waste can be recycled?
7.	If the author creates Convertible Clothing or multifunctional clothing made from batik fabric as shown in the picture below, aimed at reducing fashion waste and promoting Indonesia's cultural heritage, would the respondents be interested?
8.	From the multifunctional design above, where the clothing can be transformed into different shapes, do the respondents agree that this can reduce fashion waste?
9.	If viewed from the aesthetic composition, which design motif is the most attractive and most suitable to be applied to everyday clothing?
10.	According to your choice above, is that fashion style suitable for use on a resort vacation?

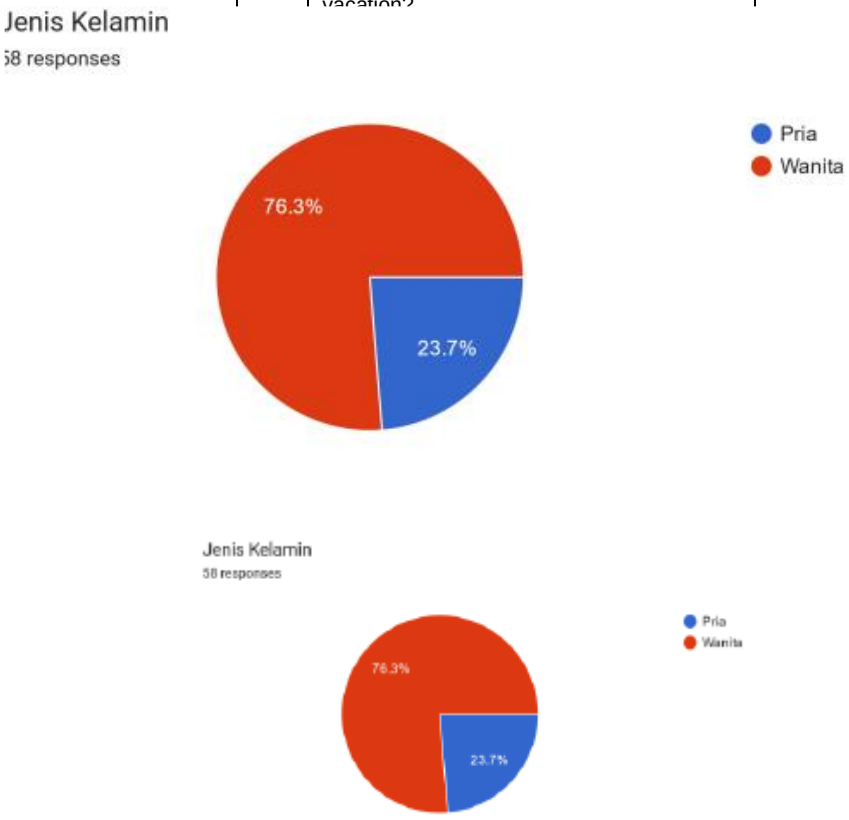


Figure 1. Percentage Diagram of the Questionnaire Respondents' Gender
(Source : Writter, 2024)

From the diagram above, it can be concluded that 76.3% of the respondents are women, and 23.7% are men.

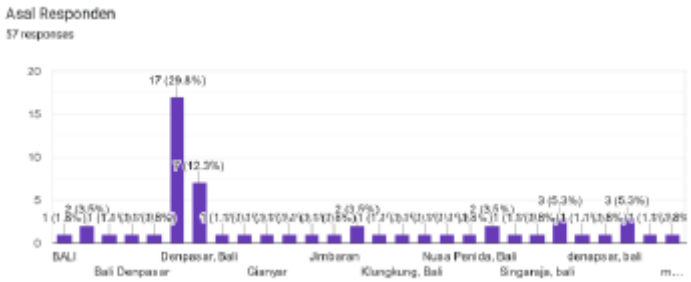


Figure 2. Questionnaire Percentage Diagram
Respondent Origin
(Source: Writter, 2024)

From the diagram above, it can be concluded that the majority of respondents are from the city of Denpasar and from the Bali region.

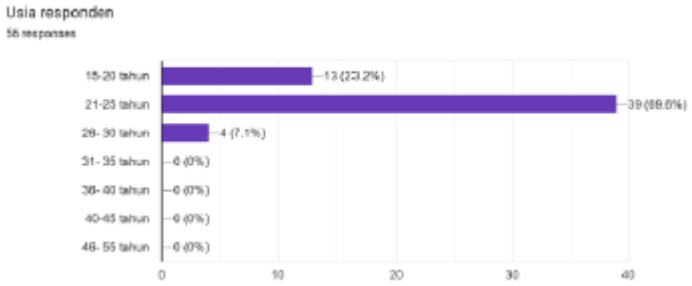


Figure 3. Percentage Diagram of Respondent Age
(Source : Writter, 2024)

From the diagram above, 69.6% (39 people) of the respondents are aged 21-25 years, 23.2% (13 people) of the respondents are aged 15-20 years, and 7.1% (4 people) of the respondents are aged 26-30 years. It can be concluded that the majority of the respondents are teenagers aged 20-25 years.

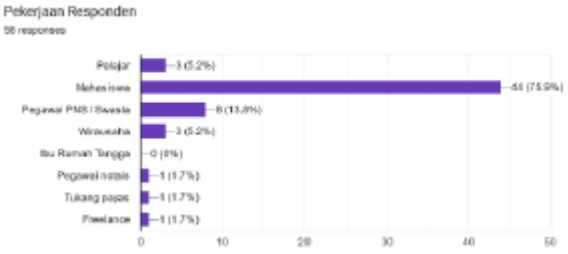


Figure 4. Percentage Diagram of Respondent Job Questionnaire
(Source: Writter, 2024)

The respondents' occupation as students has a total percentage of 75.9% (44 people), followed by respondents working as civil servants/private employees at 13.8% (8 people), and then respondents working as entrepreneurs at 5.2% (3 people). According to the data, the conclusion from the above data is that the average respondents from the questionnaire are individuals who have a need for fashion according to their field of work. In this data, the majority are teenagers who are still students.



Figure 5. Percentage Diagram of Clothing Waste Knowledge Questionnaire
(Source : Writter, 2024)

In the first question, it can be concluded that respondents who have knowledge about clothing waste amount to 48.3% (28 people), then 27.6% (16 people) of respondents may have only heard about it without knowing further data for sure, and 25.9% (15 people) of respondents do not yet know that Indonesia produces 2.3 million tons of clothing waste. It can be concluded that education about waste and awareness in the community may have increased, but it needs to be continuously educated so that the entire community is aware of the importance of knowledge about waste, how to reduce it, and how to prevent it.



Figure 6. Percentage Diagram of the Convertible Fashion Creation Opinion Questionnaire
(Source : Writter,2024)



Figure 7 Illustration of Convertible Fashion
(Source : pintterest.com)

Regarding the question about convertible clothing, 87.9% (51 people) of the respondents are interested in the clothing and agree that it is attractive, while

13.8% (8 people) of the respondents might be interested and agree with the convertible clothing that will be produced by the author. It can be concluded that convertible clothing has its own unique appeal, making it suitable for production by the author.



Figure 8. Percentage Diagram of the Multifunctional Design Opinion Questionnaire that can reduce fashion waste
(Source : Writter, 2024)

From the above percentage, 87.9% of respondents agree that the construction design can reduce fashion waste, and 12.1% of respondents said they might agree with this. It can be concluded that the majority of respondents agree with the author's opinion, and the author can apply this multifunctional construction design to the products that will be created.



Figure 9. Percentage Diagram of the Aesthetic Composition Motif Opinion Questionnaire
(Source : Writter, 2024)



Figure 10. Illustration of the Motif with points in certain areas, and the size of the motif adjusts accordingly.
(Source :Pinterest.com)



Figure 11. Illustration of a fairly large-sized motif
(Sumber :Pinterest.com)



Figure 12. Illustration of full motif design with a single center point
(Source :Pinterest.com)



Figure 13. Illustration of a full motif design with the same size
(Source :Pinterest.com)

From the diagram above, 77.6% (45 people) of respondents were more interested in designs where the motifs were placed only in certain parts with size-adjusted

motifs, 27.6% (16 people) were interested in designs with full motifs of the same size, then 20.7% (12 people) were interested in designs with full motifs with one center point on the material or garment, and 8.6% (5 people) were interested in designs with fairly large motifs. It can be concluded that the majority of respondents preferred designs with motifs only in certain parts and size-adjusted motifs.

Discussion

1. The Process of Batik Fabric Production

In the process of batik fabric production, there are several stages, including:

a. Selection of raw materials. In this selection process, there are also two steps: choosing the main material, which is usually made from silk or other natural fibers, and ensuring the quality of the materials, which must be of high quality to achieve good batik results.



Figure 14. Main material selection process
(Source: Writter, 2024)

b. Then, it is continued with the application of the previously designed pattern onto the fabric using carbon or drawing it directly onto the fabric.



Figure 15. Drawing The Patterns
(Source: Writter, 2024)

c. The waxing process or "menyembelit" begins with the application of hot wax on the fabric according to the design pattern. The wax then acts as a protector, preventing the dye from adhering to certain areas.



Figure 16. Candle application
(Source: Writter, 2024)

d. First Dyeing Process (Ngalam): Base Color: The fabric is dyed in the desired base color. Washing: After dyeing, the fabric is washed to remove the wax and achieve a clean base color.
e. The Next Night Process (Re-waxing): Wax Addition: Wax is reapplied to protect areas that should not be affected by the next color.
f. The Next Dyeing Process (Nglorot): Additional Color Application: The fabric is dyed with an additional color, according to the desired design. Rewashing: After the dyeing is complete, the fabric is washed to remove the wax and provide color clarity.
g. Final Washing and Drying: Final Process: The fabric is carefully washed to remove any remaining dye and wax. Drying: The fabric is dried appropriately to ensure the color remains durable.
h. Finishing Process: Detail Completion: The final process involves adding any necessary details or finishing touches. Quality Inspection: The fabric is inspected to ensure the quality and accuracy of the design.

2. Conceptualization of Motifs and Designs

a. Description of the "Mother Earth" Concept

Ibu Pertiwi is a term in Indonesian that can literally be translated as "Mother Earth" or "Motherland" in English. The definition of Ibu Pertiwi encompasses a profound symbolic concept that depicts the homeland or earth as a "mother" that provides life, fertility, and protection to humanity. It symbolizes the close relationship between humans and nature, as well as our responsibility to protect, nurture, and preserve the environment and natural resources for the well-being of current and future generations. Mother Earth also reflects love and care for the homeland and the culture of a country. This term is often used in the context of nationalism, patriotism, and environmental preservation.

b. Concept Mind Mapping

There are several sub-sections within the concept of "Mother Earth," including:

1. The Origin of Mythology

In this section, it is explained how Mother Earth is known and believed in worldwide.

Namely:

Due to the influence of Hinduism in Indonesia, where people began to worship deities, one of which is Dewi Pertiwi, which became the origin of the term "Mother Earth."

2. Other Names

Mother Earth also has other names besides Ibu Pertiwi, such as dhara, dhart, and dhrthri, which mean the center that holds everything.

3. Symbol

Mother Earth is believed to be a symbol of life, fertility, protection, and balance.

4. Representing

Mother Earth also represents several relationships, including the relationship between humans and nature, as well as the responsibility to care for, nurture, and preserve the environment.

5. Colors

Mother Earth is associated with several colors and their philosophies, including brown, which signifies natural, conventional, and humble; green, which represents natural stability, wealth, and renewal; and black and white.

c. Keywords of the concept to be implemented in fashion

- The relationship between humans and nature is implemented through the design of asymmetrical curved geometric ornaments that resemble interconnected waves and the application of sustainable design.
- Balance is represented by the lotus flower flora, symbolizing balance.
- Fertility is symbolized by the dispersion of seeds, implemented in the form of dots to make the design appear more complex.
- Color: brown - implemented as the base color of the fabric.
- Black and white are implemented in the motif color and outline.

Mission of the work

1. Sustainable design

Sustainable design is a clothing design that considers the sustainability of life and the environment in terms of materials, dyeing techniques, and minimizing production waste.

2. Zero waste technique

Zero waste in fashion creation refers to a design and production approach aimed at reducing or even eliminating textile waste throughout the entire product lifecycle. This approach prioritizes efficiency in the use of fabrics and materials, resulting in little to no waste generated during the production process. Some principles and techniques generally associated with the zero waste approach that the author will apply are:

A. Zero-Waste Pattern: Designers strive to create fabric cutting patterns in such a way that no unused material remains. These patterns are usually meticulously designed to minimize leftover pieces and maximize fabric usage.
B. Modular Design: Clothing is designed with components that can be easily assembled and disassembled. This allows for extending the product's lifespan and updating certain parts without having to replace the entire garment.
C. Material Efficiency: Carefully selecting materials and optimizing their use. Reducing excessive cutting and maximizing the yield from each roll of fabric.

Application of Motifs and Production Techniques in Fashion Design



Figure 17. Manual sketch of the batik motif to be applied to the clothing
Source: Writter, 2024)



Figure 18. Digital sketch of the batik motif to be applied to the clothing
Source: Writter, 2024)

In accordance with the survey results and the concept presented by the author, which is "mother earth," a design featuring lotus flower motifs combined with geometric ornaments was created. Additionally, the placement of the motifs will be positioned at specific points on the garments, with sizes adjusted accordingly.



Figure 20. Digital fashion design to be produced
(source : writer, 2024)

According to the survey results and analysis conducted, the majority of respondents prefer a casual yet stylish fashion appearance. Therefore, the author created a convertible outfit consisting of a top designed like a halter top, covering the body and crossing over the neck and shoulders. The bottom of the outfit is designed like a drawstring skirt tied at the waist, creating draped folds. Of course, it is complemented with detailed batik motifs, a combination of hand-drawn and stamped patterns, which will be placed in several sections with motifs created by the author.

Market, Business and Concrete Strategies To Increase Public Awareness And Education

1. Market Analysis

Target Audience:

- Demographics: Young adults to middle-aged consumers (18-45 years old), particularly those with an interest in cultural heritage and sustainable fashion.
- Geographics: Urban areas with a strong appreciation for art, culture, and innovation. International markets can be explored, especially countries with existing interest in Batik and cultural textiles (e.g., Japan, Netherlands, and the USA).
- Psychographics: Consumers who value versatility, tradition, sustainability, and unique design in their wardrobe.

Market Trends:

- Increasing interest in sustainable fashion and slow fashion movements.
- Growing appreciation for multifunctional clothing that can be styled in different ways.

- Rising global awareness and demand for cultural heritage-inspired designs.
- Strong emphasis on customization and unique patterns in high-value markets.

2. Business Model

Product Offering:

- Convertible fashion items, such as dresses, skirts, tops, and jackets, that can be styled or worn in multiple ways.
- Incorporation of Batik patterns using traditional and innovative techniques (e.g., eco-friendly dyes or digital Batik printing).

Value Proposition:

- Versatility: One garment, multiple looks—ideal for travel, minimalist wardrobes, and mix-and-match styles.
- Cultural Pride: Integration of Batik as a unique, meaningful pattern that highlights cultural heritage.
- Sustainability: Use of eco-friendly materials and techniques to align with environmental concerns.

Revenue Streams:

- Direct sales through e-commerce platforms and physical stores.
- Collaborations with designers or brands for exclusive collections.
- Workshops or kits for DIY Batik combination techniques.

3. Marketing Strategy

Brand Positioning:

- Highlight the fusion of modern fashion with cultural heritage.
- Emphasize sustainability and craftsmanship.

Promotion Channels:

- Social Media Campaigns: Instagram, TikTok, and Pinterest for showcasing styling versatility and storytelling.
- Fashion Events: Participation in cultural and sustainable fashion shows to reach niche audiences.
- Collaborations: Partner with influencers and cultural organizations to boost visibility.
- Content Marketing: Blog posts and videos about Batik's cultural significance and styling ideas.

Pricing Strategy:

- Competitive pricing for middle-tier consumers while offering premium options for high-end markets.
- Seasonal promotions and subscription models for loyal customers.

4. Production and Distribution

Production:

- Collaborate with local Batik artisans to support communities and ensure authentic patterns.
- Use a mix of handmade and digital production techniques to balance cost and scalability.

Distribution:

- E-commerce platforms for global reach.
- Pop-up stores and partnerships with boutique retailers.
- Direct-to-consumer approach for a personal shopping experience.

5. Sustainability and Social Responsibility
1) Adopt zero-waste cutting techniques for efficiency.
2) Source from ethical suppliers and use biodegradable packaging.
3) Collaborate with Batik-making communities to preserve traditional techniques and empower artisans economically.
4) 6. Challenges and Solutions

Challenges:

1) Misappropriation concerns for traditional Batik patterns.
2) Higher production costs due to artisan collaborations and sustainability practices.
3) Educating the market on Batik's cultural and artistic value.

Solutions:

1) Obtain proper certifications and collaborations with Batik organizations to ensure authenticity and respect.
2) Efficient supply chain management to reduce costs.
3) Strong storytelling and educational marketing campaigns to build appreciation.

7. Growth Opportunities
1) Expand product lines to include accessories and home décor with Batik elements.
2) Enter the global luxury market with exclusive, handcrafted collections.
3) Explore tech-based innovations like AR styling apps to show garment versatility in real-time.
4) This approach positions Convertible Fashion Styles with Batik Pattern Combination Technique as a sustainable, culturally rich, and innovative brand ready to captivate modern consumers.

Technology And Innovation That Can Be Used In The Production Of Transformable Fashion.

1. Fabric Technologies

Sustainable and Recycled Materials
- Use of biodegradable or recycled fabrics to align with eco-conscious consumers.
- Innovative fibers like Tencel, which are versatile for multiple styling purposes.

2. Design Innovations
   1) Modular Design Techniques
      - Garments constructed with detachable components (e.g., sleeves, collars, panels) that can be reassembled for new styles.
      - Snap, zipper, or Velcro systems for easy transformation without compromising aesthetics.
   2) Convertible Mechanisms
      - Reversible Construction: Double-sided fabrics to allow inside-out transformation.

- Adjustable Drawstrings and Ties: To modify garment shapes or sizes.

3) 3D Printing in Garment Construction
   - Use of 3D-printed accessories or panels that can be snapped onto garments for added versatility.
   - Lightweight and customizable 3D elements for unique designs.

3. Advanced Production Methods
1) Laser Cutting and Engraving
   - High precision for creating modular parts or intricate patterns that fit together seamlessly in transformable designs.
2) Digital Fabric Printing
   - Use of on-demand digital printing for customized and reversible patterns, such as reversible Batik-inspired designs.
   - Eliminates waste from traditional dyeing processes.
3) Seamless Knitting Technology
   - Techniques like WHOLEGARMENT by Shima Seiki for garments that adapt naturally to different forms without seams.

4. Technology-Driven Functional Enhancements
1) IoT-Enabled Garments
   - Wearable technology: Incorporate sensors to monitor body metrics, allowing garments to adapt to user needs (e.g., expanding when detecting movement).
   - Smart controls for LED or thermo-reactive embellishments for aesthetic transformations.
2) Self-Healing Materials
   - Fabrics that repair themselves after small tears, enhancing the longevity and versatility of transformable designs.

5. Digital Design and Development Tools
1) 3D Fashion Design Software
   - Tools like CLO 3D, Browzwear, or Optitex to prototype transformable garments and visualize their adaptability virtually before production.
   - Enables simulations for testing functionality, fit, and transformation mechanisms.
2) AI-Assisted Pattern Making
   - AI-powered systems to generate multi-functional garment patterns efficiently and optimize for minimal waste.

6. Consumer-Centric Innovations
1) Augmented Reality (AR) Styling Apps
   - Allow users to visualize different ways to style or transform garments before purchase.
   - Enhances the shopping experience and helps consumers maximize usage.
2) Customization Platforms
   - Interactive systems where users can choose modular elements, fabrics, or patterns to design their transformable pieces.

7. Sustainability-Focused Innovations
1) Zero-Waste Cutting Techniques
   - Algorithms to optimize fabric usage for modular designs, ensuring minimal leftover materials.
2) Closed-Loop Recycling Systems
   - Enable worn-out transformable garments to be disassembled into raw materials for new designs.

By integrating these technologies and innovations, the production of transformable fashion can meet the demands for functionality, sustainability, and modern aesthetics.

5. CONCLUSION

Batik, as a cultural heritage of Indonesia, holds immense value. Although recognized as Indonesian Cultural Heritage by UNESCO on October 2, 2009, there are still challenges in encouraging the community to adopt batik as everyday clothing. Some people are still reluctant to wear it because they consider it outdated or only suitable for formal events. However, the new fashion trend that combines batik with modern designs, such as in the ready-to-wear convertible fashion style, is starting to attract a lot of attention. This clothing, designed to reduce fashion waste and support a more sustainable consumer lifestyle, can provide a different look in a short time. This aligns with efforts to change public perception of batik and support local products.
The author also emphasized the negative impact of the fashion industry on the environment, highlighting the role of the clothing industry as the second-largest contributor to pollution in the world. By promoting convertible batik combination fashion styles, it is hoped that the community can return to loving local products and reduce the need to buy many different clothes. Thus, awareness of environmental impact can be increased while still preserving Indonesia's cultural wealth. Data collection used the batch processing method, which is a combination of qualitative and quantitative methods conducted through literature study, interviews, and filling out Google Form questionnaires. Based on the survey results, it can be seen that the majority of respondents are interested in the convertible clothing that the author will produce, so the author is determined to create a unique convertible clothing line. Additionally, the respondents have also suggested to the author that the majority prefer casual clothing styles with motifs placed only in certain areas, with sizes that will be adjusted by the author.

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CULTURAL HERITAGE PRESERVATION A CERAMIC FUSION DESIGN INSPIRED BY EAST JAVA COFFEE DRINKING CUSTOM

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ABSTRACT

The primary objective of this research is to safeguard and enhance awareness surrounding the abundant cultural legacy of East Java by amalgamating facets of its varied traditions, less familiar to external audiences, such as the Remo dance and distinctive coffee-drinking practices of its inhabitants. Employing the intricate craft of ceramic carving, this investigation aims to encapsulate the robust, resolute, and fervent nature inherent in East Java. The study relies on the acquisition of data from historical and cultural sources, employing the IMO (inner, middle, outer) method for cultural identification, supplemented by interviews, observations, and exploration. The ultimate outcomes of this exploration yield two coffee sets that reflect the local customs of East Java, notably the unique practice of pouring coffee into the saucer—an increasingly rare phenomenon in urban areas. The design incorporates elements of the Remo dance and employs carving techniques, fusing visual, ideational, and auditory aspects of the dance into the coffee sets. This endeavor successfully melds both cultures into ceramic design, contributing to a broader understanding of East Java's traditions, as evidenced by user reviews.

Keywords: *design, ceramic, tradition, coffee, culture of East Java*

1. INTRODUCTION

Since the pandemic ebbed in 2021 people worldwide have exhibited growing interest in spending time doing activities at home, and one of the popular choices chosen are pottery ceramics. From global ceramic demand analytics, it is reasonable to expect this trend will continue on an upward trajectory through 2028 with a predicted compound annual growth rate(CAGR) of around 4.4%(Grand View Research, 2022). Additionally, ceramic products that embody a strong identity are more in demand, given that a strong identity can enhance the product's existence in the global market and enhance individual user experience. The identity can be by applying cross pollination design strategies that combine various cultural influences into the product, which lead to new opportunities for local area ceramic artists seeking ways to strengthen locally made products. Indonesia has many regions with vast amounts of culture. However only few in number are prominent enough to be recognized by others. By looking back into its history and to the people's behavior that intermixed into many of its cultures and arts, it’s apparent that East Javanese people proclaim the value of solidarity and heroism. One of East Java arts and culture is the opening of the Ludruk performance, Remo dance that portrays the story of a warrior defending their nation, which is now used to welcome visitors. Another custom is the way East Java peoples’ drink their coffee which is already uncommon to find in the central city, but can be easily located in street food stalls and street side restaurants for common folks. With this in mind, this study aims to create a ceramic art inspired by Remo dance and incorporate it with the coffee drinking custom from East Java

which not only increase the number of East Java designs but also help broaden outsiders' knowledge of East Java cultures.

2. RESEARCH METODOLOGY

This research will be conducted with secondary research followed by primary research through data collection from the historical and cultural sources, the identification of culture using IMO (inner-intangible level proclaiming the spiritual or ideal side, middle-behavioral level proclaiming the function and usability side, outer-tangible level proclaiming the physical or visual side) method in 3 cultural levels (Lin, 2007), interviews, observations, exploration and experimentations, as well as collections of user reviews and prototypes.
Secondary research was used to collect data starting from ceramics orpottery basics for introducing the way pottery is made, an in-depth research about the culture of East Java by looking for their similarity of value especially on the cultures chosen for this study - Remo dance and coffee-drinking custom - beginning from their history, values, aspects, forms, and others that filled up the design identification method of IMO (Inner, Middle, and Outer). Other than that, there was also the study of Carl Jung's Color Energy theory —about how personality can be depicted as colors on how it represents oneself and how others perceive them—and the study of shapes psychology to support the transformation of Remo dance into the design later on.
**While in primary research, the study was done first handedly by identifying the process in ceramic handbuilding technique of slabbing and ceramic surface decoration in carving firstly. It was followed by diving through a series of experimenting the basic shape formed by Remo dance forms, the carving technique, how the surface depth affected the picture shown by the poured liquid, how a shape impacted the draping process, and on how, if possible, a locking system can be introduced to the design or what new shape can be used but still stable enough to use. In deciding the best one this study used the QFD (Quality Function Deployment) method and grading 1-4 for each indicator to be looked for on each piece, such as the ergonomic, the smoothness in dripping, has the least residue, the timeto cool down, and the best volume in the saucer shape. In this phase, the study also interviewed some East Java coffee lovers by asking some coffee drinking habits and their preferences. Like, what type of coffee they drink, where they usually did it, the routine or course of action in making and drinking coffee, the usage of cup's saucer to the East Java people, and some suggestions. It helps in giving insight about the coffee-drinking custom and habits to tackle any inconvenience or what feature to be added or removed. Afterward, some observation about the coffee-drinking custom of pouring it into the saucer rather than drinking it from the glass was done to fill in the "why's" that was not quite answered through the interview. From the collected data and by merging them following the moodboard, some prototypes were made to test out the material, pictures from the carvings, the color scheme, the forms and ergonomics, weight, and the auditive aspect. Which was graded and chosen to be developed as the final product using QFD (Quality Function Deployment) method. Finally, when the final product was ready, it went through 5 users to be tested out directly where 2 users are local from East Java and the others are not, thus finding out the different impacts it can give to the locals and to the outsiders. The user review was closed with the filling of some questionnaires to gradethe product starting from the concept ideas, the delivery of the planned vibe, the delivery of education on East Java cultures, the function, the uniqueness, the carving, and the quality of the product.

3. RELATED RESEARCH

3.1 Secondary Research Result

From the data collected from the secondary research it shows that East Java upholds the value of heroism and fellowship to live as a pact in quite a high esteem with their traditional arts implementing the value of freedom, simplicity, and the usage of their

flora and fauna (Mahalia, 2023)(Tri Wedawati et al., 2022). They also use carving techniques to almost all their designs in order toconserved this art until now. These values can be seen in one of their cultures, which is Remo dance that this study used as one of the concepts. Remo first started as a collective dancing form of entertainment for the people. It started to have the theme of heroism when it merged with Ludruk performance and the start of colonialism in Indonesia as a show of criticizing the invaders plus a way to encourage the locals. Nowadays, it has become another form of entertainment as well as a show of welcoming non-locals. Remo dance has 4 main aspects: ideation (theme of heroism), visual (costume and makeup from the 18 centuries), physical-kinesthetic (dancing forms), and auditive (music and costume accessories such as *gongseng*, ankle band of bells that work as rhythm). With the help of IMO method, it can be identified that this study will proceed with slabbing handbuilding ceramic technique where the process used thin 3-4mm thick clay to be assembled by parts and used carving decoration technique like sgraffito and mold pressing to its surface.

Table 1. IMO Design Method

Outer	Middle	Inner
Dance form 	As in entertainment, a show of encouragement, a welcoming	Heroism, showing of strong, fast, and hard pace personality
Costume 	Characterization, theme of 18 centuries, rhythm bells	Telling a story of a knight fighting and defending their nation as a show of appreciation to those who fight and support[4].
Makeup: strong, deep, bold stroke (Apriliani & Wilujeng, 2020) 	Characterization 	
Color; red, white, black 		

Source: Hartanto, et al., 2022

The experiment on the shape formed in the dancing forms (*tancep, salam pembuka*, and *tanjak*) led into 3 basic shapes shown in figure 1 that displayed all of them using a variety of rectangles. These shapes will later be used as the basic form of the design (Designex Studio, 2020).



Figure 1. Shapes Formed from Remo Dane (Tancep Form; Salam Pembuka Form; Tanjak Form)
Source: Hartanto, et al., 2022

The carving technique, as shown in figure 2, was explored in ways:
(a) carving the outline drawing angled outward, (b) carving the outline drawing angled inward, (c) carving in the pictures, (d) carved out the background, and (e)combination of c and d (DK, 2019). Exploration a made a gradation of color outward as opposed to exploration b that has a gradation inward to the picture. Due to that exploration b has a smallerpicture than a. Exploration c carved in the picture in as opposed to exploration d that carved out the background which made the

picture pop out. Exploration has the most unique result that gives a sense of arrangement which ones at the back and the front.



Figure 2. Carving Technique & Depth Experiment (Carving in; Adding it up)
Source: Hartanto, et al., 2022

The experiment on dripping was done to some existing saucer with different depth and form. Through this experiment and the help of QFD method, the one with the best compatibility with the indicator waswith the height of 3 cm, depth of 2.5 cm, and volume of 60 mm. Lastly for the locking experiment, it was done using a dummy shown on figure 2. Though this experiment was not as accommodating or efficient as it was meant to be.



Figure 3. Dripping Experiment on Existing Saucer & Locking Experiment Dummy
Source: Hartanto, et al., 2022

From these exploration and experimentations, there are some things to be aware of:
1. Remo dance forms gives off a blocky stature in variety of rectangles, such as trapezoids, parallelogram, rectangle, and rectangle with raised sides
2. The way of carving and angle used affects the picture result. A slant side will give a gradient color, the protrude surface will have lighter color, and a carved out surface will have darker color. A combination of this technique might give a more detailed and varied carved picture.
3. The carvings on the saucer need to have at least a depth of 2mm for it can still be seen on 40 ml of coffee liquid. Adding up the surface might not be a good idea if the saucer will still be used as the glass placement since the protrude area might make the glass stand unstable. Other than that, the water flowon the added area experiment is less preferable than the waterfall-like flow on the carved in experiment.
4. The saucer design will have a height of 3 cm, depth of 2.5 cm, and volume of 60 mm with ±13 cm diameter. There will not be any locking feature since it isn't convenient to use other than for serving moments. The glass will become a hindrance whiledrinking from the saucer and it will need another saucer or coaster to prevent droplets reaching the table surface.

To get more accustom the behavior of the East Java people, a few questions and observation were done to 4 locals that like to drink coffee. The questions moved around their knowledge and behavior on East Java coffee drinking custom. Through interviewing and observation, there were some points that that can to be noted: (1) The coffee used is black coffee that still has the grounds, such as the Robusta coffee that is also one of East Java biggest production as they're placed 5th place in all

Indonesia(Kurnia, 2024); (2) This is a very common activity between the locals in various places starting from their house, outside, stalls, and other places. It is used for relaxation, a routine, to socialize, to get more energy after a long day, and also to welcome visitors(Gumulya & Helmi, 2017) (In'am Widiarma, 2024);(3) In East Java Tradition, the coffee is drunk with the grounds still inside. So the coffee was usually set aside for a few moments to let the ground settle before drinking. There is also the drinking custom where the coffee will be poured on the saucer. Most say it gives us less time to wait for the coffee to cool itself. But there are also other facts such as; it help filtering the grounds from the coffee easier, it shows as a social way to drink by sharing with other where one use the saucer and the other use the glass, also with width of the saucer mouth, it forces the user to slurp little by little bit of coffee which enhance coffee aroma in the tongue. Thus it gives a different sensation than the usual way of drinking it (Editorial Kopi Keliling, 2013).



Figure 4. User Observation
Source: Hartanto, et al., 2022

3.3 Design Concept and Criteria

By combining Remo dance and East Java coffee-drinking habits by pouring the coffee into the saucer, it resulted in coffee sets consisting the glass, saucer, and a coaster with surface carving decoration technique that implement the visual and ideation aspects of Remo dance as well as the auditive aspect on the form itself. Following the custom in East Java, the glass will be on the slimmer and taller side with the capacity of 200 ml and an overall blocky-rectangle form —out of the shapes formed by Remo dance form and shapes psychology— alongside bold-deep carving lines in accordance with the elements on Remo makeup (visual aspect). The color palette used were red, black, and white in accordance to Remo costume and fiery red of Carl Jung's theory.

3.4 Design Process & Prototyping

The designing process started with sketching and adding features from the cultures. Some features like the auditive aspect need some model experiment to determine whether it can be added or not. The first step after the sketches are making the design pattern for the clay with additional 20% upscale —to maintain the final measurement since clay shrinks up to 20% when fired— and making a slab by flattering the clay that passed the wedging process. The slabs were cut according to the pattern made and arranged to make a form and glued together using scoring-slip. Later on when the clay dried enough into leather hard, colored it using colored slip with 5-10% pigment. When the slip dried enough (but still lather hard) the surface was marked and carved. Before going into the 1st firing it needs to be dried until bone dry. It then went through sanding and lazing before going inside the kiln the second time. For the carvings on the saucer, it was made with a quicker method which is stamping a mold into the saucer surface. At first, a model was made using a carved slab. Then rubber silicone was poured to duplicate the carving. A few test trial models were made to be assessed with QFD method with different indicators depending on their function (as a glass, as a saucer, and as a coaster). The glasses prototype were graded for their stabilitysmoothness in pouring process, the ease of cleaning, the sound of auditive aspect, volume reach 200 ml, color and carvings, the form, and the ergonomics. Where the saucer looks for their ergonomics, dripping, form, volume, and the carvings.

3.5 Final Design

This coffee set was made with the East Java people's pouring methodwhere to drink the coffee one needed to pour it into the saucer to drink it from. With Remo dance as the main concept, this idea was meant to not only introduce and boarding others of East Java traditions but also transferring the impression of energy and motivation like how Remo dance was performed to motivate the people and how coffee has caffeine to amplify adrenaline. The final design was made with altering and developing the chosen prototypes such as scaling up the size to be able to accommodate 200ml of liquid on the glass, simplifying the form so it become more ergonomics, lessening the weight, changing the color to make the red more dominant than before, and also changing the ball inside the auditive room at the bottom from circular into 12 sided dice which indeed proven to make more noise than before. For easier pouring,the front of the lid has a mini spout. The design on the glass is taken from the Remo costume with some carvings to represent fire and some vertical lines in addition to represent other flora elements.



Figure 5. Final Product & Carvings on the Saucers
Source: Hartanto, et al., 2022

4. RESULTS AND DISCUSSION

Though it comes to a final design, the final product was not what was originally envisioned due to technical issues, such as glaze-clay-kiln stability and firing process. The final product was tested on 5 people (age above 24 and likes to drink coffee) directly where 2 users are locals from East Java and the others are not.

Table 2. Product Evaluation to Users based on Design Criteria

No.	Design Criteria	Score
1	Concept Idea	3
2	Sucess of portraying the idea/ impression of giving energy and motivation	3.8
3	Education in East Java tradition	4
4	Functionalism	3.8
5	Carving results	4
6	Product uniqueness	4
7	Final quality	2
	Total	3.6 out of 4

Source: Hartanto, et al., 2022

5. CONCLUSION

Through this study, the result manages to combine both cultures into ceramic design by producing coffee sets different from the common ones. With the help of the IMO method, it helped in classifying which element on Remo can be applied on which aspect. By doing so, it aided in interpreting inspiration from cultures into a design element by providing a design structure to be analyzed. Other secondary research theories such as Carl Jung's Color Energy and shapes psychology helped the

personification of East Java personality and Remo dance. The experiment and other primary research utilized the data from secondary research to move on a certain flow of action to fill more of the missing pieces not mentioned before. As a result, this study helps in broadening others knowledge or at least showing a glimpse on East Java cultures as proven by the user review process. With the opportunities given by the rising demand on ceramics and infusion of culture into design, it becomes a great timeto develop local products for potters. Yet, the process was not always a smooth sail. This study was more focused on the culture and finding ways to infuse it into ceramic design that it lacks the study on the more practical one such as the kiln firing and the color experimentations. Due to this, the final color and glaze comes out not as it's expected to be. The same goes for theauditory aspect. The sound became muffled when there were drinks inside the glass. Therefore, the future development of this study is recommended to dive into solving these problems foremost. For instance, experimentation on different temperature and placement of firing, pigment percentage, changing the auditive location and increasing the number of bells, and other means.

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A COMPARATIVE STUDY OF K-NEAREST NEIGHBORS AND RANDOM FOREST CLASSIFIERS ON DIABETES

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The early detection of diabetes is crucial for effective management and prevention of complications associated with this chronic health condition. Machine learning techniques offer promising approaches for developing predictive models that can support medical decision-making. This study investigates the performance of two popular classification algorithms—K-Nearest Neighbors (KNN) and Random Forest—in predicting diabetes based on a dataset comprising key health indicators, including glucose levels, blood pressure, insulin, BMI, and age. These optimizations are implemented through grid search cross-validation to enhance model performance.The models are evaluated using accuracy, precision, recall, and F1 score as key metrics. Results show that the KNN model achieves an accuracy of 70.13%, while Random Forest reaches a higher accuracy of 75.97%. Additionally, Random Forest demonstrates better recall and F1 scores, indicating a stronger ability to correctly identify positive diabetes cases and maintain a balance between precision and recall.This study concludes that Random Forest is a more suitable model for diabetes prediction in this dataset, offering reliable and interpretable results that could support healthcare providers in early diagnosis. Future research may explore other advanced algorithms, data balancing methods, and feature engineering techniques to further improve prediction accuracy.

Keywords: *Diabetes Prediction, Machine Learning, K-Nearest Neighbors, Random Forest*

1. INTRODUCTION

This study aims to compare the effectiveness of KNN and Random Forest models in predicting diabetes. By identifying a model that balances accuracy and interpretability, this research hopes to support healthcare providers in making more proactive, data-driven decisions. Additionally, this study contributes to the growing literature on machine learning in healthcare, demonstrating the potential of advanced algorithms to improve patient outcomes and support preventive health strategies. Early detection of diabetes is crucial as the disease often progresses without prominent symptoms until severe complications such as cardiovascular disease, kidney failure, neuropathy, and retinopathy emerge. These complications significantly impact patients' quality of life and increase healthcare costs. Recognizing that early intervention can prevent or delay these outcomes, this study seeks to advance the development of precise diagnostic tools that are not only effective in identifying individuals at high risk of diabetes but also capable of intervening at a pre-diabetic stage.To address these challenges, we turn to machine learning-based predictive models, which offer a promising avenue for transforming diabetes management. These models provide an accurate, scalable, and efficient means of assessing diabetes risk. Particularly, techniques such as K-Nearest Neighbors (KNN) and Random Forest are explored for their potential in medical classification tasks. KNN operates effectively on well-defined, low-dimensional datasets by categorizing individuals based on similarities with neighboring data

points. Conversely, Random Forest utilizes an ensemble method to construct multiple decision trees, which enhances prediction accuracy and reduces the risk of overfitting in complex, high-dimensional health data. While these models hold promise, they also come with limitations that must be considered. KNN, for instance, can be significantly influenced by the presence of noisy data or irrelevant features, which may skew its accuracy. It also struggles with large datasets due to its computational intensity in calculating distances between points. On the other hand, Random Forest, despite its robustness against overfitting, can still be computationally expensive and may perform poorly if the hyperparameters are not optimally set. Furthermore, both models can suffer from biases introduced by imbalanced datasets, a common issue in medical data. This study aims to compare the effectiveness of these models in predicting diabetes, with a focus on balancing accuracy and interpretability to aid healthcare providers in making proactive, data-driven decisions. By addressing the gaps in current predictive strategies and highlighting the strengths and weaknesses of each model, this research contributes to the growing literature on machine learning in healthcare and underscores the potential of these advanced algorithms to improve patient outcomes and support preventive health strategies.

2. RESEARCH METODOLOGY

This section outlines the methodological steps followed to compare the K-Nearest Neighbors (KNN) and Random Forest models in predicting diabetes(Hasas et al. 2024). These steps include data preprocessing, model selection, hyperparameter tuning, and performance evaluation. The research stages carried out in this study can be seen in Figure 3.1. Start: The process begins with the initiation of the data collection phase. Data Collection: This stage involves gathering the necessary data for diabetes prediction, which includes various health indicators such as glucose levels, BMI, and insulin. Handling Missing and Zero Values: Before further processing, the dataset is cleaned to handle missing or zero values that could affect the accuracy of the models. Feature Scaling: To ensure that all numerical inputs have a comparable scale, the data undergoes normalization or standardization. Model Selection: Two machine learning models are considered: K-Nearest Neighbors (KNN): A simple algorithm that classifies each data point based on the majority class of its 'k' nearest neighbors Random Forest: An ensemble model that builds multiple decision trees and aggregates their predictions to improve accuracy and control over-fitting Data Splitting: The dataset is divided into training and testing subsets, typically with an 80/20 split, to evaluate the models effectively. Hyperparameter Tuning: Key parameters for each model are adjusted, such as the number of neighbors for KNN and the number of trees for Random Forest, to find the optimal settings for best performance. Model Training: Each model is trained on the training dataset to learn from the features presented. Model Evaluation: After training, the models are tested using the separate test dataset to evaluate their performance based on various metrics: Accuracy: The proportion of true results among the total number of cases examined. Precision, Recall, and F1 Score: These metrics provide insight into the models' ability to identify diabetic cases correctly without overpredicting. End: The process concludes with a final evaluation of the models' performances, and the best-performing model is selected for practical application in predicting diabetes.

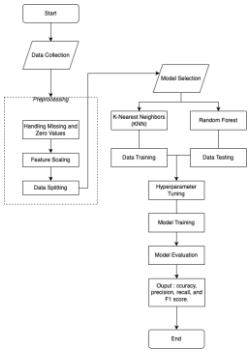


Figure 1. Research Stages

Data Collection and Description

The dataset used in this study, obtained from Kaggle's Diabetes Dataset, consists of various health indicators commonly associated with diabetes risk, including the number of pregnancies, glucose levels, blood pressure, skin thickness, insulin levels, body mass index (BMI), diabetes pedigree function (genetic risk factor), and age. Each record is classified as either diabetic (1) or non-diabetic (0), forming a binary classification task.

Data Preprocessing

The dataset used for this study is the Pima Indians Diabetes Database.

- **Data Overview**
  - **Rows:** 768
  - **Columns:** 9 (8 features and 1 target variable)
- **Data Conditions**
  - **Duplicates:** There are no duplicate rows in the dataset.
  - **Target Distribution:**
    - Class 0 (Non-Diabetic): 500 samples.
    - Class 1 (Diabetic): 268 samples.

Data Splitting:

The dataset was split into training and testing sets with a ratio of 80:20. The training set was used to build and tune the models, while the testing set was reserved for final evaluation to provide an unbiased assessment of model performance.

Model Selection

K-Nearest Neighbors (KNN):

KNN is an instance-based learning algorithm that classifies data points based on the majority class of their nearest neighbors(Wahyudi et al. 2022). It is simple yet effective for various classification tasks, especially when data is well-defined. In this study, KNN was evaluated with different values of k (number of neighbors) and weighting schemes (uniform vs. distance-based) to determine the optimal configuration(Shimpi, Shanmugam, dan Stonier 2024). The following are the steps in the K-NN classification process: Determining the parameter k, k as the value of the nearest neighbor (k, value can be an odd number, depending on the training data used)(Abaker dan Saeed 2021). The formula for determining the value of k is as follows

$$k = \sqrt{n}$$

Calculating the distance between training data and testing data using the Manhattan Distance formula. The formula for calculating distance is as follows:

$$d_m(x, y) = \sum |x_i - x_j|$$

Where:

- *d: distance between xxx and yyy*
- *x: center data of the cluster*
- *y: data on the variable*
- *xi: data at the iii-th cluster center*
- *xj: data for each jjj-th data point*

Random Forest:

Random Forest is an ensemble learning method that constructs multiple decision trees during training(Shimpi, Shanmugam, dan Stonier 2024). By combining the outputs of numerous trees, Random Forest reduces the likelihood of overfitting and improves prediction accuracy(Georganos et al. 2021). This study examines the impact of different hyperparameters on Random Forest performance, including the number of trees (n_estimators), maximum depth (max_depth), and minimum samples required for a split (min_samples_split)(Sekulić et al. 2020).

3. RELATED RESEARCH

In recent years, machine learning has gained widespread application in healthcare, especially for the prediction and classification of chronic diseases such as diabetes.

1. Study by (Abnoosian, Farnoosh, dan Behzadi 2023)

Title: *A machine learning approach for diabetes prediction using feature selection and classification techniques* This study explores the effectiveness of machine learning algorithms, including KNN and Random Forest, in predicting diabetes outcomes using selected features from clinical datasets. The key findings are:

- The use of **feature selection techniques** substantially improves prediction accuracy.
- **Random Forest** outperforms KNN in terms of accuracy and stability, especially when utilizing a subset of relevant features.

The study highlights the importance of effective feature selection to enhance the performance of machine learning models. Random Forest demonstrates superior performance compared to KNN in handling the complexities of diabetes data

2. Study by (Malik, Harous, dan El-Sayed 2021)

Title: *Comparative analysis of machine learning algorithms for diabetes prediction*

This study compares the performance of several machine learning algorithms to determine the most effective method for diabetes prediction, with a focus on evaluating accuracy and efficiency. The findings include:

- **Random Forest** demonstrates better accuracy and recall compared to KNN, particularly when applied to large and complex datasets.
- The study suggests exploring hybrid approaches as a potential strategy for improving prediction performance.

Conclusion:

This study underscores the critical role of selecting the appropriate algorithm to achieve accurate predictions. Random Forest consistently outperforms KNN in

diabetes prediction. Furthermore, integrating multiple algorithms could lead to more robust and adaptive predictive systems.

3. Study by (De Silva et al. 2021)

Title: *Predictive modeling of diabetes using machine learning algorithms: A systematic review*

This study provides a systematic review of various machine learning algorithms used for diabetes prediction. Key observations include:

- **Random Forest** consistently outperforms KNN across multiple studies.
- Random Forest excels in handling **imbalanced and complex datasets**, demonstrating higher accuracy and robustness.

Conclusion:

The review highlights Random Forest as a more reliable option compared to KNN for diabetes prediction, particularly due to its superior ability to manage complex and imbalanced data.

Findings from these studies reveal that:

1. **Random Forest** consistently delivers better accuracy, stability, and performance compared to KNN, particularly for complex and imbalanced datasets.
2. The application of feature selection and the integration of multiple algorithms can enhance prediction accuracy in diabetes diagnosis.
3. Random Forest remains a robust tool for predicting complex diseases such as diabetes, playing a crucial role in supporting early diagnosis and more effective intervention strategies.

4. RESULTS AND DISCUSSION

This section presents the findings of the comparative study between the K-Nearest Neighbors (KNN) and Random Forest (RF) classifiers for diabetes prediction, focusing on their performance metrics and visual insights.

Model Evaluation

The models were evaluated on a stratified test set consisting of 20% of the dataset. Key performance metrics, including accuracy, precision, recall, and F1-score, were used to assess their predictive capabilities. Below is the summary of the results:

1. K-Nearest Neighbors (KNN):
- Accuracy: 70.13%
- Precision: 75% (Non-Diabetes), 58% (Diabetes)
- Recall: 80% (Non-Diabetes), 52% (Diabetes)
- F1-Score: 78% (Non-Diabetes), 55% (Diabetes)

KNN struggles with the minority class (Diabetes) due to its sensitivity to overlapping data points and noise. While its accuracy is reasonable, it sacrifices recall in identifying diabetic patients, leading to higher false negatives.

2. Random Forest (RF):
- Accuracy: 75.97%
- Precision: 79% (Non-Diabetes), 68% (Diabetes)
- Recall: 85% (Non-Diabetes), 59% (Diabetes)
- F1-Score: 82% (Non-Diabetes), 63% (Diabetes)

Random Forest consistently outperformed KNN across all metrics. It demonstrated higher precision and recall, particularly in detecting diabetic patients. The ensemble nature of RF provides robustness against noisy data, explaining its superior performance.

Confusion Matrix Analysis

Figure 2 illustrates the confusion matrices for both models. KNN has a higher number of false negatives, misclassifying diabetic patients as non-diabetic, which could be problematic in a healthcare context. On the other hand, Random Forest reduces false negatives significantly, making it more reliable for identifying diabetic

patients.

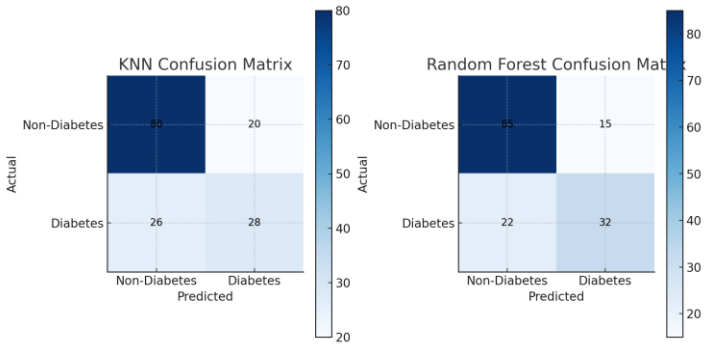


Figure 2. Confusion Matrices

ROC Curve and AUC

The Receiver Operating Characteristic (ROC) curves of both models were plotted to analyze their ability to distinguish between classes. The area under the curve (AUC) values were as follows:

- KNN: 0.73
- Random Forest: 0.84

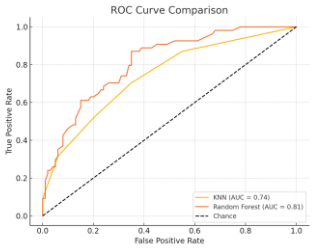


Figure 3. ROC Curve and AUC

Feature Importance

Random Forest's feature importance analysis revealed the following significant predictors of diabetes:
1. Glucose: The strongest predictor, as expected, given its direct association with diabetes.
2. BMI: Indicates the role of body weight in diabetes risk.
3. Age: Highlights that older individuals are more susceptible to diabetes.
Figure 4 shows the feature importance as identified by Random Forest, aligning with established medical knowledge.

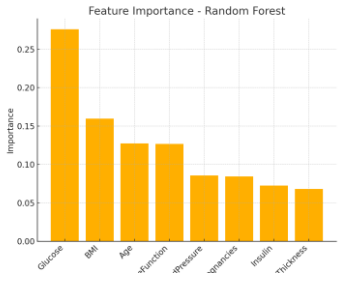


Figure 4. Feature Importance

Comparative Insights

From the results, the Random Forest classifier is more reliable than KNN for this dataset. Its ability to handle imbalanced classes, capture non-linear relationships, and mitigate the influence of noise makes it the preferred choice. However, KNN remains computationally simpler and can be effective with fine-tuned parameters on smaller datasets.

5. CONCLUSION

study demonstrates that Random Forest is a more robust and accurate classifier for diabetes prediction compared to KNN. Specifically, Random Forest's ensemble method, which integrates multiple decision trees, allows it to perform well on complex, high-dimensional data, reducing overfitting and improving overall prediction accuracy. In our analysis, Random Forest achieved an accuracy of 75.97%, with a precision of 79% for non-diabetic predictions and 68% for diabetic predictions. In contrast, KNN recorded lower metrics, with an overall accuracy of 70.13%, a precision of 75% for non-diabetics, and 58% for diabetics. This substantial difference in performance underscores Random Forest's superior ability to detect diabetic patients with higher precision and recall, making it a valuable tool for healthcare applications. Future studies may explore hybrid models or further optimize hyperparameters for KNN to enhance its performance, particularly in datasets where simplicity and computational efficiency are prioritized.

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MABAR AND SIKESYA: IOT TECHNOLOGY INNOVATIONS FOR ENHANCING FLOOD PREPAREDNESS IN YEHEMBANG KANGIN VILLAGE

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ABSTRACT

This article explores the implementation of MABAR (Modul Anti Blabar/Banjir) and SIKESYA (Sistem Informasi Kebencanaan Desa Yehembang Kangin), aimed at enhancing flood preparedness in a disaster-prone rural area. The MABAR system, utilizing solar-powered sensors for real-time flood detection, demonstrated high accuracy and reliability even during adverse weather conditions. SIKESYA, a mobile application, integrates real-time weather data and participatory mapping to provide essential disaster information, including hazard maps and evacuation guidance. The active involvement of the local community in system development and training sessions improved their awareness and readiness, significantly enhancing their response capabilities during emergencies. Furthermore, the integration of these technologies had a positive impact on the local tourism sector by increasing visitor safety and boosting economic growth. The success of this integrated model offers a practical and scalable solution for disaster risk reduction in similar rural areas, providing valuable insights for future research and application in flood mitigation strategies.

Keywords: MABAR, SIKESYA, IoT, Disaster Mitigation

1. INTRODUCTION

Yehembang Kangin Village, located in Mendoyo District, Jembrana Regency, Bali, is a region known for its diverse natural tourism potential, including waterfalls, river tubing, hiking trails, and camping grounds (Desa Yehembang Kangin, 2024). However, despite its natural beauty, the village faces significant risks of natural disasters such as flash floods, landslides, extreme weather, and coastal erosion. In recent years, the village experienced severe flash floods in 2021 and 2022, resulting in extensive damage (Denpost, 2022). These incidents led to the destruction of community infrastructure, washed away livestock, inundated homes, and severed vital road and bridge connections, isolating parts of the village. The increasing frequency and intensity of extreme weather events pose a critical threat to both residents and visitors (Badan Nasional Penanggulangan Bencana, 2024).

The core problem faced by Yehembang Kangin Village is the high disaster risk in an area heavily reliant on nature-based tourism. The current lack of an effective early warning system and comprehensive disaster information leaves both the local community and tourists vulnerable. Additionally, there is limited infrastructure in place for disaster mitigation, such as hazard maps, evacuation routes, and temporary evacuation points (TES). These issues highlight the urgent need for an integrated solution to enhance disaster preparedness and ensure the safety of residents and visitors.



Figure 1. Disaster Potential Map in Yehembang Kangin Village

To address these challenges, two innovative technologies have been developed and implemented: MABAR (Modul Anti Blabar/Banjir) and SIKESYA (Disaster Information System for Yehembang Kangin Village).

MABAR (Modul Anti Blabar/Banjir) is an Internet of Things (IoT)-based Early Warning System (EWS) specifically designed to monitor river conditions in real-time. The system utilizes ultrasonic sensors, water level detectors, and rainfall sensors, all powered by solar energy. When water levels reach a dangerous threshold, MABAR sends early warning notifications through an Android application. This technology enables the local disaster response team (Pokdarwis) and the community to initiate timely evacuation measures. The use of solar power also aligns with environmentally friendly practices, making the system suitable for remote and rural areas with limited access to conventional power sources (I. G. D. Y. Partama et al., 2022).

SIKESYA (Sistem Informasi Kebencanaan Desa Yehembang Kangin) is an Android-based application that integrates real-time disaster data, weather updates from BMKG (Indonesian Meteorological Agency), and historical disaster records. It provides comprehensive information about current weather conditions, river water levels, and hazard maps, offering guidance on safe areas and evacuation procedures. SIKESYA aims to enhance public awareness and disaster knowledge, while also serving as a reliable source of safety information for tourists (I. Partama et al., 2024).

The implementation of MABAR and SIKESYA is expected to offer an effective, efficient, and integrated solution for disaster mitigation in Yehembang Kangin Village. This approach supports sustainable tourism development by ensuring a safer environment for both local residents and visitors. Furthermore, these innovations contribute to the achievement of the Sustainable Development Goals (SDGs), particularly Goal 11 (Sustainable Cities and Communities) and Goal 13 (Climate Action), by enhancing community resilience and disaster preparedness (Sudipa, Harto, et al., 2023).

By leveraging IoT technology and fostering active community participation, this project aims to create a responsive and data-driven disaster mitigation ecosystem. The successful implementation of MABAR and SIKESYA in Yehembang Kangin Village can serve as a model for other disaster-prone areas in Indonesia, demonstrating the potential of local innovations in addressing global challenges related to climate resilience and disaster risk reduction.

2. RESEARCH METODOLOGY

This article outlines a structured methodology designed to address disaster challenges in Yehembang Kangin Village while enhancing community disaster preparedness and tourism safety. The process consists of several key stages, including socialization, technology development, training, evaluation, and stakeholder reporting.



Figure 2. Research Methodology Flowchart

a) Socialization and Needs Assessment The initial stage of the research involves socialization with key stakeholders, including village authorities, community leaders, the tourism awareness group (Pokdarwis), and local farmers. A participatory approach is employed to gather insights about disaster risks and specific needs of the community. Surveys and interviews are conducted to assess the current conditions in disaster-prone areas and to identify optimal locations for installing early warning systems. During this stage, detailed plans for the implementation of MABAR and SIKESYA technologies are presented, highlighting their benefits and anticipated outcomes.
b) Development and Implementation of MABAR Technology The next stage focuses on the technical design and implementation of the MABAR (Modul Anti Blabar/Banjir) early warning system. Hardware development involves using ultrasonic sensors, rainfall detectors, water level sensors, and solar panels to ensure energy efficiency. These sensors are integrated with an Arduino microcontroller, enabling real-time data processing. The software component includes the development of an Android application utilizing Webhook and Google Data Studio for interactive data visualization (Saputro et al., 2024; Setiawan et al., 2024; Sudipa, Sarasvananda, et al., 2023; Wibowo & Kraugusteeliana, 2024). The system is installed at strategic points along the Yeh Sumbul River and undergoes beta testing to evaluate its accuracy and reliability under various weather conditions.

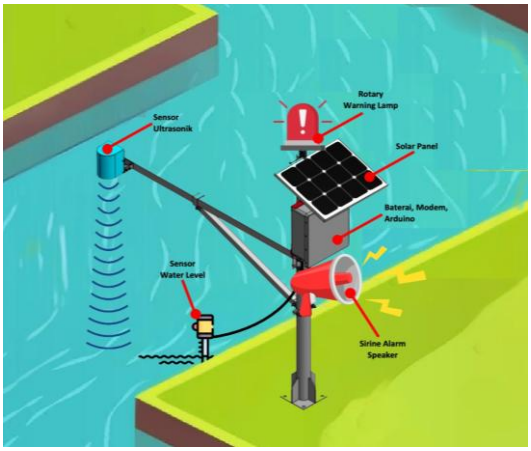


Figure 3. Design of the MABAR (Tool)

c) Development of the SIKESYA Application The SIKESYA app focuses on delivering accessible disaster information to the village community. This Android-based application integrates real-time weather data from BMKG (Meteorological, Climatological, and Geophysical Agency) alongside historical disaster data specific to the area. Key features include weather forecasts, river water level monitoring (linked with the MABAR system), hazard maps, and evacuation guidance. The mapping process is conducted with active community participation, resulting in accurate and locally relevant disaster maps. Comprehensive training sessions are provided to ensure users can effectively utilize the application for disaster response.



Figure 4. Design of the SIKESYA Application

d) Capacity Building and Knowledge Transfer This phase aims to enhance the local community's ability to operate and maintain the technology independently. Disaster response training, conducted in collaboration with the local disaster management agency (BPBD), covers search and rescue techniques, disaster mitigation strategies, and effective use of MABAR and SIKESYA. Additionally, Pokdarwis members receive training in tourism management and digital marketing to enhance visitor safety and the overall tourist experience. Knowledge transfer is facilitated through detailed guides and training materials, empowering the community to sustain the technology without external dependencies.

e) Evaluation and System Sustainability The success of the systems is assessed through comprehensive evaluation, including user feedback and extensive

system testing. Beta tests and surveys measure system performance in terms of detection accuracy, notification response times, and user satisfaction with the SIKESYA app. Focus group discussions are conducted to gather insights on the impact of the technologies on disaster preparedness and tourism safety. Based on the evaluation results, necessary adjustments are made to enhance the systems. A long-term maintenance plan is developed with local stakeholders, ensuring sustainable operation of MABAR and SIKESYA technologies.

f) Reporting to Stakeholders The findings and outcomes of the research are documented in detailed progress reports submitted to stakeholders. These reports outline the achievements, challenges encountered, and recommendations for future improvements. Comprehensive reporting ensures transparency and provides a valuable reference for academics and practitioners seeking to adopt similar disaster mitigation models in other regions facing comparable risks.

3. RELATED RESEARCH

Research on the application of Internet of Things (IoT) technology has shown that it improves early warning systems for disaster mitigation. A portable, energy-efficient early warning system for natural disasters like floods is being developed in this study (Akbar et al., 2023). The suggested system uses IoT-connected water level and weather sensors. Real-time data transmission to a central server and mobile app access enable rapid detection and improvement (Akbar et al., 2023). This study shows that IoT-based solutions can outperform human techniques in catastrophe detection and response. An IoT-based solution is ideal for MABAR, which uses water level sensors and solar power modules to notify rural communities of early warnings. Disaster mitigation research for flood-prone areas focuses on Android-based disaster information mobile apps. The paper describes the development of an app that gives real-time weather, water level, and evacuation advice for high-risk communities. Extreme Programming provides iterative development and user feedback in the app. The study shows that mobile apps can boost public knowledge and preparation (Ardhana, 2022). These discoveries are crucial to the creation of SIKESYA, an Android app that provides real-time disaster data and evacuation information. SIKESYA helps communities make faster, more informed emergency decisions by integrating historical and real-time data.

4. RESULTS AND DISCUSSION

The MABAR (Modul Anti Blabar/Banjir) system has been successfully implemented at two strategic locations along the Yeh Sumbul River, an area known for its susceptibility to flooding. Testing results demonstrated that the water level sensors and rainfall detectors used in the system were able to detect changes in water conditions in real-time with a high degree of accuracy. Early warning notifications were sent via an Android application and a Telegram group, enabling the community to respond quickly when water levels exceeded the designated safety threshold. Additionally, the use of solar panels as the primary energy source for the MABAR system proved efficient and stable, even during overcast or rainy weather. This indicates the system's reliability under various weather conditions, making it a sustainable and environmentally friendly technological solution.



Figure 5. Implementation of the MABAR Tool

The development of the SIKESYA application (Disaster Information System for Yehembang Kangin Village) focused on delivering accurate and easily accessible disaster information to the local community. The application integrates real-time weather data from BMKG (Meteorological, Climatological, and Geophysical Agency) and water level data obtained from the MABAR system. One of the standout features of the app is the interactive map, which highlights disaster-prone areas and evacuation routes, created using participatory mapping methods involving the local community. The evacuation guidance and real-time notifications offered by the ap p have been instrumental in helping residents plan effective mitigation measures during flood events. Evaluation results show that over 80% of users found the app's features to be effective in providing the necessary information during emergency situations.



Figure 6. Implementation of the SIKESYA Application

The implementation of these technologies has resulted in a significant improvement in the community's preparedness for flood disasters. Post-training surveys revealed that 85% of respondents reported increased knowledge on how to respond to early warnings and execute safe evacuations. Active involvement of the community in the participatory mapping process and intensive training sessions has enhanced their sense of ownership of the developed system. Villagers, especially members of the Pokdarwis (tourism awareness group), were trained in using the SIKESYA app and interpreting the displayed data, enabling them to make more informed decisions during emergencies. This active participation not only enhanced the community's technical skills but also strengthened their overall readiness in facing disaster risks.

Another positive outcome of the technology implementation is seen in the tourism sector. The presence of the SIKESYA app, which provides safety information and

evacuation guidance, has increased the sense of security for tourists visiting Yehembang Kangin Village, especially during the rainy season. This has contributed to a rise in tourist visits and brought positive economic impacts to the local area. Additionally, members of the Pokdarwis who received training in tourism management and digital marketing were able to offer improved services, enhancing visitor satisfaction and reinforcing the village's image as a safe and welcoming tourist destination.

5. CONCLUSION

The implementation of the MABAR system and SIKESYA application has helped in disaster preparedness and community resilience in Yehembang Kangin Village.The solar-powered MABAR system provided accurate real-time flood detection and early warning notifications, showcasing efficiency and sustainability in mitigating flood risks, even under challenging weather conditions. The SIKESYA app delivered reliable and interactive disaster information, including hazard maps and evacuation guidance, which were well-received by users, leading to improved community response during emergencies. Active participation from the local community in the system's development and training further strengthened their readiness and sense of ownership. Moreover, the integration of these technologies positively impacted the local tourism sector by increasing visitor safety and boosting the economic growth of the village. The success of this integrated disaster mitigation model offers a practical and scalable solution that can be adapted to other disaster-prone areas, providing valuable insights for future research and applications in disaster risk reduction.

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PUBLIC SPACE REPRESENTATION OF RAMAYANA SHENDRATARI OPEN STAGE AT PRAMBANAN TEMPLE IN THE THEORY PRODUCTION OF SPACE

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ABSTRACT

Prambanan Temple is a place of worship and also a tourist spot for activities for local visitors and foreign tourists, and can be visited every day from morning to evening. While the Prambanan Ramayana ballet is a performance that combines dance and drama without dialogue, taken from the Ramayana story.This study aims to describe the representation of space produced according to the spatial and social context in the perspective of the theory of Space Production, namely by feeling, understanding, and experiencing the existing space perceived space- conceived space-lived space. This study uses a descriptive qualitative method, namely the collection of primary data sources and secondary data. Data collection techniques are carried out using observation, interview and documentation methods. Data analysis techniques used are data reduction, data presentation and drawing conclusions. From the presentation that has been delivered, Henry Lefebvre's argument is considered to be able to provide a solution to the problem of social space production in Prambanan Temple. Three spatial characters (dimensions of spatial practice, spatial representation and representational space) are expected as a study that can unravel the problem of social space construction activities in the public space of the open stage of the Ramayana Ballet of Prambanan Temple.

Keywords: Temple Prambanan, Stage, Ramayana, Space

I. INTRODUCTION

1.1 Background

Prambanan Temple as the largest Hindu temple in Indonesia based on the Siwagrha inscription, this temple began to be built during the reign of Rakai Pikatan (mid-9th century) of the Ancient Mataram Kingdom, is one of the cultural heritages of the Indonesian nation. In addition, Prambanan Temple is also mentioned in the popular legend of the love story of Roro Jonggrang and Bandung Bondowoso. The Prambanan temple area had undergone restoration which began in 1981 during the Colonial era until it was completed in 1953 during the Independence era. Finally, currently, the Prambanan temple area has various attractions that are one of the favorite tourist attractions for domestic and foreign tourists, one of which is the existence of an open stage public space. This open area of public space is a social public space to display dance and drama arts activities.

The Prambanan Ramayana Ballet is a performance that combines dance and drama without dialogue, taken from the Ramayana story. The Prambanan Ramayana Ballet is usually held every Tuesday, Thursday, and Saturday, performances on the open stage (Open Stage) only in the dry month (May-October), outside of that the performances are held on the closed stage (Trimurti Stage) in January-April & November-December. The activities held in the two spaces are the construction of social space production carried out by the community in the formation of public space as a new social space.

As Henry Lefebvre argued, social space is shaped by social action, both individually and collectively. It is social action that gives “meaning” to how a spatial space is conceived by those who inhabit and animate the space. The production of social space concerns how spatial practices are realized through perceptions of the environment that are built through networks that link social activities such as work, private life, and leisure. (Lefebvre, 1991) Future perspective projections on Ramayana Ballet Open Stage which will definitely increase the number of tourist visits along with the operation of the Solo - Yogya toll road.

1.2 Problem Formulation

Based on the problem identification above, the problem formulation in this research is:

1. How is the process of forming a new space as a representation of social public space carried out at the open stage public space of the Prambanan Temple Ramayana Ballet?
2. How to process social public space based on Lefebvre's three-dimensional space carried out at the public space of the Ramayana Ballet Open Stage at Prambanan Temple?

1.3 Objectives

This study aims to describe the production of social public space at the public space of the open stage of the Ramayana Ballet at Prambanan Temple from the perspective of Henry Lefebvre's theory of Space Production.

2. RESEARCH METODOLOGY

The research method used in this study is descriptive qualitative with a case study approach. The case in question is the phenomenon that occurred at Prambanan Temple. Here it is necessary to analyze the formation of a new social public space from activities carried out in the Prambanan Temple area as the object of research. Space is not formed by itself, but space is formed due to activities in public spaces such as Prambanan Temple. This study focuses intensively on one particular object that studies a case. Case study data can be obtained from all parties concerned, in other words the data collected comes from various sources (Nawawi, 2003)

The theory used in this research is *The Production of Space by Henry Lefebvre.* Space is always a social space because it is produced socially. Space is a social product. The concept of space production, which contains an understanding of space that is fundamentally tied to social reality. The understanding of space as in itself, will never find an adequate epistemological starting point. In producing a new social space, Lefebvre uses the basis of the three dimensions of space as a social product. The Theory of Space Production can analyze the problems that exist in the Prambanan Ramayana Ballet Open Stage.

3. RESULTS AND DISCUSSION

3.1 The process of forming a new space as a representation of social public space carried out at the open stage public space of the Ramayana Ballet at Prambanan Temple?

Lefebvre (1991) argued that space (Lefebvre called it *space*, without distinguishing the definition of *space* and *place*) is related to **the production process because space is produced socially**. This process occurs in society where society not only has power but also practical understanding in everyday life including practical political economic actions to make changes. Where this change will define the dynamic meaning of a space. According to him, social space is always related to social activities, where it is also related to time and society factors (in this case, Lefebvre relates it to the main factors in social sciences, namely **space, time and humans**). These three factors form the meaning of space in society. Social space is never identical or the same because each space carries the specificity of its formation related to history (as a representation of time in space) and its society. The steps taken start from restoration, change and sustainability, as follows:

Currently, Prambanan Temple has undergone changes, so that Prambanan Temple currently has many benefits, including being used as a place to perform the Ramayana dance drama, then being used to carry out the Tawur Agung ceremony

by Hindus, being used as a place for hatha yoga, as a place or destination for tirta yatra for Hindus and as a tourist spot for the general public.

Of course, with the new toll road infrastructure towards Jogja that facilitates access to Prambanan Temple, the Ramayana ballet's open stage public space will have more visitors. This performance is actually held to preserve culture, preservation and the Hindu epic of the story of Rama and Sinta, and to introduce Prambanan Temple as a world heritage site. Held in an open space on the west side of the Prambanan Temple complex, so that the stage used is set against the backdrop of Prambanan Temple itself. The audience's seating also has a capacity of around 900 people. The activities that are running will certainly form a social space due to the community activities in the Prambanan Temple area.



Figure 1. Changes to the Open Stage of the Ramayana Ballet at Prambanan Temple
(Source: Public Relations of Prambanan Temple)

a) The Open Stage in the colonial era was in front of the Prambanan temple area with an area that was not so large, but was always used for activities at that time. (Picture 1-2)
b) In 1961, an open stage was built for the Ramayana dance drama within the Prambanan Temple complex (Figure 3).
c) Due to the location of the Prambanan Temple open stage which violates archeological regulations, in 1980 the open stage which was previously inside the temple area **was moved** outside the main temple complex or the west side, along with the construction of the Tri Murti closed performance building (Figure 4).

The continuity of the transformation from Ramayana relief images to social product activities on the Ramayana dance drama stage at Prambanan Temple.

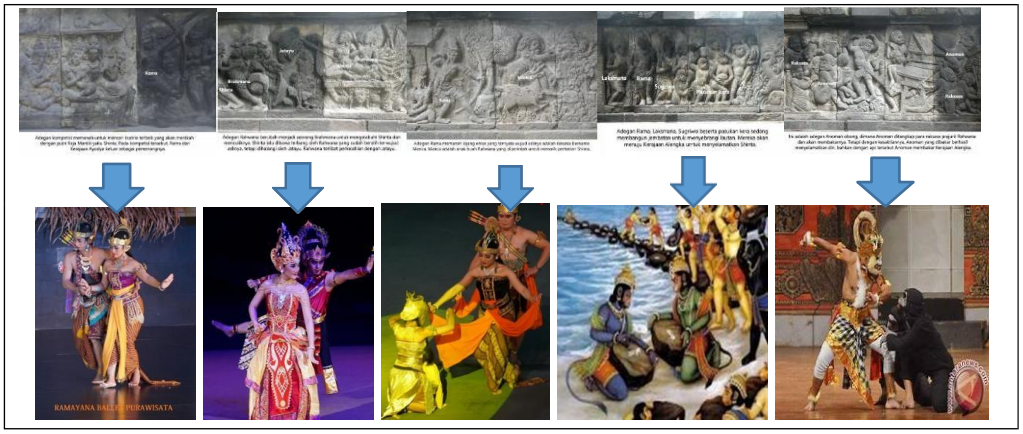


Figure 2. Transformation of the Ramayana Relief image into the Ramayana Ballet
(Source: Public Relations of Prambanan Temple)

Transformation of some temple reliefs from 72 Ramayana relief panels as an example of a depiction of how Shinta, Rama's wife, was kidnapped by Rahwana. The commander of the wanara (monkey) nation, Hanuman, came to Alengka to help Rama find Shinta. This story is presented in the Ramayana Ballet, a wayang orang performance that is routinely performed in a public open stage every full moon night.

3.2 How to process social public space based on Lefebvre's three-

dimensional space carried out at the public space of the Prambanan Ramayana Ballet Open Stage?

Public space is a space that functions as a place to accommodate community activities, both individually and in groups, where the form of this public space is very dependent on the pattern and arrangement of the building mass (Rustam Hakim, 1987). According to Carr et al. (1992), the typology of public space emphasizes the character of its activities, location and formation process. Ideal Public Space According to Carr, public space must have three things, namely responsive, democratic, and meaningful.

Meanwhile, according to Henry Lefebvre (1991), the concept of space that Descartes said was **absolute space**, while Kant conveyed it as **abstract space**. As another perspective in understanding space compared to previous thinkers, Lefebvre presents a new concept of space as **a social space** related to a social phenomenon. A concept that refers to the production of space, the formation of a new space. Space is not just a physical or geographical entity, but rather a social product formed through social interaction and relationships. Analysis of social public space in Prambanan Temple according to Lefebvre's three dimensions of space are:

a) Representational Space*:* This is the space experienced and lived daily by individuals. This space includes symbolism, meaning, and emotional relationships attached to certain places, such as public spaces. Social public space here is formed at certain times, namely during community activities during school holidays, end of year, Eid and Hindu religious holidays. Community activities are attended by many people and are spontaneous in nature which ultimately become one of the requirements for the formation of social public space.



Figure 3. Social Public Space Activities
(Source Public Relations Doc)

b) Representations *of Space*: This is the space produced through planning, science, and engineering. Architects, urbanists, and city planners create this space through maps, diagrams, and plans that often ignore the real experiences of the users of the space. As a representation of space in Prambanan Temple, of course based on the Siwagrha inscription, this temple began to be built around 850 AD by Rakai Pikatan, and continued to be developed and expanded by Balitung Maha Sambu, during the Medang Mataram kingdom. The original plan of Prambanan Temple was rectangular, consisting of an outer courtyard and three courtyards, namely Jaba (outer courtyard), Tengahan (middle courtyard) and Njeron (inner courtyard). The outer courtyard is an open area that surrounds the outer courtyard. The outer courtyard is rectangular with an area of 390 m2.

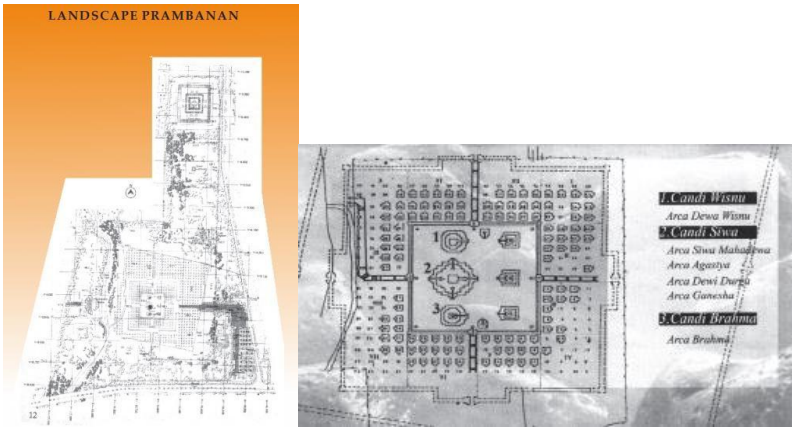


Figure 4. Landscape and Original Plan of Prambanan Temple

(Source Jordaan, Roy E.. 1996. In Praise of Prambanan; Dutch Essays on the Loro Jonggrang Temple Complex. Leiden: KITLV Press)

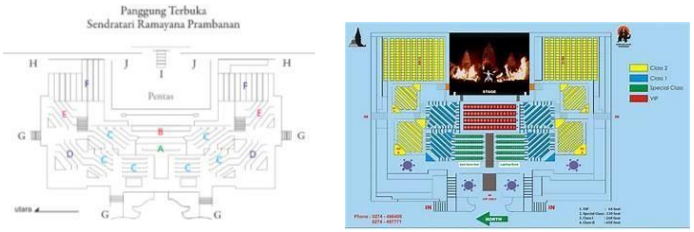


Figure 5. Open Stage Plan of Ramayana Prambanan
(Source https://id.wikipedia.org/wiki/)

c) *Spatial Practice*: This is how space is used and organized in everyday life. It includes routine activities such as working, shopping, and social interactions that shape and are shaped by the space around us. Ramayana Ballet activities are activities that are produced at any time and this activity is a requirement for the formation of a social public space created by the community together in the same place with a large number of people. This activity involves dancers, musicians and audiences.



Figure 6. Prambanan Ramayana Ballet Activities
(Source Public Relations Doc)

4. CONCLUSION

4.1 Conclusion

1. The creation of open public space production at the Ramayana Ballet Open Stage was due to the fulfillment of the requirements for public space production, such as the existence of open space for gathering, the existence of activities, the existence of social interaction from, by, for the community, and social communication.
2. Based on Lefebre's 3-dimensional space, the problems regarding the production of social space at Prambanan Temple and the Open Space of the Ramayana Ballet Stage can be explained.
3. There is a very interesting finding that the statues at Prambanan Temple also serve as supporting construction for the temple buildings in the Prambanan area.
4. Temple architecture with traditional Javanese Hindu style design and Prambanan motifs can be a patron for the development of Nusantara design culture.

4.2 Suggestions

For researchers, this article still needs to be developed, because it is still basic, it needs further analysis as proof of its findings, researchers accept criticism and suggestions for improvement, thank you.

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USER RESEARCH ON HOUSEHOLD FOOD WASTE AMONG URBAN RESIDENTS IN JAKARTA: UNDERSTANDING BEHAVIORS FOR UI UX DESIGN

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ABSTRACT

Indonesia is the second-largest producer of food waste globally, making it a significant issue that demands urgent attention. To address this problem, various technological tools, such as mobile apps, can help users track and manage their food consumption. Unfortunately, most existing apps are designed for Western contexts and are not well-suited to Indonesian households. Developing an effective app requires comprehensive user research. This study leverages the Food Consumption Management model and the Motivation, Ability, and Opportunity framework to identify key behaviors contributing to food waste at the household level. Given the exploratory nature of the problem, a mixed-methods approach was used, combining surveys and interviews from diverse household settings. The study identified five key challenges: impulsive shopping, knowledge gaps in food management, time constraints, family dynamics, and the motivation to save money. Based on these findings, the proposed app features include real-time notifications, AI-assited recipe suggestions, quick meal planning modes, collaborative tools for family use, and progress-tracking dashboards. Gamification is also suggested to enhance user engagement and promote sustainable behaviors. This study provides preliminary research on user behavior for UI UX App Design, so the app can offer features that effectively promote sustainable food habits in Indonesian households.

Keywords: *user research, food consumption management, motivation, ability, opportunity*

1 INTRODUCTION

Food waste is a significant global issue with profound environmental, economic, and social implications (Roka, 2022). Every year, approximately 1.6 billion tons of food waste are generated worldwide (Esben Hegnsholt, Shalini Unnikrishnan, Matias Pollmann-Larsen, Bjorg Askelsdottir, 2018). Our country ranks as the second-largest producer of food waste globally, following Saudi Arabia (Novitri, 2021). In Jakarta alone, the city produces over 7,700 tons of trash daily, organic waste is the most (60%) (Siregar & Tjahjono, 2020). The waste comes from households, hotels, restaurants and supermarkets (Tobing, 2024).

One way to address this issue is by leveraging technology (Tamasiga et al., 2023). Several applications are currently available to help track household food consumption and reduce food waste. (Jiequan Hong, Anicia Jaegler, 2024; Radenkovic & Laska, 2020) Unfortunately, most apps available are designed for Western countries. These existing apps often fail to meet the specific needs of Indonesian households, where cultural and logistical factors differ. To design the right app, the first step is to conduct user research to ensure that the app is suitable to users' needs (Interaction Design Foundation, 2024). This paper focuses on user research regarding household food consumption among urban residents in Jakarta, aiming to identify key behaviors, habits, and attitudes that contribute to

food waste at the household level. By conducting both qualitative and quantitative research, we seek to uncover the underlying factors influencing food waste, such as purchasing habits, food storage practices, meal planning, and awareness of waste reduction strategies.

Previous research by (van Geffen et al., 2016) has developed two models for studying household consumption: the Food Consumption Management (FCM) model and the Motivation, Opportunity, and Ability (MOA) framework. This study is novel because it applies both frameworks that are originally developed by van Geffen et al. (2016)—to a new cultural and geographical context: urban households in Jakarta and use this framework as preliminary research for ui ux design. By focusing on the unique consumption behaviors, challenges, and motivations of this population, the study expands the application of these models, addressing gaps in research on food waste in non-Western settings and providing insights tailored to Indonesian urban communities.

2 RESEARCH METHODOLOGY

The research is exploratory research. It is a type of research used to investigate a problem or situation where there is little or no information available (Soufan, 2023). It is flexible and adaptive making it ideal for the dynamic and user-centered field of UI UX design (Fronemann & Peissner, 2014). With this research method user needs and preferences can be identified to inform the later design process to create more effective and user-friendly interfaces (Hassan, 2024).

The research begins with a literature review of the Food Consumption Management (FCM) and Motivation, Ability, and Opportunity (MOA) models, followed by quantitative surveys and qualitative interviews to examine food waste behaviors. Data is analyzed across the six FCM stages—planning, provisioning, storing, preparing, consuming, and disposal—through the MOA lens, identifying key barriers and motivators. Insights guide the design of a mobile app with user-centered features.

3 RELATED SEARCH

3.1 *Food Consumption Management (FCM)*

According to (van Geffen et al., 2016) to effectively reduce waste at the household level there should be six stages: planning, provisioning, storing, preparing, consuming, and disposal. It should become a routine that is practised overtime.

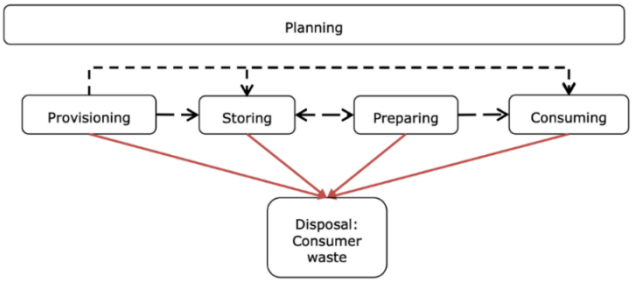


Figure 1. Food Consumption Management Model
Source: (van Geffen et al., 2016)

1. Meal Planning

The first step is meal planning, which involves organizing and prioritizing food consumption. By planning meals in advance, individuals can purchase only the necessary ingredients in the required amounts, avoiding impulsive shopping or overbuying.

2. Provisioning Stage

The provisioning stage is when the food is acquired through various means, such as in-store purchases, online shopping, home cultivation, or receiving food as gifts. This stage plays a critical role in food waste reduction by influencing the quantity and type of food brought into the household.

3. Food Preparation

Food preparation encompasses the processes of cooking and meal organization. it determines how efficiently ingredients are utilized and how leftovers are managed. Proper portioning during preparation ensures that meals are cooked in quantities suitable for immediate consumption, minimizing the likelihood of excess food.

4. Consumption

The consumption stage refers to the actual eating of food. Consumer behaviors during this phase, such as portion sizes, eating habits, and meal preferences, significantly impact the level of food waste.

5. Storage

It involves proper handling, organization, and preservation of food to prolong its freshness and prevent spoilage.

6. Disposal

The disposal stage involves the management of leftover food, with options including composting, repurposing, or discarding uneaten food.

3.2 *Motivation, Ability and Opportunity (MOA)*

MOA discusses how do consumers behave regarding their food waste at the level of individual, social and societal (van Geffen et al., 2016).

1. **Motivation**
   Reflects an individual's willingness to engage in reducing food waste. It can include environmental concerns, financial savings or ethical considerations.

2. **Opportunity**
   This involves external conditions that influence food waste management, including the availability of proper storage facilities, access to preservation tools and technology, infrastructure for disposal or recycling, and the presence of community programs promoting waste reduction.

3. **Ability**
   Represents the consumer’s knowledge and skills for effective food management, including knowing about meal planning, understanding food labels or having the skills to cook with leftovers.

All these factors are interrelated and play a significant role in determining whether consumers will adopt behaviors that prevent food waste. A lack of ability to manage food consumption can increase food waste, while insufficient opportunities can demotivate consumers from taking action.

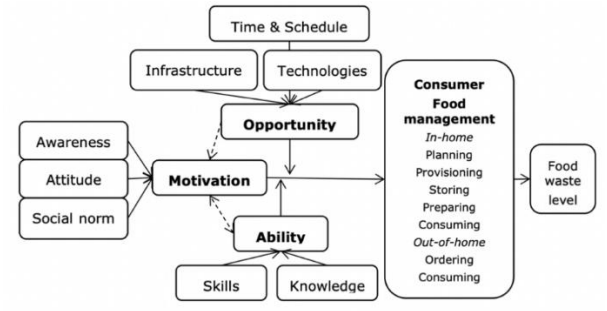


Figure 2.Motivation, Ability, Opportunity (MOA) Model
Source: (van Geffen et al., 2016)

3.3 User Experience Factor

When designing an intuitive and user-friendly application, it is essential to consider the user experience (UX) factors (Gumulya, 2023). These factors influence how users interact with a product or service, aiming to improve their overall satisfaction and ease of use. The key UX factors to consider (Moule, 2012):

- Usefulness: Does the app fulfill a clear and essential purpose?
- Usability: Is the app easy to navigate, with minimal effort required from the user?
- Learnability: Can users quickly learn how to use the app with little guidance?
- Aesthetics: Does the app's design visually appeal to users, enhancing their overall experience?
- Emotions: Do the positive emotions the app and brand evoke influence users' long-term willingness to engage with it?

4 RESULT & DISCUSSION

4.1 Interview data

From the interviews with 10 respondents, 5 households and 5 individuals. Several themes can be identified in each stage of FCM

Table 1 Interview Result

FCM Stages	User action	Problems
1. Meal Planning	Planning meals or dishes for the week	• **Uncertainty** about what can be prepared or cooked. • **Forgetting** to check existing food supplies at home. • **Failing to** stick to the shopping list and meal plan.
2. Provisioning Stage	Procuring groceries or food items according to planned requirements.	• Making **impulsive purchases** of food items, often influenced by limited-time discounts. • Lack of **understanding** regarding the **appropriate quantity** of food to buy, leading to **over-purchasing** or buying in excessively large portions. • **Insufficient communication** among household members during grocery procurement, increasing the likelihood of food stockpiling.
3. Food Preparation	Preparing or reprocessing food effectively to ensure it is safe and suitable for	• Cooking **outcomes do not meet expectations** (e.g., burnt or overcooked dishes). • Using only some ingredients may result in **leftover items** being forgotten and eventually discarded.

	consumption.	• **Failing to prepare food** according to the planned recipe or portion size.
4. Consumption	Consuming food in portions as planned initially	• Storing leftover food but ultimately not consuming it due to **forgetting or the food spoiling** over time. • Consumers aim to **avoid illnesses** associated with consuming spoiled food
5. Storage	Storing ingredients or food in appropriate locations to extend their shelf life and prevent premature spoilage.	• **Lacking knowledge** or awareness of proper food storage techniques to maintain freshness for a longer period. • **Being unaware** of the shelf life of food items. • **Disorganized or cluttered** storage spaces increase the likelihood of forgetting about stored food.
6. Disposal	Discarding food that is no longer safe or suitable for consumption.	**Lacking access** to sustainable food disposal methods.

Source: Authors' Data, 2024

4.2 Questionnaire data

Authors distribute questionnaires to 63 respondents to identify their shopping habits and the factors that contribute to food waste in their household.

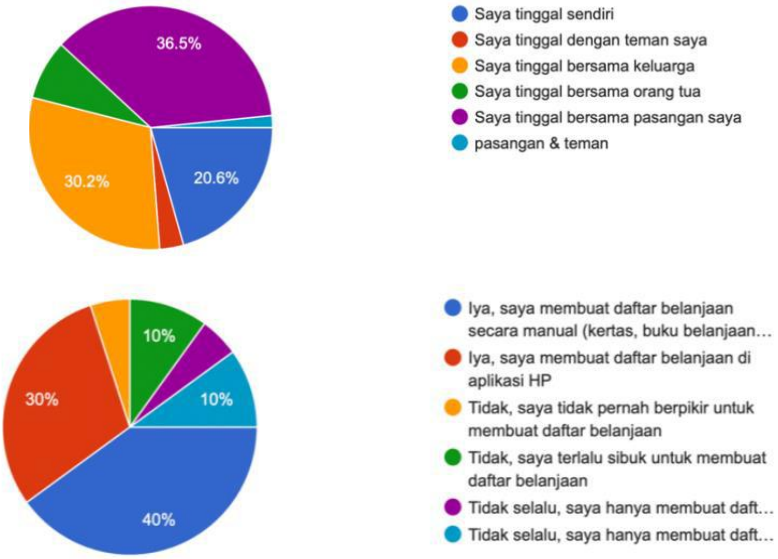


Figure 3.Questionnaire Data
Source: Authors' Data, 2024

From the data several conclusions can be drawn:

- Respondents living with a partner or family tend to generate more waste compared to those living alone.
- On average, 50% of respondents spend between IDR 1,000,000 and 2,000,000 per month on groceries, 50% of them often making 3-4 shopping trips each month.
- 30.2 % of respondents prioritize the freshness and quality of products when grocery shopping over the quantity of the items.

- More than half of the respondents frequently create shopping lists before purchasing groceries, using both manual (40%) and digital methods on their smartphone devices (30%).
- Before shopping, 55% of respondents typically check their refrigerator, freezer, and kitchen, or plan the meals they will cook before making a shopping list.
- Over half of the respondents indicated that cooking according to portion sizes is not a priority for them, and they only occasionally consider portion control.
- The primary factor contributing to food waste is that some family members don't finish their meals. The second factor is changes in family members' plans, leading to prepared food going unused. The third factor is respondents not routinely checking or being unaware of food expiration dates, resulting in food being left too long in the refrigerator, freezer, or pantry.

The second questionnaire was developed to collect data on behaviors and factors contributing to the process of creating a grocery shopping list. The survey was completed by 24 respondents, with no restrictions on age, gender, or occupation. The questions in this second survey were designed to understand the habits surrounding grocery list creation, which is crucial for developing the application.

The results from the data collection through the questionnaire on factors contributing to the process of creating a grocery shopping list, completed by 24 respondents, indicate the following:

- While 58.3% of respondents create a weekly shopping list, 45.8% rarely follow it, with impulsive shopping influenced by discounts, spontaneous purchases, and time constraints for quick meal preparation.
- 37.5% of respondents expressed satisfaction with the meals planned in advance, which could be attributed to a lack of time or limited sources and references for exploring a variety of dishes.
- Flexibility was highlighted as a key factor, as seen in meal planning and adaptability to changes. The integration of nutritional considerations (41.7%) aligns with health-conscious choices.
- Grocery list planning is usually done by one person in the family, with occasional input from others, and often includes non-essential items like ready-to-eat snacks.
- The majority (62.5%) aim to avoid excessive spending, emphasizing the financial aspect of list-making. This reflects impulsive behaviors, driven by desires and special offers.
- Respondents often group shopping items by category (45.8%) and balance needs with wants (70.8%), with half prioritizing discounts for cost savings.
- While many occasionally review and update their shopping lists, there is still a preference for spontaneous shopping.
- About 62% of respondents have used meal planning apps, but most stopped due to complexity, difficulty in use, or failure to fit into their routines.
- 50% of respondents plan meals a day before grocery shopping and tend to prefer simple meals for ease of preparation.

- 37.5% of respondents expressed satisfaction with the meals planned in advance, which may be attributed to a lack of time or limited resources and references for exploring a variety of dishes.
- Flexibility is key, as observed in meal planning and adapting to changes. The inclusion of nutritional considerations (41.7%) aligns with health-conscious choices.

4.3 Data analysis

We conduct thematic analysis on both interview and questionaire data

Table 2 Thematic Analysis

FCM Stages	MOA	Themes
1. Meal Planning	Motivation: Willingness to reduce food waste	Avoid excessive spending
	Opportunity: External factors influence food management	Time constraints in meal planning
		Health-conscious choice
		Lack of communication within households
	Ability: Food management skills and knowledge	Limited sources or references for exploring diverse meals
		Lack of portion control knowledge
2. Provisioning Stage	Motivation	Desire for discounts and savings
		Focus on freshness and quality
	Opportunity	Spontaneous shopping behavior
	Ability	Difficulty sticking to the shopping list
3. Food Preparation	Motivation	Desire for quick meals
		Health-conscious choices
	Opportunity	Limited time for preparation
	Ability	Lack of cooking skills
		Inconsistent preparation
4. Consumption	Motivation	Desire for convenience
	Opportunity	Family members not finishing meals
		Changes in family members' plans
	Ability	Lack of consistency in portion control
5. Storage	Motivation	Desire to preserve food
		Avoiding spoilage
	Opportunity	Lack of proper storage systems
	Ability	Lack of knowledge in food storage techniques and shelf life
		Disorganized storage spaces
6. Disposal	Motivation	Avoiding foodborne illness
	Opportunity	Unawareness of expiration dates
	Ability	a lack of knowledge or access to sustainable methods of food disposal

Source: Authors' Data, 2024

We conclude several themes that occur along with the FCM model are:

Impulsivity vs. Planning

Impulsive buying and a lack of adherence to shopping lists are recurring issues across provisioning and meal planning stages.

Lack of Knowledge

Several themes point to gaps in knowledge regarding portion control, food storage, and expiration dates.

Time Constraints

A common theme is the pressure of time, which affects meal planning, preparation, and storage, leading to impulsive decisions and food waste.

Family Dynamics

Communication gaps and changed plans within family members contribute to wasted food, unplanned purchases, and unused leftovers.

Reduce waste to save money

The desire to reduce waste and save money is a motivating factor, but the lack of sustainable disposal practices and storage knowledge is a significant barrier.

From the data, we conclude to focus on the meal planning stage of FCM model, since food waste is a complicated process and to tackle it all on one app will be too confusing for the users. The user research is concluded by putting the reccomendation to the user experience factors.

Table 3 UX Factors for Meal Plan App

Themes	User Experience Factors	App feature reccomendation
Impulsivity vs. Planning	Usefulness: Fulfills a clear purpose.	Real-time Notifications: Alerts about deviating from planned items or exceeding budgets during shopping.
Lack of Knowledge		AI-Based Suggestions: Recommendations for recipes or meals that use ingredients nearing expiration.
Time Constraints	Learnability: Quick to master.	Quick Planning Mode: An express meal planning option for users with limited time, focusing on easy and efficient recipes
Family Dynamics	Usability: Easy to navigate.	Collaborative Planning Tools: Shared shopping lists and meal plans that family members can update in real-time.
Reduce waste to save money	Aesthetics: Visually appealing design.	Progress Tracking: A dashboard showing reductions in food waste and money saved over time.
	Emotions: Promotes positive, lasting engagement.	Gamification: Rewards for consistent adherence to plans, minimized waste, or trying new sustainable habits.

Source: Authors' Data, 2024

5 CONCLUSION

This study aimed to inform the design of a mobile app tailored to Indonesian households, addressing food waste issues by considering cultural and logistical factors. Using the Food Consumption Management (FCM) model and the Motivation, Ability, and Opportunity (MAO) framework, the research identified key challenges in user behavior, such as impulsive shopping, knowledge gaps, time constraints, and family dynamics, while highlighting the desire to reduce waste and save money. The study proposes user experience factors like usefulness, usability, learnability, aesthetics, and emotional engagement to guide the development of app features such as real-time notifications, AI-powered recipe suggestions, meal planning modes, collaborative tools, and progress-tracking dashboards. Gamification elements are suggested to enhance engagement and encourage sustainable behavior changes, providing clear direction for a practical and effective food management app for Indonesian households.

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SONG LIST RECOMMENDATION FOR STUDENT ACTIVITIES USING K-NEAREST NEIGHBORS (K-NN) METHOD

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ABSTRACT

Music plays an important role in influencing an individual's mood, concentration and productivity. However, choosing the right music for learning activities is still a challenge, as each individual has different music preferences and the right music can have a positive impact on learning focus and motivation. Based on this problem, this research aims to develop an individual preference-based music recommendation system that can help users choose music that suits their learning needs. The solution offered is the implementation of a recommendation system using the K-Nearest Neighbor (K-NN) algorithm, which combines user profile data (such as age, gender, and hobbies) with music characteristics (such as energy and valence) to determine the most suitable song. The research data was collected through surveys and Spotify API to obtain song parameters. The analysis process uses K-NN to calculate the congruence between user profiles and song data in the dataset, with the aim of recommending suitable music. The results show that the system is effective in supporting concentration and study motivation, providing suitable song recommendations based on user preferences and needs.

Keywords: *Music Recommendation, K-Nearest Neighbors, Study Concentration, Spotify API, Energy and Valence*

1. INTRODUCTION

Music plays a significant role in people's lives and has the ability to affect mood, cognition and productivity. Many studies have shown that music can not only entertain but also help improve focus and concentration, especially when studying. The study by (Helmholz, Meyer, and Robra-Bissantz 2020) revealed that access to digital music streaming services has enabled many users to listen to different types of music at any time, but this often leads to difficulties in selecting appropriate music for a particular mood or activity. Similar challenges are found in the context of learning, where inappropriate music selection can disrupt concentration or even demotivate students. Based on the survey conducted in this study, more than 50% of the respondents stated that they had difficulty in choosing the right music for studying, and the majority felt that appropriate music could improve their focus and productivity while studying. This shows a strong need for a music recommendation

system that can provide a selection of songs tailored to individual preferences and their study needs. In recent years, the development of artificial intelligence technology has offered great potential for creating recommendation systems that can provide personalized music experiences. These systems are expected to simplify the music selection process, resolve users' confusion, and allow them to listen to music that better suits their mood and activities. This research proposes a solution in the form of a song recommendation system based on the K-Nearest Neighbor (K-NN) algorithm to provide relevant music recommendations based on user preferences, such as age, gender, and hobbies, as well as music characteristics such as energy and valence. The advantage of K-NN is its simplicity in clustering data based on the closest distance, which enables matching between individual preferences and specific song attributes to produce accurate recommendations. This method has been applied in various recommendation applications due to its reliable ability to process numerical data and provide appropriate predictions. According to research by (Fadlila Surenggana, Aranta, and Bimantoro 2023), the K-NN method is able to classify music with a high level of accuracy when used for mood-based music recommendations, which shows significant potential in the context of music personalization for learning activities. The research process began with data collection through surveys and the use of the Spotify API to obtain information regarding song characteristics, such as energy and valence, which directly contribute to the emotional perception and motivational effects of the music. The data obtained from the survey includes user profiles, which include age, hobbies, and music preferences, which are then processed using the K-NN method to identify the most relevant songs. K-NN uses Euclidean distance to determine the proximity between user profiles and song attributes, allowing the system to recommend songs that suit each user's mood and learning needs. The aim of this research is to develop a recommendation system that can help students select optimal music to support concentration and study comfort. By combining user preferences and specific characteristics of songs, the system is expected to improve learning effectiveness by providing recommendations that are not only enjoyable but also appropriate to the learning context. This research also aims to contribute to the development of recommendation technology that is more efficient and accurate in supporting productive activities. The benefits of this research include increased learning comfort for students through music recommendations tailored to individual profiles, increased learning motivation, and contributions to the field of science that combines music, psychology, and artificial intelligence technology. In addition, this research can be a reference for developers of better music recommendation systems, not only for learning activities but also for various activities that require mood and concentration support.

2. RESEARCH METHODOLOGY

K-Nearest Neighbor (K-NN) Method

This research uses a quantitative approach with an experimental method, where the K-Nearest Neighbor (K-NN) algorithm is applied to analyze and recommend suitable songs based on user profiles and music parameters. K-NN is a data classification method to estimate the likelihood that a data point will become a member of a group based on the group closest to the data point. K-NN has a very simple basic concept and consists of only two steps, namely training and classification (Fadlila Surenggana, Aranta, and Bimantoro 2023). The research process is carried out through several stages, namely user data collection, music data processing, and implementation of recommendation algorithms. The development of this recommendation system includes collecting user data, analyzing music preferences, and implementing the K-NN algorithm. The system uses user profile attributes (age, hobbies, and gender) and music data (energy and valence) to generate personalized recommendations. Each stage of development

follows a phased software development cycle model to ensure integration and accuracy of results.

Data Collection Techniques

(1) Questionnaire Method

This research conducted two questionnaires. The first questionnaire was used to collect primary data from students and college students. The questions were structured to cover the frequency of listening to music while studying and how it affects concentration. Based on the results of the questionnaire that the author has distributed with 86 respondents, the author knows that 43% agree and 25% strongly agree that it is difficult to determine the appropriate song for studying and 52% strongly agree and 39.5% agree that a recommended list of songs for study activities is needed. A second questionnaire will be conducted to find out feedback on the recommendations given.

(2) Training Data Collection

The training data collection process aims to understand music preferences and their influence on study focus. Data is collected through a form that includes individual profile information, such as age, hobbies, gender, as well as a selection of 5 songs that are considered effective in improving study concentration. In addition, the Spotify API was used to collect data on musical parameters, such as energy and valence, which describe the emotional aspects of each song. This collected data forms the basis for further analysis to generate music recommendations that can support increased learning focus and productivity.

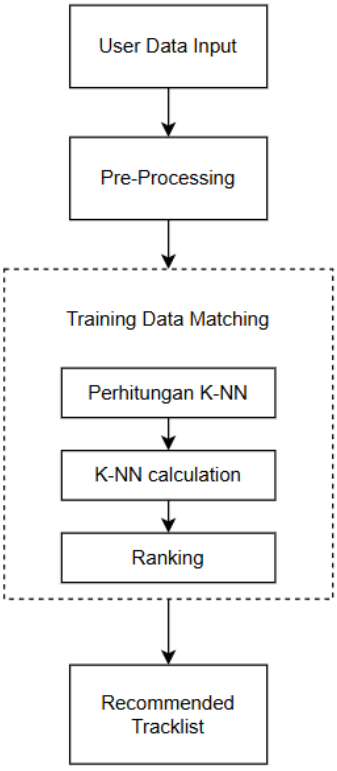


Figure 1. K-NN Models

This figure shows the flow of the song recommendation system that starts with user data input, such as age, hobbies, gender, and song preferences. The data then goes through a pre-processing stage before being matched with the training data

using the K-NN method. The K-NN process involves a distance calculation (Euclidean distance) to determine similarity, followed by a ranking process. The end result is a list of song recommendations that match the user's preferences.

Pre-Processing Stage

This stage includes data transformation to change the format or structure of the data to suit the needs of the analysis. User data includes age, hobbies, gender, energy, and valence attributes that are converted to numeric form (structured data). Attribute conversion details:

- Age: Indicates age in years.
- Hobbies: Given a numerical value, e.g. 1 for arts and creative, 2 for sports and leisure, 3 for tech and digital, and so on.
- Gender: Encoded as a binary value, i.e. 1 for male and 0 for female.
- Energy and Valence: Numerical values obtained from the song data entered by the user.

Here is an example of input data that is ready to be processed

Table 1. Pre-Processing

	age	hobies	gender	energy	valency
inputer_1	22	1,7	1	0,786	0,488
inputer_2	21	2	1	0,508	0,609
inputer_3	21	3	1	0,652	0,507
inputer_4	20	1	0	0,939	0,39
inputer_5	21	1	0	0,56	0,449
inputer_6	21	3	1	0,842	0,428
inputer_7	19	2	0	0,769	0,733
inputer_8	21	1	1	0,767	0,486
inputer_9	21	1	1	0,884	0,619
inputer_10	22	3	1	0,621	0,298

This data is used as training data to implement the K-NN algorithm. Each attribute is analyzed to generate recommendations.

(3) Quantitative Methods/Data Processing

User and song data are analyzed using the K-NN algorithm, which uses the following Euclidean distance formula:

$$D(x,y) = \sqrt{\sum_{i=1}^{n}(x_i - y_i)^2}$$

Where D(x,y) is the distance between user profile and song characteristics, and xi,yi are the attribute values at each data point.

(4) Data Source and Characteristics

Data is obtained from user surveys and Spotify API. Data characteristics include user preferences such as age, hobbies, and gender as well as music attributes such as energy and valence related to the emotions and moods of music suitable for learning activities, and are processed into training data to perform calculations to get the final results and produce song list recommendations.

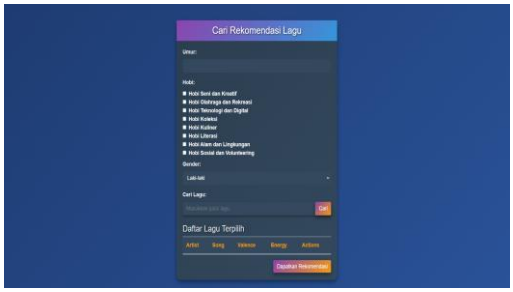
3. RELATED RESEARCH

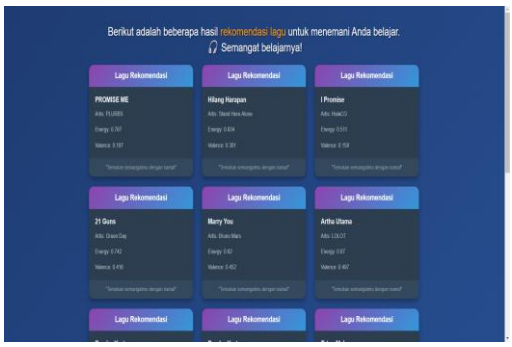
Various studies related to individual preference-based music recommendation systems show that various algorithmic methods can improve music personalization to support learning activities. (Helmholz, Meyer, and Robra-Bissantz 2020) found that music with appropriate emotional attributes can improve concentration and learning motivation. (Lestari, Adikara, and Adinugroho 2019) used the Word2Vec method to analyze song lyrics and genres, resulting in music recommendations that are more relevant to the user's mood. Research by (Giri et al. 2022) and (Situmorang, Adikara, and Ratnawati 2021) emphasize the importance of context and text-based analysis in providing more accurate music recommendations. (Fadlila Surenggana, Aranta, and Bimantoro 2023) showed that K-Nearest Neighbor (K-NN) is effective in classifying music based on mood, while (Anggoro and Izzatillah 2022) highlighted the benefits of Collaborative Filtering in Android-based applications. In addition, research by (Avandra, Mayar, and Desyandri 2023) and (DANI et al. 2022) highlighted the effect of music on learning motivation and music classification efficiency. (Josua, Herwindiati, and Sutrisno 2021) used Minimum Spanning Tree for hobby-based profession classification, and (Wagner, Schober, and Spiel 2008) examined the effect of study time on student productivity. This research shows that data-driven and algorithm-based approaches can help create a more personalized music recommendation system that is effective in improving concentration and study productivity.

4. RESULTS AND DISCUSSION

The results of this study show that a recommendation system based on the K-Nearest Neighbors (K-NN) algorithm successfully provides relevant song recommendations based on user profiles, such as age, hobbies, and gender, as well as song attributes, namely energy and valence. Using data from user surveys and the Spotify API, the system analyzes similarities between users through Euclidean distance calculations to generate a list of songs that match the user's preferences and emotional needs, especially to support learning activities. can be seen in table 2

Table 2. Results of recommended playlist for learning

No	User Interface	Description
1		In this picture is a display on the main page where the user can do the process of inputting data on age, hobbies, gender and choosing songs, then the user can do the process of finding song recommendations then the system will later calculate and present a list of song recommendations.

2		In this image you can see the results of the recommended playlist, the system has analyzed the user profile using the K-Nearest Neighbors (K-NN) algorithm. This recommendation is based on the similarity of the training data profile with user data that performs the process of searching for song list recommendations, as well as song characteristics such as energy and valence, which describe the atmosphere and emotions of songs that are suitable for learning activities.

Analysis of Test Result

The test results were carried out by assessing the application using the User Experience Questionnaire (UEQ) method. This assessment is done through filling out a Google Form specifically designed to measure user experience. A total of 35 respondents, with an age range of 15 to 23 years, provided an assessment of the song list recommendation system for learning. This test aims to understand the extent to which the system is able to meet user needs in supporting learning focus. The results of the questionnaire cover various aspects, such asusability,attractiveness, efficiency, clarity of information, and overall user satisfaction with the song recommendations provided. The data collected from respondents was analyzed to evaluate the quality of the system, correct deficiencies, and ensure that the song recommendation results are in accordance with user preferences and needs, especially in improving learning productivity. These results become an important reference for further system development.

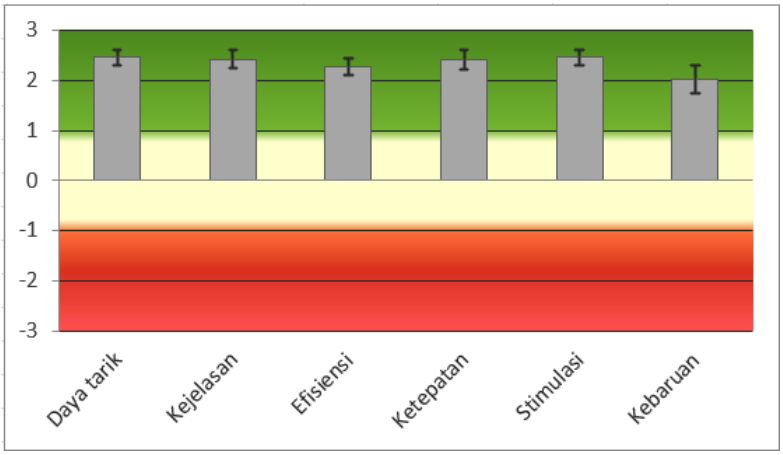


Figure 2 Graph of the average impression of respondents based on variables

Based on the results in this figure, it can be concluded that the song list recommendation system for learning consistently falls into the “very good” impression category with a minimum value of 2.0. In addition, on the efficiency scale, the system is also in the “excellent” category with a maximum score of 2.4. This shows that the system has a satisfactory and effective performance in providing song recommendations to support learning focus.

5. CONCLUSION

This K-NN-based music recommendation system makes a significant contribution in helping students select appropriate music for learning activities. The use of demographic attributes and music parameters provides recommendation results that match the user's needs, improving concentration and learning experience. Recommendations for future research include developing additional attributes as well as more complex algorithms for improved accuracy and relevance.

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IMPLEMENTATION OF A FINANCIAL REPORTING INFORMATION SYSTEM FOR SUN COMPUTER BALI STORE

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ABSTRACT

A financial reporting information system is essential for supporting the smooth operation of businesses, including Sun Computer Bali. This research aims to design a system that addresses unstructured and non-integrated income and expenditure records. The current financial reports are limited to daily summaries, lacking details on debits, credits, receivables and payables. Furthermore, store owners and employees face difficulties monitoring stock, increasing the risk of stock loss due to the absence of real-time inventory tracking. The proposed system produces comprehensive monthly financial reports, enables real-time inventory monitoring, supports decision-making, improves operational efficiency, and simplifies the tracking of profits and losses*. The system design adopts the Waterfall method, utilizing the Laravel Framework for development and MySQL for database management. System testing was conducted through user interviews to evaluate functionality, while the DeLone and McLean Information System Success Model was used for evaluation. Results indicate that the financial reporting information system effectively meets user needs, particularly in generating structured financial reports and monitoring inventory. This system significantly enhances operational management and supports the sustainable growth of Sun Computer Bali store.*

Keywords: *Information System, Financial Report, Waterfall, Transaction Recording, Stock of Goods*

1. INTRODUCTION

Business and technology have undergone significant evolution in tandem with the increasingly modern lifestyles of society. This progression is evident in various aspects of daily life, exemplified by the proliferation of retail businesses and services that streamline activities and meet human needs, which now premodinantly rely on technological advancements (Pratama and Utari, 2022). Aprianto (2021) highlights that in the real of business, whether involving the trade of goods or the provision of services, information and communication technology plays a pivotal role in facilitating transaction processes and delivering information with speed and precision. Furthermore, Riyadli and Saputra (2020) assert that information technology and systems constitute indispensable components in the management of corporate operations, particularly in the financial domain. Nevertheless, not all retail enterprises incorporate information systems into their business processes, as observed in the case of the Sun Computer Bali store located on Pejeng Tampaksiring Street, Gianyar, Bali. Sun Computer Bali is a retail business established in 2021, selling cutting-edge electronic devices to fulfill customer needs for innovative and high-quality technology. The product offered include laptops, personal computer assemblies, printers, mouse, keyboard and more. Additionally, the store provides repair services for electronic devices, covering hardware and software issues, such as system reinstallation, SSD

upgrades, keyboard repair, and similar services. The store's daily transaction volume ranges between IDR 2,000,000 until IDR 3,000,000. However, a significant issue the business faces is the lack of a systematic and integrated approach to recording income, and expenses, and generating financial reports. The second issue is that the current financial reporting system only generates daily reports without incorporating debit and credit details. Income and expenditure reports, along with profit calculations, are prepared only at the end of the month. Additionally, store owner and employees face challenges in monitoring inventory, which increases the risk of losses due to the absence of real-time stock tracking. To address these challenges, a website-based information system, titled "Implementation of Financial Reporting Information System For Sun Computer Bali Store", has been proposed. This system aims to streamline financial reporting and enhance stock management, enabling Sun Computer Bali to operate more effectively and efficiently.

2. RESEARCH METODOLOGY

2.1 Waterfall Model

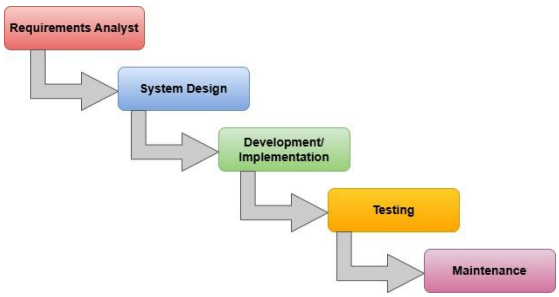


Figure 1. Waterfall Method
Source: Wahid,2020

This research applies the Waterfall system development method. This method is often refered to as the classic life cycle model or Linear Sequential Model, and describes a structure and sequential approach to software development, making it ideal for projects with clearly defined needs due to its linear and easy-to-understand characteristics, which includes the following stage (Wahid, 2020):

A. Requirements Analysis
In this analysis stage, communication is conducted with the customer, namely Sun Computer Bali, to understand the objectives to be achieved. Effective communication is crucial for obtaining project initialization, including problem analysis, data collection, and defining software features and functions (Risald and Lafu, 2021). Primary data is obtained directly from sources through interviews and observations, while secondary data is gathered from existing sources, such as documents, reports, or other references. The collected data will be analyzed to gain an in-depth understanding of the currenct needs and problems, which will serve as a strong foundation for system design.

B. System Design
At this stage, the main focus is on creating a software program design, which includes software design, data structure, user interface, and coding process (Herdiansyah, et al., 2021). Researchers compile a system design that serves to determine hardware needs and system requirements, identify functional requirements, compile system flowchart, and provide an overview of the system.

C. Development/Implementation
At this stage, the software describes how the system program works and how its functions can be used by the user (Fauziyah and Sugiarti, 2022). In this research, the code writing stage or system implementation is carried out by

coding using the Laravel Framework, and MySQL as database management by the previously designed system design.

D. Testing
After the system is designed, the next stage is to conduct a testing process to ensure that the resulting application runs well and meets predetermined expectations (Badrul and Ardy , 2021). This test aims to evaluate application or information system performance, functionality, and its ability to meet user needs. The testing method used in this research is the DeLone and McLean Model (D&M IS Success Model).

E. Maintenance
This stage is the final step in the Waterfall model, where the completed software is put into operation and maintained to ensure its performance remains optimal. Maintenance includes fixing errors that were not detected in the previous stages. According to (Listiyan and Subhiyakto, 2021) at this stage, direct testing of the applications or information systems used by the users is performed. Afterward, an analysis is conducted to identify any deficiencies that may arise. If deficiencies are found, maintenance will be carried out to correct them, as developments and changes are inevitable in the industrial world.

2.2 System Overview

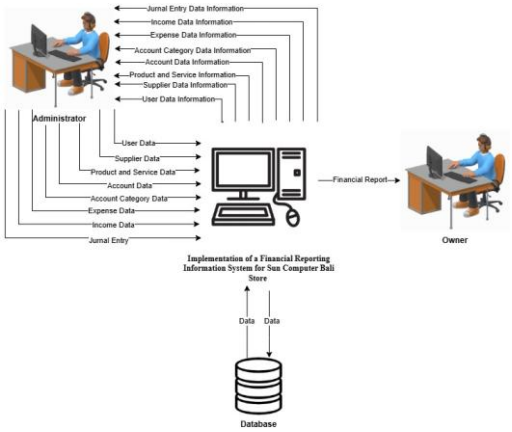


Figure 2. System Overview
Source: Personal,2024

In the implementation of the financial report information system at the Sun Computer Bali store, the administrator starts the process by logging into the information system. After successfully logging in, the administrator can input the required data, such as supplier data, goods, services, accounts and account categories. If there is an income or expense transaction at the store, the administrator will record it through the available menu, namely Income, Expenditure, and Journal Entry. Based on the inputted data, the system will process the information to produce various financial reports. These financial reports can then be accessed by the shop owner and downloaded in Excel file format for further use.

3. RELATED RESEARCH

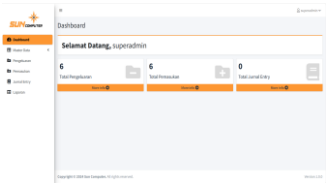
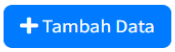
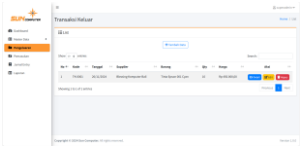
This research can be realized thanks to references from previous research results. Research with the journal title “Financial Reporting Information System at Website-Based Salon with SDLC Method” compiled by (Desmayani, et al., 2021) produces a financial reporting information system using the SDLC method and black box testing for the testing method. Another article that is relevant in this context is that researched by (Chan and Maiyana,2023), entitled “Designing a Web-Based Store Management Application”. In this study, a web-based store management application was designed that could help manage stock items and generate

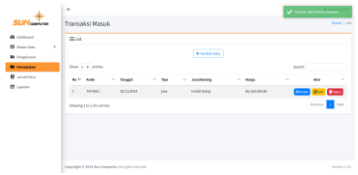
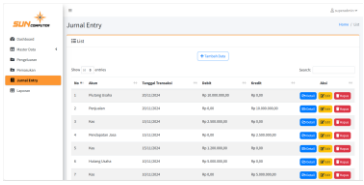
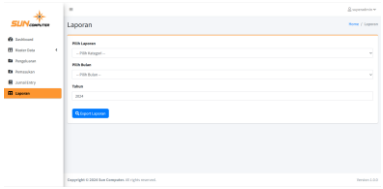
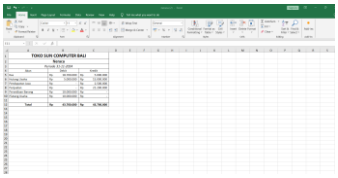
financial reports using the Codeigniter framework. Another research that also discusses information system related to financial reports and stock management is research by (Pratini, Juliharta and Wijaya, 2020) entitled "Design of a Web-Based Sales and Financial Report Information System (Case Study UD. Taru Lestari Sibetan Village, Bebandem District)". In this study, there are problems in managing financial data, stock data, and sales, therefore this study aims to present a sales information system model development with a qualitative approach and using a waterfall-based Software Development Life Cycle (SDLC) development method, as well as using the Laravel framework as the backend and the VueJs framework as the frontend. Another source that is relevant to this topic is a journal entitled "Design of a Web-Based MSME FoodyBestie Financial Report Information System" by (Alfarisi and Matondang, 2022), which produces a financial report information system and there are inventory functions to manage stock records. Another research that can be used as a references is "Designing a Financial Report Information System for Pharmacies Using the K-NN Algorithm" which was researched by (Sari and Batubara, 2021). With the design of this financial information system, pharmacy owners can easily determine whether the pharmacy is experiencing profit or loss, and users (administrator) can create reports from each data, such as reports on income data, expenses, reports on types of goods, and other reports.

4. RESULTS AND DISCUSSION

The result of this research is the implementation of a financial report information system at the Sun Computer Bali store, as shown in Table 1.

Table 1. Results of Implementation of Financial Statement Information System at Sun Computer Bali store

No.	User Interface	Description
1		The following is the Login interface for the Financial Report Information System at Sun Computer Bali. Users are required to enter their assigned username and password.
2		This dashboard menu presents important data in real-time, including total income, total expenses, and journal entries.
3		The "Add Data" field serves to enter various types of data such as suppliers, accounts, goods or services. Although each type of data has different information, the process of filling in the data in each field remains the same.
4		This menu is used to record all expenses incurred by the store, including those for purchasing stock items, operational costs, and other expenditures.

5		This feature is designed to record all income transactions received by the store. It encompasses various income sources, including revenue from product sales, service fees, and other financial inflows.
6		This feature is designed to record every financial transaction in detail, including both income and expenses. Accurate journal entries are essential records and serve as a foundation for preparing comprehensive financial statements.
7		The features on this menu allow users to select and export different types of financial reports according to their needs. Once a particular report is selected, users can download it in Excel format.
8		The following is an example of the export results of the financial statements in the form of an Excel file.

Source: Personal, 2024

4.1 Analysis of Test Results

All functions in the system must be tested so that the system can be said to be free from errors and the result obtained must be by the needs set at the previous stage (Arista and Nugroho, 2023). The results of this system test were obtained through an assessment conducted using a qualitative approach. The evaluation involved interviewing users (administrator) to gather their feedback on the system that has been developed. The success of the system trials was measured using the DeLone and McLean model framework as a reference. The DeLone and McLean Model (D&M IS Success Model) is an information system success measurement model developed by Willian H. Delone and Ephraim R. McLean (Ernawati, Hermaliani and Sulisyowati, 2021). The following are the results of the assessment related to the implementation of the financial reporting information system at the Sun Computer Bali store.

Table 2. Assessment by User

No.	Indicator	User Feedback	Percentage
1	System Quality: The extent to which the system is easy to use by its users.	The user (administrator) stated that this system is easy to use and very helpful in preparing financial reports, income and expenditure reports, and monitoring stock items.	93%
2	Information System: Refers to the quality of information that users receive from the developed system.	The information presented is easy to understand and provides features that suit user needs.	95%
3	Use: Refers to the extent to which the developed system is utilized.	The information system is used to generate financial reports, as well as income and expenditure statements.	95%
4	User Satisfaction: Represents	User provide positive feedback,	95%

	user evaluations of the information system's interface.	stating that the system's design is attractive, responsive, visually pleasing, and simple to use.	
5	Individual Impact: Highlight how the system facilitates users in performing their tasks.	The financial reporting system accelerates the creation of income, expenditure, and financial reports.	90%
6	Organization Impact: Describes the system's ability to enhance the flow of information within Sun Computer Bali, particularly in monitoring profit and loss.	The implemented system expedites the preparation of financial reports and allows real-time monitoring of stock levels.	95%

Source: Personal, 2024

5. CONCLUSION

The design and implementation of a website-based financial reporting information system were completed using the Waterfall Model, MySQL as a database management, and the Laravel framework. This system includes several features, such as stock management, recording store income and expenses, and generating financial reports. Based on the results of system testing conducted through user interviews, all features received positive feedback and functioned effectively to meet user needs. The implementation of this information system has had a significant impact on the operational efficiency of the Sun Computer Bali store. Improved recording accuracy, time efficiency, and real-time stock monitoring capabilities directly support revenue growth and reduce operating costs. The author concludes that the success of this system is that the information system is designed according to business needs and can produce accurate and integrated financial data.

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EXAMINING DIGITAL ENTREPRENEURIAL INTENTION FROM VARIOUS THEORIES

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ABSTRACT

Indonesia faces the challenge of a low number of entrepreneurs which has implications for economic growth and global competitiveness. One strategic solution to overcome this is the development of digital entrepreneurship considering the rapid digital transformation in various sectors. Efforts to increase digital entrepreneurship in Indonesia require a deep understanding of the factors that influence digital entrepreneurial intentions. This study aims to identify the theoretical basis and see the factors in it that support digital entrepreneurial intentions. This study was conducted using an explorative method by searching for previous empirical research in reputable international journals. Various theories were found such as Theory of Planned Behavior, Self-Determination Theory, Technology Acceptance Model, Social Cognitive Theory, Social Cognitive Career Theory, Entrepreneurial Event Model. The results of the study are expected to contribute to further researchers to be able to test digital entrepreneurial intentions so that they can support the growth of digital entrepreneurship in Indonesia.

Keywords: Digital Entrepreneurs, Start Up Digital, Entrepreneurial Intentions, Entrepreneurs Research Model, Entrepreneurial Intentions Theory.

1. INTRODUCTION

The increasingly developing digital technology in the world, especially in Indonesia, is changing the pattern of business creation and making digital entrepreneurship increasingly popular. Digital technology is considered to be able to open up various new options for entrepreneurs to create and develop their businesses (Darmanto, 2022). Information technology has caused local and regional markets to be replaced by global markets (Younis et al., 2020). Although there is a lot of literature on digital entrepreneurship, comprehensive information available on intentions in this context is still limited (Sahrah et al., 2023). Amid the increasingly recognized importance of digital entrepreneurship, this concept is still in its early stages of entrepreneurship research and its determinants are not widely understood (Elnadi & Gheith, 2023). The number of entrepreneurs in Indonesia remains low, accounting for only about 3.47% of the total population, which is below the 4% benchmark required for robust economic development (Pratama, 2024). This issue is primarily driven by challenges such as limited access to funding, insufficient entrepreneurship education, and inadequate support for the business ecosystem.
Digital entrepreneurial orientation has recently become an interesting research topic, as evidenced by the increasing trend of entrepreneurial orientation research in the digital field. Although research on entrepreneurial intention is extensive and comprehensive, there is a clear gap in research that focuses on digital entrepreneurial intention. There are not many previous studies that specifically discuss Digital Entrepreneurial Intention (DEI). Existing research on digital entrepreneurial intention shows that this field needs to be qualified as a whole and several factors have not been considered (A A Mir, 2023). The theory underlying the testing of digital entrepreneurial intention is deemed necessary to be mapped to make it easier for further researchers to conduct research. With this background,

this study examines in depth various theories to study digital entrepreneurial intention. The novelty of this study is that there has been no previous research that summarizes the theoretical basis that can be used to test DEI in the last 5 years published in Scopus journals.

2. RESEARCH METODOLOGY

The research was conducted using an explorative method. A literature review was conducted to find previous research results related to the antecedents of Digital Entrepreneurial Intention. The search focused on reputable international journals Q1-Q4 with publication years 2019-2024. 68 related articles were filtered by producing articles related to quantitative research and were empirical findings. From the filtration process, 19 articles were finally found which were analyzed to find the theoretical basis used. This method was carried out to be able to see the latest theories in the last 5 years that were used to test DEI.

3. RELATED RESEARCH

Theories that have generated numerous entrepreneurial studies are: Theory of Entrepreneurial Event, Theory of Planned Behavior, and Social Cognitive Theory (Susetyo & Lestari, 2014). According to the Theory of Planned Behavior, entrepreneurial intention can develop from three fundamental aspects: personal, social, and environmental (Susetyo & Lestari, 2014). Current research on digital entrepreneurship intentions suggests that this field requires extensive examination, and many factors remain to be investigated (Ajaz Akbar Mir et al., 2023). Other theories that have been analyzed to determine factors influencing digital entrepreneurial intention include Self-Determination Theory (Chang et al., 2018) and Social Cognitive Theory (Chang et al., 2020). Despite examining several theories in past research, there is a demand for more thorough studies that could support these alternative theoretical frameworks. As a result, there is an opportunity for various other theoretical models to be considered as precedents for intentions in digital entrepreneurship.

4. RESULTS AND DISCUSSION

4.1 THEORY OF PLANNED BEHAVIOR

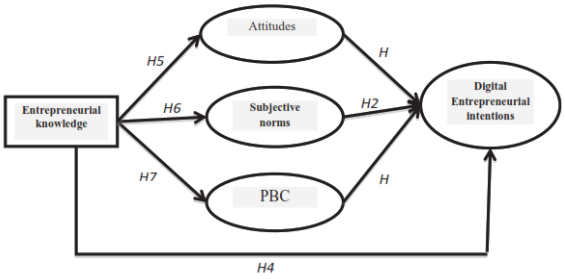


Figure 1. Sample Reserach Framework Based on Theory of Planned Behavior
Source: (Yaghoubi Farani et al., 2017)

The theory of planned behavior (TPB) assumes that the intention to perform a behavior is a good predictor of the behavior itself (Fishbein & Ajzen, 2011).Intention is defined as an internal state that influences a person's attention to a particular behavior. The planned effort to perform the behavior also reflects the intention (Siqueira et al., 2022). Previous research using this theory includes several important points. Research by (T. T. Nguyen et al., 2024) shows that personal attitudes and perceived behavioral control play a role in entrepreneurial intentions. TPB is influenced by three variables: attitudes toward behavior, subjective norms, and perceived behavioral control (Xin, 2023).

4.2 SELF-DETERMINATION THEORY

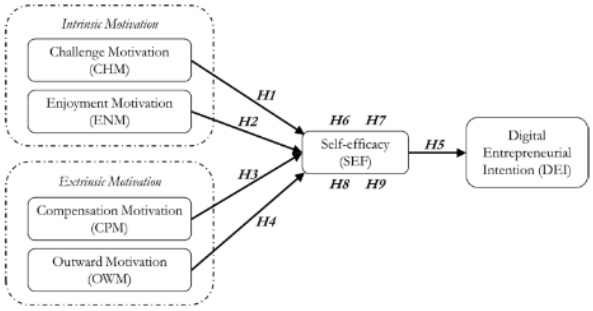


Figure 2. Sample Reserach Framework Based on Self-Determination Theory
Source: (Ridwan & Fiodian, 2024)

Self-Determination Theory (SDT), individual actions are influenced by intrinsic and extrinsic motivations as discussed by . If individuals accept challenges and believe that entrepreneurship can provide satisfaction and rewards, their entrepreneurial intentions tend to increase. Previous studies using this theory cover several important points. In particular, the study (Ridwan & Fiodian, 2024) attempts to discuss the motivations that drive individuals to pursue digital entrepreneurship, the factors that shape their intentions, and the essential requirements for success as a digital entrepreneur.

4.3 TECHNOLOGY ACCEPTANCE MODEL

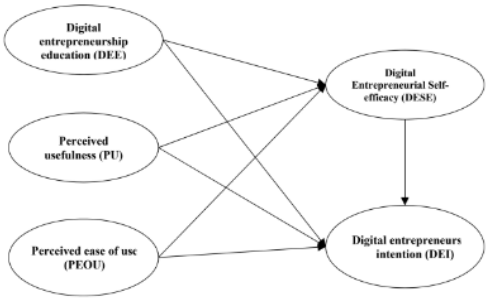


Figure 3. Sample Reserach Framework Based on Technology Acceptance Model
Source: (Wibowo, 2024)

The Technology Acceptance Model (TAM) is suitable for explaining the acceptance of technology use. Developed by (Robbins, 1964), this model is an extension of the theory of reasoned action (TRA). Perceived usefulness (pU) relates to a person's belief that technology will improve performance, while perceived ease of use (peOU) refers to a person's belief that technology will help achieve goals. Previous research using this theory includes several important points. Research from (Wibowo, 2024) explains that in principle, TAM can be applied to many domains, including digital entrepreneurship intentions and behavior.

4.4 SOCIAL COGNITIVE THEORY

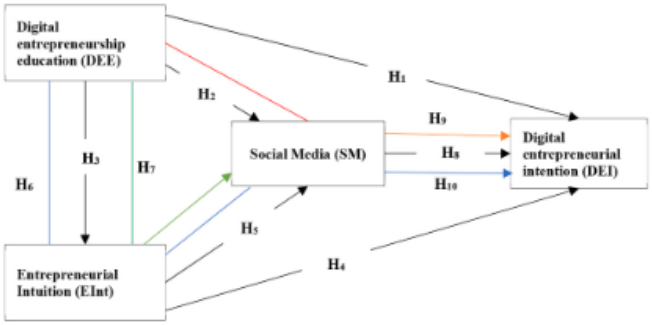


Figure 4. Sample Reserach Framework Based on Social Cognitive Theory
Source: (Wibowo, 2023)

Social Cognitive Theory (SCT) explains how digital entrepreneurship education influences digital entrepreneurial intentions, with a focus on social media and entrepreneurial intuition. SCT emphasizes the importance of observational learning, self-efficacy, and reciprocal determinism in human behavior (Bandura, 2002). Previous research using this theory includes several important points. Research by (Wibowo, 2023) provides insight into increasing interest in digital entrepreneurship through digital entrepreneurship education. According to research (Xin, 2023) self-efficacy is influenced by four aspects: direct experience, emotion, indirect experience, and verbal persuasion, indicating the use of SCT to discuss the mediating role of digital entrepreneurship self-efficacy.

4.5 SOCIAL COGNITIVE CAREER THEORY

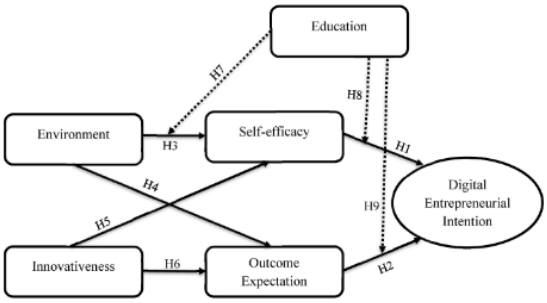


Figure 5. Sample Reserach Framework Based on Social Cognitive Career Theory
Source: (Pham, 2024)

Social Cognitive Career Theory (SCCT) is a motivational framework for career decision-making and has been adapted to explain the dynamics of career choice in diverse contexts. The theory states that career interests or intentions are shaped by the interaction of multiple factors in the environment, personal attributes, and behaviors (Lent et al., 2017). Previous studies using this theory include several important points. The relationship between various theories and the influence of social media on the entrepreneurial intentions of business graduates in digital ventures found that several factors such as competence, self-efficacy, and subjective norms significantly influenced their attitudes toward DEI (Gangadhara & Kumar, 2024).

4.6 Entrepreneurial Event Model

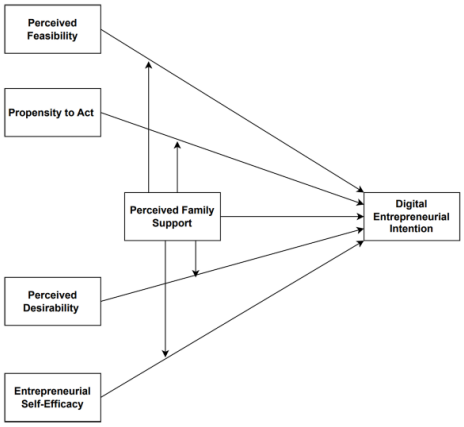


Figure 6. Sample Reserach Framework Based on Entrepreneurial Event Model
Source: (P. N. D. Nguyen, 2024)

The Entrepreneurial Event Model (EEM) is an integral part of the theoretical foundation for empowering digital entrepreneurs (Usman & Sun, 2022). Previous studies using this theory cover several important points. The study (P. N. D. Nguyen, 2024) makes a significant contribution to the entrepreneurship literature by applying and extending the EEM model to digital entrepreneurship in developing countries. This study also promotes societal development goals by highlighting the transformative power of digital entrepreneurship for inclusive and sustainable growth.

4.7 DISCUSSION

Based on a search of reputable international journals Q1-Q4 with a publication year range of 2019-2024, 68 articles discussed related topics. The articles were then filtered to identify research with a quantitative approach and empirical findings. The screening process resulted in 19 articles which were further explained to determine the basic theories used in studies related to Digital Entrepreneurial Intention. The purpose of this analysis is to reveal the main theories that are the basis for studying this phenomenon. The results of the analysis found six theories that are often used to test Digital Entrepreneurial Intention. First, the Theory of Planned Behavior (TPB) involves three direct variables: attitude, subjective norms, and perceived behavioral control (PBC). TPB can be the main reference for research that utilizes this third variable. Second, Self-Determination Theory (SDT) has one direct variable, namely self-efficacy. Third, the Technology Acceptance Model (TAM) relies on two direct variables: perceived usefulness and ease of use. Fourth, Social Cognitive Theory (SCT) uses one direct variable, namely social media. Fifth, Social Cognitive Career Theory (SCCT) includes four direct variables: environment, self-efficacy, innovation, and outcome expectations. Finally, the Entrepreneurial Event Model (EEM) has four direct variables, namely perceived feasibility, propensity to act, perceived desire, and entrepreneurial self-efficacy.

5. CONCLUSION

This study found 6 theories used to test Digital Entrepreneurial Intention. The theories are the theory of Planned Behavior, Self-Determination Theory, Technology Acceptance Model, Social Cognitive Theory, Social Cognitive Career Theory, and Entrepreneurial Event Model. In conducting a literature review, several other theories were found that could be used such as Personality trait theory and capital theory but in the last 5 years, they have not been used in research

published in reputable international journals Q1-Q4. The results of this study are expected to help further researchers to test variables that can increase DEI.

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SENTIMENT ANALYSIS OF PUBLIC OPINION ON THE IMPACT OF DEEPFAKE TECHNOLOGY USING THE NAIVE BAYES METHOD ON PLATFORM X

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ABSTRACT

The development of deepfake technology, a digital manipulation tool powered by artificial intelligence, has posed significant challenges in the modern era, particularly concerning individual privacy and reputation. This technology enables the creation of highly realistic visual content, making it vulnerable to misuse, as seen in the case of Taylor Swift, who faced the unauthorized dissemination of fake explicit content on the social media platform X (Twitter). This study aims to analyze public sentiment regarding the incident using the Naive Bayes method, chosen for its reliability in text classification, low complexity, and accuracy. The research process includes data crawling, preprocessing (cleansing, case folding, tokenizing, stopword removal, and stemming), sentiment labeling with the Vader Lexicon, and TF-IDF weighting to build the classification model. The results indicate that the Naive Bayes model achieved an accuracy of 76%, precision of 79%, recall of 73%, and an F1-score of 75%. It also revealed that the majority of public sentiment was negative (60.88%), while positive sentiment accounted for 30.12%, reflecting widespread concern over the potential misuse of deepfake technology. This study offers valuable insights into public perception and provides a foundation for developing policies to mitigate the risks associated with deepfake misuse.

Keywords: *Deepfake, Sentiment Analysis, Naive Bayes, X (Twitter), Artificial Intelligence*

1 INTRODUCTION

The development of technology has now permeated various aspects of life, including artificial intelligence (AI), which has become a global phenomenon and is utilized in daily activities. AI is in the process of transforming many aspects of human life (Mahira et al., 2023). According to (Putra and Wijaya, 2023), robots are now beginning to replace human jobs due to advancements in AI. Technology not only provides information, communication, education, and entertainment but also helps meet various needs (Ramadhan et al., 2024). While AI brings positive impacts, it also triggers negative consequences, such as the spread of deepfake-based pornographic content (Novera and Z, 2024). Deepfakes offer both benefits and risks in entertainment, such as digitally resurrecting actors or seamlessly swapping faces, but they raise ethical concerns about using people's faces without consent. The technology blurs the line between real and fake, making it difficult for viewers to distinguish truth, which challenges the entertainment industry to rethink how content

is presented in order to maintain public trust (Debroy et al., 2024). Deepfake also poses a threat to businesses and the economy. Fraudsters are now using programs to impersonate CEOs by training algorithms with speeches, YouTube videos, and TED Talks. This tactic has already been used to steal from companies, and given the influence of CEO statements on stock prices, deepfake may be used to manipulate the stock market (Yamaoka-Enkerlin, 2020). The first deepfake case emerged in 2017, featuring the face of actress Gal Gadot in a pornographic video. AI is often misused for harmful deepfake content (Situmeang et al., 2024). A relevant example is the viral deepfake photo of Taylor Swift circulating on various digital platforms. The photo depicted Taylor Swift in a fabricated yet realistic scenario due to AI manipulation. Discussions about this case are widely found on Platform X, one of the key sources of public opinion data. Twitter (X) has been a popular text-based social media platform among Indonesians for a long time (Fauziah et al., 2024). Platform X is well-known as a primary medium for discussing current topics, including deepfake technology, due to its speed in disseminating information and gathering user responses. As of October 2023, Platform X had approximately 27.5 million active users in Indonesia, making it one of the most popular social media platforms. Public sentiment regarding the use of deepfake technology is a crucial indicator in assessing its social impact. Sentiment analysis is effective in understanding public views on the risks and opportunities of technology on social media. Therefore, this study aims to examine the Taylor Swift deepfake case as a primary case study, using data from Platform X to explore public perceptions of this technology.

This research focuses on analyzing public sentiment regarding deepfakes using the Naive Bayes method. Naive Bayes is a machine learning method that uses probability and statistical calculations, introduced by British scientist Thomas Bayes (M. I. Santoso and Dzikrillah, 2024). The Naive Bayes method was chosen for this study due to its various advantages in sentiment analysis. The Naive Bayes classification method is used to make decisions by predicting a case based on the classification results obtained (Ningsih et al., 2024). The findings of this study aim to uncover public perceptions of deepfake technology.

2. RESEARCH METODOLOGY

2.1 Research Flow

In this study, the researcher conducted several steps or processes to obtain the results and conclusions of the research. The research flow to be carried out is illustrated in Figure 1.

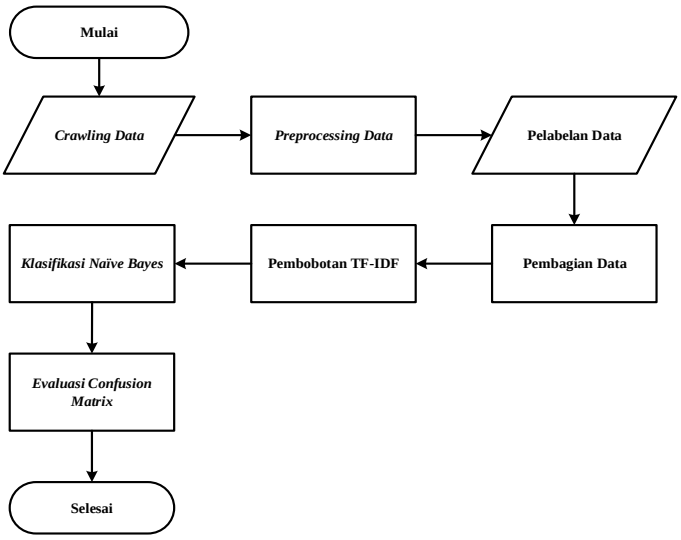


Figure. 1. Research Flow

This study begins by collecting data from X (Twitter) through data crawling, where the collected data includes the tweet's posting date (created_at), the tweet's content (full_text), and the username. Once the data is gathered, the next stage involves several preprocessing steps, including cleansing, case folding, tokenizing, stopword removal, and stemming. After the text preprocessing, the data is labeled using the VADER Lexicon method. VADER Lexicon is specifically designed to analyze microblogs, with sentiment determination based on the weight of a sentence: if the weight exceeds 0.05, it is categorized as positive sentiment; if it is less than -0.05, it is categorized as negative sentiment (Muhammad Fernanda Naufal Fathoni et al., 2024). Next, the data undergoes the TF-IDF (Term Frequency-Inverse Document Frequency) process, a weighting method used in text processing to assess the importance of a word in a document relative to a corpus. Term weighting assigns a weight to each term in a document (Ridwan et al., 2024). Subsequently, the data is divided into two sets: a training set and a testing set. The training set is used to train the Naive Bayes classification model, which is probability-based and classifies data into appropriate categories. After training the model, evaluation is performed using a confusion matrix to measure the model's performance, calculating evaluation metrics such as accuracy, precision, recall, and F1-score.

2.2 Naïve Bayes

Naive Bayes is a classification method based on Bayes' theorem with the naive assumption that each feature in the data is conditionally independent of the others given the class. This method is highly popular in text analysis and pattern recognition, particularly in applications involving text classification based on content or sentiment (Permana Putra and Farrah Syafira, 2023).

2.3 Crawling Data

Data crawling is the process of extracting information from various sources on the internet. It is used to gather data from different websites for specific purposes (Riskiyah et al., 2024). In this study, crawling was conducted using a Twitter token and the tweet-harvest tool version 2.6.1 to collect tweets from Twitter. The crawling process resulted in 2,013 data points, and after the removal of duplicate data, the cleaned dataset contained 1,375 data points.The data crawling process was carried

out from January 2024 to July 2024. The results of the data crawling are presented in Table 1.

Table 1. Crawling Data Result

created_at	full_text	username
1/29/2024	Deepfake explicit images of Taylor Swift spread on social media Her fans are fighting back Yahoo News	Security_Sleuth
1/29/2024	A Canadian man hoped his identity would remain hidden from the world despite joining in on an online campaign that circulated explicit deepfake images of They ll Never Find Me Explicit AIGenerated Photos of Taylor Swift Land X User In Hot Water	ATLBlackStar
1/29/2024	Social media platform X has temporarily blocked Taylor Swift s name from being searched after AIgenerated deepfake pornography images of the singer went viral last week	euronewsculture
1/30/2024	Deep Fake Images of Taylor Swift Taken Down Explicit AIgenerated images of Taylor Swift have been removed from X Twitter in the latest example of the proliferation of fake pornography	CyberSecInt
1/30/2024	Social media platform X has blocked searches for Taylor Swift as pornographic deepfake images of the singer have circulated online	AM800CKLW
1/31/2024	I found this on NewsBreak Taylor Swift AI pictures highlight the horrors of deepfake porn Will we finally care	worldhabbits

2.4 Preprocessing

Preprocessing is the initial stage in preparing data before further processing. The dataset will go through a series of text preprocessing steps, including cleaning, case folding (converting uppercase to lowercase), tokenizing, stopword removal, and stemming (Saputra et al., 2024). The method used to transform unstructured research data into structured data is called preprocessing (H. Santoso dkk., 2022).

2.5 Labelling

Labeling is the process of assigning labels or classifications to the collected data. In this stage, data is labeled to determine whether each sentence in the dataset has a positive or negative meaning (Muhammad Daffa Al Fahreza et al., 2024). The authors used the Vader Lexicon method to perform the labeling process. The Vader Lexicon method is a lexicon-based sentiment analysis technique specifically designed to identify sentiment in English texts, both in the context of social media and other text formats.

Table 2. Data Labeling

Full_text	Sentiment_label
Deepfake explicit images of Taylor Swift spread on social media Her fans are fighting back Yahoo News	Negative
Taylor Swift deepfakes spark calls in Congress for new legislation ltlt While many of the images appear to have been removed at the time of publication one photo of Swift was	Positive

viewed a reported 47 million times before being taken down	
You cant stop the future Deepfake is here to stay Fuck Taylor Swift soon in 3D	Negative
Easiest way to decipher this Taylor Swift deepfake thing is to ask yourself one question Does she look sexy If yes it s fake If no you ve found yourself a genuine Taylor Swift photograph Be well	Positive
If you re serious Twitter blocked search functionality for Taylor Swift due to AI deepfake porn If not	Negative

The results of the labeling process are visualized in the diagram in Figure 2 below.

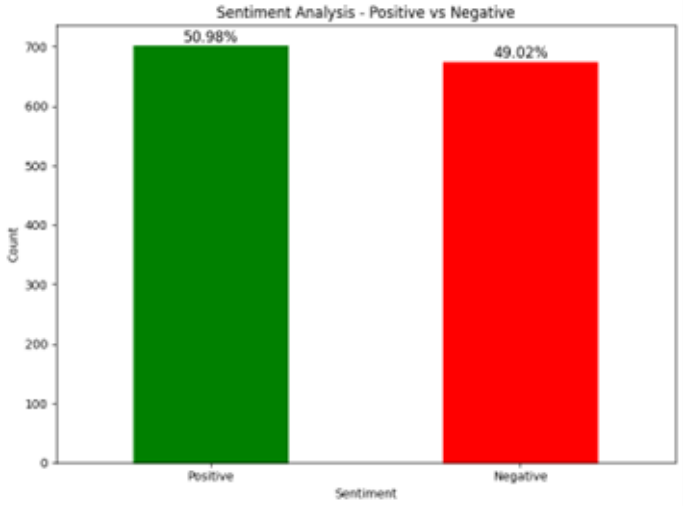


Figure 2. Labeling Result Diagram

Based on the sentiment analysis results, the diagram above shows that positive sentiment has a higher percentage, 50.98%, with a total of 701 tweets. Meanwhile, negative sentiment accounts for 49.02%, with a total of 674 tweets. This difference indicates that there are more comments classified as positive sentiment compared to negative sentiment.

2.6 Data Splitting

Splitting data serves to divide the dataset into two parts: the training data and the testing data, with a specified proportion (Sholekhah et al., 2024). In this study, the dataset is split with a ratio of 80:20, where 80% is used for training data and 20% for testing data.

2.7 TF-IDF (Term Frequency Inverse Document Frequency)

Term Frequency and Inverse Document Frequency (TF-IDF) are statistical measures that describe the importance of a term in a document within a corpus. Term Frequency (TF) refers to the frequency of a term's occurrence in a document. The more frequently a term appears, the higher its TF value. On the other hand, Inverse Document Frequency (IDF) measures the rarity of a term in a collection of

documents. The less frequently a term appears, the higher its IDF value (Syafrizal et al., 2023).

2.8 Confusion Matrix

A Confusion Matrix is a table that visualizes the performance of a model or algorithm. Specifically, each row of the matrix represents the actual class of the data, while each column represents the predicted class of the data, or vice versa (Ariqoh et al., 2023).

3. RELATED RESEARCH

The first study conducted by (Alexander et al., 2023) used the Naïve Bayes algorithm and achieved an accuracy of 82% in analyzing public sentiment about Deepfake on the YouTube social media platform. The second study by (Pratmanto et al., 2024)) also used the Naïve Bayes algorithm for their research, and found that Naïve Bayes outperformed KNN, with an accuracy of 79.96%, recall of 87.76%, and AUC of 96.40%, compared to KNN's accuracy of 78.34%, recall of 75.32%, and AUC of 92.20%. The study concluded that Naïve Bayes is more effective in providing accurate classification and distinguishing between positive and negative classes, while KNN is more accurate in predicting the positive class. The third study, conducted by (Ramadhani et al., 2024)), also used the Naïve Bayes algorithm. The results showed that the Naïve Bayes method successfully classified user sentiment using a Confusion Matrix, with an accuracy of 94.05%, precision values of 95% for positive and 81.25% for negative, and recall values of 98.84% for positive and 48% for negative. The fourth study by (Krisdiyanto, 2021) aimed to analyze public sentiment towards the implementation of the PPKM policy in Indonesia through tweets and comments on Twitter. The study found that 99% of public opinions on the PPKM policy were classified as positive, while 1% were classified as negative. Finally, the fifth study by (Syarifuddinn, 2020) compared the Naïve Bayes and KNN algorithms. The study focused on comparing the classification results of both methods and understanding public opinion trends on Twitter. The results revealed that the Naïve Bayes method performed better, with an accuracy of 63.21%, compared to KNN's 58.10%. The analysis also showed a higher number of positive opinions (610) compared to negative opinions (488), supported by the higher precision for positive opinions in Naïve Bayes (66.40%) compared to negative opinions (58.94%).

4. RESULTS AND DISCUSSION

4.1 Model Prediction Results

After the model has been trained and tested on the testing data, predictions are made using the Naïve Bayes model on the test data. Once the predictions are obtained, the next step is to count the number of predictions classified as negative and positive. These results are then visualized in the form of a bar chart to display the distribution of the model's predictions across the two classes.

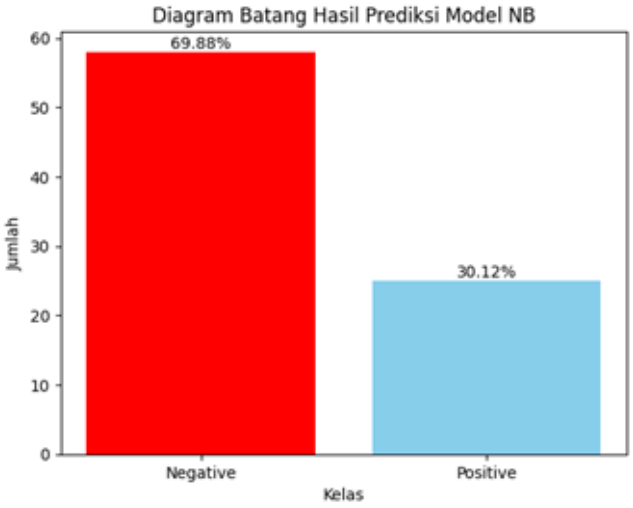


Figure 3. Diagram Of Model Prediction

Based on the diagram above, the results of the model's predictions on the test data can be observed. The prediction for the sentiment "Negative" has a percentage of 69.88%, while the sentiment "Positive" has a percentage of 30.12%. This diagram shows the distribution of the model's predictions, with a higher number of predictions for "Negative" sentiment compared to "Positive" sentiment. Based on the results in the diagram, it provides an overview of how well the Naive Bayes classification model is able to distinguish between "Negative" and "Positive" sentiments in the test data.

4.2 Model Evaluation

The performance evaluation of the Naive Bayes classification model on the test data is conducted using several commonly used evaluation metrics for classification models: accuracy, precision, recall, and F1-score. The results of the evaluation can be seen in Table 3.

Table 3. Evaluasi Model

Accuracy	76%
Precision	79%
Recall	73%
F1-score	75%

The performance evaluation results of the Naive Bayes model can be seen in Table 3, which shows that the model achieved an accuracy of 76%. This indicates the model's relatively good ability to predict sentiment based on the available data. In addition to accuracy, other metrics provide more detailed insights into the model's performance. With a precision of 79%, the model ensures that 79% of its positive predictions are correct. Furthermore, a recall value of 73% indicates that the model successfully detected 73% of the actual positive data. The combination of precision and recall results in an F1-score of 75%, reflecting the balance between the model's precision and sensitivity.

4.3 Evaluasi Model dengan *Confusion Matrix*

The evaluation process is conducted after the classification process, with the goal of measuring the performance of a model in classifying data. Below is the confusion matrix, which shows the results of true positives, false positives, true

negatives, and false negatives. The results of the confusion matrix can be seen in Figure 4.

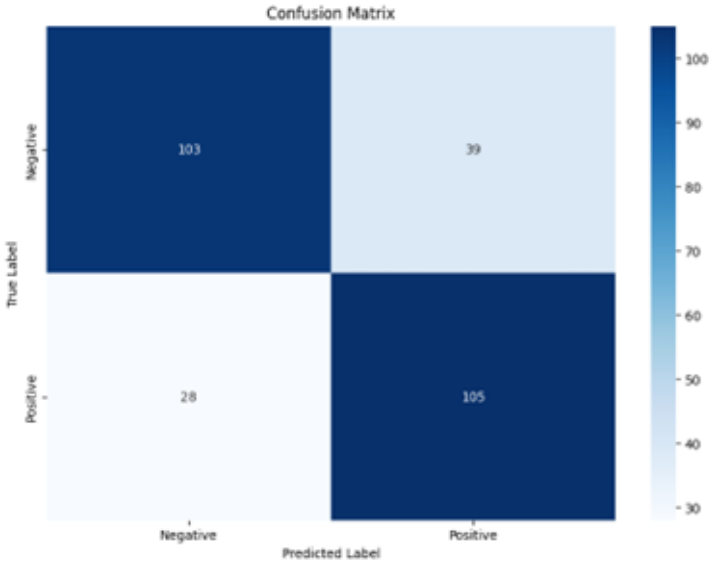


Figure 4. Confusion Matrix

The confusion matrix above shows the performance of the Naive Bayes model in classifying sentiment as either positive (Positive) or negative (Negative). The model successfully classified 105 positive data points as Positive (True Positive) and 103 negative data points as Negative (True Negative). However, there were 39 negative data points incorrectly classified as Positive (False Positive) and 28 positive data points incorrectly classified as Negative (False Negative). These results reflect the model's relatively good ability to differentiate between positive and negative sentiments.

5. CONCLUSION

This study shows that the Naive Bayes method can be effectively used to analyze public sentiment regarding the impact of deepfake technology on Platform X, with an accuracy rate of 76%. In addition, the precision value of 79%, recall of 73%, and F1-score of 75% indicate that the model performs well in classifying positive and negative sentiments, although there are still some errors in predicting certain sentiments. The model test results show that 30.12% of the data has a positive sentiment, while 60.88% (as seen in Figure 4.20) of the data reflects a negative sentiment. Positive sentiment tends to appreciate public awareness of deepfake technology misuse, while negative sentiment emphasizes the dangers and privacy violations caused by the technology. The case study of the viral Taylor Swift deepfake video on Platform X highlights how this technology can influence public perception, both positively and negatively, depending on its use context. Using Platform X as a data source is highly relevant, given the significant number of active users in Indonesia, which reached 27.5 million users. This platform is also known as the primary medium for discussions on current technological issues. Through the Naive Bayes method, this study makes an important contribution to understanding public perception of deepfake technology and its implications in the future. It is hoped that the findings from this research can serve as a foundation for the development of deepfake technology regulations and public education, so that its negative impact can be minimized, and its benefits can be maximized ethically.

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