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ABOUT THE JOURNAL

JAIIT: Journal of Advances in Information and Industrial Technology is an official journal of Faculty of Information and Industrial Technology, Telkom University. JAIIT publishes research or review articles in the field of information and industrial technology. JAIIT provides platform for research lecturers, the reviewer, practitioners, industry, and observers across Indonesia and overseas to promote, share, and discuss new issues and the advances in information and industrial technology.

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PREFACE

Welcome to the Journal of Advances in Information and Industrial Technology (JAIIT), Vol. 6, Issue No. 1. It is my great privilege and pleasure to present the third volume of this peer-reviewed journal, the first published journal under Institut Teknologi Telkom Surabaya. The aim of this journal is to accommodate the results of research publications through journals, from national to worldwide, as part of continuous improvement.

JAIIT is a national journal that focuses on theoretical and applied research in the field of information and industrial technology. JAIIT aims to provide a highly readable and valuable contribution literature to the information and industrial society in Indonesia. In the future, the vision of JAIIT is to be a reputable international journal focusing on the field of information and industrial technology. This issue (Vol. 6, No. 1, May 2024) consists of Nine research articles from various fields of study.

As the chairman of JAIIT, I would like to thank many people who supported to this journal, especially LPPM (Research and Community Service Units), Institut Teknologi Telkom Surabaya. Furthermore, as the editor in chief, I would like to extend my sincere thanks to all members of the editorial and the advisory boards from Institut Teknologi Telkom Surabaya, whose service, dedication, and commitment have made the creation of this journal possible. It is without doubt that the success of our journal depends highly on the author contribution of articles. I would also like to acknowledge the highly appreciative effort to all of manuscript reviewers for providing valuable comments and suggestions to the authors. As we are working together, we aim to continue to strive for quality and excellence in published articles.

Through seamless collaboration with all stakeholders, we aim to continue to strive for quality and excellence in publishing articles. It is our hope that JAIIT could deliver valuable and interesting information and stimulate further research to the nationwide and worldwide community of information and industrial technology. Finally, I realize that there are still a lot of aspects that have to be improved. Therefore, we are sincerely waiting for your mutual suggestions and criticism for future improvement of this journal.

Surabaya, May 2024

Amalia Nur Alifah, S.Si., M.Si.
Editor in Chief of JAIIT

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Decision Support System for Selecting Outstanding Students at the Faculty Level in University Based on the GAP Method

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ABSTRACT

The aim of this study is to develop a Decision Support System (DSS) for selecting high-achieving students in one of the faculties at University X using the GAP analysis method. This analysis is used to identify the disparities between students' expectations regarding selection criteria and their actual performance. A survey was conducted with 100 active students to gather the necessary data. The study's findings reveal disparities between student's expectations and performance regarding academic achievement and participation in student organization activities. The use of a DSS based on the GAP analysis method enhances effectiveness and efficiency and reduces subjectivity in decision-making. The study results also present data before and after implementation using the GAP/Profile Matching Analysis application. In the pre-test results, there were 96 accurate data points and four inaccurate data points, with a percentage of 96%. The post-test results indicate 98 accurate data points and two inaccurate data points, with a percentage of 98%.

1. Background

Each year, one of the universities in Indonesia (University X) faces challenges related to the selection of outstanding students. An effective and efficient selection process is crucial to ensuring accurate results aligned with expectations[1]. Furthermore, the subsequent issue lies in the fact that the process of selecting outstanding students is not yet computerized, thus hindering decision-making processes.

Related to both of these issues, one solution is to develop a Decision Support System (DSS). This development would be computer-based, leveraging knowledge and information to aid in the decision-making process [2]. One of the relevant methods regarding the decision-making process is to apply gap analysis. This analysis measures the difference between the performance of existing variables and the user's expectations regarding those variables. Several previous studies have stated that businesses with good service levels tend to have smaller gaps [3].

In this study, a smaller gap between the established criteria and student achievements will result in a higher weight value. This condition indicates that students have a greater chance of being categorized as outstanding students. The criteria and assessment standards for outstanding students at University X are listed in Table 1.

Table 1. Criteria and Standard Values for Outstanding Students

No	Criteria	Standard Value
1	Grade Point Average (GPA) for the Semester	4
2	Competition Achievements	4
3	Article Publications	4

No	Criteria	Standard Value
4	Participation in Student Organization	4
5	Foreign Language Proficiency	4
6	Personality	4

Source: University X Policy

The main objective of this study is to develop a computerized DSS to support the selection process of outstanding students at one of the faculties in University X. The implementation of this DSS is expected to reduce errors in determining outstanding students and provide more accurate and efficient results.

The gap analysis in this study utilizes the measure of student satisfaction levels regarding the services provided by the faculty [4]. This measurement will yield appropriate rankings, accompanied by recommendations. The gap analysis approach employs the profile matching method, which involves decision-making mechanisms assuming an ideal profile that an object should possess. The profile serves as a predictor variable used as a benchmark for determining conformity [5], [6]. Broadly speaking, profile matching is a method that compares the actual data values of a record and evaluates them against expected profile values, resulting in differences (GAP). The smaller the deviation produces, the greater the weight of the value and the more opportunities for recommending selection [2]. Previous studies have applied the profile-matching method in decision-making in various educational institutions, such as selecting study programs [7], determining thesis supervisors [8], decision support systems for selecting outstanding teachers [9], and determining favorite lecturers [10]. Additionally, outside of educational institutions, the profile-matching method can also be applied to business entities, such as assessing the feasibility of Micro, Small, and Medium Enterprises (MSMEs) [11], the decision support system for determining the suitability of clove plantations [12], the decision support system for classifying MSMEs [5], and the feasibility of promotional decision support systems [13].

In relation to this study and several previous ones, it's evident that the use of DSS is crucial in decision-making [10]. Furthermore, gap analysis based on profile matching has proven to be a method capable of measuring service quality [11]. Based on these findings, this study is grounded in these concepts by integrating them into the development of the DSS for selecting outstanding students.

The results of this study are expected to provide a significant contribution to several faculties at University X in enhancing effectiveness and efficiency [14] in selecting outstanding students. The ranking results through the DSS will serve as a more accurate guide and can be justified in the decision-making process for selecting outstanding students. Additionally, the utilization of the gap analysis approach is expected to improve the quality of the faculty's services for several students.

2. Methodology

2.1. Data Collection

Data collection was conducted through a survey given to several students at University X. The measurement scale used was a Likert scale with intervals from 1 to 5, representing responses from "strongly disagree" to "strongly agree." The survey was administered directly to respondents from one of the faculties at University X. The sampling techniques employed were judgmental sampling, which involves selecting samples based on specific criteria, and judgmental sampling, which involves selecting samples based on specific criteria to provide the required information [15]. The criteria for respondents in this study are students who are scholarship recipients, actively involved in student organization activities, proficient in a foreign language, possess good personality traits, have published academic articles, have participated in competitions at least once, and have a semester Grade Point Average (GPA) of more than 3.50.

This study utilized a sample of 100 respondents with a data analysis technique employing profile matching. Based on the survey results, subsequent grouping is conducted based on core factors and

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secondary factors. The weights of criteria with core factors and secondary factors are listed in Table 2 as follows:

Table 2. Grouping of Core & Secondary Factor

Core Factor		
No	**Criteria**	**Types**
1.	GPA of Semester	CF
2.	Competition Participation	CF
3.	Involvement in Student Organizations	CF
4.	Foreign Language	CF
Secondary Factor		
1.	Article Publications	SF
2.	Personality	SF

Table 3 outlines how GPA values are classified into specific ranges and the corresponding values assigned to each range. It serves as a reference guide for evaluating students based on their academic performance.

Table 3. Weight of the GPA Criterion Values

GPA Range	Value
>3.61	4
3.41-3.60	3
3.21-3.40	2
2.50-3.20	1

2.2. Data Processing

Data processing in this study utilizes core factors and secondary factors, as listed in Table 4

Table 4. Results of Data Processing for 100 Students

No	Name	C1	C2	C3	C4	C5	C6
1.	Student 1	3.88	2	1	4	4	4
2.	Student 2	3.98	2	1	4	3	4
3.	Student 3	3.85	2	3	3	2	4
4.	Student 4	3.82	1	2	3	1	4
5.	Student 5	3.00	1	1	4	2	4
….	……..	…..	…..	….	….	….	….
100.	Student 100	3.90	3	0	4	4	4

Source: Data Processing Outcome

Explanation
C1 = GPA of Semester
C2 = Competition Participation
C3 = Article Publications
C4 = Involvement in Student Organizations
C5 = Foreign Language Proficiency
C6 = Personality

Respondent Explanation
0 = Never at all
1 = Once
2 = Twice
3 = Three times
4 = More than three times

2.3. Data Analysis Profile Matching Method

The stages in data analysis using the profile matching method begin with calculating the gap values for each criterion. The calculation process involves determining the difference in values between the profile of high-achieving prospective students who receive scholarships and the reference profile of

achievement used to qualify high-achieving students. The weight of each criterion has been determined by each faculty, with the calculation formula as follows:

$$\text{Gap} = \text{Student Profile} - \text{Achievement Profile} \quad (1)$$

The calculation results of the GAP are listed in Table 5 as follows:

Table 5. Calculation Results of GAP

No.	Name	C1	C2	C3	C4	C5	C6
1.	Student 1	4	2	1	4	4	4
2.	Student 2	4	2	1	4	3	4
3.	Student 3	4	2	3	3	2	4
4.	Student 4	4	1	2	3	1	4
5.	Student 5	1	1	1	4	2	4
….	……..	…..	…..	…..	…..	….	….
100.	Student 100	4	3	0	4	4	4
Achievement Profile		**4**	**4**	**4**	**4**	**4**	**4**
1.	Student 1	0	-2	-3	0	0	0
2.	Student 2	0	-2	-3	0	-1	0
3.	Student 3	0	-2	-1	-1	-2	0
4.	Student 4	0	-3	-2	-1	-3	0
5.	Student 5	-3	-3	-3	0	-2	0
…..	……..	…..	….	……	…..	…..	……..
100.	Student 100	0	-1	-4	0	0	0

Source: Data Processing Outcome

The next step is to perform weighting after obtaining the calculation of GAP values from each high-achieving prospective student. Each profile is assigned a weighted value as a benchmark against the GAP value, as listed in Table 6.

Table 6. Weighting of GAP Values

No	GAP Difference	Weight Value	Description
1.	0	6.0	Competency matched with requirements
2.	1	5.5	Competency exceeding level one
3.	-1	5.0	Competency deficiency level one
4.	2	4.5	Competency exceeding level two
5.	-2	4.0	Competency deficiency level two
6.	3	3.5	Competency exceeding level three
7.	-3	3.0	Competency deficiency level three
8.	4	2.5	Competency exceeding level four
9.	-4	2.0	Competency deficiency level four
10.	5	1.5	Competency exceeding level five
11.	-5	1.0	Competency deficiency level five

The weighting of the GAP values then results in the weighting of the GAP values for each high-achieving prospective student, as listed in Table 7

Table 7. Weighted GAP Values Result

No.	Name	C1	C2	C3	C4	C5	C6
GAP Difference Values							
1.	Student 1	0	-2	-3	0	0	0

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No.	Name	C1	C2	C3	C4	C5	C6
GAP Difference Values							
2.	Student 2	0	-2	-3	0	-1	0
3.	Student 3	0	-2	-1	-1	-2	0
4.	Student 4	0	-3	-2	-1	-3	0
5.	Student 5	-3	-3	-3	0	-2	0
…..	……..	…..	….	……	…..	…..	……..
100.	Student 100	0	-1	-4	0	0	0
Weighted GAP Values							
1.	Student 1	6	4	3	6	6	6
2.	Student 2	6	4	3	6	5	6
3.	Student 3	6	4	5	5	4	6
4.	Student 4	6	3	4	5	3	6
5.	Student 5	3	3	3	6	4	6
…..	……..	…..	….	……	…..	…..	……..
100.	Student 100	6	5	2	6	6	6

Source: Data Processing Outcome

The next step is to calculate the core factor and secondary factor values for the high-achieving student candidates. The calculation formula is as follows:

$$NFC = \frac{\sum \mathrm{NC}}{\sum \mathrm{IC}} \tag{2}$$

$$NSF = \frac{\sum \mathrm{NS}}{\sum \mathrm{IS}} \tag{3}$$

where NCF = Average Core Factor Value; $\sum NC$ = Total Sum of Core Factor Values; $\sum IC$ = Number of Core Factor Items; NSF = Average Secondary Factor Value; $\sum$ NS = Total Sum of Secondary Factor Values and $\sum IS$ = Number of Secondary Factor Items. The calculation results of the core factor and secondary factor values are listed in Table 8 as follows:

Table 8. Core Factor & Secondary Factor Value

No	Name	C1	C2	C3	C4	C5	C6	CF	SF
1.	Student 1	6	4	3	6	6	6	5.5	4.5
2.	Student 2	6	4	3	6	5	6	5.3	4.5
3.	Student 3	6	4	5	5	4	6	4.8	5.5
4.	Student 4	6	3	4	5	3	6	4.3	5.0
5.	Student 5	3	3	3	6	4	6	4.0	4.5
…..	…….	…..	….	…	…..	…..	…..	…..	….
100.	Student 100	6	5	2	6	6	6	5.3	5.5

The next step is to calculate the percentage of the core factor and secondary factor values. The percentage set by the faculty is 80% for the core factor and 20% for the secondary factor. The formulation for calculating the total value is as follows:

$$(\mathbf{1})(x)\%NCF + (\mathbf{2})(x)\%NSF = N \tag{4}$$

where NCF = Average Core Factor Value; NSF = Average Secondary Factor Value; N = Total Value of the Aspect and $(x)\%$ = Inputted Percentage Value. The calculation results of the percentage from the core factor and secondary factor values are listed in Table 9.

Table 9. Calculation of Total Value of High-Achieving Prospective Students

No	Name	Core Factor	Secondary Factor	N
1.	Student 1	5.5	4.5	5.3
2.	Student 2	5.3	4.5	5.1
3.	Student 3	4.8	5.5	4.9
4.	Student 4	4.3	5.0	4.4
5.	Student 5	4.0	4.5	4.1
…..	………..	……	……..	……
100.	Student 100	5.3	5.5	5.3

Source: Data Processing Outcome

Further, the values of each high-achieving prospective student are sorted from highest to lowest for the selection process. The selection criteria are as follows: if a high-achieving prospective student has a total score (core factor and secondary factor) ≥ 5.3, they are selected as high-achieving student candidates. Conversely, if the total score is < 5.3, they will not be considered as high-achieving students. The details of the score intervals for eligibility as high-achieving student candidates are listed in Table 10, as follows:

Table 10. Eligibility Score Intervals

Score Range	Description
< 5.3	Not High-Achieving
≥ 5.3	High-Achieving

Source: Data Processing Outcome

Based on the eligibility score intervals, the profile matching process is then arranged from the lowest score to the highest score, as listed in Table 11.

Table 11. Profile Matching Values

No.	Name	Score	Description
1	Student 10	3.0	Not High-Achieving
2	Student 11	3.5	Not High-Achieving
3	Student 26	3.7	Not High-Achieving
4	Student 85	4.0	Not High-Achieving
5	Student 30	4.2	Not High-Achieving
…..	……	……	………..
100	Student 8	5.3	High-Achieving

Source: Data Processing Outcome

3. Results and Discussion

3.1. Pre-System Implementation Testing

The respondents totaled 100 students who are candidates for high-achieving students. The pre-implementation testing results of the GAP analysis show that there are four candidates categorized as high-achieving students, with the remaining 96 students not falling into the high-achieving student category, as listed in Table 12.

Table 12. Pre-Test Result

No.	Name	Description	Should Be
1.	Student 1	High-Achieving	High-Achieving
2.	Student 2	Not High-Achieving	High-Achieving
3.	Student 3	Not High-Achieving	Not High-Achieving
4.	Student 4	Not High-Achieving	Not High-Achieving

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No.	Name	Description	Should Be
5.	Student 5	Not High-Achieving	Not High-Achieving
…	…….	……	……
100.	Student 100	Not High-Achieving	Not High-Achieving

Source: Data Processing Outcome

3.2. System Testing After Implementation

The testing results with the implementation of the profile matching-based application yielded the eligibility of five high-achieving student candidates, while the rest were not included as high-achieving student candidates.

Based on the testing results before and after the implementation of profile matching, there are differences. In the pre-test results, there were 96 accurate data and four inaccurate data. In the post-test results, there were 98 accurate data and two inaccurate data. The post-test results of the profile-matching implementation testing are listed in Table 13.

Table 13. Post-Test Results

No.	Name	Description
1.	Student 1	High-Achieving
2.	Student 2	Not High-Achieving
3.	Student 3	Not High-Achieving
4.	Student 4	Not High-Achieving
5.	Student 5	Not High-Achieving
….	……	…….
100.	Student 100	Not High-Achieving

Source: Data Processing Outcome

3.3. Pre-Test and Post-Test Comparison Testing

The validity testing results of the pre-test and post-test are continued with a comparison between them by applying the profile matching method, as follows:

Accuracy of pre-test data $\frac{96}{100}$ x 100% = 96%

Accuracy of post-test data $\frac{98}{100}$ x 100% = 98%

The accuracy calculation of both pre-test and post-test data yielded a higher percentage value for the post-test compared to the pre-test percentage.

4. Conclusion and Recommendations

Based on the analysis, design, and implementation of the profile-matching-based application program, the conclusions of this study are as follows, the implementation of the GAP-based application with the profile-matching method can assist users in making decisions related to the selection process of high-achieving students quickly, accurately, and objectively. According to the presentation of data before and after the implementation of the GAP-based application with the profile matching method, there are differences. In the pre-test results, four inaccurate data and 96 accurate data were obtained, with an accuracy percentage of 96%. In the post-test results, there were 98 accurate data with two inaccurate data. The accuracy percentage of the data is 98%.

In relation to the testing results before and after the implementation, this study can be continued by conducting a comparative study between the GAP method and other methods related to the selection of high-achieving students. Such comparisons will help in understanding the strengths and weaknesses of each method and gaining a deeper understanding of the effectiveness and efficiency of using the GAP method.

The results of this study can be further expanded to encompass more comprehensive selection criteria for high-achieving students, allowing for a more holistic decision-making process. The findings of this study can be used to explore advanced technologies such as artificial intelligence and machine learning in developing decision support systems. The utilization of such technologies could enhance precision and accuracy in determining the ranking of high-achieving students and expedite the decision-making process.

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Analysis and Design of a Sales Application System for Micro-Scale Grocery Stalls

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Micro Scale
Return on Investment
SDLC
Waterfall

ABSTRACT

Investments in information technology often require relatively large capital allocations, but a wise strategy can optimize the use of these funds, such as through developing desktop-based sales applications according to more specific needs and scope. The grocery stall 'CV Warung Berkah' will apply this strategy to manage inventory in sales transactions. The method in designing this sales system uses the waterfall method approach, while finding out the percentage of benefits of the system built with the investment costs incurred using the return-on-investment method approach. Based on the results of the analysis and discussion in the research conducted, the sales system application for micro-scale basic food stalls is feasible to be implemented or developed with an investment feasibility test value or what is usually called ROI of 62.0%. This application system, all sales transactions are recorded accurately as material for the shop owner's analysis in deciding to purchase and inventory goods.

1. Introduction

The tight economic competition is felt by all groups, both upper-middle scale entrepreneurs and lower-middle scale entrepreneurs. For entrepreneurs who have sufficient capital investment, investing in information system technology is a long-term strategy that can be taken to continue to exist in today's tight economic competition, for example by building a digitalized information system that integrates all economic chains. This is different from small-scale entrepreneurs where the capital system only relies on internal resources with a limited scope. Let's take one example, namely small-scale basic food stalls which are generally found in residential areas. For grocery stall owners, investing in digitalization technology is not easy because they must have quite a large amount of capital [1].

The object and location of this research is "CV Warung Berkah" which is located in a residential location of residents of Comrang village, Tobat village, Balaraja sub-district, Tangerang regency. This basic food stall is an example of a small-scale home business that provides various types of daily necessities with a limited amount of capital investment. At this location, there are 8 food stalls with a population of 155 families [2]. Business competition between several basic food stalls makes the owner of 'CV. Warung Berkah' must think about finding and implementing new strategies, innovating and being creative for the survival of its business. One example of a strategy that can be implemented is managing the inventory system so that stock overloads do not occur, filtering sales transactions so that you can know the types of goods that sell quickly, and improving service to buyers and so on. This strategy cannot be implemented if the sales system process still uses conventional methods, which means all processes are carried out with manual records [3].

To implement the strategy above, one approach is to utilize advances in information technology, including building a sales application system. Even though its implementation requires quite a large investment, it can be adjusted according to needs, for example designing a desktop-based cashier application at the 'Hikmah Jaya' grocery store using the waterfall method approach. The waterfall

method is an approach to software development, where the analysis stage involves identifying needs by considering the main functions required [4]. Generally, basic food stalls are small scale and those whose business locations are in the middle of residential areas only serve their target market in the surrounding area. With capital investment and a limited target market, the development of these businesses usually does not have significant business progress each year, this is one of the factors that causes many grocery stall businesses to go bankrupt amidst business competition. Therefore, to increase competitiveness, especially in small-scale basic food stalls, a good and effective business management system is needed [5].

Investment and application of technology in a field or business does not have to be carried out totally with quite large investment capital, small and medium businesses, for example, grocery stores, can take advantage of technological advances by designing a sales information system according to current needs while considering the life cycle of the system itself (System Development Net Life Cycle) for future sales system development [6]. Therefore, in this research, based on the research object chosen and the identification of the problem analysis that has been carried out, a sales system will be built as an alternative solution to problems, especially those related to inventory management, sales transactions so that it can provide maximum service to buyers. The method for designing the sales system uses a waterfall method approach to facilitate the development of information systems in a structured manner and according to needs [7]. With this method approach, each development stage, from requirements analysis to implementation and testing, will be carried out sequentially and thoroughly, allowing better monitoring of the progress and quality of the system being developed.

Meanwhile, at the design stage of the sales system application program obtained from the results of the needs analysis, the Delphi programming language will be used with the MySQL database system management. The feasibility study or return on investment method for the system being built will be described in return on investment (ROI). This is carried out to find out whether the sales system being built is feasible or not based on the presentation of the benefits generated with the costs incurred [8].

2. Methods

The type of survey in this research is a descriptive qualitative survey, namely a type of survey in research that describes an activity on the research object[9], while data collection and processing is obtained from the results of observations and interviews on research objects which are then developed from the results of data collection from literature studies related to the research theme. The system analysis stage is the stage of identifying problems, analyzing system requirements and analyzing user needs for the system that will be built in this research [10]. Next is the system design and implementation stage, at this stage the researcher designs the implementation environment using the SDLC (System Development Life Cycle) approach for sustainable system development using the Waterfall Method. After being designed and implemented, the researcher carried out a feasibility test. This was done to determine the percentage of benefits of the system built with the investment costs incurred. The researcher used the return-on-investment method approach [11].

The final stage of this research is the implementation and maintenance of the system, this stage is the final stage after the system has been successfully built and after testing the percentage of feasibility values. Meanwhile, the maintenance phase is an activity carried out periodically to ensure that the sales application system being built is running as it should [12]. Researchers monitor application systems that have been built and utilized by users or CV Warung Berkah owners, this aims to ensure that there are no bugs or errors in the application. The stages in this research can be seen in Figure 1 below.

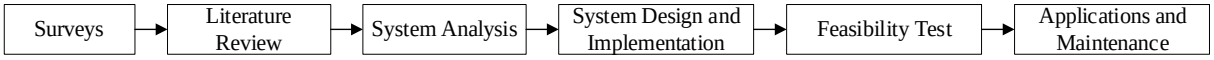

Figure 1. Research Method

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3. Results and Discussions

3.1. System Analysis

Analysis of the situation of the running system is considered very important because it can make things easier or provide an initial idea for designing the system to be developed [13]. Of the several basic food stalls in the research location, the majority of the sales transaction process still uses a manual system and it can be said that there is no specific system or recording of the sales process, whether from the process of recording or collecting data on goods, sales transactions or other reports. If this is allowed to continue gradually over a long period of time it will cause losses for the shop owner himself. Therefore, the owner of the basic food stall 'CV Warung Berkah', in this case the object of research, the researchers will create a sales application system that can carry out transaction processes automatically, making the transaction process easier and hopefully improving service for consumers. In designing the sales application system, the researcher used the waterfall method approach as can be seen in Figure 2.

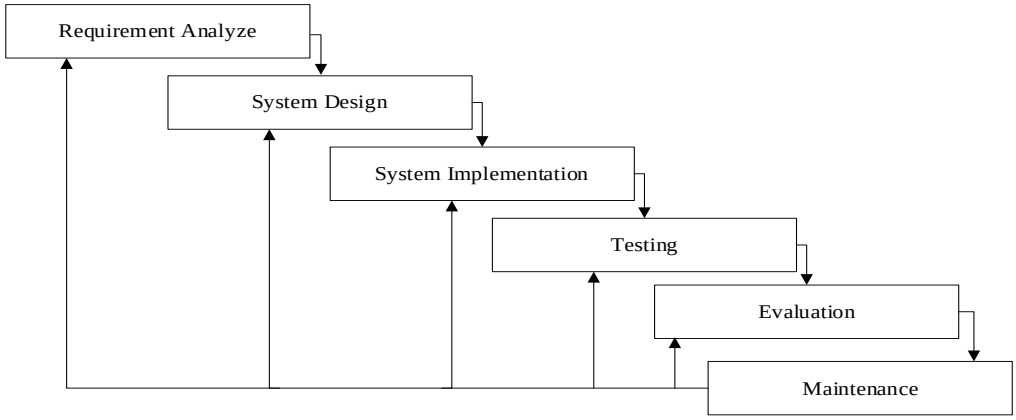

Figure 2. Waterfall Method

The grocery stall 'CV Warung Berkah' in carrying out its business processes has one worker or one shop assistant as a helper in serving sales transactions with a daily wage of IDR 80,000/day or an average of IDR 2,400,000/month with operational hours starting at 07.00 WIB until 22.00 WIB. There is no specific recording of sales transactions in carrying out the business process. The notes contained in a book are notes regarding receivables or cash bonds from buyers. Of course, this will cause difficulties in making decisions regarding inventory and subsequent purchases of goods as well as other processes.

To find out functional and non-functional requirements in building a sales system application, the researchers conducted direct interviews with CV Warung Berkah owners. This was done to meet the needs of the system that researchers will build. Researchers directly observe the problems that occur so they know the picture of the solution that will be provided. An overview of the identification of problems that occur in the research object can be seen in table 1 below.

Table 1. Identification of Problems

Problem Identification	Problems	Cause of the Problems	Solution
Inventory Management	Stock items are not updated	There is no recording of incoming goods data for purchases or records of goods sales	A system is designed that can provide menus or information regarding stock data and is integrated with the menu for purchasing and selling goods
Manual Data Management	Determining the selling price of goods is not the same between buyers and buyers.	Determining the selling price is based on the memory of the owner or serving officer.	In designing the application, a selling price field will be created or the selling price will be determined based on the cost price.

Problem Identification	Problems	Cause of the Problems	Solution
Manual Transaction Report	There are no reports on sales of goods so it is difficult to find out the profit from selling goods.	There are no written reports or data regarding profits from the sale of goods	A sales application system was designed that provides a report menu for each sales transaction, goods purchase transaction and accounts receivable records. The system is built by paying attention to user needs, so that information can be quickly accessed by users or owners to support decision-making.

3.2. System Planning

After knowing the problems and user needs of the research object, a sales system is proposed as an alternative problem solution that is tailored to the user's needs. There are several stages that researchers carry out in system design, including designing activity diagrams, use case diagrams and designing database models.

a. Activity Diagrams

The initial design for implementing the system that the researcher carried out was to create an activity diagram design, which is a visual image to describe the sequence of activities in the system to be built. Apart from that, the benefit of designing activity diagrams is that they can be used as information for sustainable system development as can be seen in Figure 3.

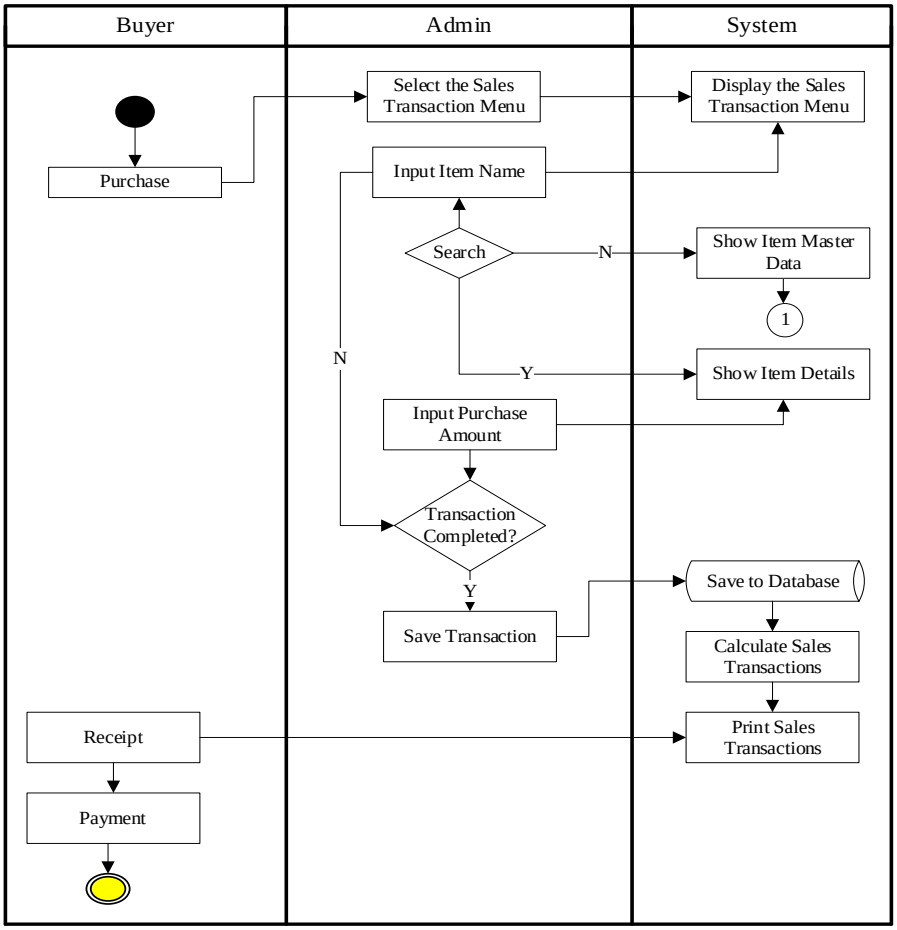

Figure 3. Activity Diagram

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b. Use Case Diagram

This diagram describes functional requirements that describe communication between users and the system[14]. This research is focused on designing a sales system application for a micro-scale basic food stall, which is a retail business that focuses on selling daily necessities for local people who have a significant role in the local economy. By increasing the efficiency of the sales system, it is hoped that it can have a direct positive impact on people's welfare, while also providing an example of the effective application of information technology on a smaller scale. In this design, there are two actors. The system can only be accessed by the admin actor or shop owner as the main actor, as seen in Figure 4.

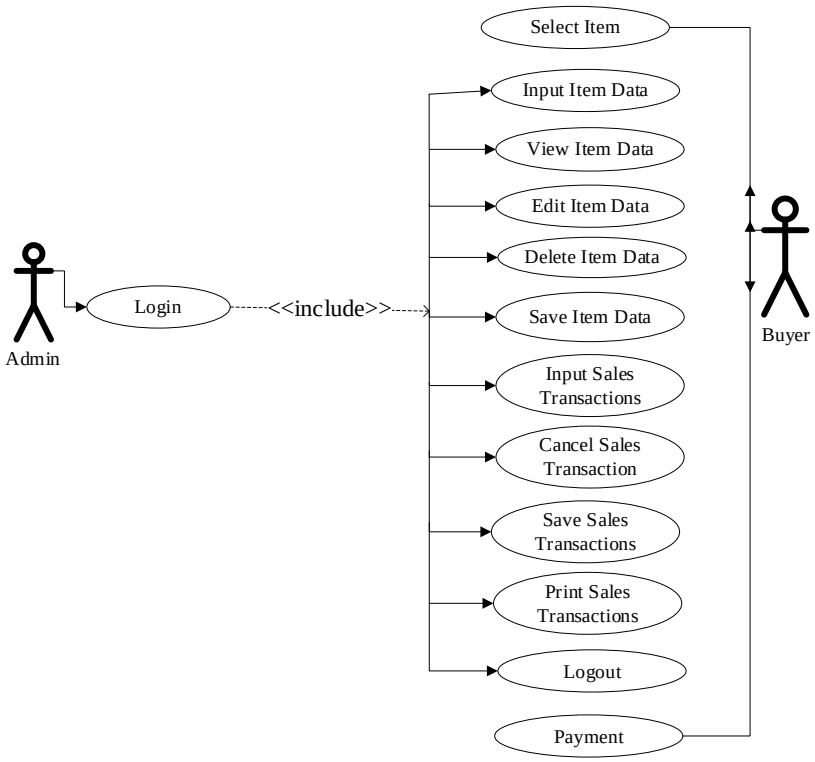

Figure 4. Use Case Diagram

c. Entity Relationship Diagram

The Entity Relationship Diagram (ER-Diagram) is a logical data model in describing the concept of database design, this data model shows the relationship between several entities in a system that will be designed [15]. The following is an overview of the ER-Diagram that will be built as shown in Figure 5.

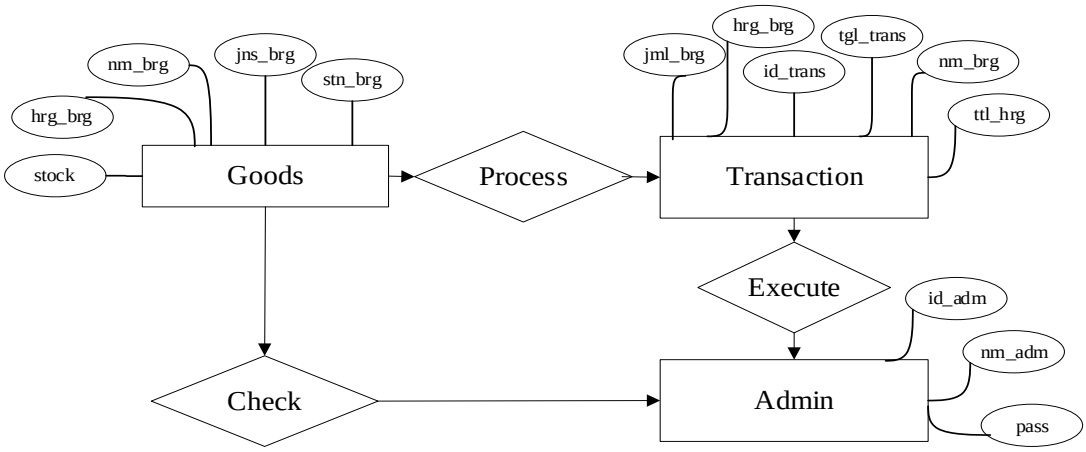

Figure 5. ER-Diagram

3.3. System Implementation

The next stage is to implement the system that has been designed into an application or software. The design of the micro-scale grocery stall sales system was implemented in the Delphi programming language with a database management system using MySQL. The following is the interface or user interface of the system that will be implemented [16].

Figure 6. Dashboard Menu

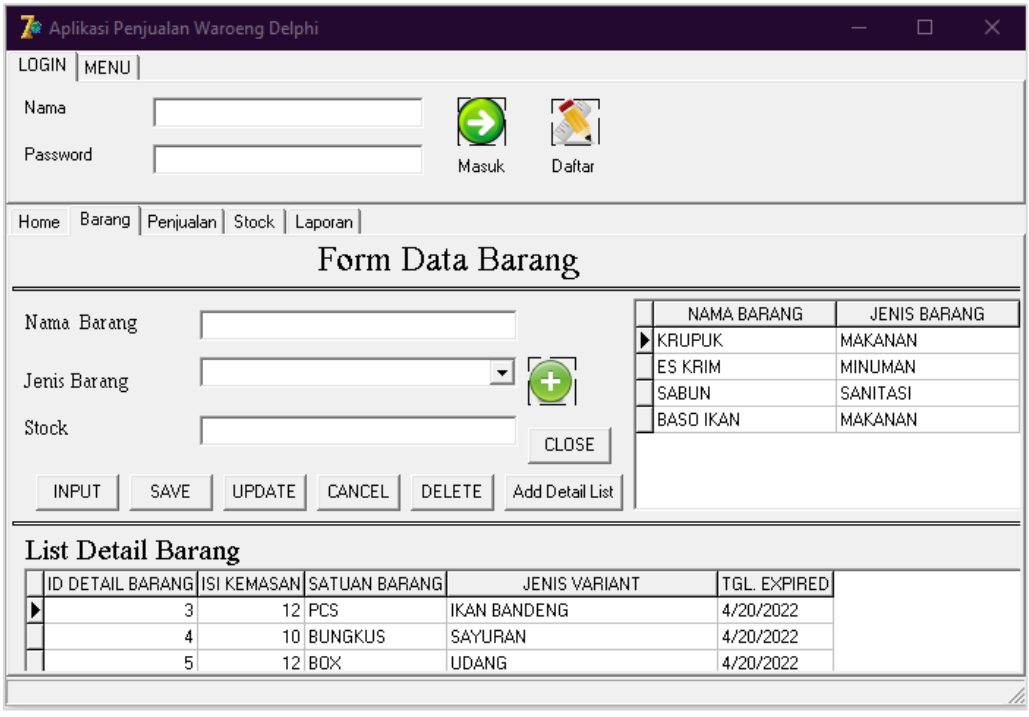

Figure 7. Inventory Item Menu

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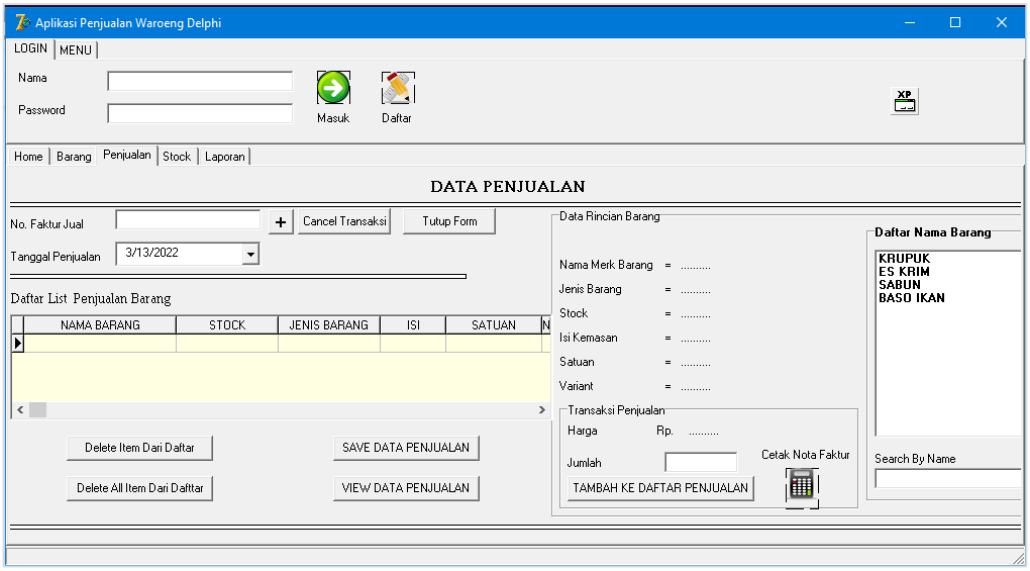

Figure 8. Transaction Menu

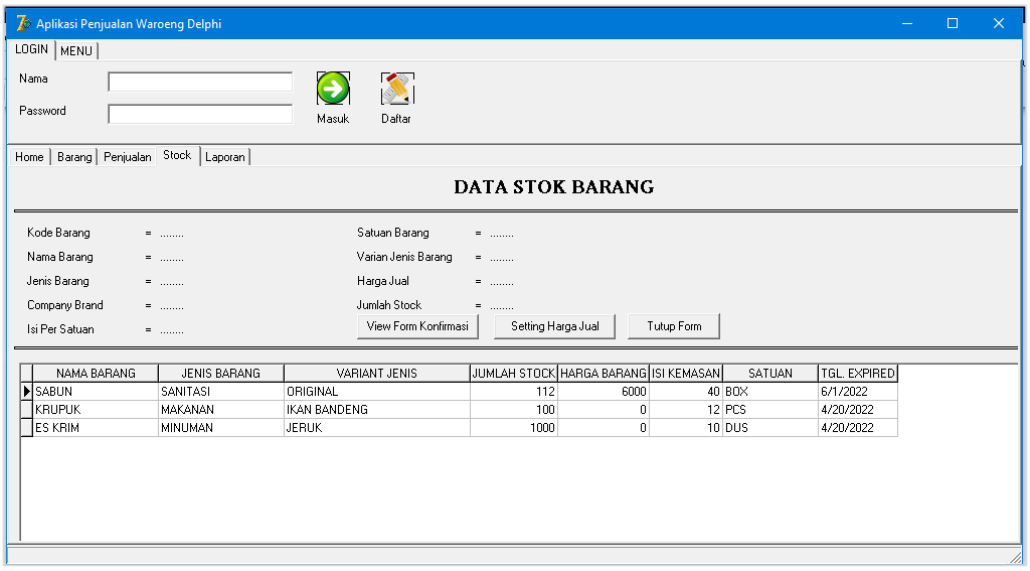

Figure 9. Inventory Menu

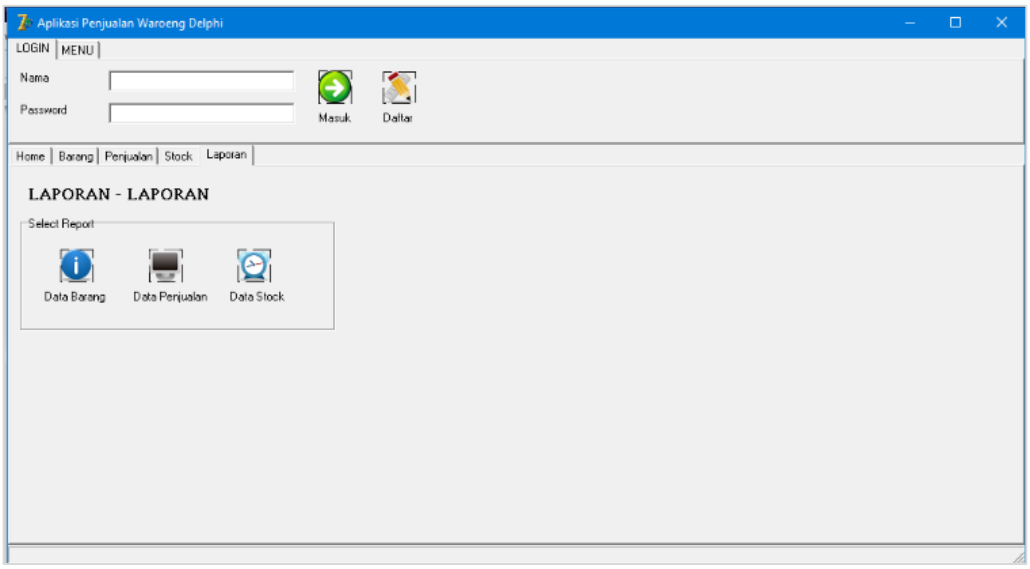

Figure 10. Report Menu

3.4. System Feasibility

The method used to test or measure feasibility is the Return on Investment (ROI) method, which is a method for measuring the efficiency or profitability of an investment. In this test, the total investment (Procurement) is estimated at IDR 5.000.000,- which is the investment cost for procuring or purchasing hardware, printer ink and receipt paper. Meanwhile, system maintenance costs and purchasing printer ink and stucco paper are carried out in the seventh month. Furthermore, the total benefits are IDR 2.100.000,- for tangible benefits and IDR 6.000.000,- for intangible benefits, respectively. The total benefits are profits from savings or increased sales for 6 months, which includes operational efficiency costs including overtime wages. and procurement of stationery, improving service or sales and efficiency of inventory costs (stock of goods that do not move). The percentage of benefits of developing a sales application system with the costs incurred (investment) is presented in Table 2 with the following formula:

$$ROI = \frac{Profit - Investment\ Costs}{Investment\ Costs} x\ 100\% \quad (1)$$

Table 2. Return on Investment

Resume	IDR
Total Benefit	8.100.000,-
Total Investment	5.000.000,-
Difference	3.100.000,-
$ROI = \frac{IDR\ 3.100.000}{IDR\ 5.000.000} x\ 100\% = 62.0\%$	

Based on the feasibility test above, the percentage rate of return on investment is 62.0%, it can be concluded that the implementation of the sales application system at the 'CV Warung Berkah' which has been designed is suitable for implementation.

4. Conclusion

Based on the research stages that have been carried out, starting from the design stage using the SDLC (System Development Life Cycle) approach, system development using the waterfall method approach to feasibility testing using the ROI (Return on Investment) method approach, then the sales system application for micro-scale food stalls in particular at the grocery stall “CV Warung Berkah' is feasible to be implemented and developed, it can be seen that the percentage of feasibility test results is 62.0%. The implementation of this application is expected to improve service to consumers through managing an organized inventory system and accurate recording of sales transactions, making it easier for shop owners to analyze decisions regarding purchasing and inventory of goods. The suggestion from this sales application system project is that although the above analysis is acceptable, in its implementation, the shop owner needs to pay attention to the capabilities of the resources they own or capital as material for long-term investment, considering that the source of capital only relies on internal resources with a limited scope.

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Design and Implementation of Tire Pressure and Temperature Monitoring System for Hatchback and Multi-Purpose Vehicle Based on IoT

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ABSTRACT

Tire Pressure Monitoring Systems (TPMS) have developed into an essential element in vehicles to improve safety and the driving experience. In general, TPMS systems rely on special hardware to collect and transmit tire pressure data to the vehicle's on-board computer and this data can only be viewed by the driver and passengers in the vehicle. In this study, we developed a remote tire pressure and temperature monitoring system using IoT technology. The MQTT protocol facilitated communication between the cloud server and controller, while the system uses Docker container to simplify program integration. The results revealed the optimal standard deviation for tire pressure in hatchback vehicles to be 2.24, and for Multi-Purpose Vehicles (MPVs), it was 2.97. For tire temperature, the best standard deviation in hatchback vehicles was 1.93, compared to 1.05 in MPVs. This system effectively monitors tire pressure and temperature changes in real time, accessible remotely via smartphones and computers.

1. Introduction

The automobile sector has advanced significantly in recent years, especially when it comes to vehicle performance and safety. Tire pressure monitoring is a crucial component of car safety since low tire pressure can decrease fuel economy, interfere with comfort while driving, and raise the chance of collisions. Given this, the Tire Pressure Monitoring System (TPMS) has emerged as a critical element of contemporary automobiles, greatly enhancing road safety [1].

Advancements in vehicle electronic technology have brought forth the Tire Pressure Management System (TPMS), becoming a crucial safety feature in vehicles. Research papers [2]-[4] have extensively explored TPMS applications for four-wheeled vehicles. A unique method for identifying tire pressure loss in a range of operational scenarios is presented in paper [5]. Studies on TPMS applications have also been conducted in [6][7], with an emphasis on identifying torsional resonance frequency variations as a sign of tire pressure drop. Furthermore, the Anti-lock Braking System (ABS) tire speed signals can be used to improve tire pressure monitoring, providing a potential path toward accurate and dependable tire pressure monitoring. To further improve the accuracy and precision of the monitoring process, a study [8] examined a tire pressure and temperature monitoring system combined with ABS control signals. These studies highlight how important TPMS is for maximizing tire performance and safety, providing essential information about tire health, and facilitating preventative actions to lessen possible road dangers.

A solution to address the issue of tire blowouts involves implementing a vehicle tire pressure monitoring system (TPMS). In [9][10], researchers devised a TPMS that presents tire pressure information on a dot matrix Liquid-Crystal Display (LCD), with pressure data transmitted via a 433MHz radio frequency (RF) module, accessible solely to the driver locally. Similarly, in [10], wireless

communication between tire sensors and TPMS modules was explored, with the author analyzing associated power consumption through simulation. In [11], experiments were conducted involving wireless transmission of data from tire sensors to TPMS modules operating at 433MHz, while data transmission from TPMS modules to a computer was examined using wired communication employing the universal synchronous/asynchronous receiver/transmitter (USART) protocol. If remote pressure monitoring is required, effective communication facilities are needed, effective communication facilities are vital to transmit vehicle data. Internet of Things (IoT) technology emerges as a potential solution for long-distance data transmission, enabling all devices to be connected online, thereby enhancing efficiency and productivity [13][14]. Numerous studies on IoT, such as those in [15][16], have been published, reflecting its widespread development and applicability.

In this study, we developed a remote tire pressure and temperature monitoring system for vehicles using IoT technology. The tire pressure and temperature data are transferred to the server via the Message Queueing Telemetry Transport (MQTT) protocol, while the system uses Docker container to simplify program integration. With this configuration, tire pressure and temperature data can be monitored remotely in real time using a computer or smartphone.

2. Methods

In this paper, we undertook in several crucial stages to develop a tire pressure and temperature monitoring system based on IoT. Figure 1 shows the flow of the research. These stages encompassed conducting literature reviews, designing the system, implementing the system, and rigorously testing its functionality. This chapter will provide an in-depth elucidation of each of these steps.

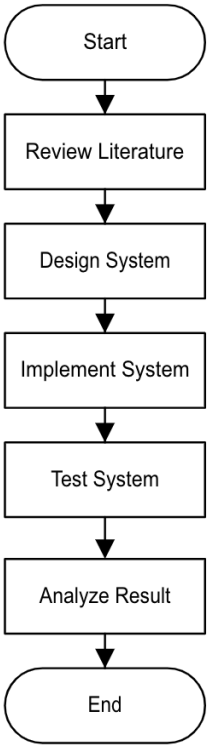

Figure 1. The Flow of the Research

2.1. Literature Review

In this chapter, we briefly explain the Tire Pressure Management System (TPMS), Internet of Things (IoT) and Docker container. There are two primary types of TPMS: direct systems and indirect systems. To achieve accurate tire pressure measurements, the direct systems need putting sensors on each tire of the vehicle separately [7]. On the other hand, the indirect systems estimate tire pressure using sensors that are already installed in the car. Tire pressure loss in this system is identified by closely

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observing changes in the recorded data [8][9]. While the indirect systems employ existing onboard sensors to estimate tire pressure indirectly, providing a more affordable option, but the direct systems provide exact real-time pressure data from each tire. By warning drivers of possible pressure abnormalities, TPMS systems significantly contribute to the improvement of vehicle safety, preventing dangerous circumstances and advancing general road safety.

The Internet of Things (IoT) is a network technology that permits industrial equipment and sensor devices to seamlessly connect and exchange data over the internet. Many studies investigating the potential uses of IoT technology have been spurred by its widespread use [12]–[15]. For example, the author of [2] looks into the application of IoT technology for a tire pressure monitoring system that makes use of the MPX5700AP sensor. Researchers used an Android smartphone and the Blynk application to show tire pressure data. In a similar vein, researchers used Internet of Things (IoT) in [15] to monitor tire pressure and temperature using independent sensors (MPX5D00AP tire pressure sensor and LM35 temperature sensor). Through smartphone integration of the Blynk app, data visualization was accomplished. One commonly used protocol for IoT is the Message Queueing Telemetry Transport (MQTT), which operates on TCP/IP and is open source [16].

A Docker container is a lightweight, standalone, and executable software package that includes everything needed to run a piece of software, including the code, runtime, system tools, libraries, and settings [17]. Docker containers enable users to install and manage programs effectively on a Raspberry Pi. They do this by creating an isolated environment that can execute multiple apps reliably across different development and production environments, making use of the Pi's limited resources [18].

2.2. System Design

This section outlines the system design for an Internet of Things-based tire pressure and temperature monitoring system for vehicles. The block diagram shows the parts and connections in the system, as shown in Figure 2. The Raspberry Pi 4B serves as the system's central controller. The controller has a Docker container installed, which makes managing software apps easier. The controller is equipped with an RTL-SDR radio signal receiver, which is intended to receive and decode temperature and pressure data signals sent by tire sensors. RTL-SDR is a type of Software Defined Radio (SDR) device. SDR is a contemporary radio communication system that differs from others in that it uses software implementations running on a computer or embedded system in place of conventional hardware components including mixers, filters, amplifiers, modulators/demodulators, and detectors [19]. With the RTL2832U chipset, RTL-SDR devices can receive signals at frequencies between 500kHz and 1.75GHz. Furthermore added for user convenience is a Liquid Crystal Display (LCD) that shows tire pressure and temperature data in real time.

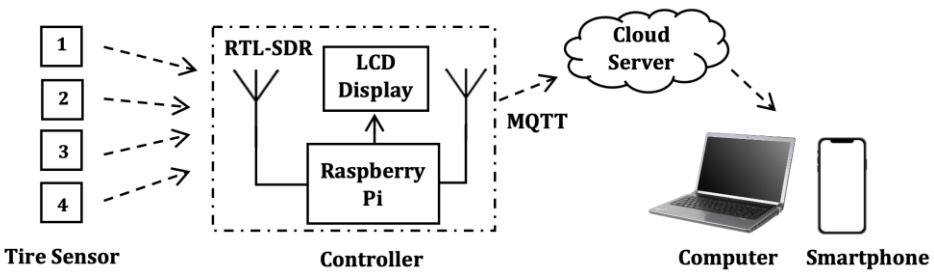

Figure 2. System Design

The system operates through the following process. Initially, the sensor transmits tire pressure and temperature data to the central controller. This data is encoded as a signal modulated with Frequency-Shift Keying (FSK) modulation and Manchester code [20][21]. FSK is a modulation technique employed in telecommunications, particularly radio transmission. This modulation alters the frequency of a carrier signal to transmit the data. In FSK modulation, distinct frequencies represent the data being

transmitted. Manchester code is a type of line code that signifies each data bit through transitions or polarity changes in the signal. It is applied broadly in data communications, notably in Ethernet and certain wireless communication standards. Manchester code exhibits resilience against noise and distortion. Subsequently, the controller receives the data and decodes it into hexadecimal format, containing sensor ID data, pressure data and temperature data. The information that has been decoded is then shown on the LCD panel. In addition, the internet is used to send the data to cloud servers. The transmission from the controller to the cloud server utilizes the Message Queueing Telemetry Transport (MQTT) protocol, commonly employed for IoT purposes, running on TCP/IP and being open source. By using a browser program and the cloud server link, users may monitor tire pressure and temperature data from computers and smartphones. This method allows pressure and temperature readings to be shown in real-time on the dashboard's LCD screen as well as through computer and smartphone applications.

2.3. System Implementation

This section outlines the thorough implementation procedure for an IoT-based tire pressure and temperature monitoring system. This system employs hardware with specifications outlined in Table 1, while the physical appearance of the device is depicted in Figure 3. This system uses a Raspberry Pi 4B because the Docker container can be installed on it. We use RTL-SDR to receive data signals from the tire sensor.

Table 1. Device Specification

No	Device	Specification
1	Raspberry Pi 4B	Quadcore Cortex A-72
		Broadcom BCM2711
		2GB RAM
		IEEE 802.11ac Wireless
2	RTL-SDR	Realtek RTL2832U Chip
		Frequency Range 500kHz ~ 1,766MHz
3	Tire Sensor	Frequency 433MHz
		Pressure Value Range: 0 ~ 210 psi
		Temperature Value Range: -40^{o} ~ 90^{o} Celcius
4	Smartphone	MediaTek Helio G95 2.05 GHz
		6GB RAM
		Android 13
5	Computer	AMD Ryzen™ 5
		8 GB RAM
		512 GB SSD Hard drive
6	Powerbank	Battery 10Ah

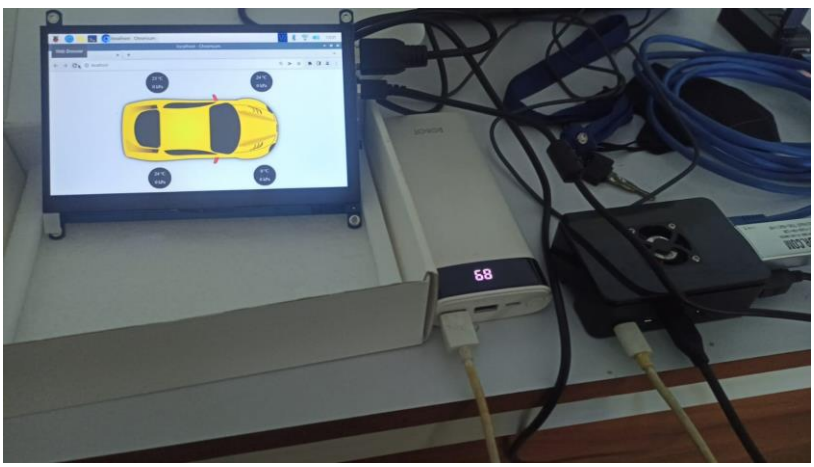

Figure 3. The Physical Appearance of The Device

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In this setup, tire sensors transmit tire pressure and temperature data via radio signals utilizing FSK modulation, with a transmission frequency of 433MHz. The controller then captures and decodes the transmitted data. This decoded data comprises sensor ID, tire pressure value and tire temperature value, all of which are showcased on the LCD screen. To achieve this visual representation, we employ the HTML programming language accessible through a browser application. The LCD display is shown in Figure 4, along with a picture of an automobile. It shows tire pressure data in kiloPascals (kPa) and tire temperature values in degrees Celsius (°C). Pascal (Pa) is the international unit for pressure values. The definition of Pascal (Pa) is the force of one Newton applied to one square meter (N/m2). By giving drivers immediate access to tire pressure and temperature measurements, this design improves driving convenience.

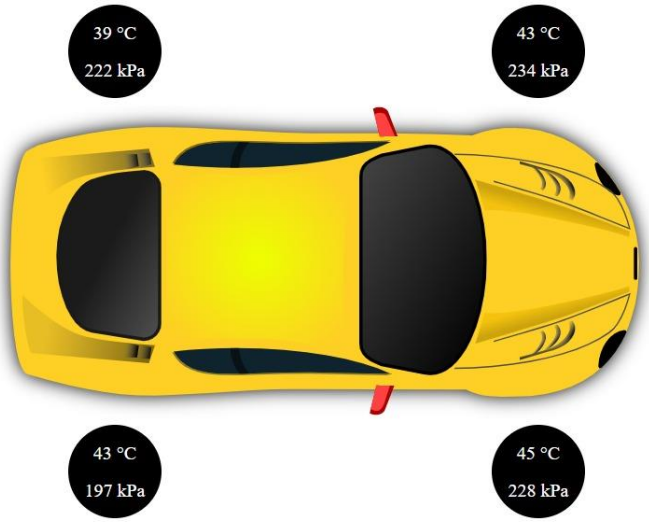

Figure 4. Display of LCD Screen

Data on temperature and tire pressure are sent to a cloud service in addition to being displayed on the LCD. Using the MQTT protocol, the controller sends this data to the cloud server. Because it uses cloud-based storage, users can obtain pressure and temperature data remotely from computers and cellphones by using the IP address associated with the cloud server. We create web browser-accessible HTML-based applications to make access easier from computers and smartphones. Tire pressure and temperature measurements in kPa and °C are displayed in Figure 5, which shows the user interface of the application for PCs and smartphones. This easy-to-use program guarantees smooth functioning and easy reading on PCs and cell phones.

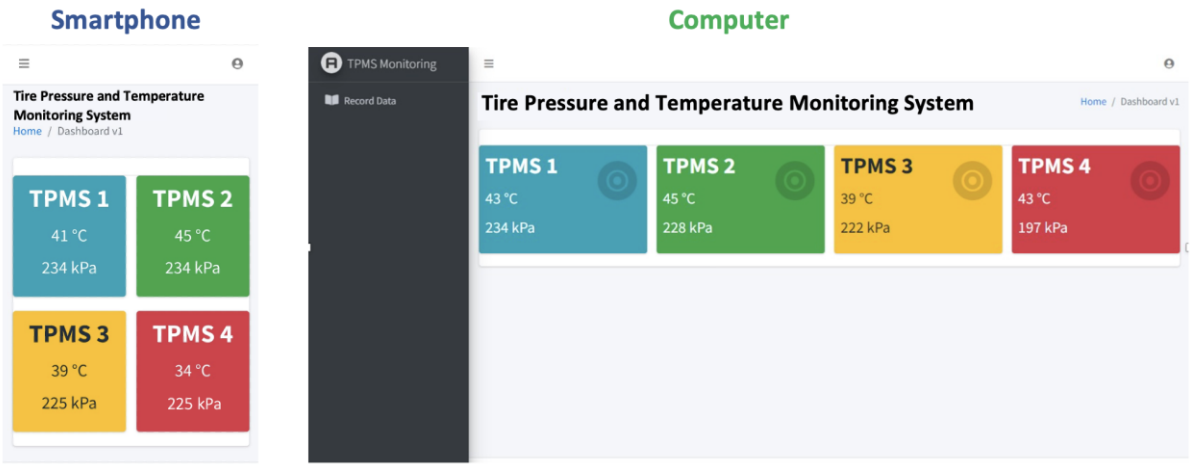

Figure 5. User Interface Application on Smartphone and Computer

3. Results and Discussions

To assess the system's performance, a 25km test drive was conducted during daylight hours. The evaluation involved two vehicle types: hatchback vehicle and multi-purpose vehicle (MPV), with their specifications outlined in Table 2. During the test, tire sensors were affixed to each tire of the vehicles. Figure 6 illustrates the positioning of the sensor on a car tire and provides a visual representation of the sensor's physical design.

Table 2. Specification of Vehicles

Parameters	Hatchback Vehicle	Multi-Purpose Vehicle
Dimensions	Length: 359.5 cm	Length: 439.5 cm
	Width: 159.5 cm	Width: 173.0 cm
	Height: 148.0 cm	Height: 166.5 cm
Engine Capacity	1250 cc	1,298 cc
Tire	185/55 R15	185/65 R15

Figure 6. Tire Sensor

3.1. Testing Results for Hatchback Vehicle

In the first test, we conducted the testing using a hatchback vehicle. From the test results, the system is capable of recording and displaying changes in pressure and temperature values. Figure 7 illustrates the monitoring results of tire pressure in kPa. The results indicate that the pressure values in all tires are quite fluctuating. These fluctuations could be due to varying road conditions, and measurements were also taken while the vehicle was in motion. From the results, the average pressure values for each tire were found to be 233.4 kPa for the first tire, 231 kPa for the second tire, 222.5 kPa for the third tire, and 193.4 kPa for the fourth tire. Additionally, we calculated the standard deviation values for each tire's pressure data. The standard deviation value for the first tire is 2.08, for the second tire is 4.39, for the third tire is 2.24, and for the fourth tire is 5.92. From these results, the best standard deviation value is 2.24.

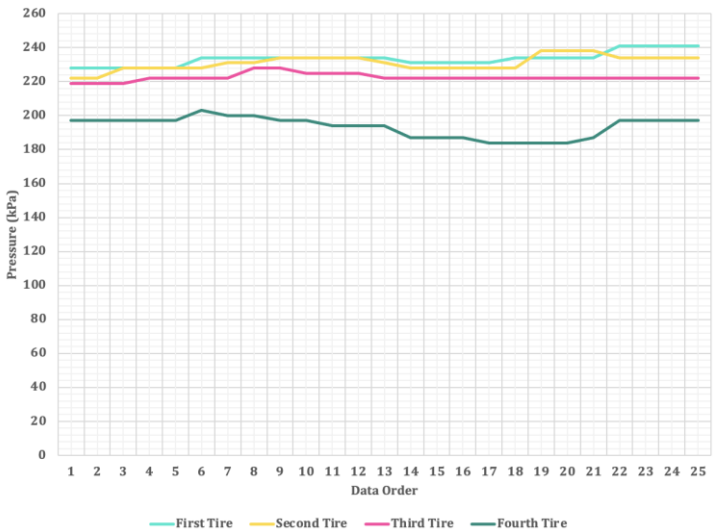

Figure 7. Tire Pressure Results for Hatchback Vehicle

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In addition to pressure values, we also conducted tire temperature monitoring tests. The results of the tire temperature monitoring are shown in Figure 8. The tire temperature data is displayed in degrees Celsius (°C). The test results indicate that tire temperatures fluctuate. From the testing, the first and second tires have higher temperatures compared to the others because tires 1 and 2 are positioned closer to the car's engine. Thus, tire temperatures are influenced not only by environmental temperatures but also by engine heat. Additionally, we calculated the average and standard deviation values of tire temperatures. From the test results, the average tire temperatures are 41°C for the first tire, 43.8°C for the second tire, 38.4°C for the third tire, and 37.9°C for the fourth tire.

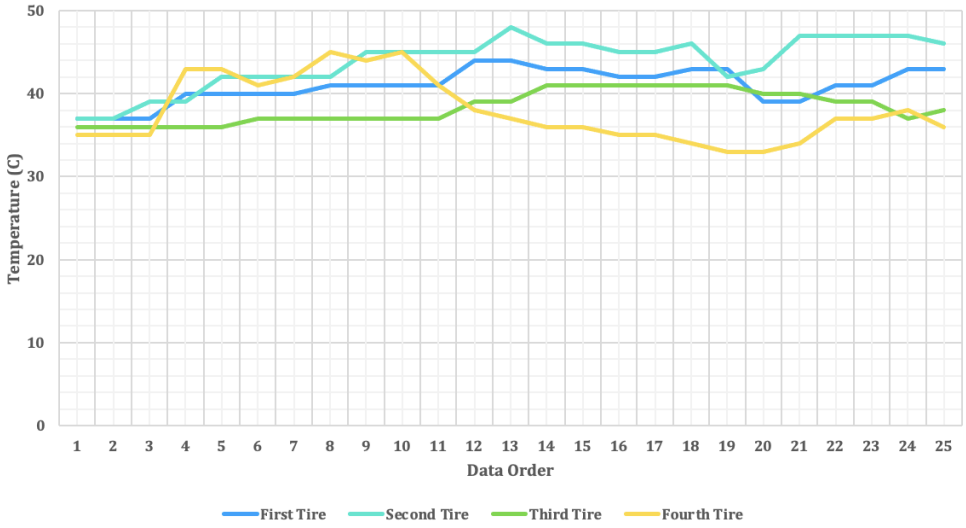

Figure 8. Tire Temperature Results for Hatchback Vehicle

The standard deviation of temperature value for the first tire is 2.08, for the second tire is 3.18, for the third tire is 1.93, and for the fourth tire is 3.87. The best standard deviation value is 1.93. This indicates that third tire relatively low variability in temperature value.

3.2. Testing Results for Multi-Purpose Vehicle

In another test, we conducted the experiment using a multi-purpose vehicle. According to the results, the system effectively records and presents real-time changes in pressure and temperature values.

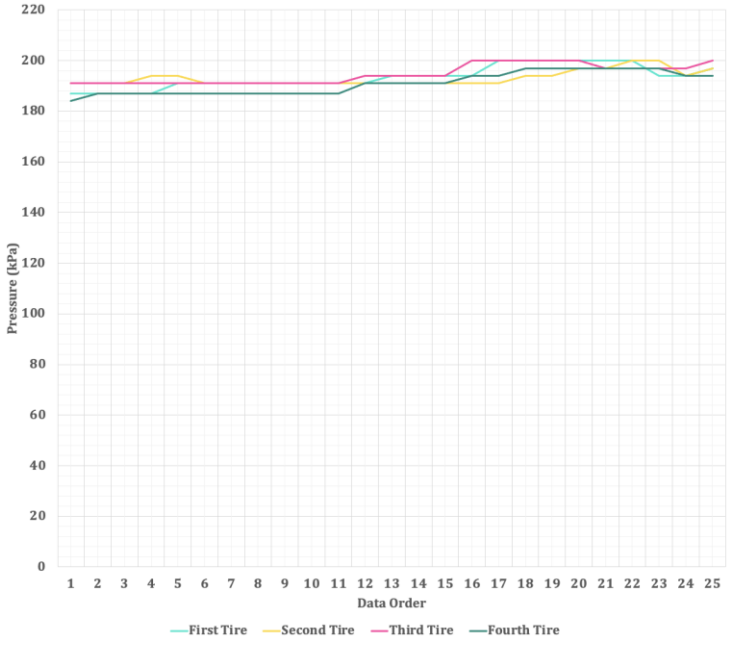

Figure 9. Tire Pressure Results for Multi-Purpose Vehicle

Figure 9 depicts the monitoring outcomes of tire pressure measured in kPa. The results reveal that pressure values in all tires quite fluctuations, likely attributable to varying road conditions, with measurements taken while the vehicle was in motion. The average pressure values for each tire were determined as follows: 193.5 kPa for the first tire, 193 kPa for the second tire, 194.6 kPa for the third tire, and 191 kPa for the fourth tire. Moreover, standard deviation values were computed for each tire's pressure data, resulting in 4.5 for the first tire, 2.97 for the second tire, 3.78 for the third tire, and 4.38 for the fourth tire. Among these, the most favorable standard deviation value is 2.97.

Furthermore, tire temperature monitoring tests were conducted. The results of these tests are depicted in Figure 10, with tire temperature data presented in degrees Celsius (°C). The findings indicate fluctuations in tire temperature. Interestingly, the temperature is relatively consistent across all tires. This uniformity can be attributed to the vehicle under test utilizing a rear-wheel drive system, resulting in similar temperatures between the front and rear tires. Additionally, we computed the mean and standard deviation of tire temperatures. According to the test results, the average tire temperatures were as follows: 29.8°C for the first tire, 27.9°C for the second tire, 28.6°C for the third tire, and 31.8°C for the fourth tire. The standard deviation values were determined as 1.05 for the first tire, 0.76 for the second tire, 1.19 for the third tire, and 1.05 for the fourth tire. Among these, the most favorable standard deviation value is 1.05. This indicates that third tire relatively low variability in temperature value.

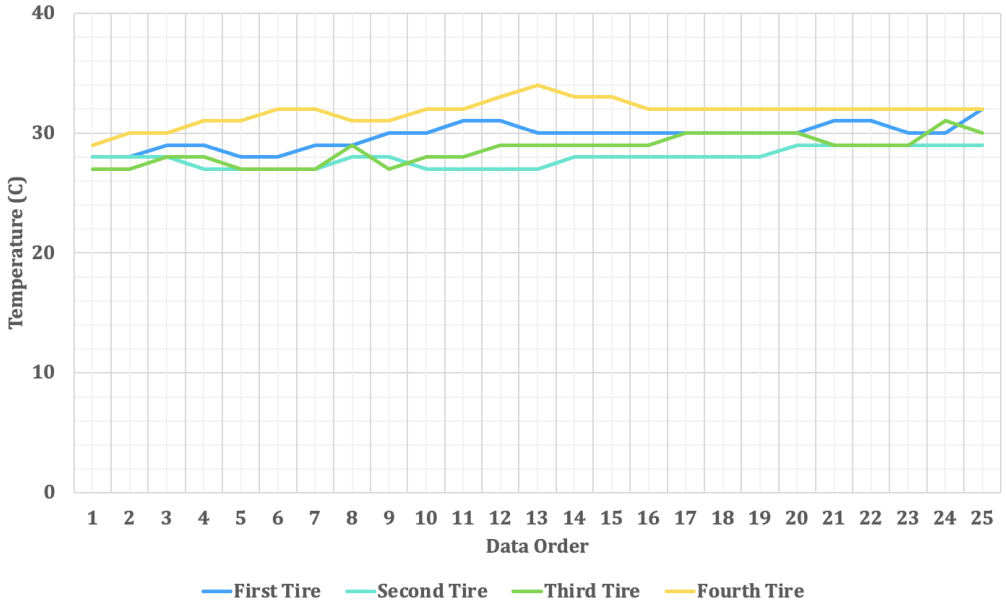

Figure 10. Tire Temperature Results for Multi-Purpose Vehicle

Based on the results, the system can monitor a vehicle's tire pressure and temperature data in real-time. This data is accessible remotely, allowing users to check it from a computer. Additionally, the information can be monitored via a smartphone. This ensures that users can keep track of their vehicle's condition from anywhere.

4. Conclusion

Vehicle accidents resulting from burst tires are common occurrences. Often, these accidents happen because drivers continue to operate their vehicles despite tire pressure and temperature exceeding safe thresholds. To address this issue, this paper presents a solution in the form of a vehicle tire pressure and temperature monitoring system, leveraging Internet of Things (IoT) technology. This system displays tire pressure and temperature information on various platforms, including LCD screen, computer, smartphone. It efficiently monitors variations in tire pressure and temperature through real-time tracking. The tests were conducted on both hatchback and MPV cars. The best standard deviation for

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tire pressure levels in hatchback cars is 2.24, while it is 2.97 for MPV cars, according to the results. The best standard deviation for tire temperature values in hatchback car is 1.93, while for MPV car, it is 1.05. This indicates relatively low variability in tire pressure and temperature. This system plays a vital role in enhancing vehicle safety and mitigating accidents stemming from tire conditions. In future studies, researchers aim to develop a system for monitoring tire pressure and temperature and tracking position of vehicle.

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Static Analysis of Single Shaft Hub Wheel Cover to Determine The Strength Level of The Cover

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ABSTRACT

The cover on the wheel hub serves to protect the most important components and support the weight coming from the body, so it must be designed as well as possible to support the existing weight. The cover on the wheel hub also functions as a balance when driving so that the cover is made with strong material and is not easy to corrode because the part is often subjected to mechanical pressures. The problems that occur in the Nusantara Energy Manufacturing company (MEN) make researchers want to develop a cover design on a single shaft wheel hub to increase the strength of the cover in receiving pressure from vehicles, drivers, and passengers. In this research, a simulation study is carried out to design the cover and perform static simulations to determine the value of deformation and stress that occurs in the single shaft wheel hub cover. The material used in the cover design is Aluminum Alloy 6061 with a load value of 2177 N and 2912 N. The maximum deformation value on the MEN cover is 0.272 mm, a strain value of 0.007, and a stress value of 730.805 N/m2 with a load of 2177 N. At 2912 N loading, the maximum deformation value is 0.111 mm, a strain value of 0.003, and a stress of 307.538 N/m2. It can be concluded that the MEN cover has a higher static value than the YMMotorcover. There are several factors such as the thickness of the cover on the parts used as supportpoints.

1. Introduction

There are various types of electric vehicle transportation. One of them is a molis. Molis stands for electric motorcycle. Molis is in great demand from the wider community, especially for people who live in cities. Motors from electric vehicles are abbreviated as BLDC or Brushless DC. This motor has 2 types, namely Mid-Drive and Wheel Hub, where the Wheel Hub is located on the rear wheel and integrates with the wheel, while the Mid-Drive is in the middle of the frame and requires a transmission when moving the rear wheels. Mid-Drive has disadvantages including its high price, requires a transmission to drive the rear wheel and difficult disassembly if at any time there is damage to the motor [1].

Wheel Hub has several advantages including, a much cheaper price, and does not require a transmission when moving the motor. The wheel hub has a hollow shaft which functions as a support for the motor so that it can rotate smoothly [2]. This hollow shaft is locked on both swim arm arms. The hollow shaft on the wheel hub has two types, namely single shaft, and double-sided shaft. In addition to the number of shafts, the difference between the two-wheel hubs lies in the design of the wheel hub cover [1].

Many things must be considered when designing a single-shaft wheel hub, namely durability, safety, cost, and others [3]. Not only that, one of the most important components of the single-shaft wheel hub besides the shaft is the cover. Where this component functions as a protector as well as a weight support that comes from the motorcycle body and the weight of passengers [4]. So that these components must be designed as well as possible so that they can support the existing loads.

One of the workshops that serves electric vehicle conversions is CV Manufaktur Energi Nusantara. The company, located in Surabaya, is researching and developing an electric scooter, a type of vespa

sprint 150 matic. The vespa sprint vehicle weighs 147 kg [5]. The vehicle requires a transmission to drive the rear wheel has a tire with a size 12 ring and is locked on the rear drum. The drum functions as a support for the weight of the vehicle and the weight of the passengers. A double shaft wheel hub can be installed on the Vespa Sprint. However, this requires redesigning the transmission of the vespa. The impact of redesigning the transmission is that it costs a lot of money.

The problems that occur in the company make researchers want to do the design of the single shaft wheel hub cover. This research aims to increase the strength of the cover in receiving pressure from vehicle loads, riders, and passengers [6]. So far, one of the efforts that can be made to increase the strength in accepting the compressive force of a product design is through static simulation. As carried out by Muhammad Fayrus in simulating a single sided hollow shaft for E-Scooter volta wheel hub products with type 302 [1]. Considering the importance of strength analysis on the wheel-hub cover to ensure the wheel-hub cover can withstand the load, it is necessary to carry out a static analysis test. In previous research, static analysis tests had never been carried out on a CV MEN, so to guarantee the strength of the material it is necessary to carry out a comparative test between YMMotor and CV MEN as a comparison of material strength values where YMMotor has already been involved in the electric scooter vehicle business. Based on these problems, this research aims to analyze the strength of CV MEN's cover wheel hub and compare it with YMMotor as a benchmark product that already exists.

1.1. Related Companies

This research was conducted at one of the electric vehicle conversion workshops in Surabaya, namely CV Manufaktur Energi Nusantara. The company was founded by Telkom University Surabaya lecturers and established in 2020. The MEN company helps the government to overcome the fossil energy crisis. One of the efforts is to provide electric vehicle parts with local dynamo (Electric Motor) products. Currently the company is conducting research on a single shaft wheel hub cover where the cover will be subjected to a static analysis process in this study.

1.2. Electric Vehicles

Electric vehicles are vehicles whose main power source is an electric motor, where the motor is given a voltage by the battery [6]. Electric vehicles have several important components, namely: 1) Battery, 2) Controller, 3) Motor, 4) Vespa Matic transmission, 5) Cover Wheel Hub.

1.3. Things to Consider when Designing the Cover

The position of the wheel hub cover is located below and is prone to friction and water exposure. In terms of material selection, several factors must be considered, for example, materials that are lightweight, strong, and have high corrosion resistance. In general, wheel hubs are made of aluminum 6061 alloy. Because the material is lightweight and resistant to corrosion [7] Al6061 material has AlO (OH) and Al (OH) 3 content and there are other elements such as calcium, potassium, magnesium, sodium, iron, and oxygen and the material includes light metals [8]. This research uses Aluminum Alloy 6061 materials because the material is commonly used in automotive or other construction equipment and the material has heat resistance properties, as well as good weldability [7].

1.4. Stress Concept and Strain

Stress is the ratio between the tensile force acting on the surface area of the object. Basically, the concept of stress can be defined as the amount of force acting on a unit area and is formulated as follows: Stress formula:

$$Stress(\sigma) = \frac{F}{A} \quad (1)$$

where σ= stress (N/m^2); F= force (N) and A= surface area (m^2). The concept of stress and strain can be illustrated with 2 square beams, which can be seen as a beam loaded with a force (F) at the ends as shown in Figure 1.

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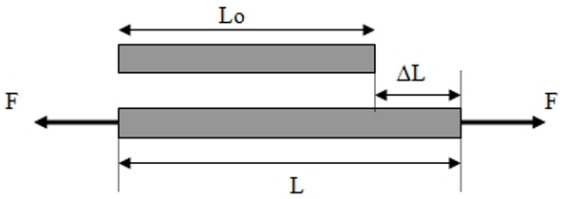

Figure 1. Beams Before and After Being Stretched

The beam is loaded with an axial force and experiences a change in length, this is called strain. Since stress acts in the direction perpendicular to the plane surface, it is called normal stress [9]. Strain is expressed as the increase in length per unit length of stress at a point calculated after the strain is measured. Systematically the strain can be formulated as follows:

Strain formula:

$$\varepsilon = \frac{\Delta L}{L} \tag{2}$$

where ε = Strain; ΔL = total length gain (mm) and L = starting length (mm). The relationship of stress and strain can be formulated as follows:

Elastic modulus formula:

$$E = \frac{\sigma}{\varepsilon} \tag{3}$$

where E = elastic modulus; σ = stress and ε = strain.

2. Methods

There are 2 proposed designs of the single shaft wheel hub cover concept. In this study the design to be compared is the cover design from YMMotor, because the YMMotor cover already has a finished product and is an example of a design in making the MEN cover design. The second cover uses the MEN company cover, because CV Manufaktur Energi Nusantara is researching and developing a single shaft wheel hub cover with a diameter reference equalized with the comparison cover, the method used during the design process of the cover is carried out by interview method when conducting research and design designer.

In general, the material used in making the cover is made of aluminum alloy 6061 because the material is lightweight and has high resistance to corrosion [8]. The datasheet of aluminum alloy 6061 can be seen in Table 1 below.

Table 1. Properties Aluminum Alloy 6061

Material	***Density***	***Yield Strength***	***Ultimate Tensile Strength***	***Elastic Modulus***	***Poisson's Ratio***
Aluminum *Alloy* 6061	2700	275 Mpa	124 Mpa	69.0 Gpa	0.33

The process of designing a 3D design, the software is used to design the proposed design and conduct static simulations carried out on the single shaft wheel hub cover [10]. In this study, a static loading test was carried out. Static loading is to test the cover design when given a static force continuously and does not involve dynamic loads because based on the formulation of the problem this research focuses on the results of the strength of the cover design when given a force and the type of force acting on the proposed cover there is only a static force because there is no distance between the force acting on the center point so that the moment value is zero [11]. At the stage of the simulation process, a FEM (Finite element method) or finite element method is analyzed, which is suitable for calculating forces in internal forces [12].

Finite Element Method is a numerical method used to obtain solutions to differential problems or integral equations [13]. Because these equations are often used as models in engineering problems. In

engineering practice and academic research, the physical system observed is very complicated because it involves a continuum with geometry shapes, loading, and support conditions. Therefore, numerical solution methods are needed to obtain solutions to these problems [14].

The test was carried out twice with the first test weighing the driver and vehicle, the second test with the weight of the driver, passenger, and vehicle. The test used an MSI laptop with Intel Core i7 gen 10 specifications with a NVIDIA GeForce GTX 1660 Ti graphics card and 8 RAM.

After conducting static simulation testing, the next step is to collect simulation data. The data include deformation, strain, and stress [15]. After collecting the required data, at this stage an analysis will be carried out on the results of the cover design, the data collected will be analyzed to answer the objectives of the problem formulation above and conclusions will be drawn from the design results on both covers [16].

3. Results and Discussions

3.1. 3D Design Draft of YMMotor Cover

The results of 3D design on the YMMotor single shaft wheel hub cover model. In Figure 2 can be seen the results of 3D design YMMotor, where the cover has a diameter of 225 mm with a cover thickness of 31 mm. The YMMotor cover has 4 bolt holes with a diameter of 12 mm located in the middle of the cover, where the bolts function as a holder on the wheels that have 4 holes. In the center of the cover is a bearing with a diameter of 61.75 mm with a height of 15 mm up, the bearing is also found on the inside cover with a height of about 16.75. There is also at the end of the cover a bolt hole that serves to lock the cover on the rotor with a diameter of 4 mm. The back of the cover in place of the bolt is a little thick because the area functions as a bolt holder when mounted on alloy wheels, the thickness is around 10 mm. Next, the results of the YMM cover rendering will be shown in Figure 2.

3.2. 3D Design Draft of MEN Cover

The 3D design of the MEN cover can be seen in Figure 2. The cover has an outer diameter of 225 mm. The cover has 5 bolt holes in the middle of the cover with a diameter of 8 mm which serves as a holder on the wheels, in the center of the front cover there is a circle with an inner diameter of 38.5 mm with a depth of 9 mm to the end of the center of the cover it serves to place the shaft. At the end of the cover has 8 bolt holes with a diameter of 6.5 mm as a lock on the rotor. Towards the rear view of the cover there is a bearing holder with an outer diameter of 68 mm and an inner diameter of 52 mm where it has a height of 14 mm. The bearing holder functions as a bearing housing which will later become a shaft holder during assembly can be seen in Figure 3 rendering of the MEN cover.

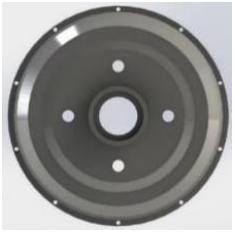

Figure 2. YMMotor Front View Rendering

Figure 3. MEN Front View Rendering

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3.3. Determination of Loading Points on Single Shaft Cover

Determination of the loading point on each cover serves to select the part of the cover surface that is subject to load when the simulation will be carried out [17]. The loading point on the cover is selected at a place that is used as a holder when given a load. In the simulation test of the two covers, the selected loading is a torque/rotation load. Because the cover experiences rotation when mounted on the wheel hub.

3.4. Determination of Limiting Conditions on the Cover

The condition limitation points or fix support given to the MEN and YMMotor covers is located at the bolt holder and bearing holder located in the center of the cover, where the bolt becomes the loading point because the place becomes a support for the wheels while the bearing holder functions to support the entire wheel hub. Can be seen in Figure 4 and Figure 5 the loading point given to the cover.

Figure 4. Load on MEN Cover

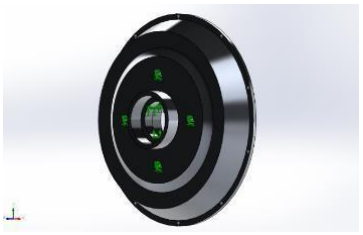

Figure 5. Load on YMMotor Cover

3.5. Static Simulation of Loading on Single Shaft Cover

After conducting static simulation tests on both covers, the next step is to select the results of deformation, stress, and strain. The selection of the deformation value is chosen with the smallest value because deformation has an impact on changing the shape of an object when given a force. The selection of strain is also selected with the smallest value because strain has an impact on the increase in length of an object when given a force. Yield strength on both covers has a value of 55,148, because both covers use 6061 aluminum alloy material. It was concluded that the YMM cover was chosen because it had the smallest value.

There are several factors that cause the YMMotor cover to have a thicker cover thickness than the MEN cover, as well as the bolt holder located in the middle of the YMMotor cover has a rather thick layer, this has an effect because the bolt holder point has a different cover thickness compared to the MEN cover, the thickness of the bearing holder which is thinner than the YMMotor cover is the cause of the MEN cover having a high static value. It can be seen the difference in the pictures below the YMMotor cover and the MEN cover in the deformation results with 2177 Newton loading. It can be seen the MEN cover in the left picture and the YMMotor cover in the right picture. In the front view, the surface of the MEN cover does not change significantly. However, the deformation results on the cover get a large value compared to the YMM cover. On the YMM cover there is a change in the circle line in the center. The YMM cover changes shape when given a force but has a small deformation value. It can also be seen from the side view deformation results, where both covers have changes in the cover surface area, both covers experience changes towards the bottom. This is because the anchoring point on the cover is selected at the bolt holder and bearing housing and is given a torque force.

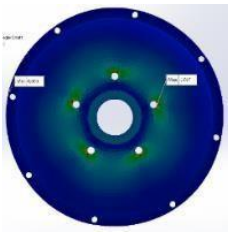

Figure 6. Strain Results Front View of MEN Cover

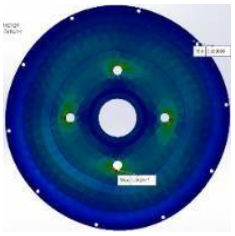

Figure 7. YMMotor Cover Deformation Result

Figure 6 and Figure 7 explain the comparison of strains that occur on both covers from the front view. In the figure, the YMM cover experienced changes in the cover surface area caused by the influence of strains that occurred in the bolt place. The front view of the MEN cover does not appear to have a significant change, but the cover also experiences strains in the same section as the YMM cover.

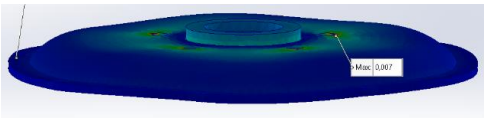

Figure 8. Strain Results Side View of MEN Cover

Figure 9. Strain Results Side View of YMMotor Cover

Figure 8 and Figure 9 show the results of strains that occur on both covers in the side view. The MEN cover shows that the surface of the cover affected by the strain has changed towards the bottom and the locking bolt has changed shape. On the YMM cover, changes occur in the locking part of the bolt, the cover does not experience changes in the upper area, because that part of the cover has a thickness contained in the bolt holder.

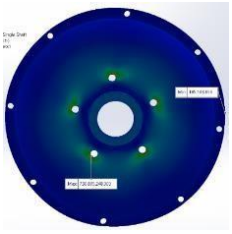

Figure 10. Front View Stress Result on MEN Cover

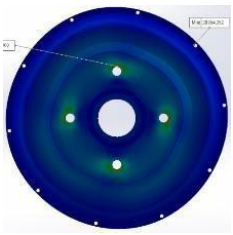

Figure 11. Front View Stress Result on YMMotor Cover

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Furthermore, Figure 10 and Figure 11 can be seen the results of stress in the front view. The MEN cover shape has stress in the place of the retaining bolts. However, the stress that occurs on the cover does not show changes in the cover surface area when viewed from the front view. In the right picture, the YMM cover experiences changes in surface conditions at certain angles. The surface of the cover transforms from a circle to a square.

Figure 12. Stress Results Side View of MEN Cover

Figure 13. Stress Result of YMMotor Cover Side View

Furthermore, in Figure 12 and figure 13 can be seen the side view of the MEN cover. The cover changes in the area around the bearing place. These changes are caused by the stress that occurs in the area. The YMM cover experienced significant changes at the bottom of the cover. Where at the bottom there is a change.

3.6. Stress and Strain on the Proposed Cover

At this stage, the stresses and strains that occur in the proposed cover will be explained. As explained above. The loading point given to the cover is located at the bolt place on the wheel holder and the bearing place in the center of the cover. This test uses torque with a clockwise rotation direction, and it can be seen in Figure 14.

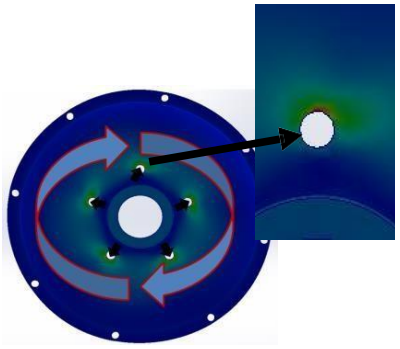

Figure 14. Stress Result on Proposed Cover

In Figure 14 the blue arrow indicates that the load is applied in a clockwise direction. The result of stress on the cover is shown in the black arrow. Where the stress moves from the place of the wheel holder bolt to the surface of the cover until it finally disappears. The strain results on the proposed cover can be seen in the figure below.

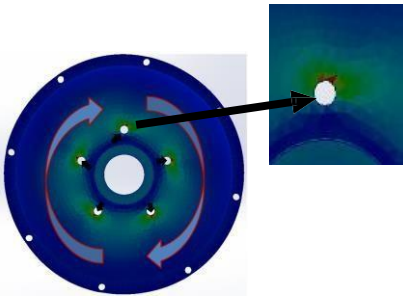

Figure 15. Strain Results on the Proposed Cover

In Figure 15 can be seen the test results of the strain. The loading and force applied to the cover are the same as the previous test. It can be seen the results of strains that occur on the proposed cover. At the place of the bolt for the alloy wheel there is a strain that occurs which is marked in green and there is a slight red color, which indicates that the maximum strain occurs in that area. Strain on the proposed cover moves in the area around the bolt place because the section was chosen to be the loading point during the simulation test. The strain value moves from where the bolt moves to the outside of the area on the surface of the outer cover and the green color transforms into blue. This indicates that in the blue area no strain occurs.

3.7. Result Implications

Based on the simulation results on the cover, related companies can use the YMMotor cover design as a reference for making the next cover. The thickness of the cover as well as the points prone to deformation, strain, and stress can be equalized with the comparison cover [18]. Related companies can make the design in the middle of the cover thicker because in that area there is a support point that functions to support the wheel hub, and the design of the bolt holes is designed with the same thickness as the YMMotor cover to reduce the occurrence of strains at that point.

The MEN cover in the long term is not recommended because, from the simulation test results, the deformation, strain, and stress values have a large value compared to the YMMotor cover. The thickness of the bolt holder and the thickness of the cover is one of the factors causing the simulation value to be high and it is also necessary to conduct experimental studies to validate the results of the simulation [19].

4. Conclusion

The conclusions obtained from the static analysis of the proposed design on the MEN cover are that the cover was carried out two tests with the first test of the weight of the driver and vehicle with a load value of 2177 N. The results obtained were the maximum deformation value of 0.272 mm, strain value of 0.007, stress value of 730.805 N/m². The second test with the weight of the rider, passenger, and vehicle with a load value of 2912 N. The maximum deformation value of 0.111 mm, strain value of 0.003, stress value of 307.538 N/m² was obtained. Comparisons made on the two covers can be concluded if the proposed design on the MEN cover has higher deformation, strain, and stress values than the YMMotor cover [20]. There are several factors for the occurrence of the simulation test value, namely thickness, cover radius, and bolt diameter on a cover that is less thick.

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The Impact of Enterprise Systems on User Performance using the IGRACIAS V.1 Application at Telkom University Jakarta

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ABSTRACT

Telkom University Jakarta is a new educational institution, previously known as Institut Teknologi Telkom Jakarta. Telkom University Jakarta Campus obtained a legacy system called IGRACIAS V.1 as an education management software. The IGRACIAS V.1 application raised the question of whether legacy applications in new institutions can accelerate the flow of education management in pursuing competitors. This research provided a deeper exploration of the influence of legacy enterprise system applications implemented in new institutions. The impact of legacy applications requires accurate measurement to serve as a reference for further development. The IT Balanced scorecard was chosen to measure whether the implementation of the legacy IGRACIAS V.1 application has had an impact and development direction that is in line with the goals of the new institution. The results show that two domains based on the IT Balanced scorecard need improvement, namely User Orientation and Future Orientation.

1. Introduction

In this modern era, technology is increasingly used in various fields of work to facilitate workflow. Technology development also must be connected to the attention of the world of education as it supports the needs of teachers and students in universities or similar institutions. Universities are required to keep up with developments and adapt to the existence of technology [1], [2]. Previous studies have discussed the difficulties faced when developing an Enterprise System (ES) in education are still experiencing ups and downs. Problems arise from various perspectives and variants of cases in various universities [2], [3].

The implementation of ES cannot be separated from the support of Information and Communication Technology (ICT) [3], [4]. Technology encourages more significant investment in development and implementation in education because technology is developing rapidly [5], [6]. Technology often needs to work better primarily due to the level of expertise possessed by ICT managers [7].

Telkom University Jakarta (TUJ) is a new player in the education world in Jakarta. TUJ was formerly established under Institut Teknologi Telkom Jakarta (ITTJ). TUJ has a parent foundation and primary campus in Bandung, known as Telkom University (Tel-U) [8], [9]. Telkom University developed an educational application called IGRACIAS V.1, released in 2013, to assist in the academic management business process. Thus, ITTJ adopted the IGRACIAS V.1 application as a legacy system from Tel-U.

Therefore, this research aims to explore more deeply the influence of legacy enterprise system applications implemented in new institutions, the impact of education management applications, and the future landscape of application development through an IT Balanced Scorecard [10].

2. Methods

The research methodology is depicted in Figure 1. The research began with an analysis of Telkom University Jakarta's IGRACIAS V.1 application and conducted a literature study on the IT Balanced scorecard framework [10]–[13]. Then, from these results, the author categorized the assessment results, prepared a questionnaire, and distributed it to the users of iGracias, such as lecturers and other related units. All respondents are regular users of the IGRACIAS V.1 application.

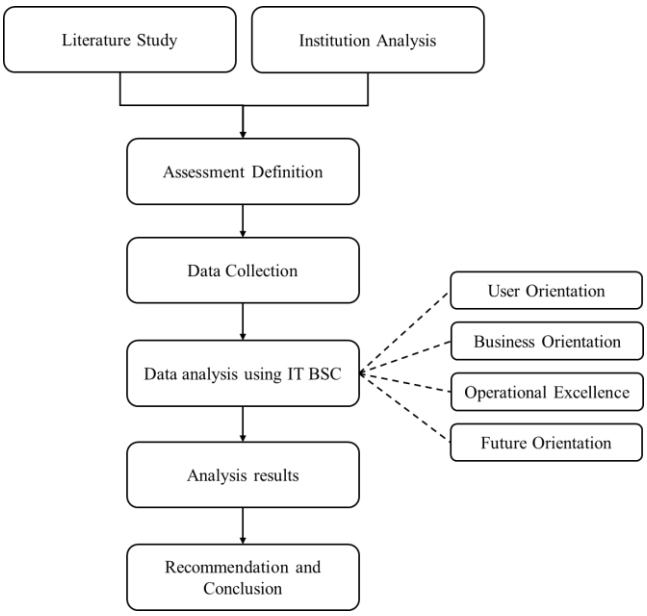

Figure 1. Research Methodology

2.1. Institution Analysis

This research begins by analyzing the IGRACIAS V.1 application. The analysis is obtained from interviews with the Head of the Information Technology Center. From the interview results, the authors mapped the indicator values for assessment and determined the idea of the problem. Furthermore, the authors define the assessment based on the IT Balanced scorecard literature study conducted by Van Grembergen and Van Bruggen.

2.2. Literature Study and Assessment Definition

Balanced Scorecard consists of two words: scorecard and balanced. The word balanced is defined as a performance that can be measured in a balanced manner by looking at both sides: financial and non-financial. The meaning of the word scorecard is a card that can be used as a record of performance results by looking at current conditions and future conditions [11]. The Balanced Scorecard framework is shown in Figure 2.

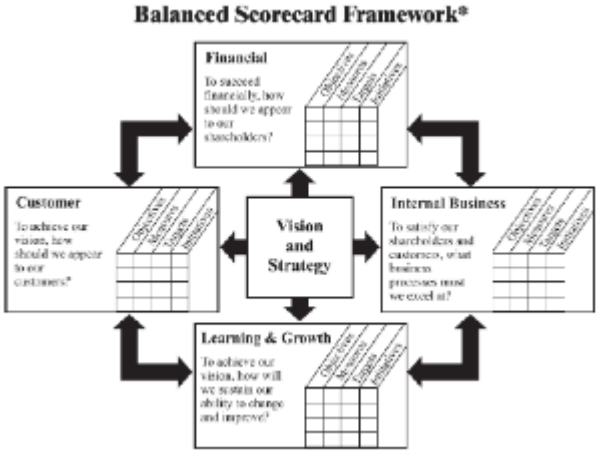

Figure 2. Balanced Scorecard Framework

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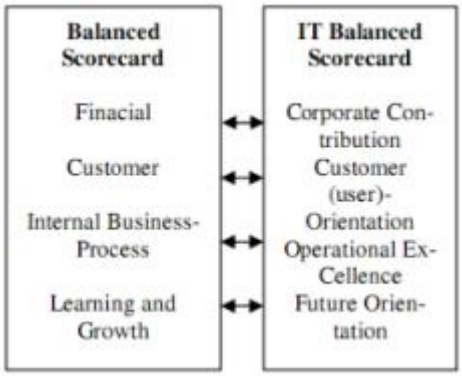

Figure 3. IT BSC Transformation

Research by Grembergen [12] adapted the Balanced Scorecard from Kaplan & Norton model) to be applied in the context of information technology. BSC is broadly utilized to measure businesses' and public service organizations' financial and non-financial performance, including Higher Education Institutions[13], [14]. In the IT BSC, the perspective is that an organization's IT department is an internal service provider. Thus, the four perspectives are adjusted to the changes that occurred. The four perspectives that are adjusted in the IT Balance Score Card (IT BSC) are as follows: (1) Business Orientation (Corporate Contribution), (2) User Orientation, (3) Operational Excellence, and (4) Future Orientation[12]. The indicators are listed in Table 1.

The IT Balanced Scorecard is described in Figure 3 above, according to Van Grembergen and Van Bruggen. The business orientation perspective shows how changes in business value are created from the application of IT systems and investments. The user-oriented perspective represents the user's assessment of the use of IT systems. The operational orientation perspective represents the work of IT processes to create and distribute the applications [15]. The future orientation perspective represents the need by the organization to be compatible with technology and IT systems to help complete work and meet needs in the future.

Table 1. Assessment based on IT BSC Perspectives

User Orientation	**Business Orientation**
How is the user experience of the IT system implementation? **Objectives:** Users feel the benefits and convenience of using the application. **Indicators:** - Users find it easy to use the IT system. - Instructions and assistance in using the application are easily obtained by users. - Users feel faster in completing work.	How significant are the investment opportunities and business changes from the implementation of the application? **Objectives:** Gain a baseline of business contribution from IT system investments. **Indicators:** - Knowing the level of efficiency gained by implementing IT systems. - Provide features that are compatible with the business processes of the organization or company.
Operational Excellence	**Future Orientation**
How effective and efficient the IT system is in helping users get the job done. **Objectives:** Users can use the features in the app to help get the jobs done. **Indicators:** - IT systems are in line with the needs of organizational and company business processes. - Users get education and assistance to make it easier for users to adapt to IT systems.	How IT system development can accommodate future needs. **Objectives:** Development of application features according to the needs and benefits of training to users. **Indicators:** - Application feature development can be as needed and completed according to the timeline. - Training assists users in using the latest features or modules.

In order to determine the assessment of the effectiveness of using the IGRACIAS V.1 application, the analysis results from Telkom University Jakarta are compared with studies of similar research [4], [15], [16]. The results were then compared with the IT Balanced scorecard theory by Van Grembergen and Van Bruggen. The results were then compared with the IT Balanced scorecard theory by Van Grembergen and Van Bruggen. The comparison results assessed the four perspectives, namely Business Contribution, User Orientation, Operational Excellence, and Future Orientation, and the indicators listed in Table 1.

2.3. Data Collection

After the indicators were determined, the author converted the values into a 17-question questionnaire. The questionnaire was then distributed to 23 active lecturers at Institut Teknologi Telkom Jakarta. In addition, the results of interviews conducted with the Head of the IT Department became one of the assessments to determine the value of the Business Contribution perspective.he indicators were determined, the author converted the values into a questionnaire consisting of 17 questions. The questionnaire was then distributed to a group of 23 active lecturers at Institut Teknologi Telkom Jakarta. In addition, the results of interviews conducted with the Head of IT Department became one of the assessments to determine the value of the Business Contribution perspective.

2.4. Population

The questionnaire was addressed to 23 active lecturers at Telkom University Jakarta Campus, and the sample obtained for this assessment amounted to 20 people.

2.5. Likert Scale Rating

The Likert scale is a sequential scale where respondents choose one option that best matches their judgment [17]. The author used a 5-point Likert scale classified as "Strongly Agree" on a scale of 5, "Agree," "Neutral," "Disagree," and "Strongly Disagree" on a scale of 1. The Likert scale is specified in Table 2.

Table 2. The 5-Point Likert Scale

Scale	Score
Strongly Agree	5
Agree	4
Neutral	3
Disagree	2
Strongly Disagree	1

2.6. Data analysis using IT BSC

The distributed questionnaires are then processed based on the literature that has been studied previously. Approximately 87% of the total sample of 100% of respondents was obtained. Each questionnaire was tested for validity using the Pearson method [18] and its reliability using Cronbach's Alpha [19], [20]. Then, the results are mapped into the IT BSC assessment domain, as shown in Table 3.

Table 3. Assessment based on IT BSC perspective

Perspective	Objective	Assessment
Business Orientation	- Business Value of IGRACIAS V.1 functions. - Alignment of IGRACIAS V.1 with the organization's strategy.	- The suitability of the IGRACIAS V.1 application in meeting the needs of the learning management system. - The suitability of the IGRACIAS V.1 application functions with the ITTJ strategy and the new opportunities offered to support the development of the latest learning strategies.

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Perspective	Objective	Assessment
User Orientation	- User Satisfaction - User interaction with the IT unit. - User Education	- User convenience in using and accessing IGRACIAS V.1. - Availability of education to make it easier for users to adapt to the IGRACIAS V.1 application. - Availability of support from the IT unit.
Operational Excellence	- IT system is in line with the needs of the business process.	- Alignment of IGRACIAS V.1 application functions with the needs of users.
Future Orientation	- Development of the latest features and requirements.	- Availability of updates in the IGRACIAS V.1 application. - User involvement in updating IGRACIAS V.1 functions.

3. Results and Discussions

In this research, the interview process is used to find problems. The interview was conducted with the Head of the IT Division at Telkom University Jakarta (TUJ). Data collection is carried out using quantitative methods, namely questionnaires. The questionnaire distribution received 20 respondents from 23 lecturers at TUJ, or 87% of the population. Each lecturer gets 17 questions covering four IT Balanced scorecard method domains. The results of the assessment by respondents are described in Table 4.

Table 4. Respondent Questionnaire Data

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17
Respondent 1	5	5	5	5	3	5	5	4	2	5	2	4	4	5	4	5	5
Respondent 2	5	4	4	5	5	5	5	5	3	4	2	3	4	2	4	4	1
Respondent 3	3	3	4	5	4	4	4	4	4	3	4	4	4	4	3	4	4
Respondent 4	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3	2	3
Respondent 5	3	3	4	4	4	4	4	3	3	4	4	3	4	4	4	4	4
Respondent 6	3	3	3	4	4	4	4	4	3	4	4	4	3	4	3	4	4
Respondent 7	4	5	3	5	4	4	4	4	4	5	5	4	5	5	4	4	3
Respondent 8	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2	4	2
Respondent 9	4	4	2	3	3	3	4	4	2	3	3	4	2	4	3	4	2
Respondent 10	4	5	4	5	5	5	4	4	4	5	5	5	4	5	5	5	4
Respondent 11	4	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4
Respondent 12	4	3	3	4	4	3	3	3	3	4	3	4	3	4	3	4	3
Respondent 13	5	3	3	3	3	3	3	3	3	3	3	4	3	3	3	4	3
Respondent 14	4	4	4	4	4	4	4	4	4	4	4	4	3	4	3	3	3
Respondent 15	4	3	3	4	4	3	4	4	4	3	4	3	3	3	3	4	4
Respondent 16	4	5	3	5	4	4	4	4	2	2	2	5	3	2	4	4	2
Respondent 17	4	3	4	5	4	4	4	4	2	3	2	4	5	2	4	4	3
Respondent 18	4	5	4	5	4	4	5	4	4	4	3	4	4	4	5	5	4
Respondent 19	5	4	4	4	4	5	5	4	3	4	4	4	4	4	5	5	4
Respondent 20	4	4	3	4	3	4	4	3	3	4	2	5	3	2	4	3	2

The questionnaire is then processed to test the validity of each indicator. The validity test was performed using the Pearson Product Moment method and the SPSS application, and the results obtained are listed in Table 6. The validity test calculation begins by determining the Degree of freedom (Df) value with the formula Df = N-2, where N is the number of respondents. The result is 18. According to the r table in Table 5, which uses a significant level of 5%, the N = 18 uses a value of 0.468.

Table 5. The r table Pearson

N	The Level of Significance		N	The Level of Significance	
	5%	1%		5%	1%
3	0.997	0.999	38	0.320	0.413
4	0.950	0.990	39	0.316	0.408
5	0.878	0.959	40	0.312	0.403
6	0.811	0.917	41	0.308	0.398
7	0.754	0.874	42	0.304	0.393
8	0.707	0.834	43	0.301	0.389
9	0.666	0.798	44	0.297	0.384
10	0.632	0.765	45	0.294	0.380
11	0.602	0.735	46	0.291	0.376
12	0.576	0.708	47	0.288	0.372
13	0.553	0.684	48	0.284	0.368
14	0.532	0.661	49	0.281	0.364
15	0.514	0.641	50	0.279	0.361
16	0.497	0.623	55	0.266	0.345
17	0.482	0.606	60	0.254	0.330
18	0.468	0.590	65	0.244	0.317
19	0.456	0.575	70	0.235	0.306
20	0.444	0.561	75	0.227	0.296

Table 6. Initial Data Pearson Correlation Value

Item	Item																	Total Score
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
1	1.00	0.40	0.24	0.11	0.00	0.36	0.40	0.31	-0.21	0.21	-0.33	0.13	0.20	0.00	0.30	0.45*	-0.16	0.29
2	0.40	1.00	0.25	0.52*	0.17	0.55*	0.55*	0.42	0.05	0.43	0.00	0.52*	0.27	0.35	0.55*	0.45*	-0.03	0.63**
3	0.24	0.25	1.00	0.56**	0.35	0.73**	0.56**	0.32	0.18	0.46*	0.01	-0.06	0.60**	0.29	0.36	0.42	0.44	0.67**
4	0.11	0.52*	0.56**	1.00	0.59**	0.67**	0.58**	0.56**	0.10	0.30	-0.06	0.27	0.76**	0.16	0.52*	0.51*	0.15	0.70**
5	0.00	0.17	0.35	0.59**	1.00	0.50*	0.32	0.58**	0.42	0.26	0.37	-0.02	0.49*	0.14	0.33	0.37	-0.04	0.56*
6	0.36	0.55*	0.73**	0.67**	0.50*	1.00	0.77**	0.56*	0.02	0.56*	0.03	0.25	0.60**	0.26	0.63**	0.53*	0.17	0.79**
7	0.40	0.55*	0.56**	0.58**	0.32	0.77**	1.00	0.70**	-0.02	0.36	-0.12	0.01	0.47*	0.20	0.57**	0.60**	0.16	0.67**
8	0.31	0.42	0.32	0.56**	0.58**	0.56*	0.70**	1.00	0.11	0.13	0.04	-0.03	0.37	0.12	0.20	0.42	-0.12	0.51*
9	-0.21	0.05	0.18	0.10	0.42	0.02	-0.02	0.11	1.00	0.35	0.73**	-0.09	0.17	0.38	-0.05	0.00	0.22	0.38
10	0.21	0.43	0.46*	0.30	0.26	0.56*	0.36	0.13	0.35	1.00	0.39	0.08	0.44*	0.68**	0.35	0.37	0.33	0.71**
11	-0.33	0.00	0.01	-0.06	0.37	0.03	-0.12	0.04	0.73**	0.39	1.00	-0.06	0.16	0.67**	-0.04	0.15	0.40	0.41
12	0.13	0.52*	-0.06	0.27	-0.02	0.25	0.01	-0.03	-0.09	0.08	-0.06	1.00	0.05	0.13	0.28	0.24	-0.07	0.25
13	0.20	0.27	0.60**	0.75**	0.49*	0.60**	0.47*	0.37	0.17	0.44*	0.16	0.05	1.00	0.27	0.43	0.53*	0.19	0.70**
14	0.00	0.35	0.29	0.16	0.14	0.26	0.20	0.12	0.38	0.68**	0.67**	0.13	0.27	1.00	0.11	0.55*	0.59**	0.67**
15	0.30	0.55*	0.36	0.52*	0.33	0.63**	0.57**	0.20	-0.05	0.35	-0.04	0.28	0.43	0.11	1.00	0.54*	0.28	0.63**
16	0.45*	0.45*	0.42	0.51*	0.37	0.53*	0.60**	0.42	0.00	0.37	0.15	0.24	0.54*	0.55*	0.54*	1.00	0.43	0.76**
17	-0.16	-0.03	0.44	0.15	-0.04	0.17	0.16	-0.12	0.22	0.33	0.40	-0.07	0.19	0.59**	0.28	0.43	1.00	0.47*
Skor Total	0.29	0.63**	0.67**	0.70**	0.56**	0.79**	0.67**	0.51*	0.38	0.71**	0.41	0.25	0.70**	0.67**	0.63**	0.76**	0.47*	1.00

Sig. values for the items * Correlation is significant at 0.05 level (2-tailed) and ** Correlation is significant at the 0.01 level (2-tailed) with N = 20

A reliability test using Cronbach's Alpha takes statement data from the validity test, which amounts to 13 valid statements. Reliability calculations are carried out per domain in the IT Balanced scorecard, as many as four in Tables 7, 8, and 9.

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Table 7. Reliability Test Result

		N	%
Cases	**Valid**	20	100.0
	Excluded	0	0.0
	Total	20	100.0

Table 8. Reliability Statistic

Cronbach's Alpha	N of Items
.887	13

Table 9. Item Total Statistic

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected item-Total Correlation	Cronbach's Alpha if Item Deleted
2	45.10	36.621	0.538	0.881
3	45.40	36.568	0.667	0.875
4	44.70	36.011	0.704	0.873
5	45.10	38.832	0.465	0.884
6	45.00	35.579	0.797	0.869
7	44.90	37.042	0.702	0.875
8	45.15	39.187	0.476	0.884
10	45.20	36.168	0.612	0.877
13	45.45	35.418	0.658	0.875
14	45.40	35.411	0.485	0.888
15	45.30	36.116	0.594	0.878
16	44.95	35.743	0.728	0.872
17	45.75	37.355	0.343	0.895

The determination of validity or invalidity from the Pearson Correlation results is shown in Table 10. Indicators 1, 9, 11, and 12 were removed from the questionnaire data because they produced invalid information based on the Pearson Product Moment method, namely having a Rxy value < R-table and a Sig. value (2-tailed) > α.

Table 10. Indicators or Statement Validity Test Results

Statement	Rxy	Rtable (0.05)	Sig. (2-tailed)	α = 0.05	Validity
1	0.294	0.468	0.200	0.05	NV
2	0.63	0.468	0.003	0.05	V
3	0.671	0.468	0.001	0.05	V
4	0.699	0.468	0.000	0.05	V
5	0.559	0.468	0.010	0.05	V
6	0.788	0.468	0.000	0.05	V
7	0.673	0.468	0.010	0.05	V
8	0.511	0.468	0.210	0.05	V
9	0.380	0.468	0.990	0.05	NV
10	0.713	0.468	0.000	0.05	V
11	0.414	0.468	0.069	0.05	NV
12	0.251	0.468	0.286	0.05	NV
13	0.697	0.468	0.000	0.05	V
14	0.668	0.468	0.001	0.05	V
15	0.628	0.468	0.003	0.05	V
16	0.761	0.468	0.000	0.05	V
17	0.473	0.468	0.035	0.05	V

The explanation of Cronbach's Alpha process is divided into 3 parts as follows:

a. Case Processing Summary: All respondents filled out the questionnaire, which is 100%.
b. Reliability Statistics is the overall value of 13 indicators. The Cronbach's Alpha results show a value of 0.887, which indicates that this research questionnaire is reliable as the value is above the minimum threshold of 0.6.
c. Item-Total Statistics is table 9 containing the value of Cronbach's Alpha per indicator. If we compare the values in column 4, from item_2 to item_17, all of which have a value above 0.6, we can conclude that all indicators are reliable.

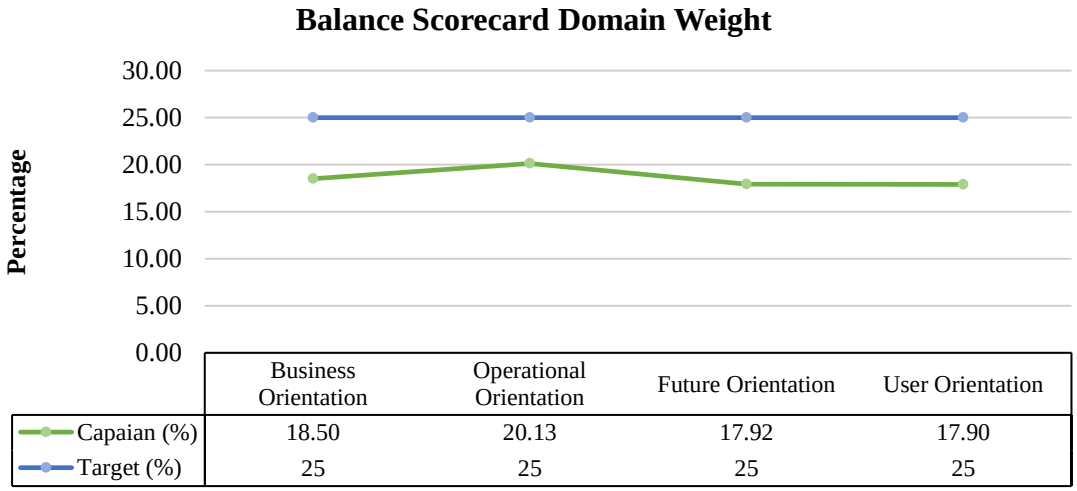

Figure 4. Balanced scorecard IT Domain Weight Chart

Based on Figure 4, each IT-Balanced scorecard domain has an influence of 25%. The results of the graph are translated into Table 10.

Table 11. Percentage Gap per Domain

	Outcomes (%)	Target (%)	Gap (%)
Business Orientation	18.50	25	6.50
Operational Orientation	20.13	25	4.88
Future Orientation	17.92	25	7.08
User Orientation	17.90	25	7.10

Referring to Table 11, it can be concluded that the biggest gap is in User Orientation by 7.1% followed by Future Orientation by 7.08%. Both of these can be the basis for developing applications so that users and the future of the application can be used more optimally.

4. Conclusion

Based on the results of the questionnaire calculation, respondents indicated that the assessment conducted using the four domains of the IT Balanced scorecard (Business Orientation, User Orientation, Operational Orientation, and Future Orientation) indicated that the development of the IGRACIAS V.1 application needs to be improved in the User Orientation and Future Orientation domains. This conclusion answers the researcher's question that the new institution is in line with premature application development even though the IGRACIAS V.1 application was previously developed first. This is because business factors and the vision of the institution can be different. The application of research methods using the IT Balanced scorecard is able to explore and assess the current condition of the institution, especially with a similar case, namely the IT department.

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UI/UX Design of Vendor Ordering Information System Using Design Thinking Method: Case Study CV. MOVED4

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ABSTRACT

Moved4 is an event organiser (EO) service that aims to help people across Jakarta organise events such as weddings, graduations, concerts, and seminars. They use marketing methods that are done manually, such as distributing brochures and broadcast messages. Moved4's target market is business owners aged 18-55 who need EO assistance to organise their events. The main focus in user interface (UI) and user experience (UX) design is user comfort. This is achieved through a design thinking approach consisting of four phases: empathise, define, ideate, prototype and test. MOVED4's UI/UX design received a SUS (System Convenience Scale) score of 79.25%, which indicates a high level of excellence. This indicates that users find it comfortable and easy to use the dashboard, which is crucial for successful technology adoption among target users.

1. Introduction

With the entry of the globalization era, information technology has become increasingly important to achieve information goals. Generating more useful and significant information is the goal. This goal is to help the process of making quick and precise decisions. The changes and dynamics that occur in a rapidly developing society, in line with the times and technological advances, make the application of information technology a must. The presence of technology has a central role in facilitating the lives of Indonesian people, with one example occurring in the tourism sector [1].

For example, people living in the Special Capital Region of Jakarta know that there are many entertainment events in the city, such as concerts, weddings, and student graduations[2]. However, CV MOVED4 still relies on a manual approach in its marketing efforts and dissemination of information regarding the Event Organiser packages offered to the people in the capital city. This approach involves the use of pamphlets and advertisements in print media. Consequently, there are limitations in marketing reach, so the activities offered by MOVED4 lack widespread knowledge among the public[3]. Users often have difficulty finding event venues that suit their needs and preferences, especially in areas they are new to. Information technology is essential to find an effective solution to the problem [4].

To improve people's access to information, the creation of a web application for booking and information about event venue locations is necessary. Users need a tool that helps them find venues that suit their preferences and needs, taking into account price, location, and reviews. Designing a UI/UX prototype of the venue finder application is expected to improve user experience. The Design Thinking method is used to produce a functional application design that takes into account the psychological and emotional aspects of the user, thus providing a satisfying and effective experience. This approach focuses on a deep understanding of user needs and integration of technology and business needs [5].

Users of the venue application are the main focus of the design process in this research. The design thinking method will be used to understand the needs and difficulties that users face when searching for venue locations. Stages including empathy, definition, ideation, prototyping, and testing will be applied systematically to ensure that the application created is not only effective in providing venue location information. Thus, the application of the Design Thinking method is key to creating a satisfying user experience through this web-based venue locator application. The design thinking method is an effective approach to addressing this problem by encouraging team collaboration and innovation of solutions. In addition, this research shows the importance of updating the features of the application to improve the user experience in the future [6].

In this situation, it is expected that the development of a simple design and web-based application will provide support to CV. MOVED4 to promote the activity packages offered, such as Weddings, Graduations and Concerts, as well as simplify the management of order data to the creation of order and sales reports on Event Organizers [7]. Therefore, the application of strong design principles is very important to ensure that the internship registration system in the Batu City Government provides a positive and efficient experience for users. One approach that can be used in the UI/UX design process is the 'Design Thinking.' method. Design thinking is used as a method of analysis through the process of understanding user needs and focusing on forms, relationships, behaviour, interactions and human emotions to produce an optimal solution [8]. There are five stages in the design thinking method, which are emphasise, define, ideation, prototype, and test [9].

This method emphasises an in-depth understanding of user needs and perspectives before designing a suitable solution. In this article, we will talk about how this method can be applied in the context of the design of the booking information system at MOVED4. With this approach, it is expected that the internship registration system will become more intuitive and efficient and will fulfil the needs of all stakeholders. In this article, we will discuss each stage of the design thinking method and how to practically apply it to optimise the user experience in the booking process at MOVED4.

2. Methods

The method used in this research is the Design Thinking method. Design Thinking is a problem-solving method that focuses on the user. This method is used as a solution-based approach to overcoming challenges or problems, as well as promoting creative thinking and active participation in innovation [10]. The stages in this method, starting from empathise, define, ideate, prototyping, and testing, are shown in Figure 1, along with an explanation of each stage.

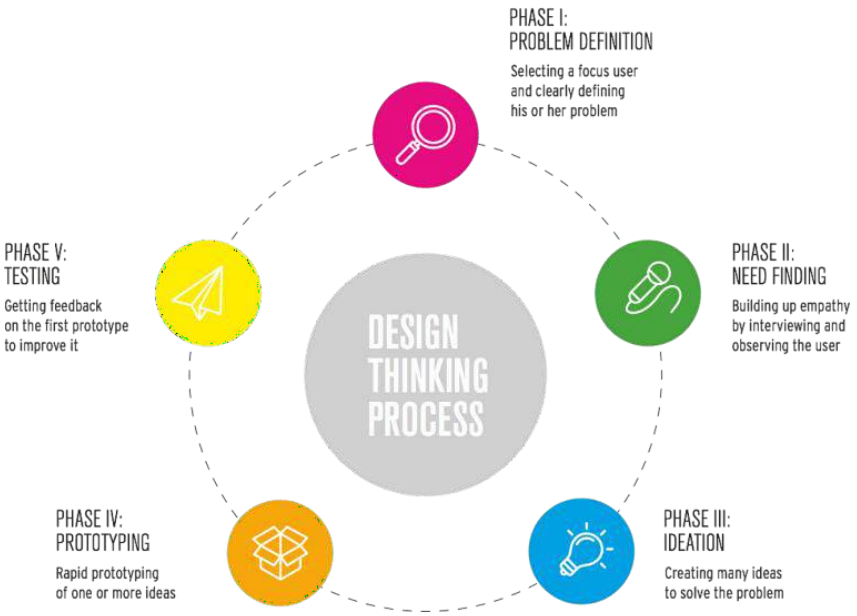

Figure 1. Design Thinking Methods

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2.1. Problem Definition (Empathise)

Figure 1 has the first circle in pink, indicating the first stage of Design Thinking, where the researcher attempts to understand and get a sense of the user's wants, problems, and needs through observation, interviews, or case studies. Further analysis and understanding of the data and information gathered from the user empathy process, which includes the designed user group criteria [11].

2.2. Need Finding (Define)

Figure 1 has a second circle coloured green, indicating the next stage and definition. This stage is conducted after understanding the user's needs and problems and determining which areas need improvement or enhancement. The current researchers are trying to find new solutions using the HMW (How Might We) approach. This method creates questions that open minds and encourage innovative ideas, which help researchers find more effective solutions[12].

2.3. Ideate

Figure 1 has a second circle in green indicating the next stage, definition. This stage is done after understanding user needs and problems and determining which areas need improvement or enhancement. The current researcher tried to find a new solution by using the HMW (How Might We) approach. This method creates questions that open the mind and encourage innovative ideas, which helps researchers find more effective solutions [13].

2.4. Prototype

Figure 1 shows the fourth orange coloured circle indicating the prototype stage. This stage comes after collecting potential ideas and is used to create a model or prototype of the suggested solution. Sketches, wireframes, or simple application models are some examples of this protocol [14]. At this stage, the team can further visualise and test the previously created ideas to gain a better understanding of how the solution will be implemented in real life. The main focus of this phase is to build a solution to overcome the constraints in the product and solve the previously identified problems.

2.5. Testing

Figure 1 shows the fourth orange circle indicating the prototype stage. This stage follows the collection of potential ideas and is used to create models or prototypes of the proposed solution. Sketches, wireframes, or simple application models are examples of this stage. At this stage, the team can better visualize and test the ideas previously generated, gaining a better understanding of how the solution will be implemented in real life [15]. The main focus of this phase is to build solutions to address constraints in the product and solve the previously identified problems. In this testing stage, the researchers used the System Usability Scale (SUS) method, which follows the rules as follows [16]:

a. Each question uses a value of 1-5 to facilitate the assessment in the testing phase
b. For each odd-numbered question, the score obtained from the user is reduced by 1.
c. For each even-numbered question, the final score is obtained by subtracting the user's score from 5.
d. The SUS score is obtained by summing the scores for each question and then multiplying by 2.5.

For further calculations, the SUS score of each respondent is averaged by summing all the scores and dividing by the number of respondents using the following formula:

$$\bar{x} = \frac{\sum x}{n} \quad (1)$$

where:

$\bar{x}$ = Average Score;
$\sum x$ = Amount SUS Score;
n = Number of Respondents.

With this formula, it is expected to help determine the average needs of the respondents to assist in testing.

3. Results and Discussions

3.1. Problem Definition (Empathize)

To develop the criteria for user groups during the 'Empathy' stage, researchers refer to relevant literature reviews and practical knowledge. These criteria are formulated by considering the important characteristics of users of the web-based venue search application. Additionally, feedback and input from potential users are taken into account when forming user group criteria. The first step is data collection through questionnaires to test whether the website to be developed is indeed less relevant and needs improvement. To test this, researchers also use the System Usability Scale (SUS) method because all the questions created for development and testing are displayed, and the results of these questions can be used as data or information for the research. The questions from the System Usability Scale can be seen in the SUS Questionnaire table [17].

Tabel 1. System Usability Scale Questionnaire

No	Questionnaire
1.	I think I will use this system again.
2.	I find the system unnecessarily complex.
3.	I find the system easy to use.
4.	I need assistance from others or technicians to use this system.
5.	I feel that the system's features are functioning properly.
6.	I find many inconsistencies in the system.
7.	I find the system confusing.
8.	I think others will quickly understand how to use this system.
9.	I encounter no obstacles when using this system.
10.	I need to familiarize myself with the system before using it.

By using the user group criteria, the researcher can ensure that interviews are conducted with relevant and representative individuals or groups. After collecting data for each question answered by respondents, the next step is to apply the System Usability Scale rules. The results from applying these rules can be seen in the following table.

Table 2. Questionnaire Calculation from Previous Website

From Result Score										Result	Score (Result x 2.5)
L1	L2	L3	L4	L5	L6	L7	L8	L9	L10		
1	3	1	1	3	4	2	1	2	2	28	70
1	1	1	3	1	3	1	2	2	1	16	40
3	1	2	2	2	2	3	1	2	3	21	52.5
1	3	1	3	2	4	1	3	3	2	23	57.5
1	3	3	2	2	1	2	1	2	2	19	47.5
3	1	2	1	3	2	3	2	2	4	23	57.5
1	3	1	3	5	3	1	3	3	1	24	60
1	1	4	1	1	2	2	1	4	5	22	55
3	2	3	2	4	4	3	2	2	2	27	67.5
1	1	2	1	2	1	1	3	1	3	16	40
Score Rate SUS											**54.75**

After applying the rules in the System Usability Scale, the final score or average score is determined to be 54.75. Once the final score is known, the next step is to input this final score into the acceptability range, as shown in the following image.

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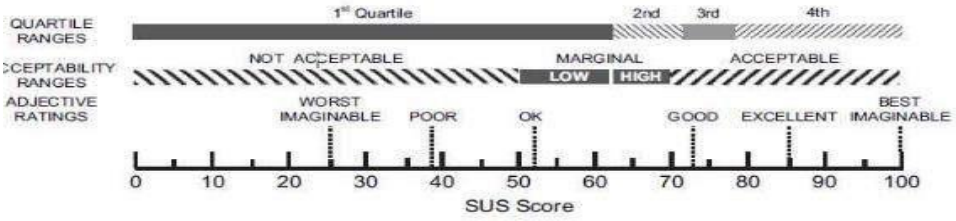

Figure 2. System Usability Scale Score

Based on Figure 2, it can be concluded that the average score from the SUS questionnaire falls under the "Marginal Low" category in the Acceptability Ranges and "OK" in the Adjective Ratings category.This helps in collecting more specific and relevant data. The purpose of this questionnaire is to understand more deeply the needs, problems, and preferences of users. The researcher conducted a questionnaire to 10 respondents according to the user group criteria through a questionnaire question on Google Forms. The information obtained from these interviews is very important in answering key questions, such as what users desire and need, what problems they often face, and what they expect from the solution or application to be developed.

3.2. Need Finding (Define)

After conducting interviews, the information obtained was in the form of answers from previous interviews. The researcher then compiled the problems experienced by users along with the solutions offered to overcome these problems. After compiling the problem definition, the researcher used Figma Jam to classify the problems faced by users and identify things that must be followed up immediately. In addition, to formulate the solutions offered to solve the problems experienced by users, researchers used the How-Might-We approach.

Table 3. How-Might We Problem Users

No	Criteria User
1.	How can we provide personalised recommendations to users based on previous events and their preferences?
2.	How can we ensure that users can quickly access and compare different event venues?
3.	How can we integrate user reviews and ratings to help users make better decisions?
4.	How can we offer virtual tours and interactive maps to give users a better understanding of the venue?
5.	How can we integrate booking and payment functionality to simplify the event planning process?

3.3. Ideate

In the Ideate stage, the researcher summarised the problems identified in the previous stage into creative ideas and solutions that could be implemented in the venue finder app design. Each idea and solution was explored in depth to ensure that the app design covers various aspects of user needs well.

Table 4. Solution Idea

No	Criteria User
1.	Create a ‘Review & Rating’ feature that allows users to leave reviews and ratings about their experience at the venue.
2.	Create a ‘Review & Rating’ feature that allows users to leave reviews and ratings about their experience at the venue.
3.	Provide a profile view for each venue, including detailed information about facilities, operating hours, and user reviews.
4.	Provides a filter-based search feature that allows users to filter search results according to their preferences.
5.	Integrate a Chat feature so that users can ask the event organiser for more information directly.
6.	Provides a display of price information and facilities offered by each venue.

3.4. Prototype

After exploring the ideate stage to find solutions in the solution ideation process, the next step is the prototype stage. This process starts with creating a wireframe or a rough picture of the design of the new application to be developed. The wireframe serves as a basic framework that includes the structure and layout of the main elements of the application. Then, the wireframe will be gradually detailed and enhanced into a more detailed and accurate high-fidelity view as the prototype progresses. This process allows the team to build systematically and refine the app design with attention to every detail, resulting in a prototype closer to the desired final version.

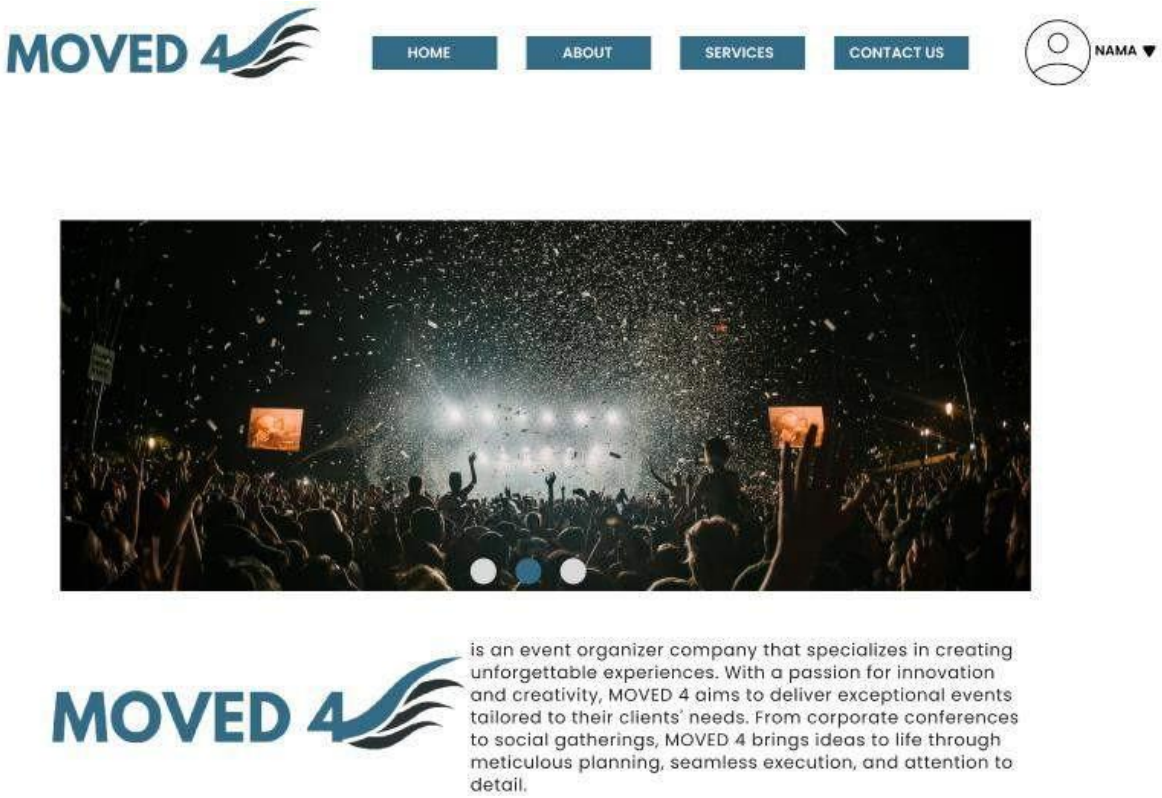

Figure 3. Dashboard View

The dashboard is the first view that appears when a user opens a website. Usually, this dashboard contains a logo, name, or image that introduces the app to the user while taking them to the main view. In other words, the dashboard is the initial page that displays the identity or brand of the application, allowing users to easily access all content or features of the application.

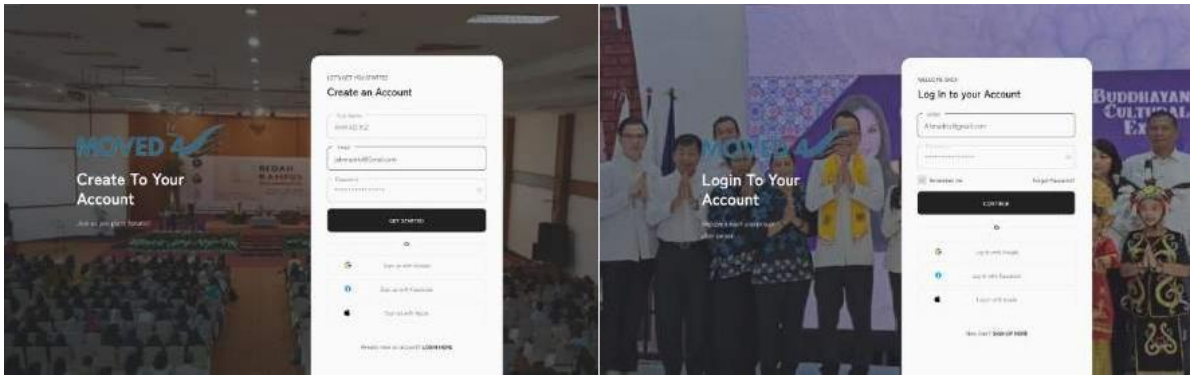

Figure 4. Sign Up and Log In View

The login page prompts users to enter identification information such as username and password to access certain accounts or features within the app. This serves as the entry point for users who already have a registered account. If users do not yet have an account, they can select the 'Register Now' option

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to go to the registration page, where users are asked to create a new account by entering the required personal information, such as full name, email address, and password.

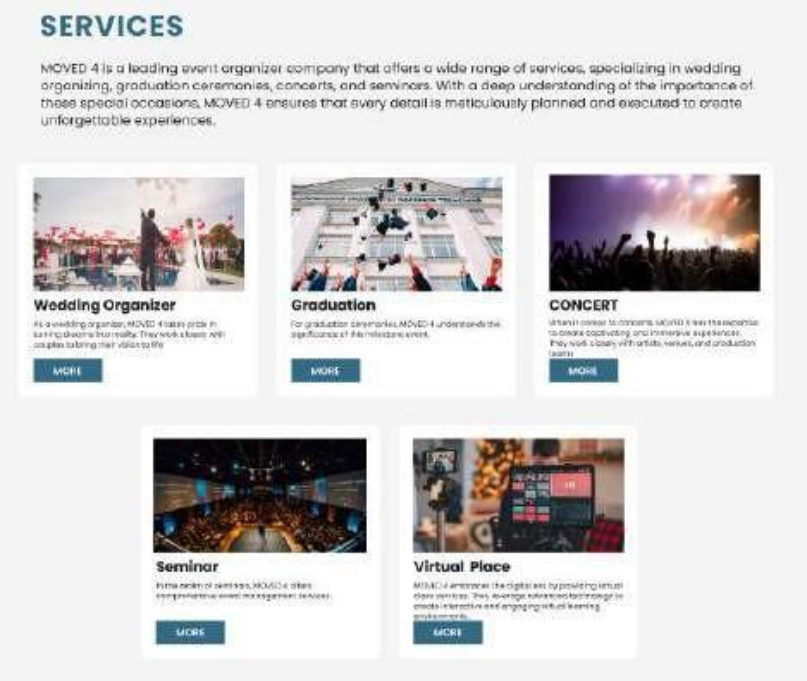

Figure 5. Display of Services Available

An available services page is a section of a website that provides detailed information about a particular entity, product, service, or content. It allows users to gain a more in-depth understanding of the subject they are searching for or want to learn more about. On this page, users can find details such as a full description, facilities, reviews, location map, and also venue provider contacts.

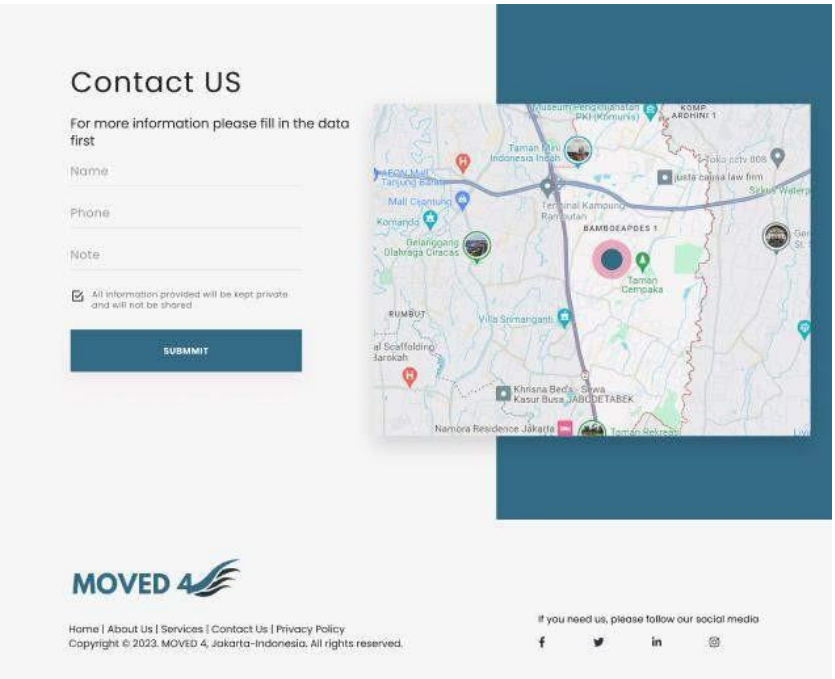

Figure 6. Maps View of MOVED4 Locations

A map/location details feature is part of an app or website that provides users with relevant geographic or location information. This feature allows users to visually see the location on a map, often using digital map services such as Google Maps or OpenStreetMap. With this feature, users can easily find the location of an event venue, view distances, routes, and other information.

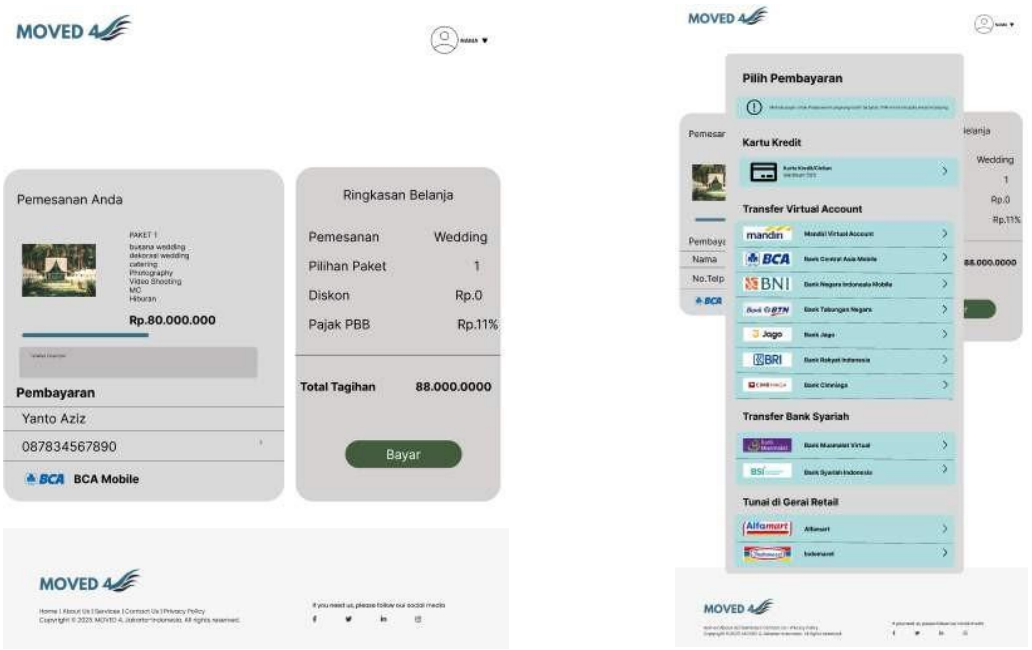

Figure 7. Payment Menu View

The payment menu feature is a part of an app or website that provides multiple payment options relevant to the user. This feature allows users to use payments through various platforms. With this feature, users can easily complete the payment for the event they are about to choose.

3.5. Testing

At this point, we will test the prototype using the System Usability Scale (SUS). SUS is a tool used to evaluate how well the interaction between the financial information system and the user functions. This method involves only ten questions and does not require a large sample size. In this test, ten respondents will be given a questionnaire to measure their understanding of the concept by using the prototype to record ten transactions at an event. Ten indicators have been designed to be evaluated by the respondents using the above testing method for preference values in the survey.

Table 5. Questionnaire Form

Code	Criteria User	Score
L1.	I will use this website frequently to book event organizer services.	1 – 5
L2.	I find this website too complicated to use.	1 – 5
L3.	I think this website is easy to use to book event organizer services.	1 – 5
L4.	I need help from other people or technicians to use this website.	1 – 5
L5.	I think the features on this website are integrated and work well.	1 – 5
L6.	I think many features on this website are not appropriate.	1 – 5
L7.	Most people will understand how to use this website easily and quickly.	1 – 5
L8.	In my opinion, this website is not practical to use.	1 – 5
L9.	I think there is no problem in using this website to book event organiser services.	1 – 5
L10.	Before using this website, I need to learn and get used to it.	1 – 5

Furthermore, respondents' responses were calculated using the SUS formula. The average score of each participant was calculated by summing up all scores and dividing by the number of participants. The formula for calculating SUS scores is as follows:

Scale Description:

1 : Strongly Disagree (SD)
2 : Disagree (D)
3 : Undecided (U)
4 : Agree (A)
5 : Strongly Agree (SA)

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Furthermore, the response results were assessed using the System Usability Scale (SUS) formula. This formula calculates the average score of each participant by summing up all the scores and dividing by the number of participants. To calculate the SUS score, the following steps are followed:

1. Subtract the user's score by 1 for each question with an odd number.
   [User score - 1 = question score] (2)
2. Subtract 5 from the user score for each question with an even number.
   [5 - User score = question score] (3)
3. Sum up all the scores from each question given to each participant, then multiply the result by two and a half. The result of [1st question score] + [2nd question score] +... + [etc question score] * 2.5 is the total score of the respondents.
4. After collecting all the scores from steps 1 to 3, calculate the average value. The SUS score result is calculated from the total score of the respondents divided by the number of participants.After the calculation of the SUS score, the result is as follows:

Table 6. Questionnaire Calculation From

From Result Score										Result	Score (Result x 2.5)
L1	L2	L3	L4	L5	L6	L7	L8	L9	L10		
5	1	5	1	2	3	5	3	5	4	34	85
3	2	3	1	4	2	3	1	4	3	26	65
3	2	3	2	3	1	3	1	4	2	24	60
3	1	4	1	1	4	5	3	2	4	30	75
4	4	4	3	3	3	5	3	5	3	37	92.5
4	1	1	3	4	3	4	3	5	1	29	72.5
4	3	3	2	5	3	4	2	4	4	34	85
3	1	4	2	4	3	5	1	3	4	30	75
3	4	4	3	4	3	5	3	5	3	37	92.5
4	1	4	3	4	2	5	3	4	2	32	80
Score Rate SUS											**79.25**

According to SUS score data, the test is successful and acceptable if the score range reaches 70 and falls into the GOOD category. The SUS calculation results from 10 respondents with an average value of 79,25 are included in the Best Imaginable category, so it can be concluded that the UI/UX design of the Booking Information System website at CV MOVED4 has met the needs of users to help them place orders, check locations and make payments more efficiently and effectively.

4. Conclusion

The research conducted during the testing of the MOVED4 UI/UX prototype using design thinking showed that the MOVED4 platform received positive feedback from 10 users who participated in the usability testing. According to the System Usability Scale (SUS), a score of 79.25 out of 100 indicates a high level of excellence. Based on Figure 2, it can be concluded that the average SUS score falls under the "High Acceptable" category in the Acceptability Ranges and "Good" in the Adjective Ratings category. This helps in collecting more specific and relevant data. During this process, the approach focused on understanding user needs and generating appropriate solutions has proven to be effective.

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Application of Naive Bayes Algorithm for Sentiment Analysis of Service and Facility Satisfaction (Case Study: PKU Muhammadiyah Sukoharjo General Hospital)

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ABSTRACT

PKU Muhammadiyah Sukoharjo Hospital is a health facility located in Sukoharjo, Central Java. The role of the hospital in the Sukoharjo community is very important in terms of the level of community satisfaction with its services and facilities. Opinions and assessments from the community also affect the assessment of the quality of service provided by the hospital. A large assessment can be seen on Google Maps review, which will take time for the community. Public complaints on Google Maps review of PKU Muhammadiyah Sukoharjo Hospital became the basic object of this research. This research uses the Naive Bayes algorithm to categorize the assessment based on positive and negative sentiments. Two hundred nine review data from Google Maps were processed with text processing and classified using Naïve Bayes. Test results using 10% test data show a dominant positive sentiment, with 90% accuracy, 94% precision, and 83% recall.

1. Introduction

Google Maps is an official platform owned by Google that is used on Android or Web systems. Android users can see reviews of visitors who have visited a place, whether an object is good or not, through reviews on Google Maps. Users provide various reviews on Google Maps, which can be seen in the review column [1]. Google Reviews from Google Maps, which makes it easier for businesses, institutions, and visitors to see the assessment of an assessment in the form of text and scores to measure visitor satisfaction [2]. Community ratings on Google Maps Reviews can be analyzed based on data collected through web scraping. In the scraping process, data crawling will occur as much as the data needed. The database that has been collected facilitates the process of analyzing an object. [3].

The services provided by the hospital mainly have a composition of two views, namely positive and negative [4]. This research was conducted by looking at visitor complaints at the PKU Muhammadiyah Sukoharjo General Hospital, which became the core of the object of this research. It took visitor review data from Google Maps' review of PKU Muhammadiyah Sukoharjo hospitals. Besides being easy to get review data, the location of the hospital is close to the author.

There are various algorithms that can be used in data classification and sentiment analysis, such as the Naive Bayes algorithm, Support Vector Machine (SVM), Random Forest, and K-Nearest Neighbor (KNN). Based on several reference articles that researchers have read, the Naïve Bayes algorithm has fairly high accuracy results and, in terms of time, is fairly fast in conducting sentiment analysis compared to other classification algorithms. [5]. In previous research from [6] with the research title Aspect-based Sentiment Analysis of Yogyakarta Tentrem Hotel Reviews using the Random Forest Classifier Algorithm based on the results of his research obtained the results of 90% accuracy value and 90% fl score, this value uses the best tree number and tree depth parameters that have an important influence on the prediction results.

In the research [7] with the research title Family Contribution in Predicting Students Graduating on Time Using the Support Vector Machine Model, the accuracy value is 86%, the f1 score is 93%, the precision score is 86%, and the recall score is 99%. Research from [8] with the research title Twitter User Sentiment Analysis on PPKM Extension Using the K-Nearest Neighbor Method, the accuracy score is 69.5%, recall is 69.5%, and precision is 68.7%. In the research [9] with the research title Application of Data Mining to Predict the Number of Best-Selling Products Using the Naive Bayes Algorithm Case Study (Toko Prapti), the accuracy value is 83.3%, precision is 84.2%, and the recall is 88.9%.

Although there are some weaknesses in the Naive Bayes algorithm, such as being vulnerable to outlier data and probability estimation is difficult, based on previous studies mentioned above, the Naïve Bayes algorithm has the advantage that the amount of training data is relatively small to predict the parameters needed in the classification process. Comparison of the Naive Bayes algorithm with other alternative algorithms such as decision trees, namely decision trees divide data based on rules that are easy to understand but tend to overfit on training data and are less efficient in classifying complex text data, comparison with SVM itself lies in text processing time, SVM requires more complicated parameter tuning which is time-consuming in processing text data, for comparison with random forests itself is almost the same as SVM, namely in higher computation time than Naive Bayes but random forests tend to give good results, and for comparison with Gardien Boosting lies in more complicated parameter tuning and more computational resources. If high model complexity and accuracy are required, alternatives such as SVM, Random Forests, or gradient boosting can be explored. The Naïve Bayes algorithm has also proven to be quite fast and accurate when applied to large datasets [10]. This research was conducted by looking at visitor feedback and complaints, which became the core of the object of research by taking data from a Google Maps review of PKU Muhammadiyah Sukoharjo General Hospital. The research explains the processes that produce sentiment analysis. The Naïve Bayes algorithm was chosen and used because it has been widely used for text mining processes because it has a high accuracy value and also has a relatively fast classification time in sentiment analysis in previous studies [11].

Based on the above background, the researcher will use the Naive Bayes algorithm in the research of visitor sentiment analysis on services and facilities at PKU Muhammadiyah Sukoharjo General Hospital. It is hoped that the results of this study can help the hospital monitor and manage the services and facilities of PKU Muhammadiyah Sukoharjo General Hospital better.

2. Methods

In this research, there are several processes or stages that must be carried out to get the best results [12]. The process consists of collecting data through scraping and then preprocessing the text, which consists of case folding, tokenizing, filtering, and stemming. After that, the data will be categorized using the Naive Bayes algorithm. The data evaluation stage involves the use of a Confusion Matrix, and for visualization, WordCloud is used, which can be seen in Figure 1 below.

Figure 1. Research Flow

2.1. Data collection/Data scraping

At this stage, the dataset is manually clustered using scraping techniques from the website and a Chrome extension called Instant Data Scraper. The data source comes from the Google Reviews page about the Sukoharjo General Hospital. The data that is successfully obtained is then stored in .csv format to facilitate the next stage.

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2.2. Prepocesing Text

The next stage is text preprocessing; not all record data and attributes can be used, so it is necessary to preprocess text or efforts to process initial data in order to obtain better data [13]. This text preprocessing stage consists of 4 stages, namely case folding, tokenizing, filtering, and stemming, which can be seen in Figure 2 below [5].

Figure 2: Text preprocessing stage

a. Case Folding

This case folding stage is the process of leveling letters that previously contained capital letters to be converted into all lowercase letters. This helps reduce variation and ensure consistency in text analysis. For example, "Data" and "data" are considered the same after case folding. The impact of case folding is that it can facilitate word comparison and reduce ambiguity.

b. Tokenizing

The next stage is the tokenizing stage, which is the process of cutting or separating sentences into words per word. The impact of tokenizing itself is to facilitate text analysis, such as calculating word frequencies or building models.

c. Filtering

The next stage after tokenizing is the filtering stage, which eliminates or removes words that are not needed in the next process, such as "and", "or", and "in". The impact of filtering can reduce the dimensionality of data and increase the efficiency of analysis.

d. Stemming

The next stage is the stemming stage, which converts words that have affixes into basic words. The impact of stemming is to speed up search and ensure consistency in text analysis.

2.3. Naive Bayes

The stage after preprocessing the text is the calcification stage of the model using the Naive Bayes algorithm. Naïve Bayes is a simple classification method that can calculate all possibilities by combining the number of combinations and density of values from a dataset that has been obtained [14]. The advantage of using this method is that it requires little training data to determine the parameter estimates needed in the classification process because it is assumed to be an independent variable [15].

2.4. Confusion Matrix

The next stage is the evaluation stage using the confusion matrix, which is an evaluation method used to measure the performance of classification methods. During the efficiency measurement, there are four terms that represent the results of the classification process. The four terms include True Positive (TF), True Negative (TN), False Positive (FP), and False Negative (FN) [16]. After obtaining the values of the four terms, the values for accuracy, precision, and recall can be obtained in the following formula:

$$accuracy = \frac{TP+TN}{\text{Total}} \quad (1)$$

Where TP = data results with positive predicted values and positive actual values and TN = data results with negative predicted values and negative actual values.

$$precision = \frac{TP}{\text{TP+FP}} \quad (2)$$

Where TP = data results with positive predicted values and positive actual values and FP = data results with positive predicted values and negative actual values.

$$recall = \frac{TP}{\text{TP+FN}} \quad (3)$$

where TP = data results with positive predicted values and positive actual values and FN = data results with negative predicted values and positive actual values [17].

2.5. WordCloud

The next stage is the evaluation process, namely the visualization stage using wordcloud. This stage is characterized by a wordcloud that summarizes the overall sentiment of positive and negative reviews described in the positive and negative review documents of PKU Muhammadiyah Sukoharjo General Hospital on Google Maps.

3. Results and Discussions

3.1. Data Scraping

Data retrieval or data scraping using the Chrome extension by installing an instant data scraper to get Google Maps review data for PKU Muhammadiyah Sukoharjo Hospital. The data obtained in the form of review ID, account name, review, and time for the sentiment itself is done manually using Microsoft Excel as much as 314 data, and after cleaning, it becomes 209 data, which is divided from 154 positive data and 55 negative data. Examples of data that has been scraped and given sentiment in Table 1 below:

Table 1. Scraped review data

No	Review Id	Account Name	Time	Reviews	Sentiment
1	Br-101	Cinta Sejati	4 days ago	Of the several hospitals I visited in Sukoharjo. Here the hospital service is the longest, less satset. It's a pity about the management.	Negative
2	Br-111	Nurafanti Afanti	1 month ago	Slow	Negative
3	Br-120	Rizky Ahmad	2 month ago	Pharmacy service is very poor	Negative
4	Br-147	Diah Retno Hermastuti	4 month ago	good service and adequate facilities	Positive
5	Br-181	Sony Cahtono	4 month ago	Good service	Positive
6	Br-190	Safira Dila	4 month ago	Fast service	Positive
7	Br-216	Eva Yohana	7 month ago	Limited space for queuing in the clinic. Not worth it for visitors	Negative
8	Br-283	Freddick Listern	1 year ago	Slow administration	Negative
9	Br-317	Muhammad Faeyza	2 year ago	Good service satisfying	Positive
10	Br-323	Rayi Rayendaria	2 year ago	A comfortable hospital in my opinion. Friendly staff	Positive
11	Br-325	Alena Valency	2 year ago	Vaccines at PKU Muhammadiyah Sukoharjo can comfortably get a gift	Positive
12	Br-328	Awan Dwi Kurniawan	2 year ago	Friendly hospital staff	Positive
13	Br-329	Ryan Slametraharjo	2 year ago	Good hospital, very good service	Positive
14	Br-333	Suratmi	2 year ago	The service was satisfactory and pleasant	Positive
15	Br-346	Anang Sang Ship's Cook	2 year ago	Good hospital services	Positive
16	Br-352	Ririn Murtiah	2 year ago	Good service	Positive
17	Br-360	Agus Triutomo	2 year ago	The service was very satisfying. Thank you	Positive
18	Br-396	Rafidha Adelina Siregar	3 year ago	Satisfactory service	Positive
19	Br-400	Yussuf Faisal	3 year ago	Very good service	Positive
20	Br-402	Gilang Erlanda	3 year ago	The nurses are not friendly and the service is not satisfactory.	Negative

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3.2. Preprocesing Text Result

After data scraping, the next stage is text preprocessing; text preprocessing itself is a stage where the data will be equalized in all its forms and formats so that at the next stage, the data can be processed and processed. The text preprocessing stage consists of 4 stages, namely case folding, tokenizing, filtering, and stemming. Table 2 shows the data that has not been processed case folding; table 3 shows the data after case folding and figure 1 shows the source code of the case folding process.

a. Case Folding

The case folding stage is the process of converting all characters in a document into uniform letters, be it uppercase or lowercase. The goal is to facilitate comparison when indexing. Thus, words that have variations of capital letters can be considered equivalent.

Table 2. Data before case folding process

No	Account Name	Time	Reviews	Sentiment
1	Cinta Sejati	4 days ago	Of the several hospitals I visited in Sukoharjo. Here the hospital service is the longest, less satset. It's a pity about the management.	Negative
2	Nurafanti Afanti	1 month ago	slow	Negative
3	Rizky Ahmad	2 month ago	Pharmacy service is very poor	Negative
4	Diah Retno Hermastuti	4 month ago	good service and adequate facilities	Positive
5	Sony Cahtono	4 month ago	Good service	Positive
6	Safira Dila	4 month ago	Fast service	Positive
7	Eva Yohana	7 month ago	Limited space for queuing in the clinic... Not worth it for visitors	Negative
8	Freddick Listern	1 year ago	Slow administration	Negative
9	Muhammad Faeyza	2 year ago	Good service satisfying	Positive
10	Rayi Rayendaria	2 year ago	A comfortable hospital in my opinion. Friendly staff	Positive
11	Alena Valency	2 year ago	Vaccines at PKU Muhammadiyah Sukoharjo can comfortably get a gift	Positive
12	Awan Dwi Kurniawan	2 year ago	Friendly hospital staff	Positive
13	Ryan Slametraharjo	2 year ago	Good hospital, very good service	Positive
14	Suratmi	2 year ago	The service was satisfactory and pleasant	Positive
15	Anang Sang Ship's Cook	2 year ago	Good hospital services	Positive
16	Ririn Murtiah	2 year ago	Good service	Positive
17	Agus Triutomo	2 year ago	The service was very satisfying. Thank you	Positive
18	Rafidha Adelina Siregar	3 year ago	Satisfactory service	Positive
19	Yussuf Faisal	3 year ago	Very good service	Positive
20	Gilang Erlanda	3 year ago	The nurses are not friendly and the service is not satisfactory.	Negative

In Table 2 above, before the case folding process, the letters in the review data are still partially capitalized, and there are still numbers and punctuation marks that are not needed.

Table 3. Case folding results

No	Account Name	Time	Reviews	Sentiment
1	Cinta Sejati	4 days ago	of the several hospitals I visited in Sukoharjo. here the hospital service is the longest, less *satset*. It's a pity about the management.	Negative

No	Account Name	Time	Reviews	Sentiment
2	Nurafanti Afanti	1 month ago	slow	Negative
3	Rizky Ahmad	2 month ago	pharmacy service is very poor	Negative
4	Diah Retno Hermastuti	4 month ago	good service and adequate facilities	Positive
5	Sony Cahtono	4 month ago	good service	Positive
6	Safira Dila	4 month ago	fast service	Positive
7	Eva Yohana	7 month ago	limited space for queuing in the clinic not worth it for visitors	Negative
8	Freddick Listern	1 year ago	slow administration	Negative
9	Muhammad Faeyza	2 year ago	good service satisfying	Positive
10	Rayi Rayendaria	2 year ago	a comfortable hospital in my opinion. friendly staff	Positive
11	Alena Valency	2 year ago	vaccines at PKU Muhammadiyah Sukoharjo can comfortably get a gift	Positive
12	Awan Dwi Kurniawan	2 year ago	friendly hospital staff	Positive
13	Ryan Slametraharjo	2 year ago	good hospital, very good service	Positive
14	Suratmi	2 year ago	the service was satisfactory and pleasant	Positive
15	Anang Sang Ship's Cook	2 year ago	good hospital services	Positive
16	Ririn Murtiah	2 year ago	good service	Positive
17	Agus Triutomo	2 year ago	the service was very satisfying. thank you	Positive
18	Rafidha Adelina Siregar	3 year ago	satisfactory service	Positive
19	Yussuf Faisal	3 year ago	very good service	Positive
20	Gilang Erlanda	3 year ago	the nurses are not friendly and the service is not satisfactory	Negative

In Table 3 above, after the case folding process, letters are generalized into lowercase letters, and the removal of punctuation marks, numbers, and characters other than alphabets is involved. Thus, case folding can help ensure consistency in the use of letters and facilitate text analysis. The source code image of the case folding process can be seen in Figure 3 below.

```
# ubah teks menjadi lower
data['text_cleaning'] = data['text_cleaning'].str.lower()
data.head()
```

Figure 3. Source code case folding

b. Tokenizing

After case folding, the data then enters the tokenizing stage, which is the breakdown of words in the data into words, as in Table 4 below.

Table 4. Tokenizing result

No	Reviews
1	[of, several, hospitals, which, I, visited, in, Sukoharjo, here, service, hospital, the, longest, less, fast, regret, once, management]
2	[slow]
3	[service, pharmacy, very, bad]
4	[service, good, and, facilities, adequate]
5	[service, good]
6	[service, fast]
7	[space, limited, to, queue, at, clinic, not, worth, it, for, visitors]

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No	Reviews
8	[administration, slow]
9	[service, which, good, satisfactory]
10	[home, hospital, which, comfortable, according, to, me, staff, which, friendly]
11	[vaccine, in, pku, muhammadiyah, sukoharjo, can, with, comfort, get, gift]
12	[staff, hospital, who, friendly]
13	[hospital, hospital, which, good, service, which, very, good]
14	[service, satisfactory, and, pleasant]
15	[service, hospital, good]
16	[service, good]
17	[service, very, satisfying, thank you]
18	[service, satisfactory]
19	[service, very, good]
20	[nurse, not, friendly, and, the service, not, satisfactory]

c. Filtering

After the data tokenizing process enters the next stage, namely the filtering stage, the filtering process itself is useful for filtering or eliminating words that are not needed. The results of the filtering process can be seen in Table 5 below.

Table 5. Filtering result

Before Filtering	After Filtering
Pharmacy service is very poor	Poor pharmacy service

d. Stemming

The next stage is stemming, stemming functions to convert the affixed words in the data into basic words. To do so, the Sastarawi library is needed. The results of the stemming process can be seen in Table 6, and the literary import process in Figure 4 below.

Table 6. Stemming result

Before stemming	Afer stemming
Pharmacy service is very poor	poor pharmacy serv

```
# Stopword
import Sastrawi
from Sastrawi.StopWordRemover.StopWordRemoverFactory import StopWordRemoverFactory, StopWordRemover, ArrayDictionary
more_stop_word = []

stop_words = StopWordRemoverFactory().get_stop_words()
new_array = ArrayDictionary(stop_words)
stop_words_remover_new = StopWordRemover(new_array)

def stopword(str_text):
  str_text = stop_words_remover_new.remove(str_text)
  return str_text

data['text_cleaning'] = data['text_cleaning'].apply(lambda x: stopword(x))
data.head()
```

Figure 4. Import Sastrawi

3.3. Data Split

The next process after preprocessing is to divide the data set into two, namely train data or train data set and test data or test dataset.

```
[ ]  #memsihkan data menjadi data latih dan data training
     X = data_clean['text_cleaning']
     y = data_clean['sentimen']
     X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.10, random_state=42)
```

Figure 5. Data Split

3.4. Naive Bayes Classification Results

After the preprocessing process is complete, the data that will be processed for testing the naïve Bayes model is obtained. Testing the amount of training and test data is done by experimenting with each comparison until you get the highest accuracy. The results of the comparison of accuracy values in testing the amount of training data and test data can be seen in Table 7, and the testing process to determine the accuracy value of each comparison can be seen in Figure 5.

Table 7. Comparison of training and test data

Comparison of training and test data	*Accuracy*
90%:10%	90%
80%:20%	79%
70%:30%	78%
60%:40%	79%
50%:50%	78%

The results from the above figure show that the accuracy for the positive class is higher than the accuracy for the negative class. As a result, the overall accuracy reaches 90%.

```
# Evaluasi Model
accuracy = accuracy_score(y_test, y_pred)
classification_rep = classification_report(y_test, y_pred, target_names=['negatif', 'positif'])

print(confusion_matrix(y_test, y_pred))
print("Akurasi Model Naive Bayes : ", accuracy)
print("\nLaporan Klasifikasi :\n", classification_rep)
```

Figure 6. Testing the evaluation of the naive bayes model

Figure 5 above shows the source code for calculating the accuracy value of each comparison of training data and test data, and from Table 7 above, the highest accuracy value is 90%, with a ratio of training data and test data of 90%: 10%.

3.5. Confusion Matrix Result

The next stage, namely the confusion matrix stage above, shows that the four negative data tested are divided into 4 True negative data and 0 data as a false negative. While 15 positive data were tested, there were 15 True Positive data and 2 False Negative. The results of the confusion matrix can be seen in Table 8 below.

Table 8. Confusion Matrix Results

	True	False
Negative	4	0
Positive	15	2

Overall, the values of accuracy, precision-recall, and F1-measure, as well as the data above, have the highest accuracy values. The highest ratio is 90%: 10%. This is due to differences in the number and distribution of data in each aspect. The results themselves included a 90% accuracy value, 94% precision, 83% recall, and 87% F1 score.

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```
# Evaluasi Model
accuracy = accuracy_score(y_test, y_pred)
classification_rep = classification_report(y_test, y_pred, target_names=['negatif', 'positif'])

print(confusion_matrix(y_test, y_pred))
print("Akurasi Model Naive Bayes : ", accuracy)
print("\nLaporan Klasifikasi :\n", classification_rep)
```

Figure 7. Model evaluation

3.6. K-Fold Cross Validation Testing

K-Fold Cross Validation testing on Naïve Bayes Classifier algorithm with the amount of training and test data 90%; 10%. Through this test, data validation will be carried out using K-Fold Cross-Validation. The best results on 6 th fold. K-Fold cross-validation test results test results of the Naïve Bayes algorithm are shown in Figure 8.

```
from sklearn.model_selection import cross_val_score

# Definisikan model
naive_bayes = MultinomialNB()

# Lakukan cross-validation (misalnya, 10-fold)
scores = cross_val_score(naive_bayes, X_train_resampled, y_train_resampled, cv=10)

# Cetak skor untuk setiap fold
print("Skor Akurasi untuk Setiap Fold:", scores)
```

```
Skor Akurasi untuk Setiap Fold: [0.67857143 0.82142857 0.85714286 0.75       0.82142857 0.92857143
 0.78571429 0.85714286 0.85185185 0.62962963]
```

Figure 8. K-fold cross validation

Based on Figure 8, it is known that iterations with the highest accuracy results are at the sixth iteration with an accuracy of 0.92857143 and can be rounded to 0.93 or 93%. The average value of the K-Fold cross-validation test is 75%.

3.7. WordCloud Result

In the last stage, we visualize the data using wordcloud to identify words that appear frequently in each sentiment. Below is the wordcloud result for positive sentiment, which can be seen in Figure 9.

Figure 9. Positive Sentiment WordCloud

In Figure 9, it can be seen that the words that often appear in positive sentiments are as follows: "good", "friendly", "service", "fast" and others. For negative sentiment, wordcloud can be seen in Figure 10.

Figure 10. Negative sentiment WordCloud

In Figure 10, it can be seen that the words that often appear in negative sentiments are as follows: "service", "long", "queue", "doctor", "less", and others.

4. Conclusion

From the results of the above research, namely regarding the analysis of visitor sentiment on the services and facilities of PKU Muhammadiyah Sukoharjo Hospital on Google Maps, which amounted to 209 data that had passed the text preprocessing stage consisting of transformation, tokenization, filtering, stemming and classification using the Naïve Bayes algorithm using the Chrome extension instant data scraper, it can be concluded that the reviews of PKU Muhammadiyah Sukoharjo Hospital visitors are classified as positive with the results of 90% accuracy presentation for 94% precision value and for 83% recall value. This value shows that the Naive Bayes algorithm classification is quite good in processing Google Maps review data because the accuracy percentage results reach 90%. This value proves that public sentiment regarding the services and facilities of PKU Muhammadiyah Sukoharjo Hospital is positive.

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Implementation of Website-Based UI UX Using the Design Thinking Method: Case Study at PT Jesinra Makmur Group

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ABSTRACT

In the era of globalization, the imported goods shipping industry is growing rapidly. PT Jesinra Makmur Group, as a provider of imported goods delivery services, needs to ensure that the user experience (UI/UX) on its website platform is optimal. This research aims to redesign the UI/UX of the PT Jesinra Makmur Group website using a Design Thinking approach. The Design Thinking method consists of several stages, namely empathize, define, ideate, prototype, and testing. In this research, researchers will understand user needs, identify problems, generate creative ideas, create prototypes, and test proposed solutions. This research uses the System Usability Scale (SUS) to measure the success of UI/UX design, and a score of 87.75% was obtained, which indicates a high level of excellence. This shows that users feel comfortable and that it is easy to use the website. The results of this research are expected to provide a better solution for PT Jesinra Makmur Group to provide an optimal user experience through their website. By implementing the Design Thinking method, it is hoped that PT Jesinra Makmur Group can improve the UI/UX of their website and provide better service to customers.

1. Introduction

In the current era of globalization, the development and progress of information technology have occurred in recent years at an extraordinary speed. Of course, the ever-increasing need for information has triggered the Industrial Revolution 4.0, which emphasizes digitalization and makes digital production faster and more efficient. With the development of information technology, the Internet has become very important in various societal activities, including business, shopping, health, education and data collection [1]. This has resulted in changes in people's lives, especially in large urban areas. Influence the number of consumers who are interested in online stores that make transactions easy without being limited by time (24 hours) [2]. At this time, websites have become very important for netizens who frequently surf the digital world because they often use browser engines to search for data [3].Websites are one of the popular promotional media today. Websites have unlimited reach in time and space. To obtain a website as an effective medium for conveying information, it is necessary to implement certain strategies so that the website promotion activities carried out achieve maximum results [4]. Creating an application or website design is also necessary to generate ideas. Interface design and user experience design are important stages in the development of software [5]. User Experience (UX) is all aspects related to a user's experience in using a product, how easy it works to understand, how it feels when using the product, and how the user achieves his goals through the product. Meanwhile, one part of the program that comes into contact with and interacts directly with the user is called the User Interface (UI) (Blair-Early & Zender, 2008). In general, UX is how people feel when they use a product or service [6]. The design thinking method is used to solve problems practically and

creatively, focusing on the user. The designer will try to understand the user's needs and develop the most effective solutions to meet those needs. In carrying it out, you have to go through 5 steps, namely empathize, define, ideate, prototype, and test [7].

PT. Jesinra Makmur Group, which operates in expeditions and provides cargo services for import and export, is one of the businesses that uses website technology to introduce its business and services to customers. However, since its founding, the website has not been updated for user convenience or appearance. Apart from that, there is still very little customer information. Because cargo information is very important, especially in knowing the location and status of the cargo being transported, this really hinders business growth in the expedition sector. This research aims to redesign the appearance of the PT Jesinra Makmur Group website using the Design Thinking approach in the UI/UX creation process and the System Usability Scale (SUS) to assess user experience. System Usability Scale (SUS) is the method that will be used in this research. In this case, Usability is the ability of a product or system to be used easily and effectively by users [8]. This approach was chosen because it provides a comprehensive framework for understanding user needs and producing innovative solutions. By following the stages of Design Thinking, it is hoped that more effective and sustainable solutions can be found to improve the user experience on websites.

2. Method

This research uses the Design Thinking Method. Design thinking is a method that focuses on user needs for innovation, so it becomes a good business product because it can provide an effective solution to a problem [9]. This method is used to speed up understanding the needs of potential users through direct experimentation, product visualization, and creating prototype designs. Prototyping is usually used to apply trial and error in real scenarios to calculate estimates of resources spent in the application development process[10]. This technique greatly influences the way decisions are made, which ultimately leads to new and innovative ideas. This method focuses on user experience in addition to what users see and feel when using a product. Design thinking methods include:

Figure 1. Stages of Design Thinking

a. Empathize

Empathize (empathy) is a mechanism for understanding users of the products we design to foster deep user understanding and uncover insights and user needs [11].

b. Define

After obtaining a valid understanding of the problem, the next step is to understand and determine the various problems that have been obtained to become the main concern so that they are resolved properly [12].

c. Ideate

Ideate is the stage of idea development, usually called brainstorming. At this stage, it is hoped that ideas will emerge that can provide solutions to existing problems. It is in this process that drawing becomes creative by formulating many ideas [13].

d. Prototype

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A prototype serves as the preliminary model of a product, designed to identify potential issues early and explore various new possibilities [14].

e. Test

Tests are conducted to gather diverse user feedback on the final designs developed during the prototype phase. Although this is the final stage, the process is cyclical, allowing for repetition and revisiting earlier design stages if issues are identified [15].

3. Results and Discussion

3.1. Empathize

At this stage, the author will compile a questionnaire for active users of online expedition services. The purpose of this questionnaire is to identify problems that occur related to website layout and desired features based on suggestions from users. There are several target user criteria used in this research:

Table 1. User group criteria

No	Criteria
1.	18-45 years old, active users of online expedition services similar to this research.
2.	Frequent and familiar with online expedition websites.
3.	Often shop online and need goods delivered to your home.
4.	Online stores that rely on expedition services to send products.
5.	Individuals who move houses or offices and need expedition services to send goods.

User criteria play a very important role in directing the design of website display development and then identifying problems and opportunities for innovation and improvement. By paying attention to user criteria, researchers can produce better products according to user needs.

Table 2. Questionnaire Questions

No	Question
1.	Do you often use online expedition services to send goods?
2.	How familiar are you with various expedition service websites?
3.	How often do you shop online and need goods delivered to your home?
4.	Have you ever used an expedition service to send products from the online shop that you manage?
5.	What online delivery service do you personally use most often?
6.	Is an attractive and comfortable website appearance very important?
7.	What online delivery services have you never used?
8.	What are the important features that should be used in online shipping expedition services?
9.	How easy is it for you to track the delivery status of items being shipped?
10.	Have you ever experienced problems with online expedition services? If yes, what is the problem

After determining the criteria for the user group, the researcher created a 10-question questionnaire and gave it to 10 respondents. The purpose of these questions was to find out what needs prospective users want, what problems are often encountered in using the website, and what services should be necessary.

3.2. Define

This research uses data obtained from respondents aged 18-25 who often use the Online Expedition Services website. The sample of respondents involved are active users of online goods delivery services. These respondents have been categorized based on age, gender, and website appearance preferences.

Table 3. Grouping based on conclusions from respondents' answers

UI/UX Aspects	Information	Conclusion
Ease of use	The website is easy to use and understand, the navigation flow is clear, and the features are easy to access	A simple and responsive website appearance is very important so that visitors can easily interact with the content. A logical and organized menu structure ensures users can find the information they are looking for without difficulty. The use of clear icons and labels helps communicate function and navigation more effectively. Lastly, an easy ordering process and package tracking will improve user experience and speed up service. All these elements must be designed taking into account user needs and preferences so that the website becomes more efficient and effective.
Clear information	The Website provides complete and accurate information about services, prices, and shipping policies.	Clear and concise service descriptions, transparent and easy-to-understand price information. Shipping policies that are easy to access and understand.
Attractive Design	The website has an attractive and professional design that gives a positive impression to users	Modern and stylish appearance, use of attractive colors and images. The layout is neat and balanced.
Security and Reliability	The website provides a sense of security and comfort for users by guaranteeing data security and privacy.	Strong security system to protect user data, Clear and transparent privacy policy. Responsive and helpful customer service.
Speed and Timeliness	The website allows users to order and track packages quickly and easily	Clear and concise service descriptions, transparent and easy to understand price information. Shipping policies that are easy to access and understand.

3.3. Ideate

The Ideate phase describes the solution needed to evaluate and produce design output. In this research, online expedition services are used as an example to make it easier to create website-based layouts. The design review for this model has been consulted in advance with active users in the marketplace, so the original design is still the same.

Table 4. Solution Description

No	Solution Description
1.	Use of clear icons and labels
2.	Clear and concise service profile descriptions
3.	Logical and organized menu structure
4.	Interesting use of colors and images
5.	Provides various types of online goods delivery service options
6.	Clear and transparent information in goods tracking services
7.	Provides online payment features

3.4. Prototypes

The next step is the prototype, described after the solution is defined at the ideate stage. This process begins by creating a rough drawing or wireframe, which is gradually detailed and then improved to a more thorough and accurate view as the prototype develops. This process allows the team to systematically build and refine the application design, paying attention to every detail, resulting in a

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prototype closer to the desired final version. Researchers create prototypes so that they can be used and experienced directly by potential users.

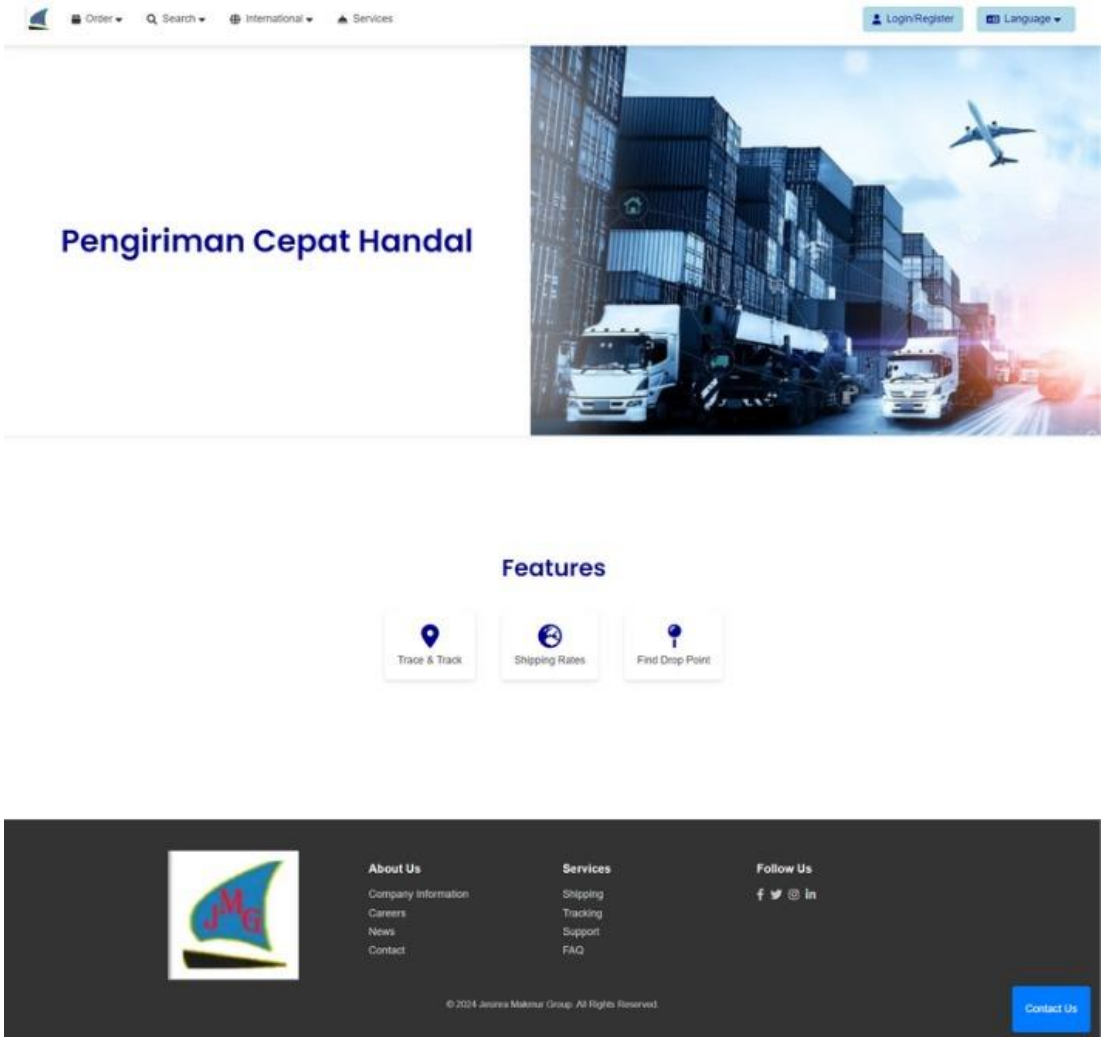

Figure 2. Dashboard View

The dashboard is the first display when a user opens a website. In general, this dashboard contains a logo, name, or image that introduces the application to the user and brings it to the main display. In other words, the dashboard is the home page that displays the identity or brand of the application.

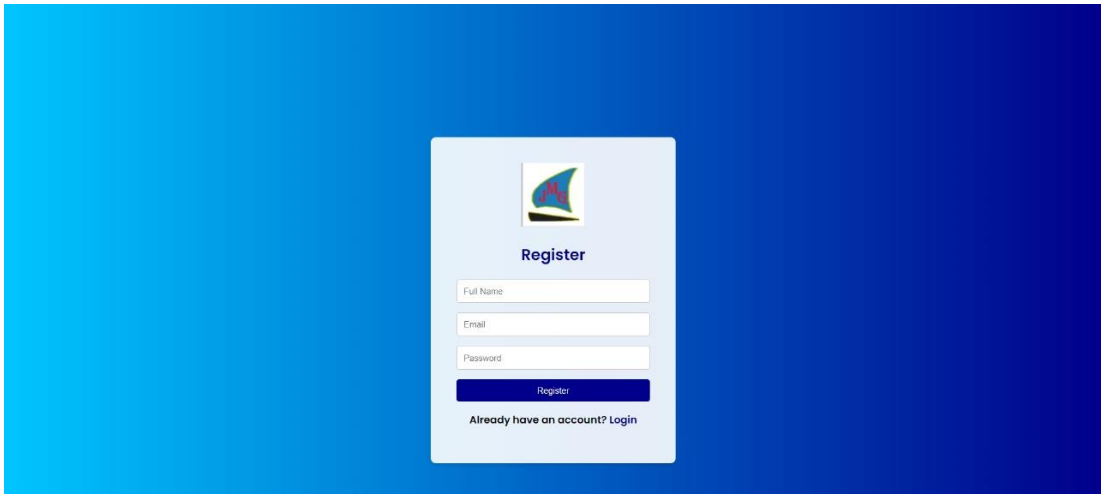

Figure 3. Registration View

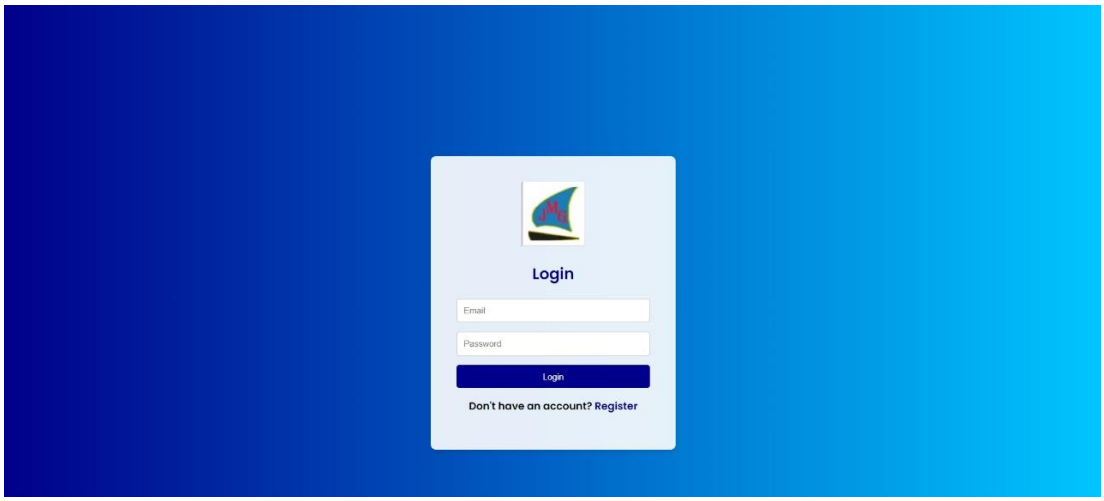

Figure 4. Login View

To enter the registration page, users are asked to create a new account first by entering the necessary personal information, such as full name, email and password.

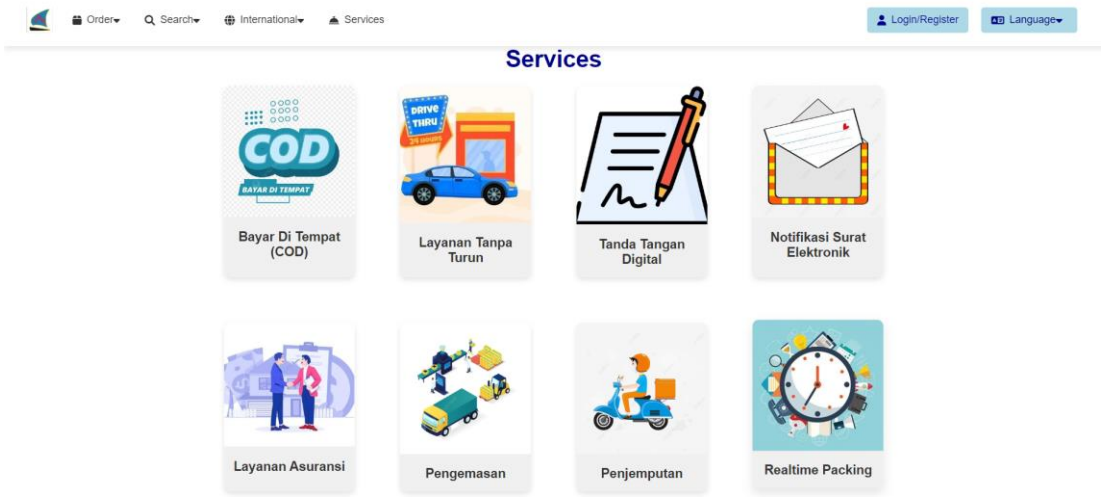

Figure 5. Display of services provided

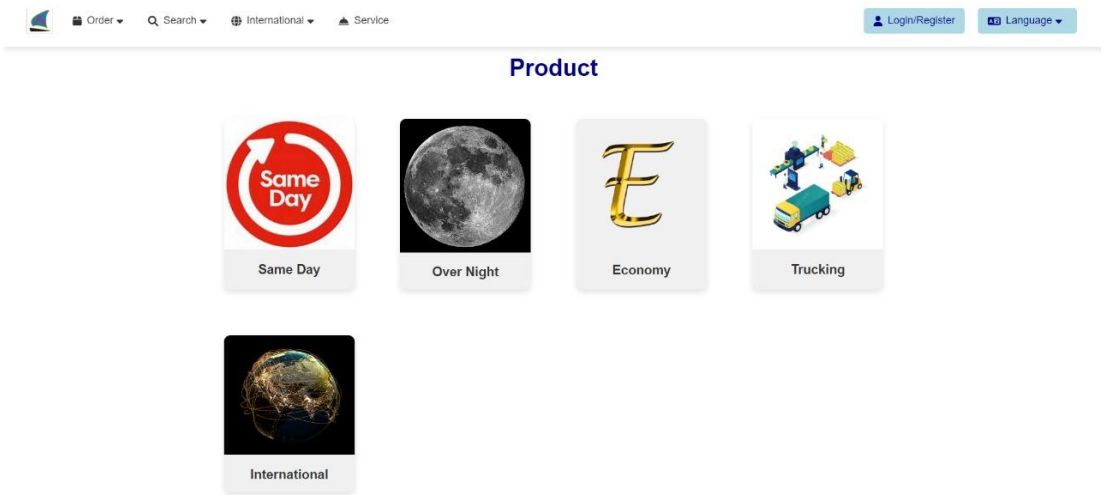

Figure 6. Product Display

Available services pages are parts of a website that provide detailed information about a particular entity, product, service or content. This allows users to understand the subject they are looking for or want to learn more about.

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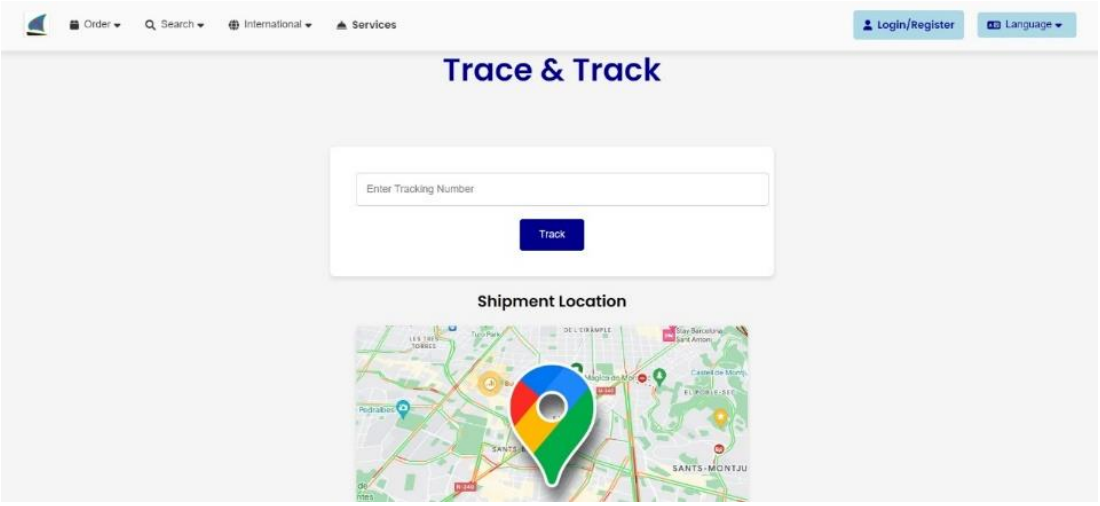

Figure 7. Trace & Track feature

This feature allows users to monitor the journey of packages or goods in real time during delivery. By using a tracking system, senders and recipients can quickly determine the position and status of goods delivery. With trace and track, users can better ensure the whereabouts and progress of goods delivery and plan receipt.

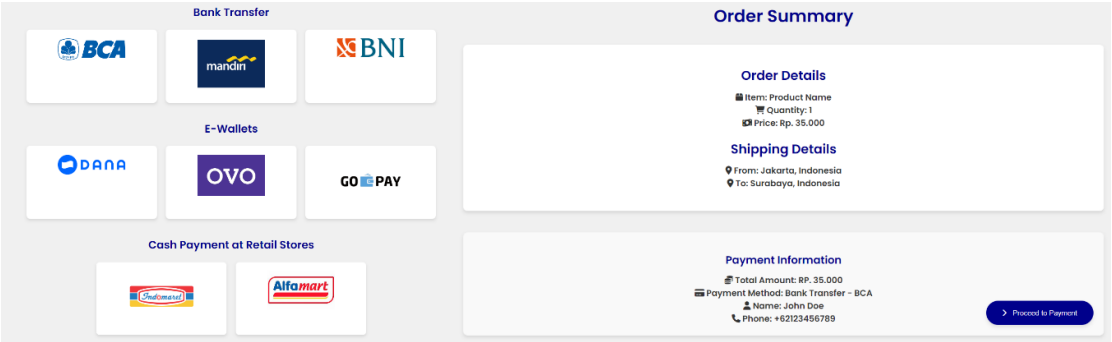

Figure 8. Payment Menu Display

3.5. Testing

The research gathered feedback from 10 participants using a System Usability Scale (SUS) questionnaire and a Figma prototype. Participants were asked to assess their understanding of the prototype through 10 questions. In the testing phase, the design's effectiveness will be evaluated using the System Usability Score (SUS) method. This technique assesses the application's usability and user satisfaction, determining whether the application is user-friendly. User comfort is gauged using the SUS, a scale from 1 to 5, where 1 indicates strong disagreement, 2 indicates disagreement, 3 indicates neutrality, 4 indicates agreement, and 5 indicates strong agreement.

Table 5. SUS Questionnaire Questions

No	Question	Mark
1.	The appearance of this website makes me think about wanting to use it again	1-5
2.	The appearance of this website is complicated to use	1-5
3.	The website appearance is easy to use	1-5
4.	I need help from another person or technician to access this Website	1-5
5.	I feel that the features on this Website work as they should	1-5
6.	I feel there are many things that are not consistent or harmonious on this Website	1-5
7.	I feel like others will understand how to use this Website quickly	1-5
8.	I find this Website very confusing	1-5
9.	I feel that there are no obstacles in using this Website	1-5
10.	I have to familiarize myself first before using this website	1-5

Furthermore, the results of the respondents' responses were calculated using the System Usability Scale (SUS) formula. In the table of questionnaires filled out by respondents, calculations are made to determine the SUS score obtained from each respondent. For odd-numbered questions such as 1, 3, 5, 7, and 9, the calculation method is the result of the respondent's answer minus one. For even-numbered questions such as 2, 4, 6, 8, and 10, the calculation method is five minus the results of the respondent's answer. The SUS score is calculated using the following formula: SUS score=(x+y)×2.5. The x and y values are the total contribution scores of each item (after adjustment if needed). SUS scores range from 0 (very poor perceived usability) to 100 (excellent perceived usability) in 2.5-point increments. The following is Table 6, which is a table that has calculated SUS for each respondent as well as the average SUS value for this prototype:

Table 6. SUS calculation

	From the Result score										Results	Total SUS
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10		
R1	4	4	4	4	4	4	4	4	4	4	40	100
R2	4	4	4	4	4	4	4	4	4	4	40	100
R3	4	4	4	3	3	3	4	3	4	1	33	82.5
R4	4	2	4	2	3	1	3	3	4	4	30	75
R5	4	4	4	4	4	1	4	4	4	4	37	92.5
R6	4	4	4	4	4	4	4	4	4	4	40	100
R7	3	3	4	4	4	3	4	4	4	3	36	90
R8	4	3	4	4	4	3	3	3	3	2	33	82.5
R9	4	3	4	2	4	3	3	3	3	3	32	80
R10	4	2	3	1	4	3	4	3	4	2	30	75
Total average score												**87.75**

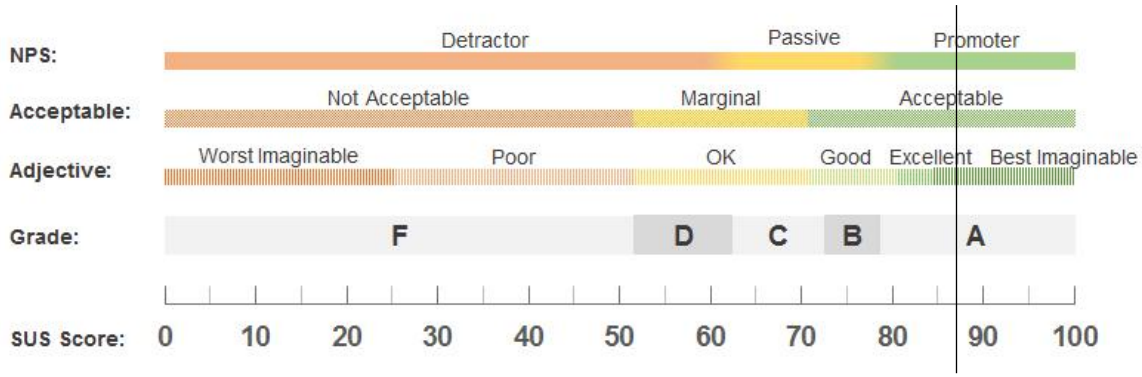

Figure 9. SUS parameters

From research into the UI/UX design of the company website PT. JESINRA MAKMUR GROUP, the final result obtained was that the average SUS score was 87.75. If we look at the adjective rating or aspects in the rating category on the website, the value is included in the "EXCELLENT" category. Therefore, researchers for PT created the UI/UX design of the information system website. Jesinra Makmur Group has catered to users to make ordering delivery services and checking locations easier.

4. Conclusion

Based on research conducted by researchers regarding UI/UX analysis and design on the PT website. Jesinra Makmur Group, using the design thinking method and the SUS usability scale system, can conclude that there is a problem with the website. Where this website has not been updated since the company was founded and has minimal information and features. So, a redesign is needed so that it can keep up with current developments and meet user needs using the method used in the testing stage for evaluation materials on the PT website. Jesinra Makmour Group is a usability scale (SUS) system

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where the average SUS result obtained is 87.75. In the adjective range, it can be concluded that the website design is in the "Excellent" category, with the grade scale obtained being "A-" and the acceptability range obtained is acceptable, which means this website is appropriate and accepted by the respondent.

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Design and Development a Web Platform Portal for Mosque Financial Management

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ABSTRACT

Transparency and accountability in the financial management of mosques is an area that requires significant attention because it builds the initial trust of the mosque in collecting funds through infaq and waqf. Currently, many mosques still use whiteboards as a tool to present their financial reports. This poses a problem for mosques when delivering financial reports to donors who live far away. Therefore, a tool that can serve as a medium for financial reporting is needed. Based on this need, the research aims to create a web-based mosque financial portal to record income (donations, alms), qurban records, and expenses. In other applications, each mosque uses an application designed for each mosque. This software has been developed to accommodate the needs of each mosque and is integrated into a single application portal. The development of this application uses the Waterfall method, which involves various stages such as user requirements, system design, implementation, and testing. This financial portal was successfully implemented in 11 mosques and prayer rooms across 5 provinces. This application features recording income (donations and alms), qurban records, and expenditure records. The test results show that many mosques can use this financial management portal to record income and expenses. Finally, we can conclude that this web-based mosque financial portal would be a viable solution to enhance the accountability services of mosques in managing their finances.

1. Introduction

Managing mosque finances often involves various challenges that can hinder transparency and efficiency. Many mosques still use bulletin boards to record financial transactions, which can limit the delivery of reports to the congregation [1]. Additionally, limited resources and a lack of information technology knowledge add to this situation's problems. As cited in articles [2] and [3], the use of traditional approaches in managing mosque finances affects the level of trust the congregation has in the mosque. This also impacts the congregation's participation in mosque activities, such as donations.

This research was conducted in response to these challenges by developing a web-based application that handles multi-mosque accounts in a single integrated application mode. This application is built with modern web technology for accessibility and ease of use by various users from multiple mosques [4]. The web model allows each mosque to enter and manage their accounts through the internet anytime, anywhere. Based on research findings that state the application of web-based technology is appropriate for financial organizations, efficient and transparent financial management can be achieved for religious organizations [5].

The benefits of utilizing this application are more valuable for mosque financial management. In addition to providing additional benefits in terms of accuracy and efficiency of financial recording, the application also offers a transparent reporting mechanism readily available to relevant parties [5]. Furthermore, this application supports mosque management and reduces the possibility of human error in managing financial flows. Previous research on the application of web-based financial applications

in Islamic religious institutions found that these applications can improve the quality of financial management and accountability [6].

2. Methods

The research was conducted step by step, starting from the analysis of user needs, followed by design and planning, and the final stage was system implementation and testing [7].

Figure 1. Research Stages [7]

2.1. User Requirement and Analysis

The requirements analysis stage in the system development process aims to identify the user and requirement system [8]. The detailed steps carried out in the user requirements and analysis stage are explained as follows:

a. Identification of Stakeholders: Identifying all parties involved in the project, including mosque administrators, congregants, and system developers.
b. Analysis of Current Business Processes: Analyzing the workflow and processes of recording income (donations and alms), qurban records, and expenditure records in the mosque.
c. Identification of Functional Requirements: Defining the key features that must be included in the financial portal, such as recording income (donations and alms), qurban records, and expenditure records.

2.2. Design

In this design stage, the Waterfall model is applied. The stages are explained in detail in Figure 2; the Waterfall model is a systematic approach in the software development cycle, where each stage can proceed only after the previous stage has been completed [9], [10].

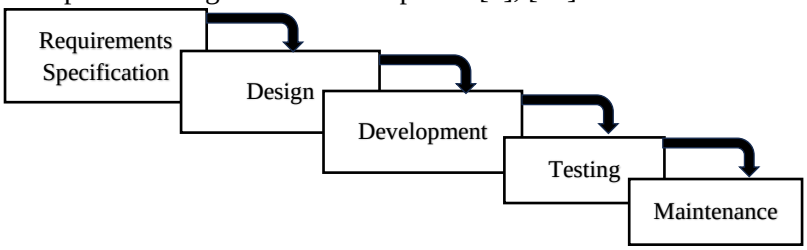

Figure 2. Model Waterfall [4]

a. User Requirements Specification
   At this stage, the analysis process will be carried out on the functional and non-functional requirements of the system being developed.
b. Design
   The design process of the system being developed uses UML Use Case Diagram modeling.
c. Implementation
   The implementation of this web-based system is developed using the PHP programming language with the Laravel framework, while the database used is MySQL [11].
d. Testing
   After the application implementation stage is completed, the next step is to test the system. The system testing process is carried out using the blackbox testing method.
e. Maintenance
   The maintenance stage is the upkeep of the application that has been deployed in the production environment to ensure the system continues to function properly

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2.3. Testing and Implementation System

This stage involves coding the application using the MySQL DBMS and the Laravel framework. Mosque officials (takmir) are granted access rights to manage activities in the mosque. To ensure that every feature in the application works properly according to the needs, each feature will be tested using black box testing. This involves testing the features by providing input and ensuring that the output matches the given scenario [9], [12] .

3. Results and Discussions

After implementing the system, the next step will be to discuss the results of the system implementation. The main problem faced in this research, based on the requirements analysis, is that the activities of recording income (donations and alms), qurban records, and expenditure records are still done manually on paper. Therefore, a tool is needed to solve this problem [13].

3.1. Functional Requirements Analysis

This analysis includes the processes that users will need to run their business processes, which are implemented into the application [14], [15]. The functional requirements of this software are detailed in Table 1.

Table 1. Functional Requirement Financial of Management Mosque

No	Functional Requirement System
1	The system has the feature to login and logout according to the specified role.
2	The system displays a dashboard and menu tailored to the user role
3	The system can configure each mosque account addition
4	The system can add, edit, delete, and search for mosque income data (donations, alms, etc.).
5	The system can add, edit, delete, and search for mosque income data (qurban).
6	The system can add, edit, delete, and search for mosque expenditure data
7	The system can send a receipt notification from the mosque income process to congregants.
8	The system can send announcements to congregants.

3.2. Diagram Use Case System

In this research, modeling is done using a use case system diagram. This model presents the interaction between users and the system [16]. The use case system depicts the system functions from the user's perspective. The detailed use case system diagram for the mosque financial portal is illustrated in Figure 3.

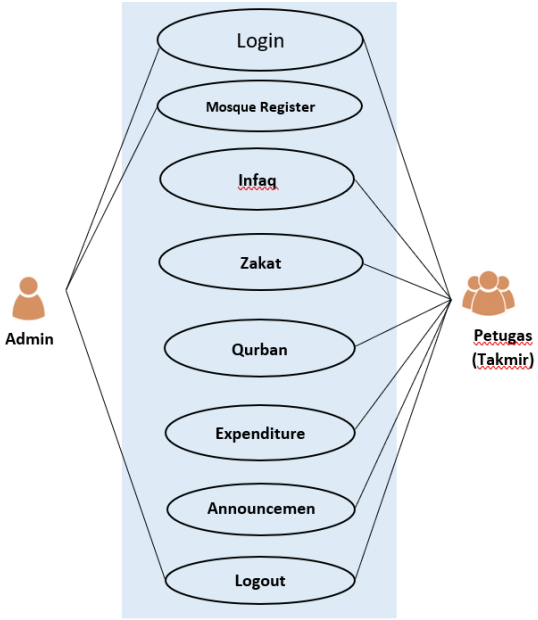

Figure 3. Use Case Diagram Financial of Management Mosque System

3.3. Implementation System

The implementation of the mosque financial portal application resulted in nine (9) menu features. The following section will discuss each menu in detail.

3.4. Login

To access the application, users must log in using the WhatsApp number/email and password that have been provided.

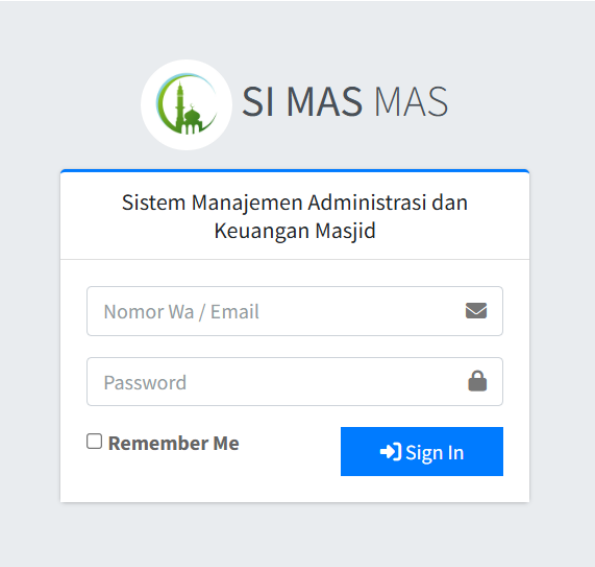

Figure 4. Login Page

3.5. Dashboard

The Dashboard displays information such as the total receipts of zakat, donations, and qurban in real-time.

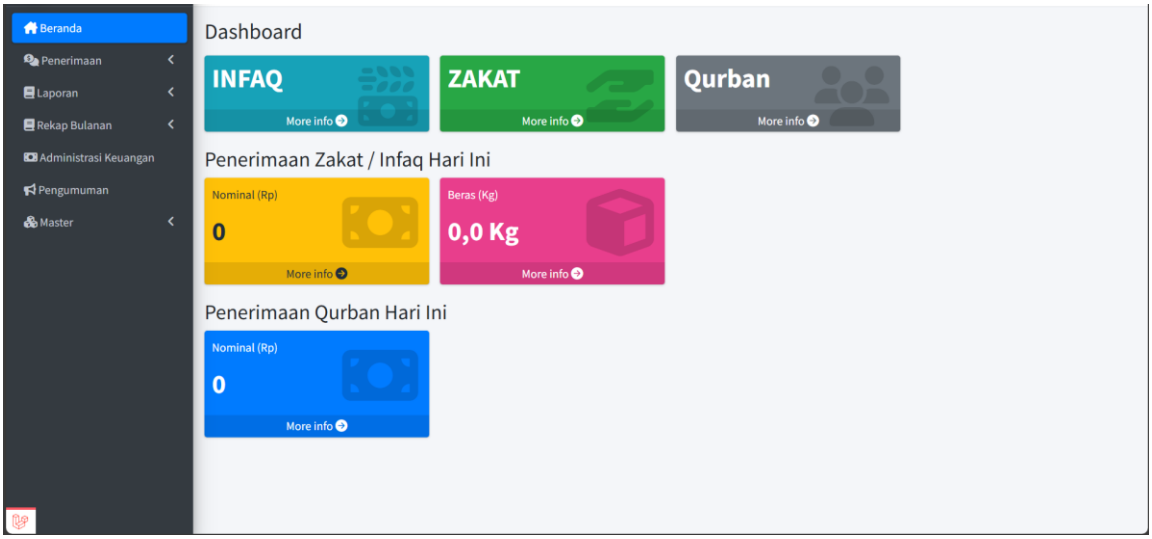

Figure 5. Dashboard

3.6. Configuration

The mosque configuration page is used to manage the mosque profile and the data of the officials (takmir) who will use the application. When a mosque account is first added, the first step that must be taken is to configure the mosque account data. This data includes the takmir information, mosque contact WhatsApp number, header photo, or mosque address. This information will be used by the system to send notifications to congregants when making donations or zakat payments.

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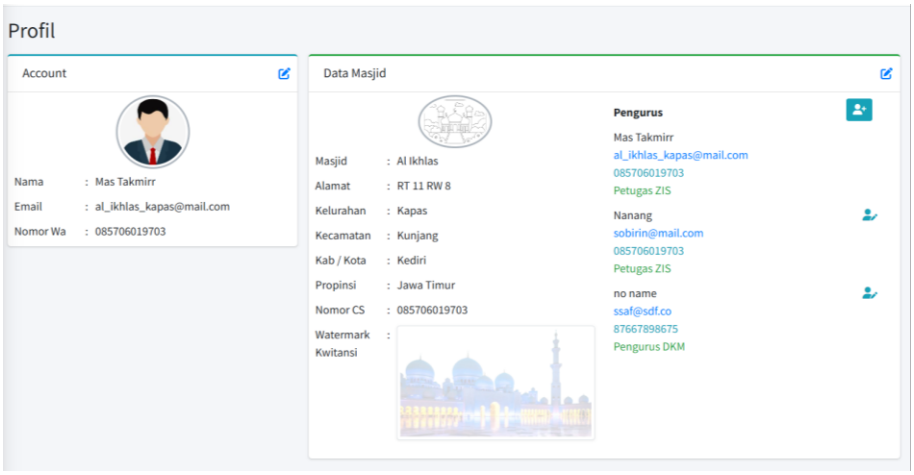

Figure 6. Configuration Mosque

3.7. Donation

The donation data page is used to manage the donation receipts from congregants/donors. On this page, users can add, edit, and delete donation data.

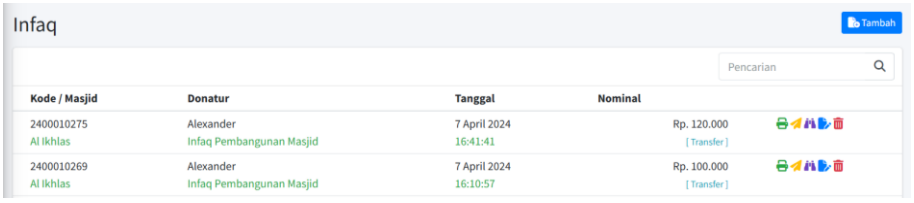

Figure 7. Donation

3.8. Zakat

The zakat data page is used to manage zakat receipts from donors. On this page, users can add, edit, and delete zakat data.

Figure 8. Zakat

Next, users can also input zakat data by filling out the form below.

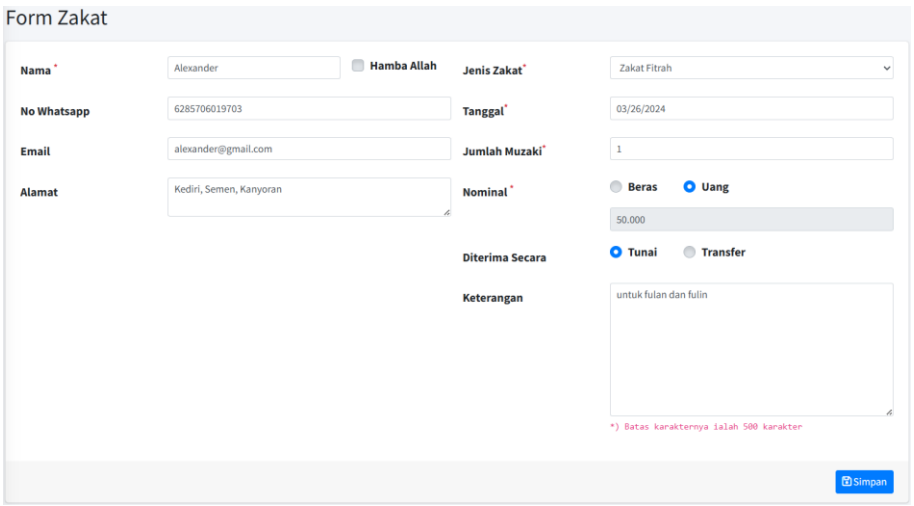

Figure 9. Form Zakat

3.9. Qurban

The qurban data page is used to manage qurban receipts from congregants or donors. On this page, users can add, edit, and delete qurban data.

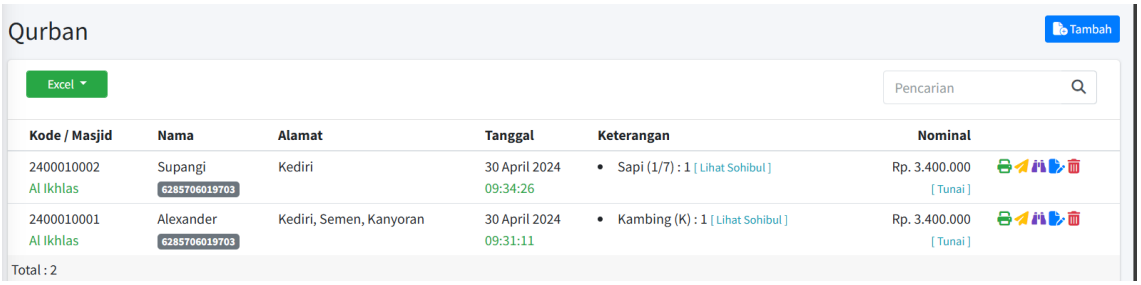

Figure 10. Qurban Process

3.10. Expenditure

The expenditure data page is used to manage the mosque's expenditure data. On this page, users can add, edit, and delete expenditure data.

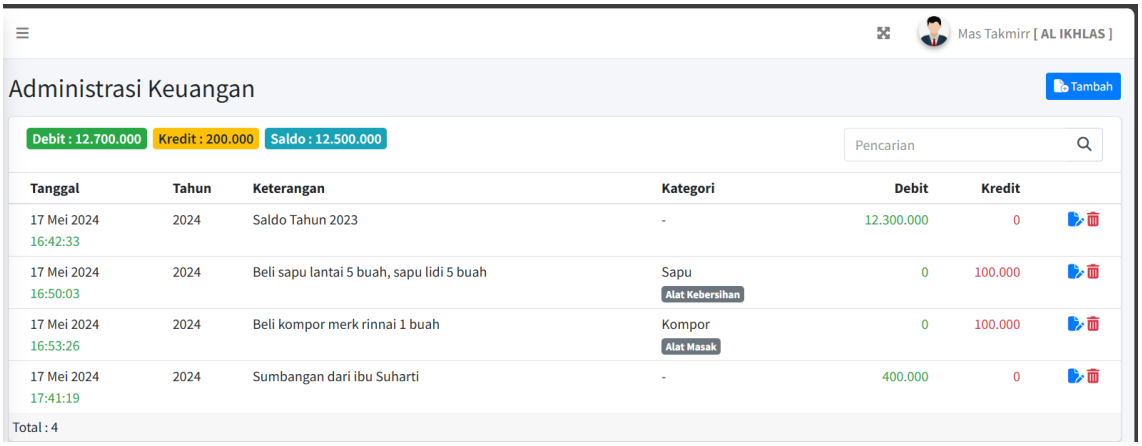

Figure 11. Qurban Data and Receipts to Congregants

3.11. Announcement

The announcement page is used to send WhatsApp notifications. On this page, users can select the recipients of the announcement to be sent. The target numbers can be grouped into administrators, donors, and congregants.

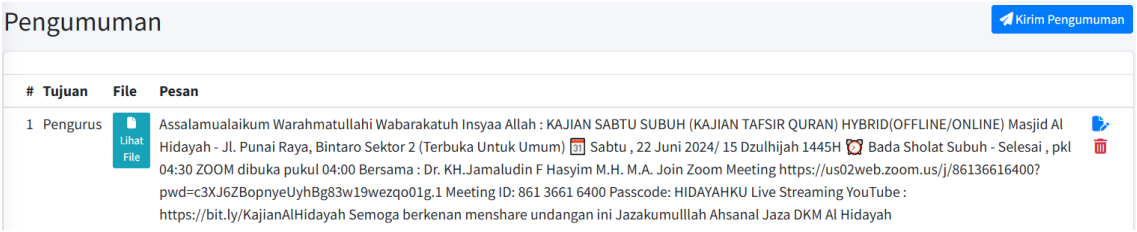

Figure 12. Announcement

Next, users can proceed with sending the announcement by filling out the form below. In this form, users can attach a file in PDF or image format and write the message that will be sent to the recipients.

DOI: https://doi.org/10.52435/jaiit.v6i1.599

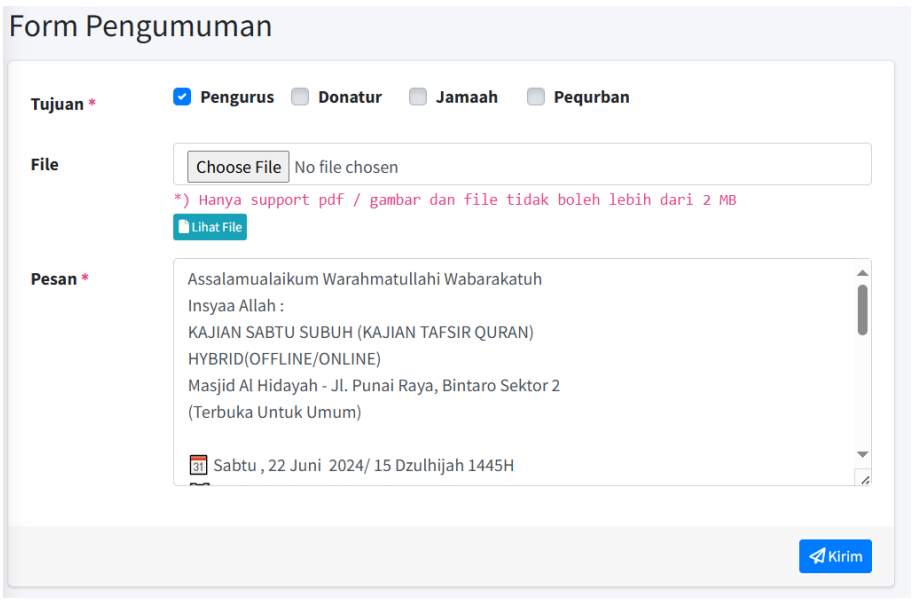

Figure 13. Form Create Announcement

3.12. Discussion

All features have been implemented, and the next step is to test each feature. Testing is conducted using predetermined scenarios. After testing the system's functionality, the next step is to train the mosque administrators to use the application.

The mosque financial portal application began to be used around February 2024. Currently, 11 mosques across 5 provinces are using the application. The response from the jamaah to the management of the mosque has been very positive. This is evident from the increased participation of the congregation in mosque activities such as qurban, infaq, or almsgiving. On average, participation has increased by about 2-5% compared to before using the application. list of mosques using the application is presented in Table 2.

Table 2. List name of mosque using portal application

No.	Name	Address
1	At Taqwaa	Dusun Bungkul, Kapas, Kunjang, Kediri, Jawa Timur
2	Al Ikhlas	RT 11 RW 8, Kapas, Kunjang, Kediri, Jawa Timur
3	Al Hidayah Bintaro	Jl. Punai Raya, Bintaro Jaya Sektor 2, Rengas, Ciputat Timur, Tangerang Sclatan, Banten
4	Roudhotul Jannah	Jl. Timbul III B RT 08 RW 04, Cipedak, Jagakarsa, Jakarta Selatan, DKI Jakarta
5	Al Karim	Dsn Bungkul, Kapas, Kunjang, Kediri, Jawa Timur
6	Baitussalam	Perumahan Kalibaru Permai RT.004/RW.07 No.99, Kalibaru, Cilodong, Depok, Jawa Barat
7	Al Muldjirin	Perumahan Pondok Pucung 1, Pondok Pucung, Pondok Aren, Tangerang Selatan, Banten
8	AL 'ASHR	Taman Kenari Jagorawi, Puspasari, Citeureup, Kab. Bogor, Jawa Barat
9	Muawanah Semarang	Jalan Mangga V Nomor 17,Lamper Kidul, Semarang Selatan, Kota Semarang, Jawa Tengah
10	Qotyatussalam	Perum Qoryatussalam Sani Jl. KSU Tirtajaya, Sukmajaya, Sukmajaya, Depok, Jawa Barat
11	Al Anwar Gondang	Rt 1 C RW1, Gondang, Watumalang, Wonosobo, Jawa Tengah

In addition to the positive impact, there are also challenges in implementing this application, such as users who are not all accustomed to using the application. Therefore, further assistance is needed to help mosque administrators become familiar with using the application. Additionally, there is feedback regarding the ease of checking transactions in account mutations, which can be integrated with wallet payment systems. This integration would reduce the steps needed for staff to verify incoming transactions to the account.

4. Conclusion

This research provides a solution for mosques in recording financial management, both income and expenses. The solution offered is a web-based financial management information system to facilitate the management of financial income and expenditures. Additionally, this application is equipped with receipts and notifications connected to the congregants' WhatsApp numbers, reducing the use of paper in record-keeping. Future development of this application includes integrating a digital wallet payment model, allowing transaction mutations to be recorded automatically.

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