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PREFACE

We would like to present, with great pleasure, the first issue of Matrix: Jurnal Manajemen Teknologi dan Informatika in Volume 14, 2024. This journal is under the management of Scientific Publication, Research and Community Service Center, Politeknik Negeri Bali, and is devoted to covering the field of technology and informatics management including managing the rapid changes in information technology, emerging advances in electrical and electronics and new applications, implications of digital convergence and growth of electronics technology, and project management in electrical, mechanical or civil engineering. The scientific articles published in this edition were written by researchers from Universitas Dipa Makassar, Universitas Mercu Buana, Universitas Bumigora, and Politeknik Negeri Bali. Articles in this issue cover topics in the field of System Usability Scale (SUS) implementation in Ruang Baca Virtual – UT Library, Designing a Helpdesk Ticketing System to Improve The Efficiency of IT Support Services on an XYZ Company-Based Website Using The Laravel Framework, Identification of Top Influence Users in Disseminating Information on The 2024 Indonesian National Election, Geolocation Data Incorporation in Mapbox for Comprehensive Mapping of Tourism Areas on Lombok Island, and Voltage Drop Comparison in Lead-acid and Lithium-ion Batteries on Electric Scooters. Finally, we would like to thank the reviewers for their efforts and hard work in conducting a series of review phases thoroughly based on their expertise. We hope that the work of the authors in this issue will be a valuable resource for other researchers and will stimulate further research into the vibrant area of technology and information management in specific, and engineering in general.

Politeknik Negeri Bali, 30 Mei 2024

Editor-in-chief

Gusti Nyoman Ayu Sukerti, S.S., M.Hum.

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System Usability Scale (SUS) implementation in Ruang Baca Virtual – UT Library

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Abstract: Universitas Terbuka (UT) implements Distance Learning and since 2012 launched Ruang Baca Virtual (RBV) application to improve student learning services and provide alternative conveniences for students to utilize teaching materials online and help other universities wish to carry out online learning as an alternative solution to face-to-face replacement lecture services. Usability is one of the key factors for successful technology adoption. During the implementation of RBV, usability testing has never been carried out. The purpose of this study was to determine student perceptions of RBV usability. RBV usability testing was carried out using the questionnaire method using the system usability scale (SUS) instrument. The test results show that a SUS score of 72,66 placing RBV in the "acceptable" range, corresponds to a grade of C and the usability of RBV can be rated as "Good".

Keywords: usability testing, System Usability Scale (SUS), Ruang Baca Virtual (RBV)

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Introduction

Universitas Terbuka (UT) as a tertiary institution that implements Distance Learning, since 2012 launched Ruang Baca Virtual (RBV) application which can be accessed at https://pustaka.ut.ac.id/lib/ruangbaca/ as a form service provided by UT to improve student learning services and provide alternative conveniences for students to utilize teaching materials online [1]. RBV provides teaching materials for 1,350 courses and currently RBV can be accessed in full text in connection with efforts to increase awareness and prevention of contracting COVID-19 and as part of UT's commitment to assisting State Universities and private universities that wish to implement online learning as an alternative solution to face-to-face replacement lecture services.

RBV is introduced with innovative technical features to address the special challenges of providing distance learning. In contrast to conventional digital library systems, RBV incorporates personalization algorithms that dynamically suggest learning materials based on students' preferences and usage patterns. In addition, RBV adopts a micro-service architecture that allows for easier system scale and updates and provides a customizable interface to facilitate accessibility for users with special needs.

Nurdiansyah et al [2] previously conducted research to determine student perceptions of RBV based on three WebQual 4.0 quality dimensions, namely information quality, service interaction, and usability, and found that the usability dimension has a negative effect on student satisfaction.

Usability is one of the key factors for successful technology adoption [3] and the overall quality of software products. Furthermore, digital library usability, which refers broadly to user experience and satisfaction when using digital libraries, has been the focus of most research [4]. Usability is very important in attracting new users and has a direct influence on user satisfaction [5]. Poor usability will reduce the use of information systems and hinder the acceptance of information systems by users which will have a negative impact on the effectiveness and efficiency of information systems and will reduce user satisfaction [6], [7].

Various previous studies related to usability testing on various information system applications have been carried out. For example testing on hospital applications [8], [9], e-commerce [10], [11], mobile applications [12], [13], [14], [15], banking applications [16], [17], [18] and various other fields.

However, as far as literature studies have been conducted, research on usability testing in RBV has never been carried out. Usability testing is a very important field that helps an application to be useful and easy to use by users [19].

Therefore, this study seeks to fill this void by carrying out usability testing of RBV to know student perceptions of RBV. Usability testing of RBV was carried out using the questionnaire method using the System Usability Scale (SUS) instrument. SUS is one of the most popular and easy-to-use questionnaires to measure the usability level of any product [20].

This research is organized into four parts. The second part describes the research method. The analysis and results are discussed in the fourth section. Finally, the fifth part is the conclusion of the research.

Methodology

This study used the System Usability Scale (SUS) as the main instrument to evaluate the usability of RBV. SUS was chosen due to its simplicity and efficiency in measuring perceived usability, as well as its wide acceptance across various application domains.

The System Usability Scale (SUS) is a reliable tool for measuring the usability of a system, which can include hardware, software, mobile devices, websites, and applications [21]. It consists of a 10-item questionnaire with five response options for respondents, ranging from "Strongly agree" to "Strongly disagree." Developed by John Brooke in 1986, the SUS is a quick and cost-effective method that provides a global view of subjective assessments of usability [22].

To calculate the SUS score, each question's score is first converted to a new number. For odd-numbered questions, subtract one from the user's score. For even-numbered questions, subtract the user's score from five. Then, sum all these new values and multiply by 2.5 to convert the original scores of 0-40 to 0-100. These scores are not percentages but should be considered in terms of their percentile ranking. A SUS score above 68 is considered above average, and anything below 68 is below average. The SUS provides a single number that reflects a composite measure of the overall usability of the system being evaluated [23], [24].

The first step taken was to prepare research instruments. The research instrument used in the study was adopted from Sharfina and Santoso's research [26]. The table of research instruments is illustrated in Table 1.

Table 1. Item in SUS

No.	Item in SUS
1	I think that I would like to use this system frequently.
2	I found the system unnecessarily complex.
3	I thought the system was easy to use.
4	I think that I would need the support of a technical person to be able to use this system.
5	I found the various functions in this system were well integrated.
6	I thought there was too much inconsistency in this system.
7	I would imagine that most people would learn to use this system very quickly.
8	I found the system very cumbersome to use.
9	I felt very confident using the system.
10	I needed to learn a lot of things before I could get going with this system.

After the research instruments were completed, the instruments were distributed to respondents. Respondents in this study were engineering students majoring in information systems at Universitas Terbuka undergraduate study program. The population in this study was 70 students. The number of samples used in this study amounted to 32 respondents. Details of research respondents can be seen in Table 2.

Table 2. Research respondents' details

PS 2022.1	Semester	Total Students	Study Group	Subjects
SI CSR6	6	24	JENEPONTO	MSIM4315/Data Warehouse
SI BM6	6	24	MAKASSAR	MSIM4315/Data Warehouse
SI CSR4	4	22	BULUKUMBA	MSIM4207/System Information Management

After the questionnaire data has been collected, the results of the data must be analyzed to give meaning to the results that have been obtained. The questionnaire data must go through various stages, starting from data entry into the computer, testing validity and reliability, and descriptive analysis.

One aspect of the descriptive analysis was evaluating the usability of the system using SUS. SUS provides a reliable metric for evaluating the usability of a product or system (Bangor et al., 2008). The SUS yields a score on a scale from 0 to 100, where higher scores indicate better usability. To interpret the SUS scores obtained in this study, the acceptability ranges and adjective ratings proposed by Bangor et al. (2008) were used as guidelines (Figure 1).
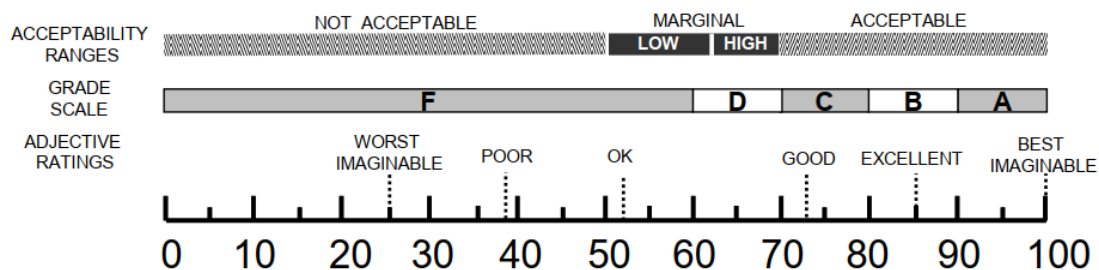
Figure 1. The score of System Usability Score (SUS)

Figure 1 shows the interpretation of the SUS score. The acceptability ranges guide how to categorize the level of system usability based on the SUS score obtained. A SUS score above 68 is considered above average usability and in the "acceptable" range. Scores below 68 are interpreted as below average or unacceptable usability.

In addition to the acceptability ranges, the grade scale maps the SUS scores to letter grades from A to F. This grading scale allows for ranking the usability level, with A being the highest pass level indicating excellent usability, and F being the lowest failing grade, indicating awful usability. Finally, the adjective ratings provide descriptive labels corresponding to different SUS score ranges to qualitatively rate the usability level. The adjective ratings are: Best Imaginable, Excellent, Good, Ok, Poor, and Worst Imaginable.

Results and Discussions

Respondents who were used as samples in this study totaled 32 people, dominated by 75% (24 people) of female respondents, and 25% (8 people) of male respondents with an average age of respondents was 21 years.

Prior to statistical analysis, the items of the absolute questions are to be tested for validity and reliability. With SPSS, validity and reliability can be done simultaneously in one way. The validity test results are presented graphically in Figure 2.

Figure 2. Questionnaire validity test results

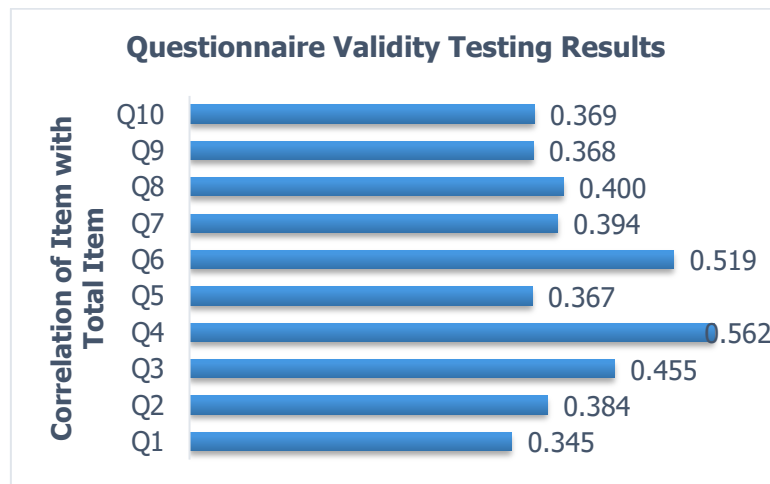The validity of the questionnaire items was evaluated by calculating the item-total correlations. The item-total correlation for a given item indicates the extent to which scores on that item correlate with the total scores across all other items in the scale [27]. It is calculated by first obtaining the total score for each respondent by summing their responses across all items. Next, for each item, the corrected total score is calculated for each respondent by subtracting their score on that specific item from their total score. The item score is then correlated with the corrected total scores across all respondents [28]. A higher item-total correlation signifies that the item is a valid measure of the same underlying construct as the overall scale [29]. To assess validity, the calculated item-total correlations were compared against established minimum criteria, commonly set at 0.3 or higher [30]. Figure 2 shows whether the item questions have good content validity or not. Items failing to meet these criteria were considered for revision or removal from the scale, as low item-total correlations suggest the item may not adequately capture the intended construct. If you pay attention, all question items have item correlation values with a total item above 0.3, meaning that all question items are declared valid.

Table 3. Questionnaire reliability test results

Cronbach's Alpha	N
.665	10

Table 3 is a table showing the reliability value. The reliability of the questionnaire was assessed by calculating Cronbach's alpha coefficient. Cronbach's alpha is a measure of internal consistency reliability that estimates how consistently individuals respond to the items within a scale [31]. It is based on the average inter-item correlation, with higher values indicating greater reliability [28]. Specifically, Cronbach's alpha values of 0.6 or higher are generally considered acceptable for establishing the internal consistency of a scale [32].

As shown in Table 3, the Cronbach's alpha value obtained for the 10-item questionnaire was 0.665. This result falls within the acceptable range, demonstrating that the items in the questionnaire have satisfactory internal consistency reliability.

The usability level of RBV was measured using a research instrument by adapting the Indonesian version of SUS questionnaire [26], designed on a 5-point Likert scale with a score of 1 for the answer criteria Strongly Disagree to a score of 5 for the answer criteria Strongly Agree.

Table 4 shows the data obtained from the usability questionnaire of RBV using the SUS architecture. The data table consists of columns of respondents worth 1–32 respondents.

Table 4. Data generated from the SUS questionnaire

No	Respondents	Actual Score										SUS
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	
1	Respondents 1	5	4	5	5	5	5	5	5	5	5	52,50
2	Respondents 2	5	4	4	3	5	2	3	1	3	4	65,00
3	Respondents 3	5	2	5	3	4	2	3	2	4	4	70,00
4	Respondents 4	5	2	5	2	5	2	4	2	4	2	82,50
5	Respondents 5	5	1	5	5	5	1	5	1	5	5	80,00
6	Respondents 6	4	2	4	1	4	5	3	2	5	3	67,50
7	Respondents 7	4	2	4	4	4	4	4	3	4	4	57,50
8	Respondents 8	4	1	4	2	4	3	5	1	5	4	77,50
9	Respondents 9	5	5	5	3	4	2	5	2	5	5	67,50
10	Respondents 10	4	2	5	3	5	5	5	2	5	5	67,50
11	Respondents 11	5	1	5	5	5	1	5	1	5	1	90,00
12	Respondents 12	4	3	3	3	4	3	4	2	4	4	60,00
13	Respondents 13	4	1	4	2	5	1	4	1	4	5	77,50
14	Respondents 14	4	3	3	2	1	5	3	1	1	5	40,00
15	Respondents 15	5	1	4	2	5	5	5	1	5	5	75,00
16	Respondents 16	5	4	3	1	4	4	3	4	2	5	47,50
17	Respondents 17	5	2	5	1	4	1	4	2	4	2	85,00
18	Respondents 18	5	2	4	2	5	1	5	1	5	3	87,50
19	Respondents 19	4	3	3	3	4	2	4	3	2	4	55,00
20	Respondents 20	5	2	5	1	5	2	5	1	5	3	90,00
21	Respondents 21	5	2	5	2	5	4	5	1	5	4	80,00
22	Respondents 22	5	1	5	1	5	1	5	1	5	1	100,00
23	Respondents 23	5	1	5	1	5	1	4	1	5	2	95,00
24	Respondents 24	5	1	5	1	5	1	5	1	5	5	90,00
25	Respondents 25	5	2	5	1	5	3	5	1	1	1	82,50
26	Respondents 26	5	4	4	2	4	2	5	1	5	1	82,50
27	Respondents 27	5	1	5	3	5	1	5	1	5	3	90,00
28	Respondents 28	5	3	2	2	5	1	3	2	3	5	62,50
29	Respondents 29	5	5	4	4	5	5	4	2	3	4	52,50
30	Respondents 30	3	2	2	4	3	2	2	3	2	5	40,00
31	Respondents 31	5	2	4	1	4	1	4	2	4	5	75,00
32	Respondents 32	4	2	5	1	3	1	4	1	5	4	80,00
	SUS AVERAGE SCORE											72,66

The score is based on the responses of students who have evaluated RBV. After calculating the 32 respondent's data into an assessment score, the next step is to calculate the average SUS assessment score from 32 respondents, namely 72.66.

Based on the information provided in Table 4 the average SUS score for RBV is 72.66, we can interpret these findings using the acceptability ranges, grade scale, and adjective ratings as follows.

A SUS score of 72.66 placed it in the "acceptable" range. This indicates that the usability of RBV is considered above average and acceptable. Referring to the grade scale, a SUS score of 72.66 corresponds to a grade of C. According to the adjective ratings, a SUS score between 68-

80.3 is described as "Good" usability. Since 72.66 lies within this range, the usability of RBV can be rated as "Good".

Therefore, based on the acceptability ranges, grade scale, and adjective ratings, the findings suggest that RBV has an acceptable level of usability, a grade of C on the usability scale, which is an average/median grade, and an adjective rating of "Good" usability, describing it as a system with satisfactory and above-average usability.

Conclusion

A SUS score of 72.66 places RBV in the "acceptable" range. This indicates that the usability of RBV is considered above average and acceptable. Referring to the grade scale, a SUS score of 72.66 corresponds to a grade of C. According to the adjective ratings, a SUS score between 68-80.3 is described as "Good" usability. Since 72.66 lies within this range, the usability of RBV can be rated as "Good".

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Designing a helpdesk ticketing system to improve the efficiency of IT support services on an XYZ company-based website using the Laravel framework

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Abstract: PT XYZ company requires a Helpdesk Ticketing system that can enhance the efficiency of their IT support services. Hence, this study aims to design and implement a web-based Helpdesk Ticketing System using the Laravel framework. The system is designed to assist the IT department in efficiently responding to and addressing employee issues. The research methodology includes user requirement analysis, system design, and application development using the Laravel framework. During the requirement analysis phase, the author identifies user needs and determines the essential features that should be present in the system. Subsequently, the system is designed, considering efficient architecture and design principles. In the development stage, the author utilizes the Laravel framework to build the Helpdesk Ticketing System. The selection of this framework is based on its capability to expedite the development process and provide the required features for the system. Additionally, the author conducts testing using the Black Box Testing method to ensure the system's functionality. The outcome of this research is a web-based Helpdesk Ticketing System that efficiently assists the IT department in handling employee issues. The system allows employees to report problems through the website, and the IT team can easily respond to and manage incoming tickets. With the implementation of this system, it is expected that the efficiency of IT support services will increase at PT XYZ.

Keywords: helpdesk ticketing system, IT support, Laravel framework, service efficiency, website

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Introduction

PT XYZ is a company operating in the household appliances industry, producing a variety of detergents and bathing equipment for all ages, and operating in the industrial sector. As a manufacturing company, they rely on information technology systems to support various operational aspects, including IT support services. However, in practice, companies often face challenges in dealing with IT service requests from departments or employees. Manual processes for recording requests, assigning tasks, and tracking completion status are often time-consuming, less efficient, and difficult to monitor [1], [2].

In order to improve the efficiency of IT support services, a website-based helpdesk ticketing system design can be an effective solution. The Helpdesk Ticketing System is a system that allows companies to manage and track IT service requests through the ticketing system [3]. The system provides a central platform that allows IT departments and other users to communicate, collaborate, and track ticket status in real-time [4], [5].

Laravel is a powerful and expressive PHP web framework designed to accelerate the process of web application development. With features such as a powerful routing system, easy database management, and built-in tools for user authentication, it allows developers to build web applications quickly and efficiently. It also offers integrated security, easy maintenance, and large and active community support.

By implementing the Laravel Website Framework-based Helpdesk Ticketing System, PT XYZ can optimize the process of handling its IT service requests. Some of the benefits that can be obtained include: (1) Increased efficiency, the ticket system will automate the assignment, and guarantee that the appropriate staff members are handling IT service requests. This saves time and improves demand-handling efficiency [6]. (2) Centralised tracking and reporting, with the ticket system, companies can track the status of IT service requests in real-time. This allows management to monitor progress in troubleshooting, identify potential bottlenecks, and take necessary action to improve efficiency [7].

Methodology

This research is a quantitative study with methods to create a basic framework to solve problems with questions. This method is called a research and development method [8]. Based on the results of the observations by conducting a direct survey in the field or location of research, namely PT. XYZ and literature studies, the research aims to create a system implementation in the form of a projected build of the ticketing system Helpdesk Ticketing System to improve the efficiency of IT support services [9]. This system is expected to optimize the level of performance of IT support services in the company PT XYZ.

The method of data collection is one of the aspects that play a role in the smoothness and success of research. In this research, the methods used for data collection are as follows: (1) Observation, The researchers conduct direct embedding into the field to find out and study the processes that support the research, (2) Literature Studies, this method involves comparing the research being done with the research that has been done before. In the first phase of the observation and literary studies, the author performs observations directly in the field to obtain data and analyze the processes already running on the PT. XYZ and conduct a literary study related to the topic and formula of the problem in this research.

In Stage Two, Identification of Needs, the author performs the identification of needs that will be implemented into the system. Once the need is identified, the result will be converted to a diagram containing information about the application needs and how the helpdesk ticketing system application can be used in the XYZ PT system [10].
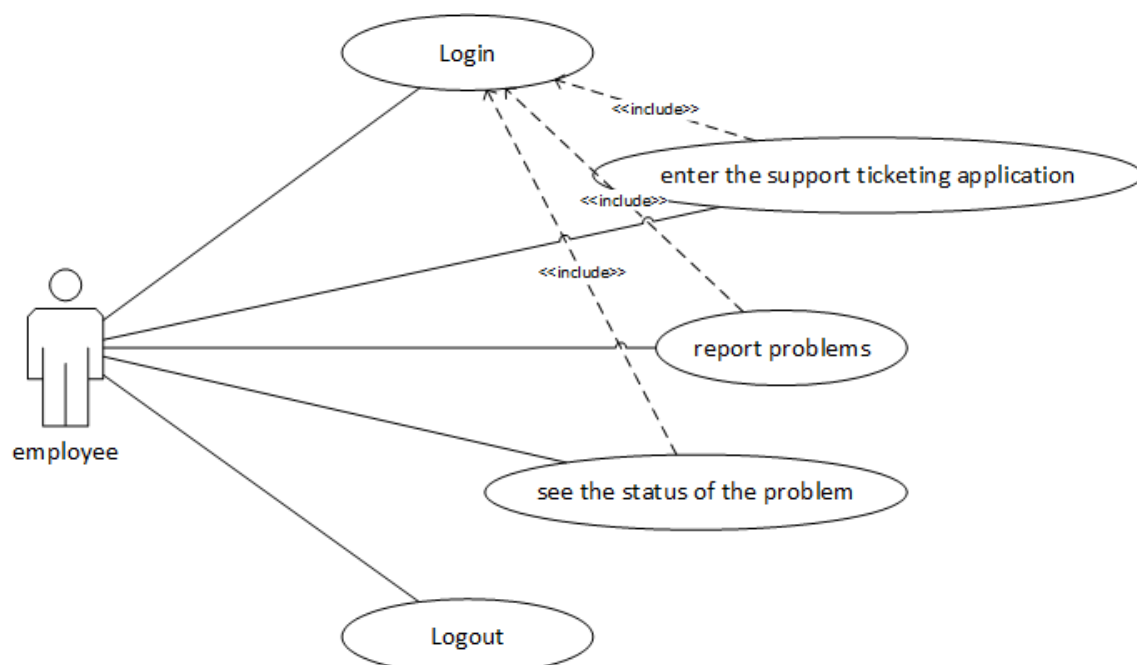
1) Usecase Diagram

Figure 1. Usecase employee diagram

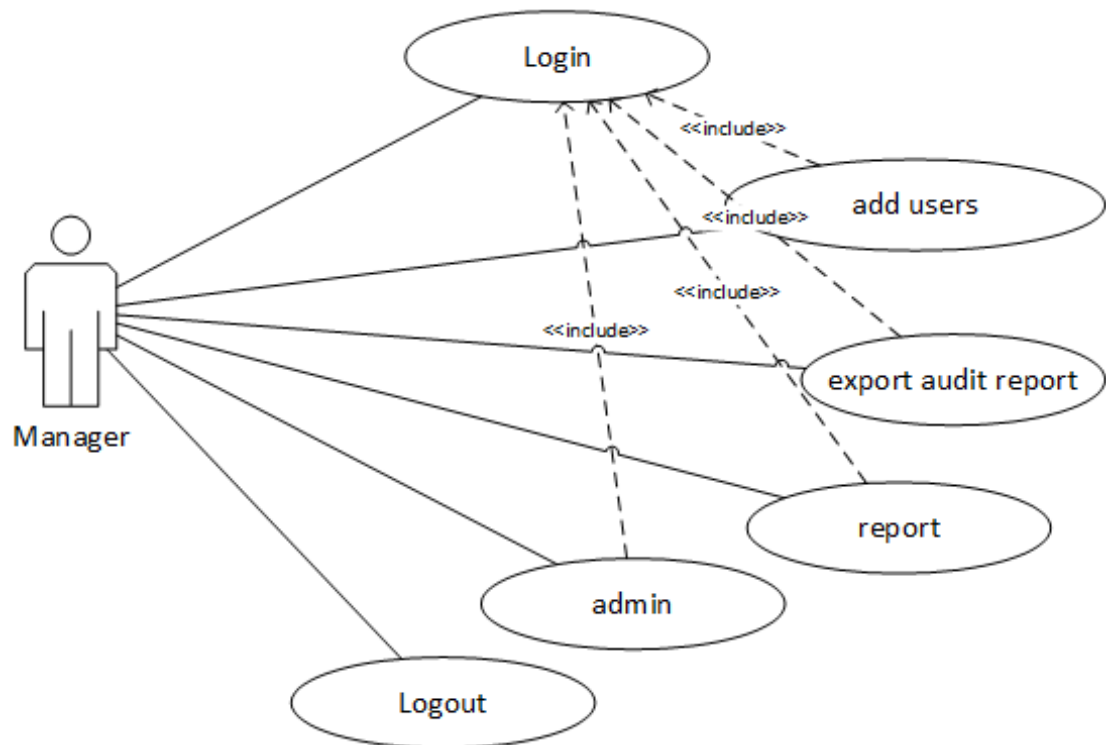Figure 1 describes the use case of the user used by the employee.

Figure 2. Usecase admin diagram

Figure 2 describes the use case of the admin that the manager uses.
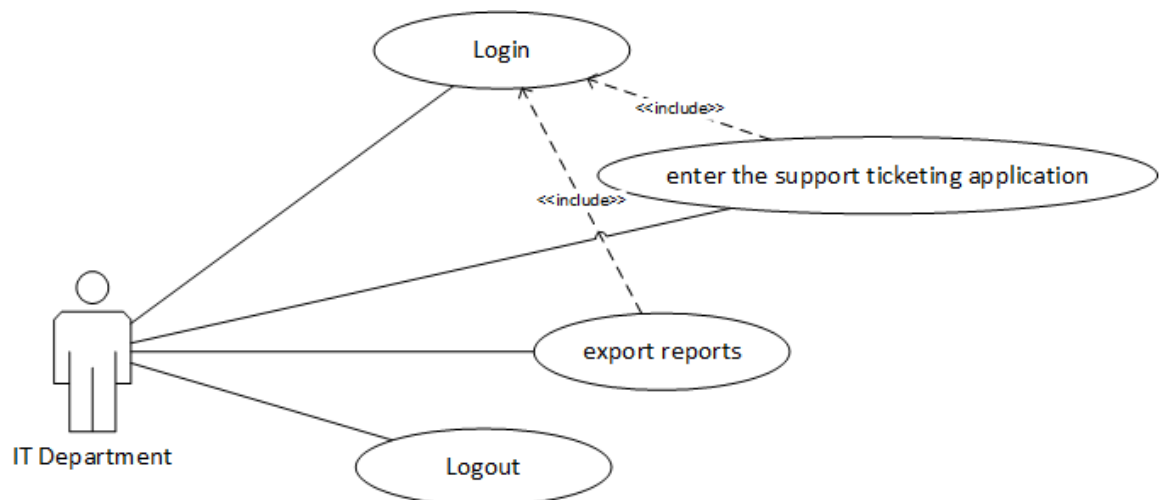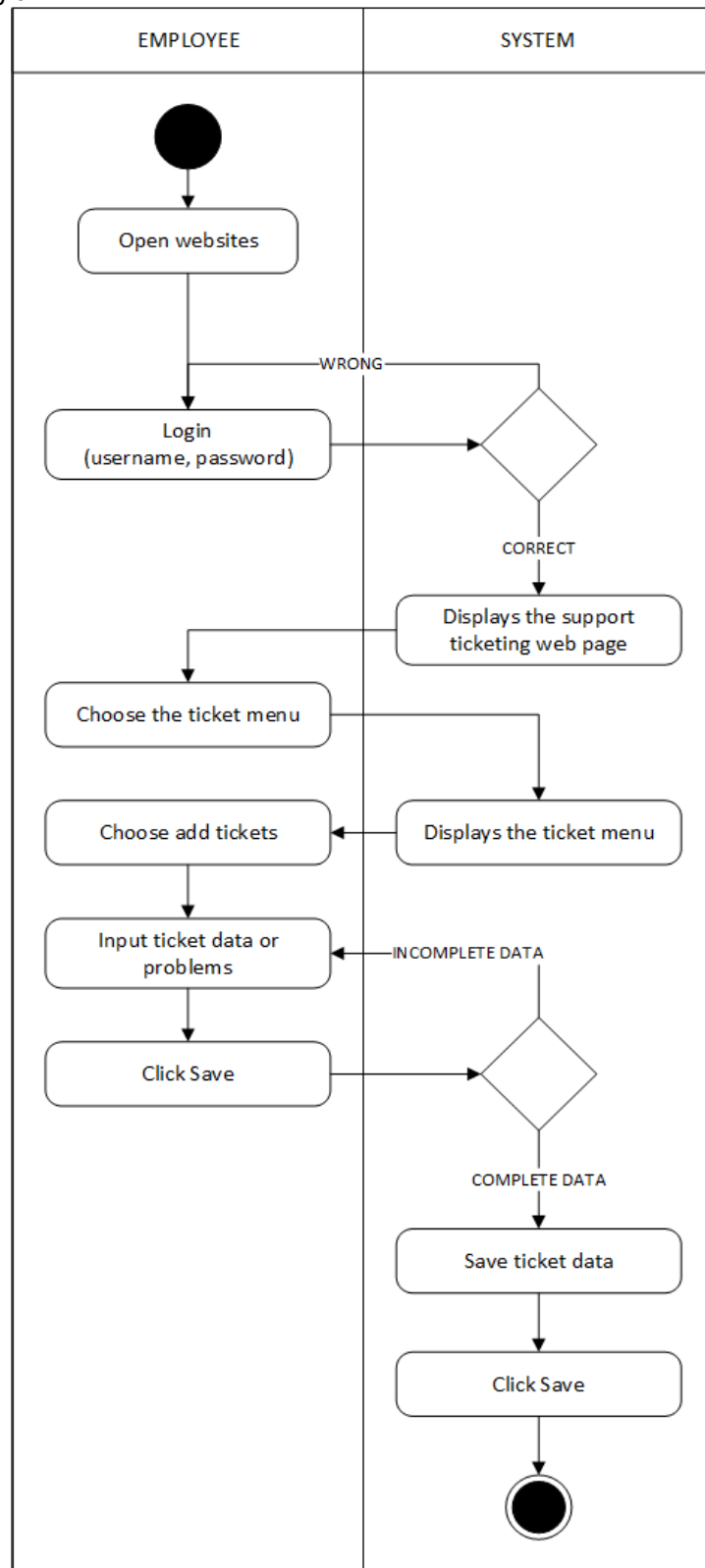

Figure 3. Usecase IT department diagram

Figure 3 describes the use case of the IT department that uses the IT network and IT software.

2) Activity Diagram

Figure 4. Activity diagram compliant input

Employees can access the support ticketing website page and do the login process. Once the login is successful, the system will display the main page. Next, the employee can choose a ticket menu that will display a list of existing tickets. Employees can enter the data of the problems they encounter and store it through the system.
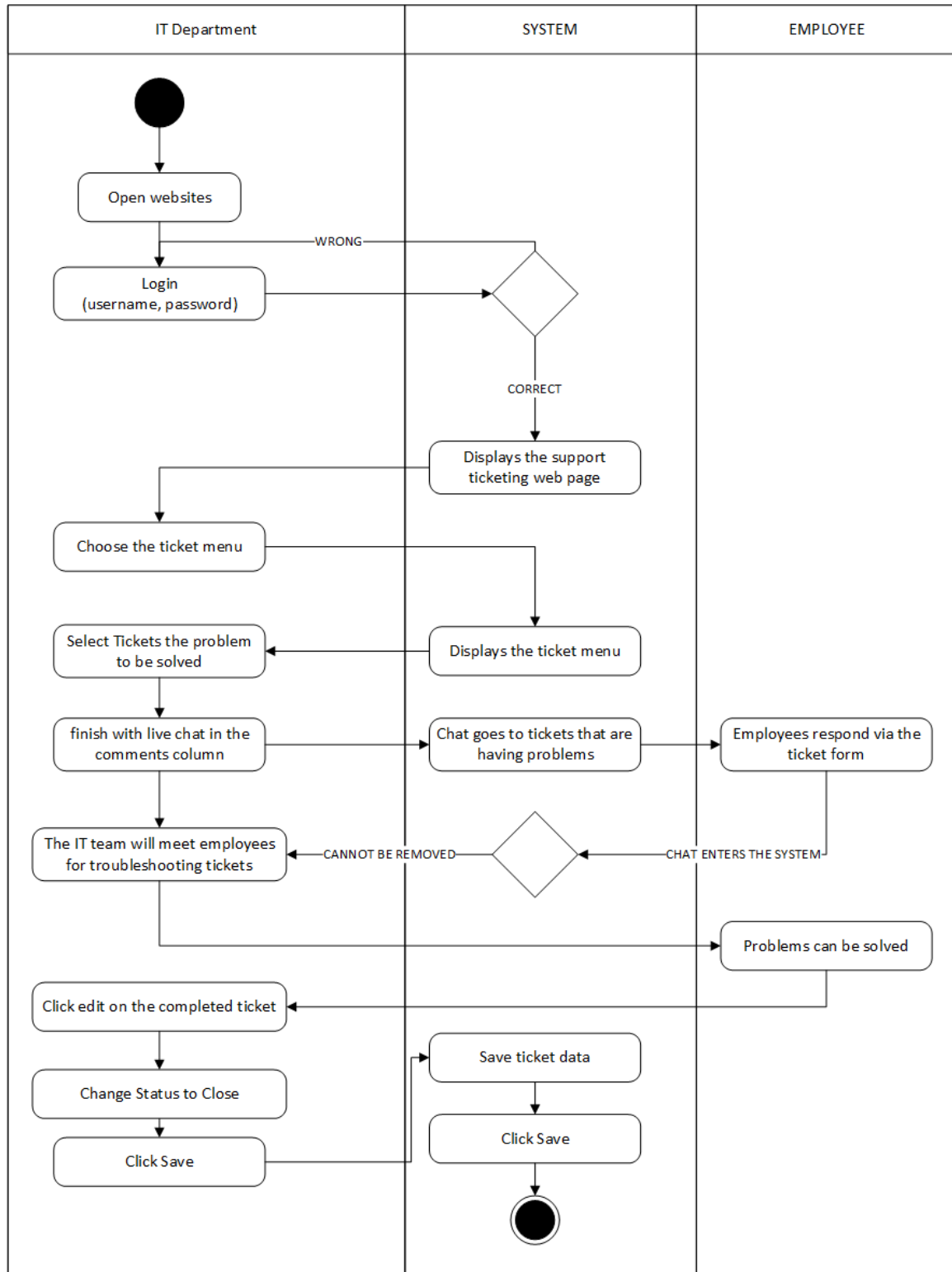
Figure 5. Activity diagram IT department completed tickets

Once the IT department logs in, the system will display the dashboard page. The IT team then chooses the ticket menu, which allows them to manage employee data and store it through the system.
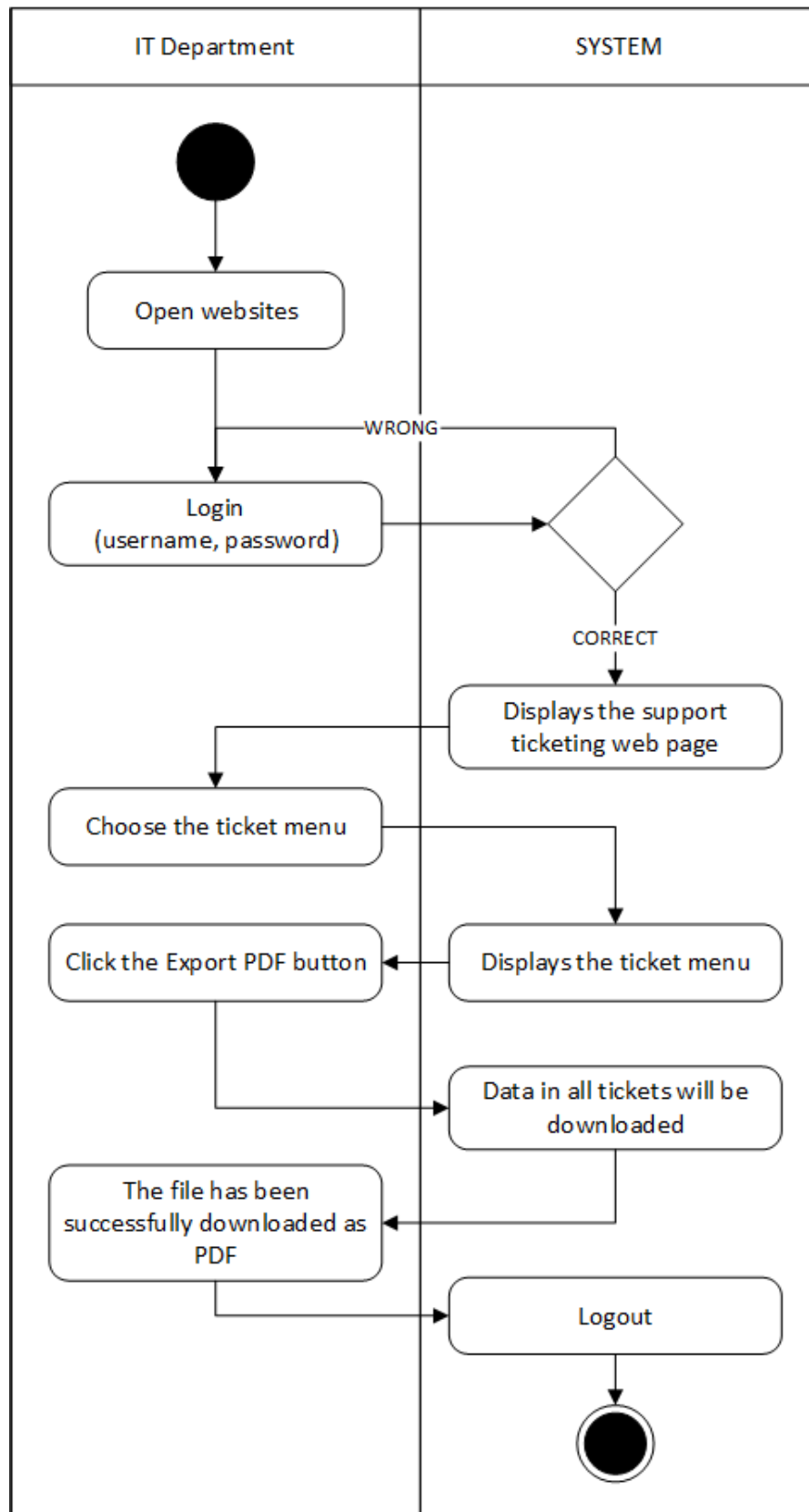
Figure 6. Activity diagram export tickets report

Once the IT department logs in, the system will display the dashboard page. The IT team then selects the ticket menu, then presses the PDF export button, and the IT department successfully downloads the PDF-format report.

The third stage is the installation of the Open-Source Helpdesk Ticketing System application using the Laragon web server and installed in the browser. The fourth phase simulates testing of the Helpdesk Ticketing System application. The fifth phase is the finalization phase of the use of the open-source helpdesk ticketing system application proposal. At this stage, conclusions will be obtained from this final task research, which has already been simulated, so that it can be proposed to be implemented on PT XYZ as a solution to the problem. In addition, the resulting output is documented as a report of recommendations using the Helpdesk Ticketing System suggestion.

Results and Discussions

Application Architecture

The application architecture has several sections, namely employees who use the Helpdesk Ticketing System application, where employees will access the server locally through the browser on their respective computers [11]. When an employee submits a complaint ticket, the problem will be handled by the IT department. The IT Department consists of IT networking and IT software. The IT team will access the application and resolve the employee's complaint ticket. If the complaint has been resolved, the application status will be changed from open to closed. Then comes the role of the manager as an admin, where this admin has full access rights to control the Helpdesk Ticketing System application [12].
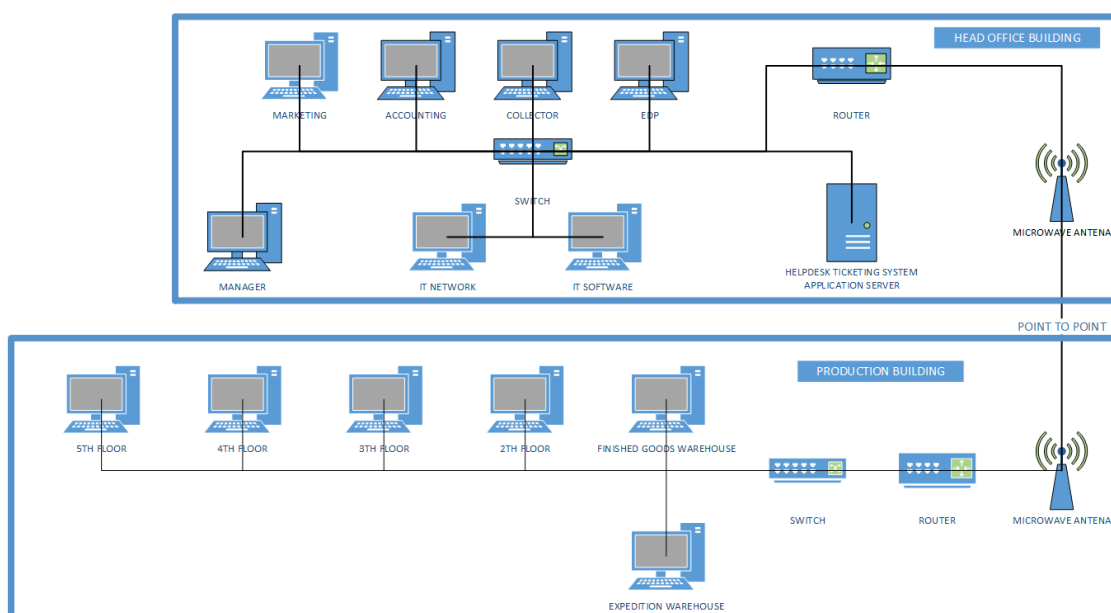
Figure 7. Application architecture

System Implementation

Here's a view of some of the menus that have been created, which are the results of the identification of problems at the methodological stage. Figure 8 explains the login appearance.

Figure 8. Page login

Figure 9. Dashboard

Figure 9 describes the main page view.

Figure 10. Add page to user

Figure 10 describes the view of adding user accounts. Figure 11 describes the view of the audit print page.

Figure 11. View the auditing print page

Figure 12. Page tickets
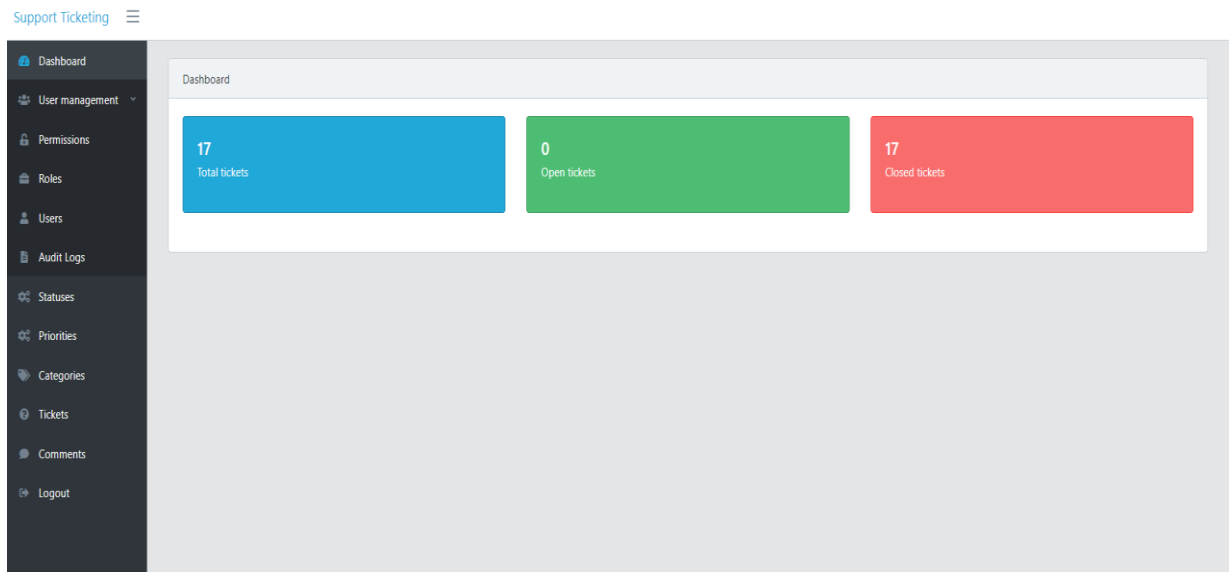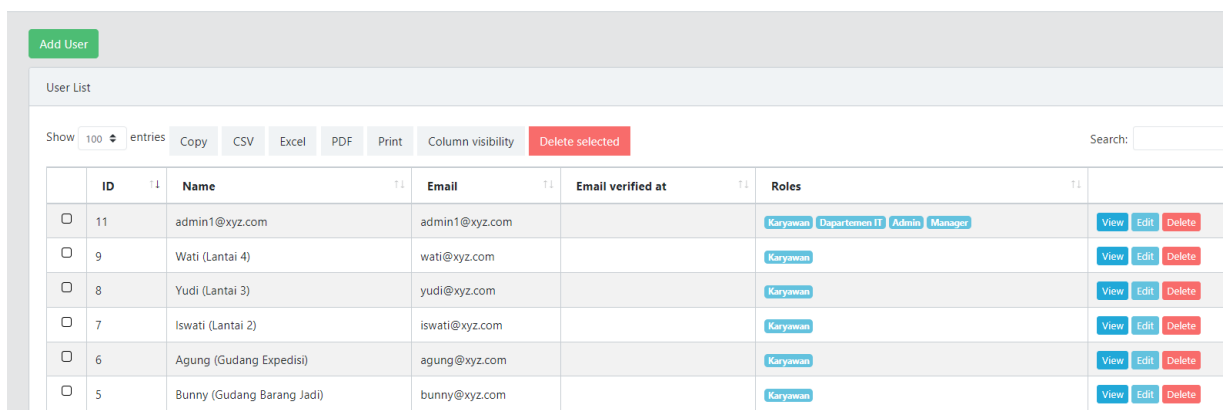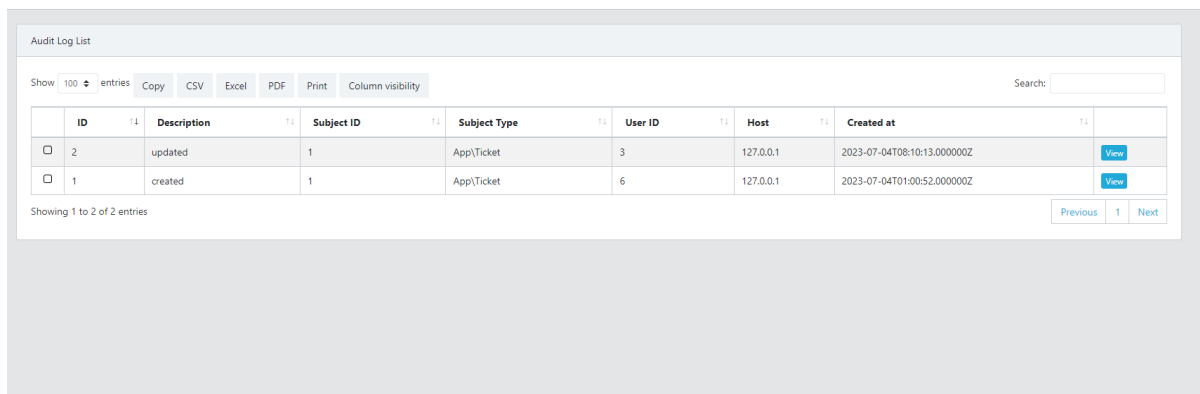
Figure 12 explains what the ticket looks like.

Figure 13. Page input tickets

Figure 13 explains the view of adding tickets.

Author Name	Agung
Author Email	agung@yuri-dee.com
Assigned To User	Cecep (IT Software)
Comments	**Cecep (IT Software) (2023-07-19 17:04:56)** I'm gonna restart the server's computer. Please wait 10 minutes. **Agung (Expedisi) (2023-07-19 17:05:26)** Well, I'll wait. **Cecep (IT Software) (2023-07-19 17:05:57)** I've restarted the computer server please try **Agung (Expedisi) (2023-07-19 17:06:15)** It's done. **Cecep (IT Software) (2023-07-19 17:06:30)** It's closed.

Figure 14. Page comment

Figure 14 describes the blatant appearance of the problem on the ticket.

Show Tickets	
ID	19
Created at	2023-07-19 17:02:48
Title	sap eror
Content	sap eror
Attachments	
Status	Closed
Priority	High
Category	Software
Author Name	Agung
Author Email	agung@yuri-dee.com
Assigned To User	Cecep (IT Software)

Figure 15. Close when tickets are finished

Figure 15 explains that the ticket view has been completed and then changes the status to closed.
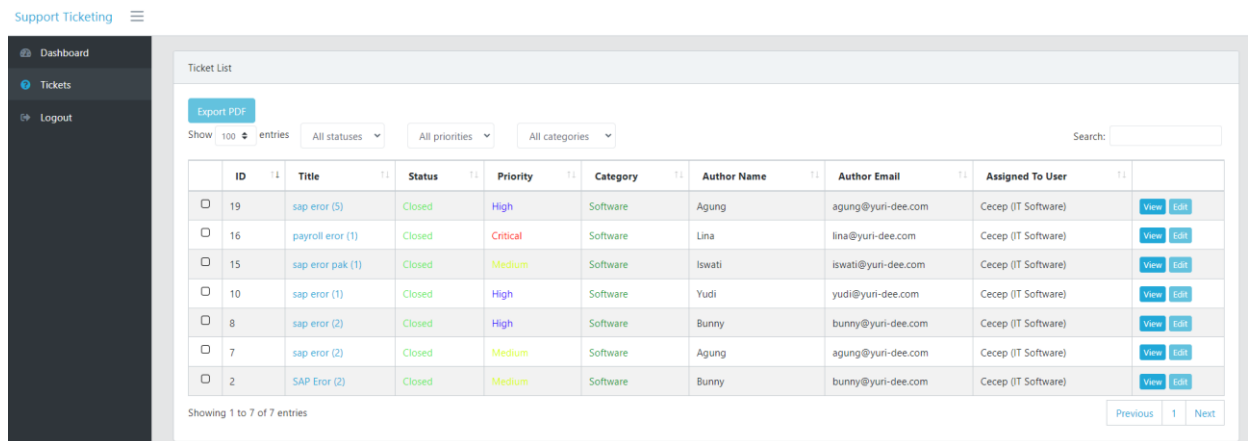
Figure 16. Check out the ticket on IT software

Figure 16 describes how the ticket page looks on the IT Software.
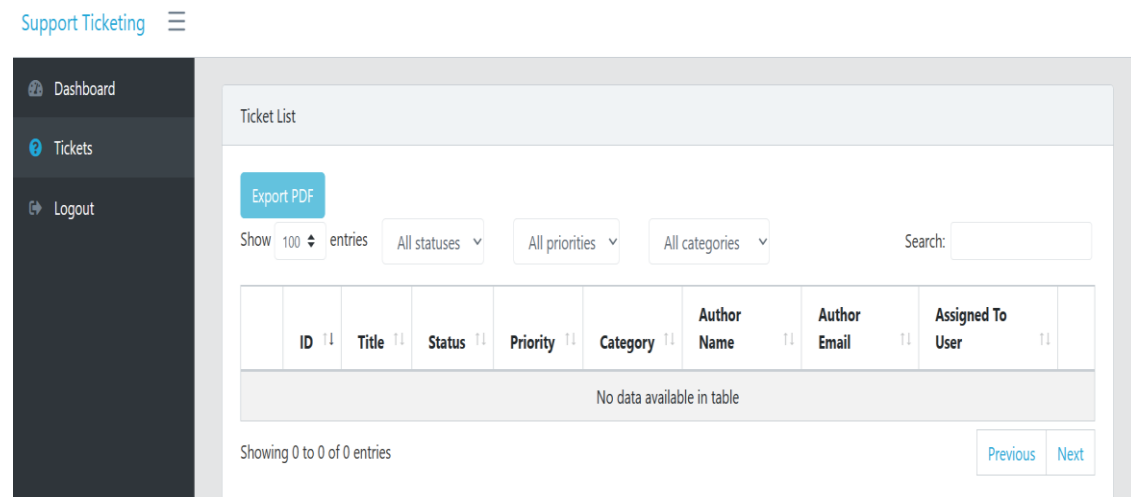
Figure 17. Look at the ticket on the network.

Figure 17 describes the appearance of the ticket page on the IT Network.

Testing Applications to Users

After the implementation phase, the next step is testing the system. This is done to ensure that the result of the system meets the needs of the employees. The researchers used Blackbox testing to test the Helpdesk Ticketing System application at PT XYZ [13], [14]. This test method is performed by testing the application based on its functionality. The purpose of this test is to find possible errors that remain in the application and to make sure that the program has been created in accordance with the intended purpose [15].

Table 1. Testing to send complaints

Type of request	Type of User	Input	Expected out-put	The output produced	Concluded
Login Applications	User	Email and Password	Showing dash-board	Showing dash-board	Succeeded
Make a new ticket.			Showing a new ticket form	Showing a new ticket form	Succeeded

Send a ticket problem.	The entire column on the ticket form is filled.	Showing a review of the tickets that have been sent	Showing a review of the tickets that have been sent	Succeeded	

The test result in Table 1 is a complaint-sending test to the department's IT and the employee will make the complaints ticket.

Table 2. The testing process of the IT department receives complaints

Type of request	Type of User	Input	Expected output	The output produced	Concluded
Login Applications	IT Department	Email and Password	Showing dashboard	Showing dashboard	Succeeded
Go to the ticket menu			Showing all complaints sent by employees	Showing all complaints sent by employees	Succeeded
When you click on the ticket, all the details will appear.			Detailed Tickets from Employees	Detailed Tickets from Employees	Succeeded

The test results in Table 2 are testing the process of the IT department receiving complaints from employees.

Table 3. Testing the printing process report on the IT department

Type of request	Type of User	Input	Expected output	The output produced	Concluded
Login Applications	IT Department	Email and Password	Showing dashboard	Showing dashboard	Succeeded
Go to the ticket menu			Showing all complaints sent by employees	Showing all complaints sent by employees	Succeeded
Click to export PDF			Download the PDF file	Download the PDF file	Succeeded

The test results in Table 3 are testing the report printing process in the IT directory.

Table 4. Process testing to solve problems through tickets

Type of request	Type of User	Input	Expected output	The output produced	Concluded
Login Applications	IT Department	Email and Password	Showing dashboard	Showing dashboard	Succeeded
Go to the ticket menu			Showing all complaints sent by employees	Showing all complaints sent by employees	Succeeded
Click the ticket and click the comment column to resolve the problem.			The message will be sent to the employee through the ticket.	The message will be sent to the employee through the ticket.	Succeeded

The test results in Table 4 are testing the process of solving problems through tickets.

Table 5. Additional user testing

Type of request	Type of User	Input	Expected output	The output produced	Concluded
Login Applications	Admin	Email and Password	Showing dashboard	Showing dashboard	Succeeded
Go to User Management and select Users.			Add all users who are already registered on the support ticketing app	Add all users who are already registered on the support ticketing app	Succeeded
Click Add User			Showing forms for creating new users	Showing forms for creating new users	Succeeded
Click Save			The new account will appear in the user column.	The new account will appear in the user column.	Succeeded

The results of the test in Table 5 are testing the process of adding a user and who can add a user who has admin access.

Table 6. Testing of an edit user

Type of request	Type of User	Input	Expected output	The output produced	Concluded
Login Applications	Admin	Email and Password	Showing dashboard	Showing dashboard	Succeeded
Go to User Management and select Users.			Add all users who are already registered on the support ticketing app	Add all users who are already registered on the support ticketing app	Succeeded
Click edit on the user you want to change.			Showing Forms for Edit Users	Showing Forms for Edit Users	Succeeded
Click Save			The user that has been edited will appear in the user column.	The user that has been edited will appear in the user column.	Succeeded

The test results in Table 6 test the editing process of the user and who can edit the user who has admin access.

Table 7. Delete the user test

Type of request	Type of User	Input	Expected output	The output produced	Concluded
Login Applications	Admin	Email and Password	Showing dashboard	Showing dashboard	Succeeded
Go to User Management and select Users.			Add all users who are already registered on the support ticketing app	Add all users who are already registered on the support ticketing app	Succeeded

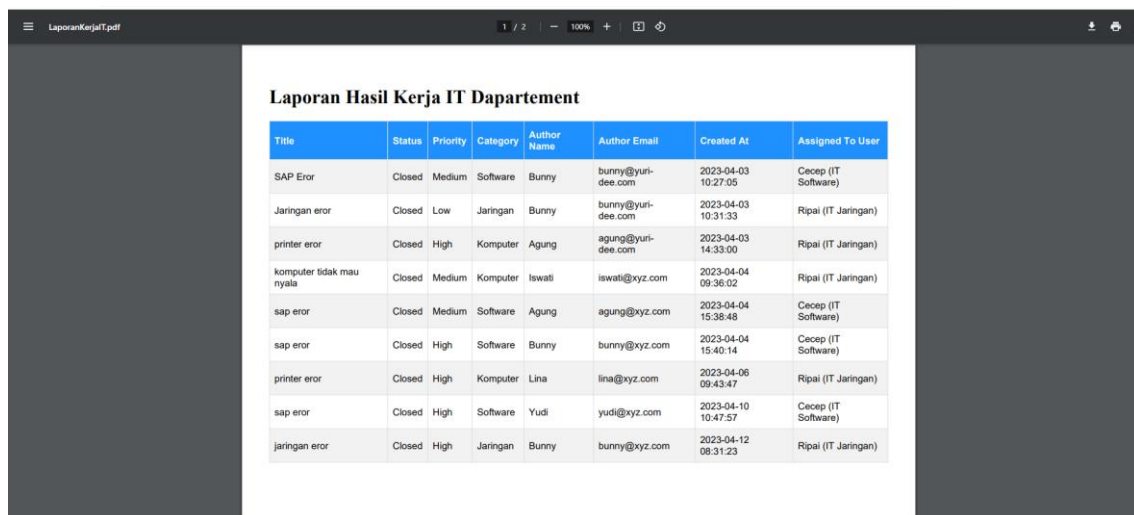| Select the user you want to be removed. | | | The successfully deleted user is not in the user column. | The successfully deleted user is not in the user column. | Succeeded |

The result of the test in Table 7 is a test of the user deletion process that can delete users who have admin access.

Table 8. Printed audit process

Type of request	Type of User	Input	Expected output	The output produced	Concluded
Login Applications	Admin	Email and Password	Showing dashboard	Showing dashboard	Succeeded
Select User Management and go to Audit Logs.			View all audits in the support ticketing app	View all audits in the support ticketing app	Succeeded
Click PDF			Download the file in PDF format	Download the file in PDF format	Succeeded
Click CSV			Download files in Excel format	Download files in Excel format	Succeeded

The test results in Table 8 are auditing printing processes that can perform auditing prints that have admin access.

From the experimental test table of some user test cases above, the features of the application or the type of service in the application object are already tested for all its functions, and the results show that the process has been successful. The author managed to add up to 15 pieces of data. Later, this application will be used in PT XYZ to help the IT team deal with complaints from employees related to IT affairs, including systems, networks, and applications

Figure 18. Results of investigation

Increased efficiency

With the implementation of ticketing support applications,
IT Department can solve problems more easily and efficiently. This improvement has been shown to increase problem-solving time.

Table 9. Efficiency results

Problems	Before the application	After the application	Efficiency
Complaints about SAP Errors	40 minutes	20 minutes	⬆ 2x and faster
The Network Complaints	60 minutes	20 minutes	⬆ 3x and faster
Application complaints	40 minutes	20 minutes	⬆ 2x and faster
complaints Printer	60 minutes	30 minutes	⬆ 2x and faster
complaints computer	60 minutes	20 minutes	⬆ 3x and faster

From Table 9, it can be concluded that there is an increase in efficiency, i.e., a measure of success assessed in terms of the size of resources for the achievement of the results of the activities carried out, which in this case is faster than the time side of solving the problem. Without this system, the IT department can't record its work, which leads to neglect. However, with the helpdesk ticketing system, a manager or a big boss can oversee the IT department's work. With the direct supervision of a manager or a big boss, the IT department can solve PT.XYZ problems quickly.

Conclusion

In the face of the current situation at PT XYZ, where the troubleshooting process of computers, networks, and software is still done manually, it is recommended to implement a website-based Helpdesk Ticketing System application using the Laravel Framework, called Support Ticketing. The designation of the Helpdesk Ticketing System application as Support Ticketing aims to facilitate its use and facilitate employees in referring to the system. Based on the discussions that have been done regarding Support Ticketing, some conclusions can be drawn as follows:

1. The application of Support Ticketing will benefit PT XYZ in accelerating and improving the efficiency of the Troubleshooting process by the IT department. In addition, it will also save quotas and pulses used when communicating with employees. By using the comment feature on the ticket related to the problem, the IT department can immediately respond and perform Troubleshooting quickly.
2. All reports from the IT department will be comprehensively recorded and accessible through the ticketing page. The reports can be downloaded in PDF file format, allowing you to save and share the reports easily. Thus, PT XYZ can have a complete record of the activities and performance of the IT department in a structured and easily accessible form.
3. After implementing the support ticketing app, there was an improvement in efficiency compared to previous performance comparisons that still relied on manual methods such as making phone calls to employees. The IT department can save costs previously spent on phone pulses and internet quota use. With the presence of support ticketing applications, the interaction between IT departments and employees becomes more efficient, fast, and well-recorded, which ultimately results in significant cost savings for PT XYZ.
4. The ticketing support app is very easy to operate by all groups.
5. The role of admin as add user and creator of audit reports.

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Identification of top influence users in disseminating information on the 2024 Indonesian National Election

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Abstract: Social media has a vital role in general elections in Indonesia because social media is one of the platforms used by presidential candidates for campaigns to gain public support. General elections in Indonesia occur every five years. Many tweets talk about presidential candidates approaching the national election period. Not least, some buzzers deliberately use Twitter to carry out propaganda against a candidate or to bring down other presidential candidates with their opinions because information can spread widely and quickly on Twitter. Based on this, it is necessary to identify influential users in disseminating information related to the 2024 National Election, especially on Twitter. Various centrality methods were used in this study to identify influence users in sharing information about the 2024 National Election such us Degree Centrality, Closeness Centrality, Harmonic Centrality, Eigenvector Centrality, and Load Centrality. For the evaluation in this study, the results of each method were compared to one another to measure the similarity and correlation between the ranking lists of users who were influential in disseminating information about the 2024 National Election.

Keywords: centrality, disseminating information, Indonesia, identification influence user, national election 2024

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Introduction

Social media has been widely used for political communication with the aim of political campaigns or verbally attacking political opponents. One of the social media that is widely used for political communication is Twitter [1]. Twitter is a microblogging that allows users to convey opinions or opinions of up to 280 characters. With the number of tweets reaching 500 million a day [2], many researchers are interested in studying data on Twitter. One area of Twitter analysis is identifying users who influence a particular topic. In politics, identifying influential actors can be used to identify actors who are buzzers or not. The buzzer in political communication on Twitter can cause political discussion to be not neutral. For certain parties, the identification of influential actors can be used as a way to conduct campaigns quickly and effectively.

In Indonesia, general elections was in 2024 to elect to be held for all lines of government, from regents, governors, and legislative bodies such as the DPR and DPRD to the President of Indonesia for the next five years. Based on this, since 2023, various parties, especially interested parties, have disseminated information and news related to the election. The dissemination of information on Twitter is unlimited and anonymous, causing the dissemination of information via social media cannot be filtered. News that is real or a hoax can spread without a filter. These stories greatly influence their readers and can further influence people's decisions to vote in the 2024 National Election [3]. The public needs to filter the information presented, especially on social media, so the information they read comes from accurate sources.

State of the art in this research encompasses various approaches undertaken to analyze the influence of social media users, particularly on Twitter, in the context of politics and elections. Previous studies have extensively explored the use of Twitter for political communication, including campaigns and verbal attacks against political opponents. Identifying influential users has become a focal point in this analysis to reveal actors acting as "buzzers" in political discussions.

These buzzers can significantly skew political discussions, which certain parties may exploit for rapid and effective campaigning.

In different contexts, research has also examined sentiment analysis related to national elections and the prediction of election outcomes using Twitter data. Studies like [4] provide a general overview of the process for predicting election results, although without specific data. Additionally, [5], [6] compare election prediction results in the US and the UK, while [1] focuses on election data from Turkey. Further, research by [7], [8], [9] has looked into identifying influential users in information dissemination, using varied data contexts such as rumor spread about floods in Indonesia [8] data from kcore-analytics.com [9], and random data [5].

However, there has been no specific research aimed at detecting influential users in disseminating information regarding the 2024 National Election in Indonesia. This study addresses this gap by focusing on identifying influential Twitter users involved in spreading information about the 2024 National Election, thus helping the public access accurate and reliable information sources. This study aims to identify social media users disseminating the 2024 National Election information. This identification process can then become a filter for the public to find accurate sources of information—data related to the 2024 National Election by crawling from Twitter. Furthermore, the data is processed to produce the required data format to identify the top-k users who disseminate information related to the 2024 National Election. Based on the results of the top-k users, it can determine who influences sharing information about the 2024 National Election.

Methodology

The data used in this study was data crawled from Twitter from 2023. Twitter data that is crawled is Twitter data that contains #Pemilu2024 in the tweet and only uses Indonesian. Furthermore, the attributes that match the needs were selected from the data: user screen name, tweet, and Retweet-Count. Then, data processing was continued with tweet processing. This tweet processing stage removed unnecessary symbols such as #, URLs, and emoticons so that the tweet data only consisted of strings. The tweet data processing stage was continued by searching for tweet data that contains Retweet interactions, which RT symbolizes as a representation of the interaction between the user who wrote the tweet and represented by the user-screen-name attribute with other users. The process was continued by separating the tweet's content with an RT that mentions the user-screen-name of another user. The final process was to delete user interactions that do not have a Retweet-Count or Retweet-Count = 0. This data row was deleted because interactions that do not have a Retweet-Count mean that they do not have interaction in their distribution, so they are considered not included in the information dissemination.

The diagram of tweet data cleaning, depicted in Figure 1, begins with gathering relevant tweets related to the 2024 election from Twitter using Twitter API. Subsequently, pertinent data attributes such as tweet text, date, user-screen-name, and tweet ID are selected for further analysis. Unnecessary symbols such as hashtags, URLs, and irrelevant emoticons are removed to streamline the analysis process. Retweeted content followed by another user's username is identified and separated to provide sentiment and public opinion analysis insights. User data rows lacking retweet interactions and possessing a Retweet-count of 0 are subsequently deleted, ensuring data integrity. Once all cleaning steps were completed, the refined data was stored in an appropriate format for subsequent analysis. This meticulous tweet data cleaning process was essential to ensure the accuracy and reliability of the data for various analytical purposes, including sentiment analysis and tracking public opinion trends during the election period. The amount of data successfully obtained in crawling Twitter data using #Pemilu2024 totaled 43,549. However, after going through the data processing process, the final amount of data that can be used in the following process is 9,303 data. This data is Twitter user interaction data related to the 2024 National Election.
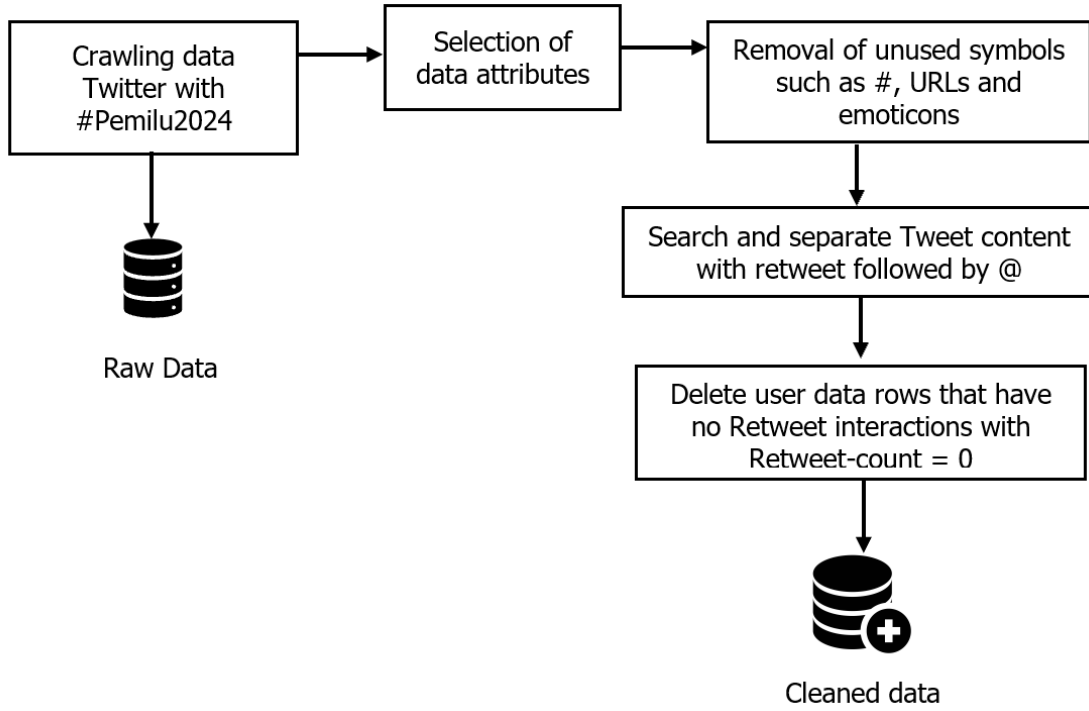
Figure 1. The steps of data processing

In addition to data, this research used several ways to identify influential users in disseminating the 2024 National Election information. These methods include Degree Centrality [10], Closeness Centrality [11], Harmonic Centrality [12], Eigenvector Centrality [13], and Load Centrality [14]. These methods are used to assess the centrality of the user on the Twitter communication network. The centrality of the user on the communication network describes the user's relationship with other users. This measure of centrality differs from one method to another. As in the Degree Centrality method, node centrality is measured by the degree that a node has [8]. Whereas Closeness Centrality looks at the centrality of a node on a network, so to calculate Closeness Centrality, we use Equation 1 [9].

$$CC(u) = \frac{1}{\sum_v d(u,v)} \tag{1}$$

Where $CC(u)$ is the closeness centrality value from the node u, meanwhile $d(u,v)$ is the shortest path between nodes u and v.

Meanwhile, one of the weaknesses of the Closeness centrality method is the inability of the way to calculate the centrality of nodes that are not connected. So, based on this, the Harmonic Centrality method was developed [15]. The equations used in calculating closeness centrality and harmonic centrality are not much different. The difference lies in the addition of condition v≠u. Thus, Harmonic centrality can be calculated as in Equation 2.

$$HC(u) = \frac{1}{\sum_{v \neq u} d(u,v)} \tag{2}$$

Where $HC(u)$ is the harmonic centrality value from the node u.

Furthermore, Eigenvector Centrality determines the centrality of a node by looking at the centrality of that node based on the centrality of its neighbors [13]. Another method that can be used to assess the centrality of a node is the Load Centrality method. The method was first developed by [16] and is known as equal betweenness because, in the process, each node sends the same amount of commodity to every other node, and then from a source, the commodity is

sent to the closest node to the target. So that all the total commodities passed by a node during all exchanges are defined as the node's load [14].

An evaluation of the 2024 National Election was carried out by measuring several evaluation criteria. The test criteria include the Jaccard Similarity Index and Kendall's Rank Correlation Coefficient. The Jaccard Similarity Index is used to measure the similarity of the top-k list of influential users from the data used based on each method used. The Jaccard Similarity Index value ranges from 0 to 1 with a value close to 1, meaning that the two lists have a higher similarity. Jaccard Similarity Index can be calculated by Equation 3.

$$J(A,B) = \frac{|A \cap B|}{|A \cup B|} \tag{3}$$

The following evaluation criterion used is Kendall's Rank Correlation Coefficient. Kendall's Rank Correlation Coefficient measures the association between two sets of rank lists. Measurements with Kendall's Rank Correlation Coefficient were carried out to see the similarity of the ranking order of the existing data.

## Results and Discussions

Results

Tests on the 2024 National Election data produced a list of top-ranking users on Twitter that are influential in disseminating information about the 2024 National Election in Indonesia. All data users were assessed for their centrality in sharing information regarding the 2024 National Election. Furthermore, the list results are sorted from most to least influential users. The intended user in this study is the user-screen-name used by the user on Twitter. The test was also carried out with each method used in this study. Table 1 shows an example of the ranking results of the ten most influential users or the so-called Top-10 users of each technique.

The results of tests in identifying influential users in disseminating information about the 2024 National Election vary from one method to another. For example, a Twitter user with user-screen-name rmp_officials is ranked first as the most influential user in disseminating information from all the centrality evaluation methods. Whereas in the second rank, the user-scree-name of the user that appears is different from one another. For example, the FixedPuan user-screen-name ranks second for evaluation with the Degree Centrality and Harmonic Centrality methods, while for the Closeness Centrality and Eigenvector Centrality methods, and the Load Centrality method, Ganjaran_app's user-screen-name ranks second. Users who occupy the ranking order of each technique can differ.

Based on the user ranking list generated from each of these methods, calculations are then carried out to measure the similarity and association between the rankings of each user. The similarity of the user ranking lists as measured using the Jaccard Similarity Index displays a comparison of the similarity of the ranking lists from a combination of one method with another. For example, the user ranking list from the Degree Centrality method is compared to the Closeness Centrality, Harmonic Centrality, Eigenvector Centrality, and Load Centrality methods. This process is carried out for each ranking list result. The test results using the Jaccard Similarity Index can be seen in Figure 2.

Table 1. Top 10 influential users of each method

Rank	Degree Centrality	Closeness Centrality	Harmonic Centrality	Eigenvector Centrality	Load Centrality
1	rmp_officials	rmp_officials	rmp_officials	rmp_officials	rmp_officials
2	TetapPuan	DPC PKB KOTA BATU	TetapPuan	DPC PKB KOTA BATU	Ganjaran_app
3	Ganjaran_app	Ricky Habibulloh	Ganjaran_app	Ricky Habibulloh	TetapPuan
4	GanjaranApp	stepanus subay	DPC PKB KOTA BATU	stepanus subay	catatanganjar
5	KPU_ID	Babul Fatih	Ricky Habibulloh	Babul Fatih	sangiranflying
6	muhammadiyah	Khairuddin	stepanus subay	Khairuddin	SERATUS_P
7	golkarpedia	Hendra ningrat Al bantani	Babul Fatih	Hendra ningrat Al bantani	DPP_PPP
8	maryshelparaiso	Asmi	Khairuddin	Petrus Riwoe	Up Ganjar Pranowo 2024
9	mypresidentid	zonapkbblitar	Hendra ningrat Al bantani	Rudolf Blasin	Diwangga Diwangga
10	Tempat Berita	Petrus Riwoe	Asmi	Asmi	GanjaranApp
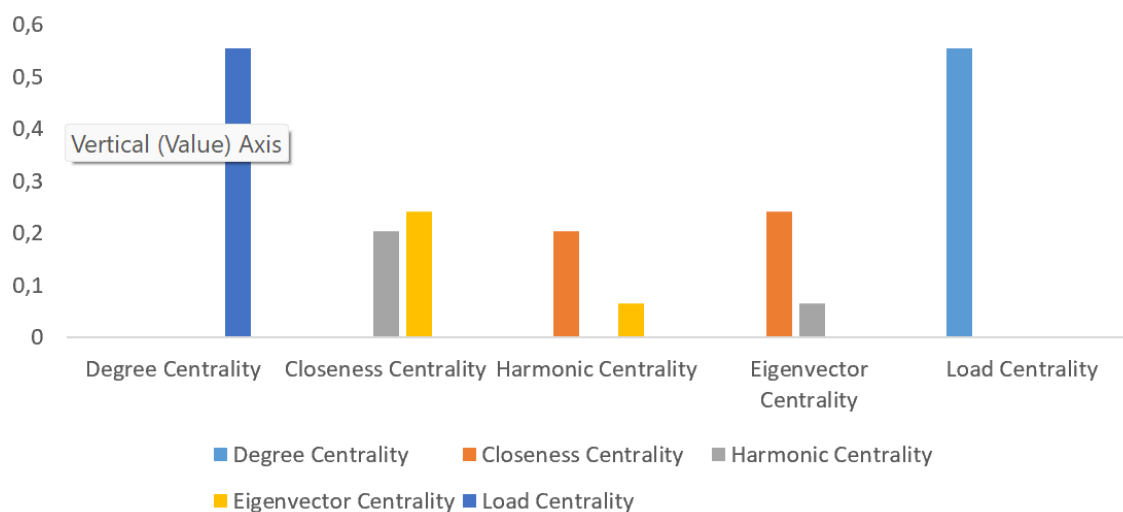
Figure 2. Jaccard Similarity Index

In the results shown in Figure 2 related to the similarity of the top user ranking list in disseminating information about the 2024 National Election, it is known that the complete ranking list produced by the Degree Centrality method has the highest similarity with the top ranking list produced by the Load Centrality method. The similarity value is 0.555. The highest value from the calculation of the Jaccard Similarity Index is bolded in Figure 2. In comparing top-ranking lists from other methods, the resulting similarity values range from 0.001 to 0.242. Furthermore, in the results of the Jaccard Similarity Index, several method comparisons have a value of 1. This value is generated because the method is compared with the technique itself, so this value is not considered in the evaluation related to the similarity of the resulting top list rank.

Furthermore, evaluation was also carried out using Kendall's Rank Correlation Coefficient to measure the correlation between the resulting top-ranking lists. Same as in evaluation using the Jaccard Similarity Index. The top ranking list of each method is compared to one another for

evaluation using Kendall's Rank Correlation Coefficient. Evaluation results using Kendall's Rank Correlation Coefficient can be seen in Figure 3.
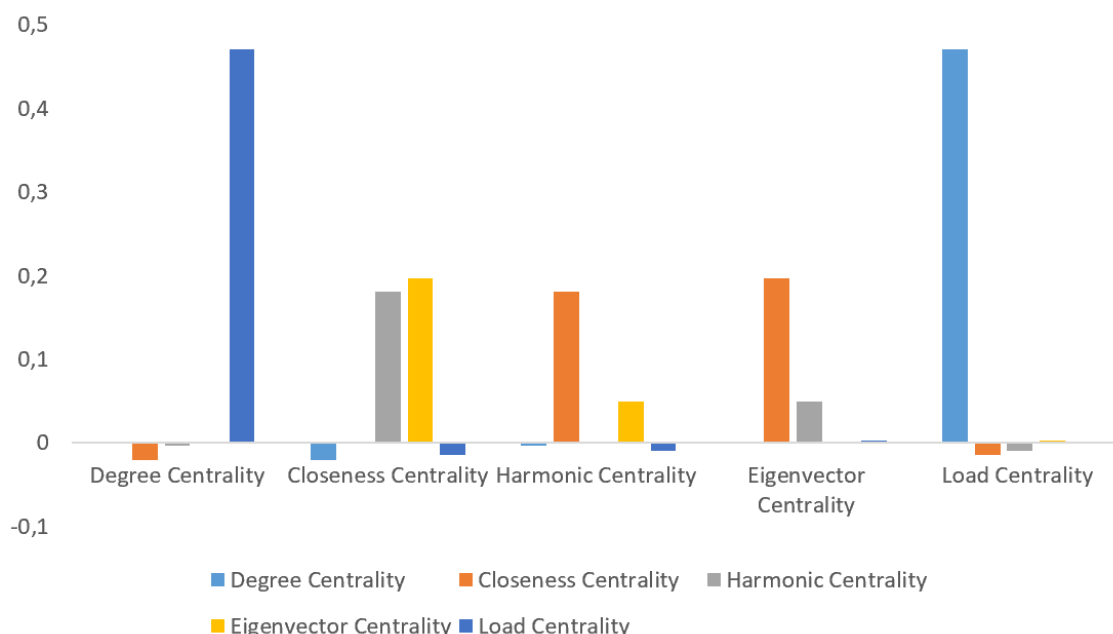

Figure 3. Kendall's Rank Correlation Coefficient

Evaluations carried out using Kendall's Rank Correlation Coefficient show the correlation of one method with the other techniques used in this study. The evaluation results using Kendall's Rank Correlation Coefficient show that the top user ranking list generated by the Degree Centrality method has the highest correlation with the complete user ranking list generated by the Load Centrality method. The resulting Kendall's Rank Correlation Coefficient is 0.471, the highest compared to other values ranging from -0.003 to 0.197. There is also a negative correlation in the evaluation of Kendall's Rank Correlation Coefficient, which means that the resulting top user ranking lists are very dissimilar. In Figure 3, the highest Kendall's Rank Correlation Coefficient is bolded.

Discussions

The evaluation results of the 2024 General Election information dissemination data on Twitter show various results. The results of implementing the method used in this study show that the ranking of influential users in disseminating information about the 2024 General Election differs from one way to another because each method uses a different concept in calculating the centrality of a user in the network, such as degree centrality which uses the degree of user connectivity, closeness centrality which measures the centrality of a node on the network and other methods.

Furthermore, the evaluation to measure the similarity of the top-ranking lists generated using the Jaccard Similarity Index shows that the Degree Centrality and Load Centrality methods have the highest similarity compared to other methods. This similarity value is 0.555. These results are in line with research conducted by Borgatti. Borgatti shows that the variation between degree centrality and load centrality at each node in a social network is relatively small, so it can be concluded that the centrality results of the two have high similarity.

The results of evaluating the similarity of the top-ranking lists using the Jaccard Similarity Index are also supported by the evaluation results with Kendall's Rank Correlation Coefficient. Evaluation using Kendall's Rank Correlation Coefficient also shows results consistent with the Jaccard Similarity Index; the top ranking list correlation of the Degree Centrality and Load Centrality methods is the highest of the top ranking list correlation combinations of other ways.

Conclusion

Research on identifying influential Twitter users in disseminating information about the 2024 General Election has been carried out in this study. This study has also used several methods of measuring user centrality in information dissemination networks. The test results of each method produce a top-ranking list that differs from one method to another. These different results are due to the concept of calculation methods that are different from one another. The evaluation showed that the Degree centrality and Load centrality methods had the most similar top-ranking lists among the methods used in this study. However, these results may change if other data and methods are used in similar studies.

Further research development can be done by adding the methods used in this research because several ways are used to measure centrality that requires modification to calculate the data used in this study. In addition, further analysis can also be carried out to determine whether Twitter users are indeed humans or bots. The research needs to be done because many information found during the preprocessing process results from bots.

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Geolocation data incorporation in Mapbox for comprehensive mapping of tourism areas on Lombok Island

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Abstract: Lombok Island is one of the islands that has many tourist areas. With so many tourist areas spread to various regions on the island of Lombok, an accurate and comprehensive tourist area mapping system is needed. The problem faced is that the existing mapping is still constrained regarding accuracy and data persistence. The solution offered in this research is the incorporation of geolocation data on the Mapbox platform to improve the accuracy and detail of data in mapping tourism areas on the island of Lombok. In this research, there are several stages carried out starting from data collection to testing. This research results in a tourist area mapping information system that applies geolocation data incorporation on Mapbox. The test results show an increase in accuracy of 8% from the previous mapping and a usability test score of 81 which means that the system developed is acceptable or feasible by users.

Keywords: comprehensive, data incorporation, Lombok Island, mapping, tourism area

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Introduction

Lombok Island is one of the islands of West Nusa Tenggara Province with enormous tourism sector potential [1] ranging from natural beauty, to its culture [2], [3]. Based on data obtained from the NTB Tourism Office, Lombok Island has approximately 25 tourism destinations [4] and 56 tourist villages [5]. With so many tourist areas on the island of Lombok, accurate and comprehensive mapping of tourist areas is needed [6] to support tourism development and also make it easier for tourists to obtain information related to tourist areas. However, until now there are still problems related to the accuracy of the information and detailed data. Often users do not reach their destination due to inaccurate information provided

Several solutions can be used for these problems, one of which is the incorporation of geolocation data on the Mapbox platform to improve the accuracy and detail of data in mapping tourism areas on the island of Lombok. This can be done by collecting geolocation data integrated with Mapbox, then performing spatial analysis and visualization of the data. Geolocation is a technology that can be used to determine the geographic location of an object using GPS, Wifi, Bluetooth or cellular signal technology [7] which also allows devices to send or receive information based on their geographic location, and can be used in various applications, such as navigation, environmental research, and location-based marketing [8]. Meanwhile, Mapbox is a platform that can be used to create interactive, flexible mapping applications [9] and provides various options for displaying data on maps such as spatial data, aerial photographs, and satellite maps [10].

This research will develop a mapping system based on the incorporation of geolocation data on Mapbox which is expected to provide accuracy and detail in mapping tourist areas on Lombok Island. Thus, the mapping results can be an important reference for tourists, government, and tourism industry players in developing and improving the quality of tourism on Lombok Island.

There are several previous studies related to the research to be conducted such as research conducted by Nurhadianto et al in 2020. The research discusses the development of a geographic information system application for tourist and culinary objects in Kudus Regency. The result of

this research is a mobile application that can be used by users to find tourist and culinary places. [11]. The next research is research conducted by Adil et al in 2022 which discusses the development of the nearest tourist recommendation spatial application using the Haversine method. This research applies geolocation technology to find the user's location with the nearest tourist area. [12]. The next research is a study conducted by Cabezuelo in 2020 which discusses the use of geolocation in organising passengers from the Airport to the City. This research combines geolocation information obtained from the user's device with the results obtained from the Mapbox service to calculate the optimal route between several destinations [13]. And there are still many other studies such as research by Sunarto and Noviawan in 2022 [14], Febrian and Nasir in 20221 [15], Suwanti and Usman in 2021 [16], Hidayat and Harjanta in 2019 [17], Hardiyanto and Airlangga in 2021 [18] and others.

The difference between the research that will be conducted by researchers and the research mentioned above is that this research focuses not only on one of the technologies, either geolocation or Mapbox, but focuses on both technologies. This research incorporates geolocation data on the Mapbox platform intending to increase the accuracy and detail of the information produced. Another difference is also in the object under study. In this research, the focus of the object studied is the mapping of tourist areas on Lombok Island including tourist attractions and tourist villages.

Methodology

In this research, there are several stages of research carried out. The stages can be seen in Figure 1.
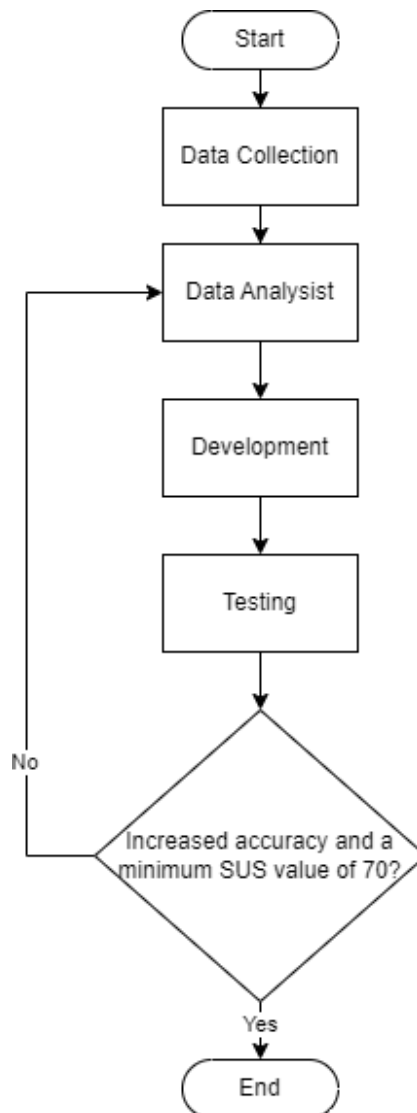
Figure 1. Research Stage

Figure 1 shows the stages carried out in this study from data collection to testing.
1. Data Collection
   The data used in this research was collected from various sources such as Lombok tourism websites, Google Maps, interviews, and others. The data collected includes geolocation data, tourist category data, and data related to tourist areas. The data is then selected according to existing data from the tourism office related to data on tourist areas on the island of Lombok.
2. Data Analysis
   At this stage, an analysis is carried out related to the data requirements used in the development of this system based on user needs.
3. Development
   At this stage, system development is carried out starting from designing the map that will be used to integrating geolocation data on the Mapbox using the available API. The system developed will be implemented on a website so that it can be accessed from anywhere and only requires a browser to access it
4. Testing
   Testing is done in several ways, namely by testing increased accuracy, usability, and a black box. Accuracy improvement testing is carried out using a confusion matrix, where in the confusion matrix the equation used to calculate accuracy is as follows:

$$Accuracy = \frac{TP + TN}{TP + FP + FN + TN} \qquad (1)$$

TP is a true positive, which in this study is if the data on the map is considered correct and indeed appropriate. FP is a False Positive, which in this study is if the location is considered correct according to what is on the map but it does not match. FN is a False Negative where the data on the map is considered inappropriate, but it is appropriate. And finally, TN or True negative, where the data is considered inappropriate and truly inappropriate. The next test is usability testing. Usability testing is a testing concept that uses a usability scale to determine the extent to which the system developed can be accepted by users [19]. The equation used to find the test value is as follows:

$$Testing\ Score = \frac{Respondents'\ Total\ Score}{Number\ of\ Respondents} \qquad (2)$$

The test scores are then categorized into 6 categories which can be seen in Table 1.

Table 1. Test Value Category

Grade	Minimum Score	Maximum Score	Percent
A	80.3	100	Percent >90%
B	74	80.2	70%<= percentile < 90 %
C	68	73.9	40%<= percentile < 70 %
D	51	67.9	20%<= percentile < 40 %
F	0	50.9	<20%

The usability level of a system is then measured in the context of the level of user acceptance of the system (acceptability range) to assess whether the system is acceptable to users or not [20]. The range can be seen in Figure 2.
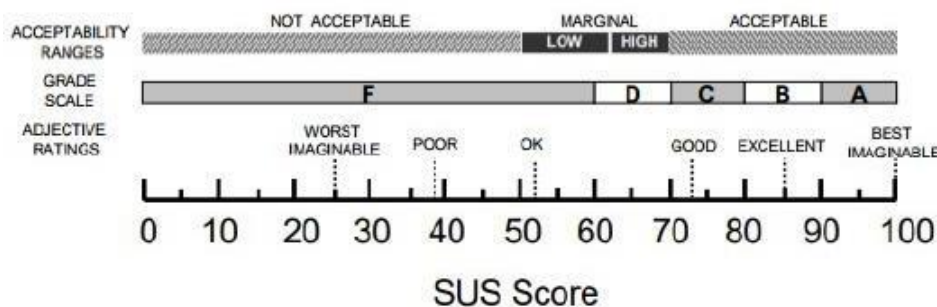
Figure 2. Acceptability Range

Figure 2 shows that if the value obtained is more than equal to 70 then the system is acceptable. In addition to testing related to system acceptance to users, testing was also carried out on the features made and whether they were following the needs or not. The test method used is a black box. Black box testing is testing that is done to ensure that the features developed are in line with expectations when they are developed [21]. The research will be declared complete if it is successful in increasing the accuracy value and the SUS Score is at a minimum of 70. However, if the accuracy does not increase or the SUS score is below 70 then the process will be repeated starting from the data analysis stage.

Results and Discussions

In this research, there are several stages of research used, namely data collection, analysis, development, and testing.

Data Collection

The data used in this research is geolocation data and other data related to tourist areas. Data sources in this research are from various sources such as Google Maps, tourism websites, and others. Examples of data used in this study can be seen in Table 2.

Table 2. Sample Research Data

No	Name of Tourist Area	Latitude	Longitude
1	Pink Beach	-8.85402	116.5622
2	Senggigi Beach	-8.47864	116.0376
3	Tanjung Ann	-8.90914	116.3212
4	Merese Hill	-8.91373	116.319
5	Kuta Beach	-8.89288	116.2826
6	Malimbu	-8.44165	116.0381
7	Sesaot	-8.50997	116.2356
8	Islamic Center	-8.57983	116.1006
9	Etc		

Table 2 shows an example of the data used in this research. Apart from the geolocation data shown in Table 2. There are also other data such as descriptions of tourist areas, tips that need to be considered, transportation that can be used, and others.

Analysis

In this system, there are two categories of users, namely admins and the general public. Based on the analysis of user needs, several functional requirements are obtained that are needed by both categories of users. The functional requirements can be seen in Table 3.

Table 3. Functional Requirements

User	Functional Requirements
Admin	1. Manage Tourism Area Data 2. Manage article data 3. Manage Gallery Data
People	1. View tourist area data both through maps and individual pages 2. View articles and galleries

From Table 3, it is found that the admin can manage and the public can only see it. From the table of functional requirements, the data needed in this research is tourist area data (including geolocation), article data, and gallery data. the data is then processed so that it can be entered into the system later.

Development

This stage starts with designing the map to be used. The map that will be used can be seen in Figure 3.
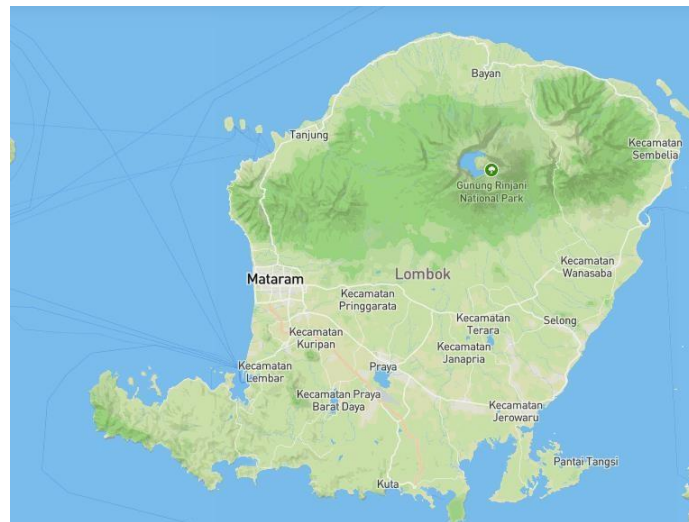
Figure 3. Map Design

Figure 3 shows the map design that will be used in the development of this system. After the design stage, we continued with the application development stage and incorporated geolocation data on Mapbox using API. The results can be seen in Figure 4.
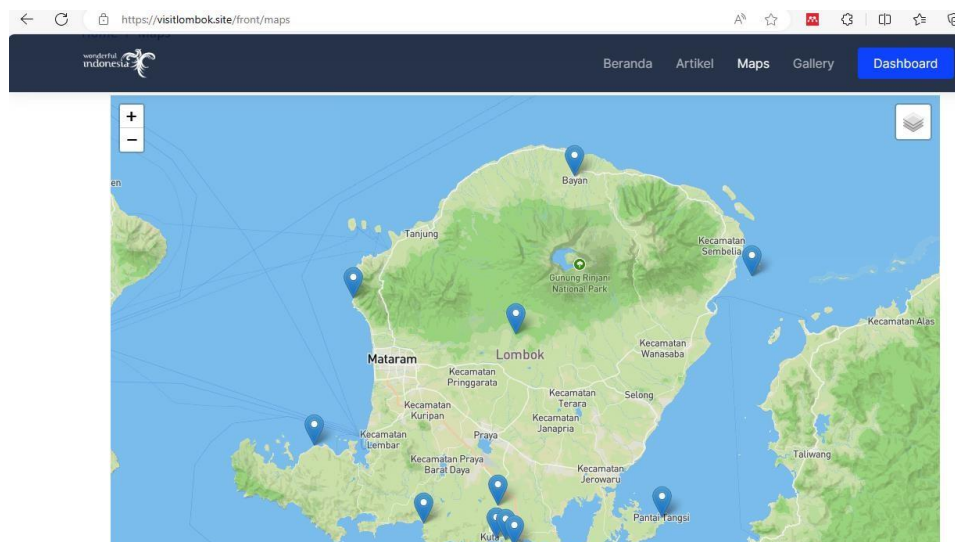

Figure 4. App View

Figure 4 Shows a map that has been given a pin related to the tourist area. The results of the data incorporation that has been implemented can be seen in Figure 5.
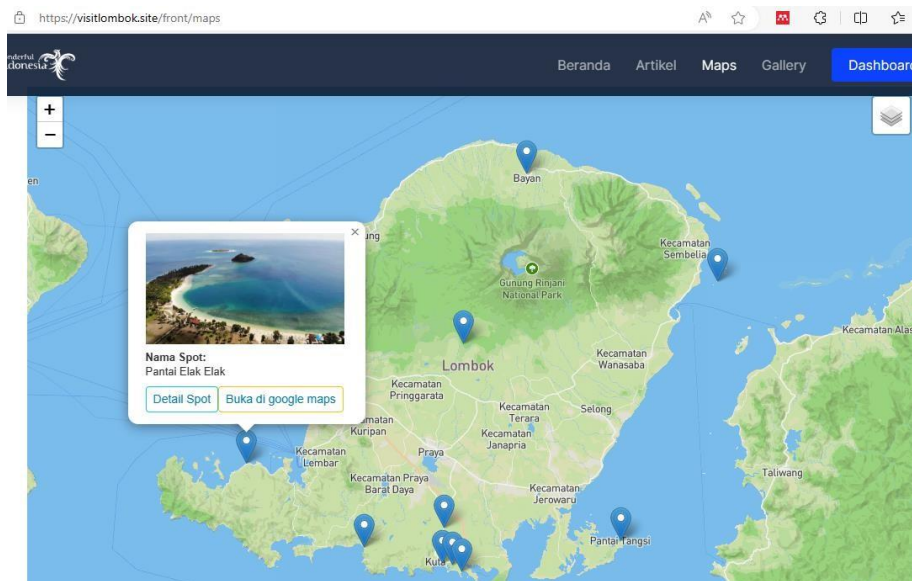
Figure 5. Map View of Data Incorporation Results

Figure 5 shows that there is a tourist area detail menu which if opened will display detailed information related to the tourist area and there is also integration with Google Maps which can provide directions to users to get to the location of the tourist area.

Testing
Testing is done to determine the accuracy obtained from the mapping system that applies data incorporation compared to G Maps. In addition, usability testing is also carried out to find out whether the system developed can be accepted by users and testing is also carried out using black box to ensure the system developed is as expected. The geolocation data accuracy test can be seen in Table 4.

Table 4. Accuracy Testing

No	Name of Tourist Area	G Maps	Confusion Matrix Category	Map Incorporation Data	Confusion Matrix Category
1	Pink Beach	√	TP	√	TP
2	Elak Beach	√	TP	√	TP
3	Circuit Motor Cross 459 Lantan	√	TP	√	TP
4	Selong Belanak	√	TP	√	TP
……	……	…..	…..	…..	……
31	Sesaot	√	TP	√	TP
32	Merese Hill	√	TP	√	TP
33	Tanjung Poki	X	FP	√	TP
34	Pancor Kopong	X	FP	√	TP
35	Jeruk Manis	X	FP	√	TP
36	Benang Kelambu	√	TP	√	TP
37	Batu Payung	√	TP	√	TP

Table 4 shows that from the 37-test data used, it was found that for Google Maps there were 3 areas with FP values and 34 areas with TP values so the accuracy results obtained using equation 1 were 92%. Meanwhile, the results of incorporating geolocation data between Google Maps and Mapbox obtained a value of 37 TP, which shows an accuracy result of 100%. This shows that

there is an increase of 8% from the implementation of data incorporation. The next test is usability testing. Usability testing was carried out by creating a questionnaire with 10 statements. each statement is symbolized in the form S1-S10. The calculation table used can be seen in Table 5.

Table 5. Usability Testing Calculation

Respondents	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Total	Total x 2.5
Respondents 1	3	3	4	3	3	3	3	3	3	4	32	80
Respondents 2	4	4	4	4	2	4	3	4	4	4	37	92.5
Respondents 3	2	3	2	3	4	4	3	4	3	4	32	80
Respondents 4	4	3	3	4	4	3	2	4	3	3	33	82.5
....	...	...	...	...	...	...	...	...	...	...	...	...
Respondents 55	3	4	3	3	4	3	2	4	2	3	31	77.5
Respondents 56	4	3	2	3	3	3	4	4	3	4	33	82.5
Respondents 57	3	4	3	3	2	4	2	3	2	3	29	72.5

Table 5 shows that the respondents used in this usability test were 57 respondents with 10 statements. From the test results obtained a value of 81 which means that the system developed is acceptable or feasible. Next, there is black box testing. This test was carried out using 16 scenarios. The results can be seen in Table 6.

Table 6. Black Box

Form	Scenario	Expected results	Description
Home Page	Display the Main Page	main page displayed	Appropriate
Article	The system displays the article	Article Displayed	Appropriate
Maps	The system displays a map of Lombok Island	Map displayed	Appropriate
	The pin of the tourist location area appears on the map	Pins appear	Appropriate
	information related to tourist areas appears	The selected tourist area information is successfully displayed	Appropriate
	Connected to G Maps	connected with G Maps	Appropriate
Galery	Displaying a Gallery of Images of Tourist Areas	Successfully displayed the tourist area image	Appropriate
Tourist Areas	Adding tourist area data	successfully added tourist area data	Appropriate
	Changing tourist area data	successfully change tourist area data	Appropriate
	Delete tourist area data	successfully delete tourist area data	Appropriate
Article Master	Adding Article Data	successfully add article data	Appropriate
	Change article data	successfully change the article	Appropriate

Form	Scenario	Expected results	Description
	Delete article data	successfully archive articles	Appropriate
	Adding Gallery Data	successfully add gallery data	Appropriate
Master Gallery	Changing Gallery Data	successfully change gallery data	Appropriate
	Delete gallery data	successfully delete gallery data	Appropriate

Table 6 shows that all the features developed have run according to expectations.

Conclusion

Based on the research that has been done. A comprehensive mapping system with the incorporation of geolocation data on Mapbox for the tourist area of Lombok Island was successfully developed. The incorporation of data increases the accuracy of the previous mapping system by 8%. In addition, the developed system also received a score of 81 for usability testing which indicates that the developed system can be said to be feasible. Based on the black box testing that has been done, the developed system shows results as expected.

The suggestion for future research is that this system is developed again by adding several features that are integrated with several data sources that allow data retrieval in real-time and the data managed is more numerous, precise, and accurate.

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Voltage drop comparison in Lead-acid and Lithium-ion batteries on electric scooters

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Abstract: This article compares the voltage drop on Lead-acid and Lithium-ion batteries used as an energy source for electric scooters. An experiment was conducted with five electric scooter users weighing 60.25 Kg, 70.60 Kg, 83.20 Kg, 95.40 Kg, and 103.75 kg to obtain data on voltage drop. Each user of this electric scooter carried out three experiments by circling about 1.07 Km at the Politeknik Negeri Bali area. This study proves that the voltage drop on the Lead-acid and Lithium-Ion batteries has a linear relationship to the weight of an electric scooter user with a 36V 400-watt BLDC motor load. The linear equation has an intercept value of -1.36766 and a slope value of 0.04791 for the Lead-acid battery. In contrast, the linear equation has an intercept value of -2.47064 and a slope value of 0.05417 for Lithium ion batteries. The average voltage drop across lead acid is 25% higher than that across Lithium-ion.

Keywords: voltage drop, lead-acid, lithium-ion, electric scooter

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Introduction

Townsend and Gouws studied the comparative review of Lead-acid, Lithium-ion, and ultra-capacitor technologies and their degradation mechanisms [1]. Other researchers, Keshan et al., said the comparison shows Li-Ion to have higher efficiency and 5-10 times the life cycle of Lead-acid. On charging and discharging, Li-Ion outperforms Lead-Acid with wide margins [2]. Lopez et al. reported for OPzS Lead-Acid batteries, an advanced weighted Ah-throughput model is necessary to correctly estimate its lifetime, obtaining a battery life of roughly 12 years at the Pyrenees and around five years at Tindouf. For Li-Ion batteries, the cycle and calendar aging must be considered, obtaining more than 20 years of battery life estimation at Pyrenees and 13 years at Tindouf. In the cases studied, the lifetime of LiFePO4 batteries is around two times the OPzS lifetime [3].

Kebede et al. said the techno-economic simulation output provided that the system with a Li-Ion battery resulted in a Levelized Cost of Energy (LCOE) of 0.32 €/kWh compared to the system with a Lead-acid battery with LCOE of 0.34 €/kWh. Besides, the Net Present Cost (NPC) of the system with Li-Ion batteries is found to be €14399 compared to the system with the Lead-acid battery resulting in an NPC of €15106. According to the result, Li-Ion batteries are techno-economically more viable than lead-acid batteries under the considered specifications and application profile [4]. Krieger et al. compared battery degradation rates and mechanisms in Lead-acid, LCO (Lithium Cobalt Oxide), LCO-NMC (LCO-Lithium Nickel Manganese Cobalt Oxide Composite), and LFP (Lithium Iron Phosphate) cells charged with wind-based charging protocols. Excellent power performance and consistent voltage and power behavior during cycling suggest that LFP batteries are well-suited to withstand the stresses associated with off-grid renewable energy storage and have the potential to reduce system lifetime costs [5]. Yudhistira et al. showed that Lithium-ion batteries have fewer environmental impacts than lead-acid batteries for the

observed environmental impact categories. The study can be used as a reference to decide how to substitute Lead-acid batteries with Lithium-ion batteries for grid energy storage applications [6]. Carroquino *et al*. reported the economic performance of Li-Ion batteries, compared to Lead-acid ones, is relatively better in hybrid systems than in PV. Greater solar irradiation favors Li-Ion batteries in PV systems but harms them in hybrid systems. In these, it would be favored by lower inflation in fuel prices. Finally, a 21% reduction in the price of Li-Ion batteries would make them the economically optimal option in all hybrid cases and if 36% is reached in all PV cases studied [7]. Muslimin et al. compared some types of batteries that are used in EVs, such as Lithium-ion (Li-Ion), Lead-acid, Nickel Cadmium (NiCd) and Nickel-Metal Hydride (NiMH), etc. Li-Ion battery has become the most popular power supply implemented for EVs [8]. Rajanna and Kumar analyzed a comparison of two types of batteries. Results show that the Lithium-ion battery has better discharging voltage and current than the Lead-Acid storage battery at various percentages of state of charge. It is also observed that while maintaining constant load voltage, the Lithium-ion battery delivers more power to the utility grid. Lead-acid battery consumes more power when charged to 100% state of charge. Lead-acid storage battery is 2.79 times costlier than Lithium-ion battery. So, for a solar photovoltaic system with high power demand, a Lithium-ion battery is more suitable both performance-wise and cost-wise [9]. Iclodean et al. said nowadays, Li-Ion batteries have the biggest market segment in equipping electric vehicles. Moderate energy consumption (14.7 kWh/100 km), the continuous decline of the cost price, advanced manufacturing technology, increased cycle life, low weight, and high energy storage potential make Li-Ion batteries an optimal choice in this field. Their disadvantage is represented by high functioning temperatures, which may negatively affect their energetic performances and lifecycle. All of these represent risks regarding the safe exploitation of the vehicle [10].

This article compares the voltage drop on Lead-acid and Lithium-ion batteries used as an energy source for electric scooters. To our knowledge, this has not been studied by other researchers.

Methodology

This study on the voltage drop on Lead-acid and Lithium-ion batteries was carried out using a brushless DC (BLDC) 36V 400-watt electric scooter, as shown in Figure 1. An experiment was conducted with five electric scooter users weighing 60.25 Kg, 70.60 Kg, 83.20 Kg, 95.40 Kg, and 103.75 kg to obtain data on the voltage drop. Each user of this electric scooter carried out three experiments by circling the 1.07 Km located at the Politeknik Negeri Bali area according to the map in Figure 2. We used an electric scooter using a 36V Lithium-ion battery with a capacity of 12 Ah and a Lead-acid of 12V×3 with a capacity of 12 Ah. The experimental results calculate the average voltage drop of each battery and each user with a different weight difference. Next is to determine the mathematical model that relates the value of the voltage drop to the user's weight. Figure 1 shows the electric scooter with a 36V 40-watt BLDC and Figure 2 shows the area experiment using an electric scooter.

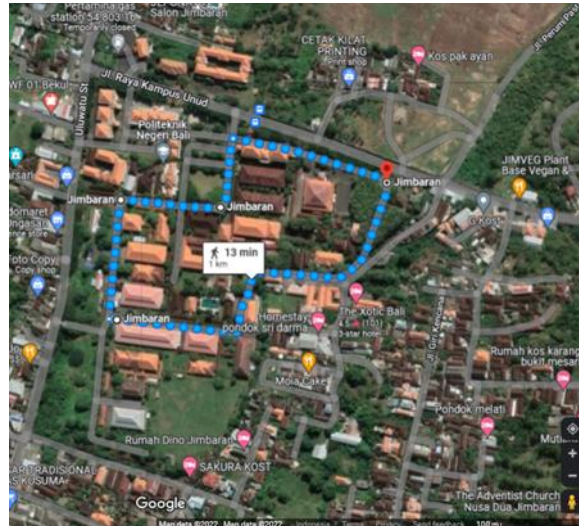**Figure 1.** Electric scooter with a 36V 40-watt BLDC

Figure 2. Area experiment using an electric scooter

The experimental results calculate the average voltage drop of each battery and each user with a different weight difference. Next is to determine the mathematical model that relates the value of the voltage drop to the user's weight.

Results and Discussions

This research is a descriptive statistical research that processes data on user weight, and voltage drop before and after using an electric scooter with a 36V 40-watt BLDC at a distance of 1.07 km at the research location.

Results

Research shows the performance of Lead-acid batteries as shown in Table 1 and the performance of Lithium-ion batteries in Table 2. In addition, the tables show the weight of electric scooter users, battery voltage before and after use for a round with a distance of 1.07 Km, and the voltage drop.

Table 1. Lead-acid data

Weight (Kg)	Before (V)	After (V)	Voltage Drop (V)
60.25	41.0	39.6	1.4
60.25	40.9	39.6	1.3
60.25	40.8	39.4	1.4
70.60	40.7	38.4	2.3
70.60	40.6	38.4	2.2
70.60	40.4	38.2	2.2
83.20	40.3	37.7	2.6
83.20	40.2	37.6	2.6
83.20	40.6	37.9	2.7
95.40	40.7	37.6	3.1
95.40	40.4	37.3	3.1
95.40	40.8	37.7	3.1
103.75	40.8	37.1	3.7
103.75	40.7	37.1	3.6
103.75	40.9	37.3	3.6

Table 2. Lithium-ion data

Weight (Kg)	Before (V)	After (V)	Voltage Drop (V)
60.25	40.0	39.2	0.9
60.25	40.2	39.3	0.9
60.25	40.1	39.2	0.9
70.60	40.1	38.7	1.4
70.60	40.3	38.9	1.4
70.60	40.0	38.7	1.3
83.20	40.0	38.2	1.8
83.20	40.2	38.6	1.6
83.20	40.1	38.3	1.8
95.40	40.0	37.2	2.8
95.40	40.1	37.3	2.8
95.40	40.0	37.1	2.9
103.75	40.2	37.0	3.2
103.75	40.2	37.0	3.2
103.75	40.2	37.0	3.2

The test results in Tables 1 and 2 show the average voltage drop value on each user's weight. Then we determine the value of the appropriate intercept and slope for the linear equation.

Discussions

Figure 3 shows the user weight vs. voltage drop data along with the linear fit of the data for an electric scooter using a Lead-acid battery. Figure 4 shows the user's weight data against voltage drops along with the linear fit of the data for an electric scooter using a Lithium-ion battery.
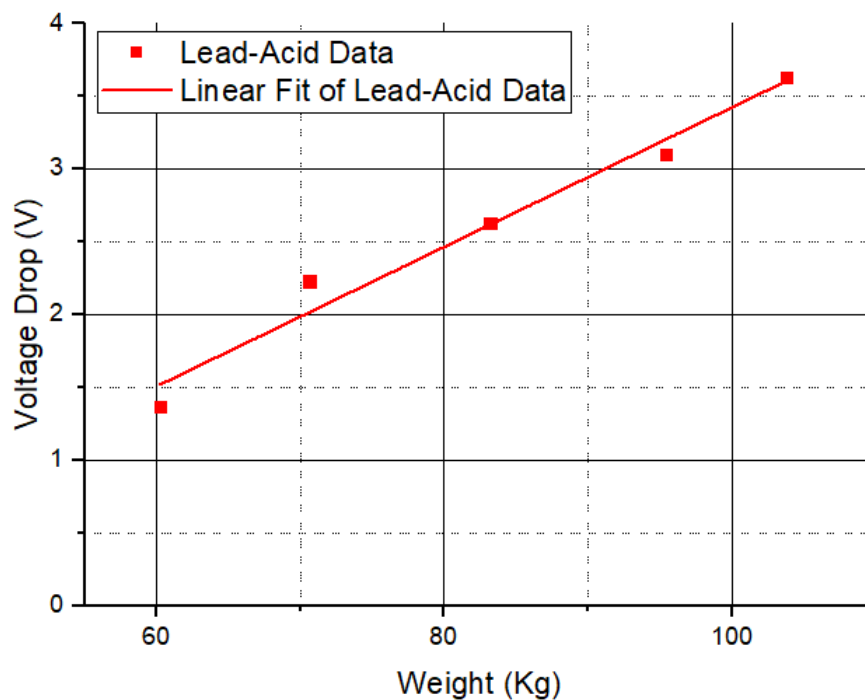
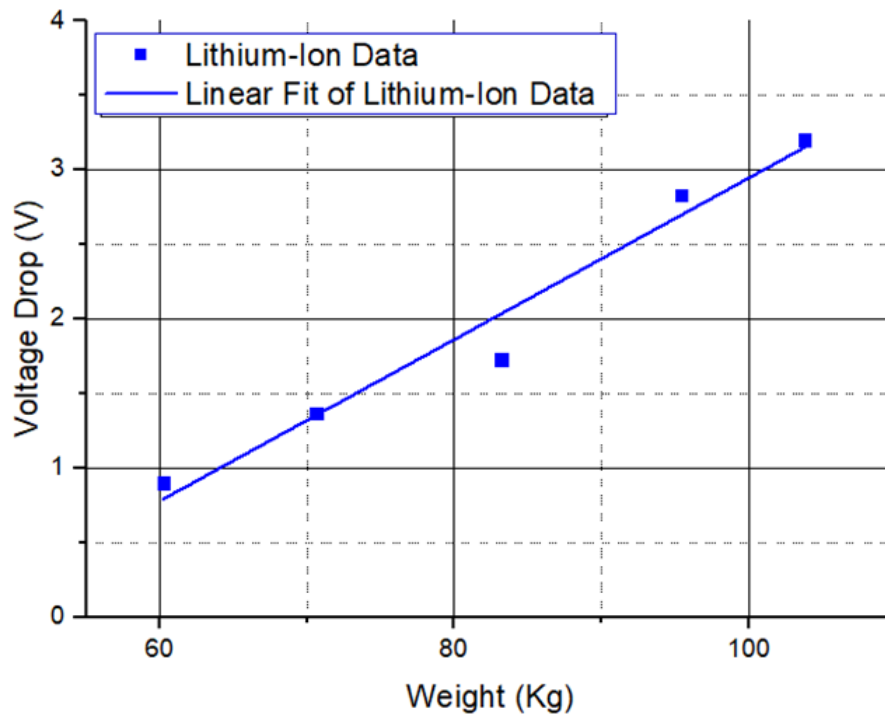**Figure 3.** Weight vs. voltage drop data for electric scooter using Lead-acid battery

Figure 4. Weight vs. voltage drop data for electric scooter using Lithium-ion battery

The test results in Tables 3 and 4 show the average value of the voltage drop on each user's weight, then we determine the value of the appropriate intercept and slope for the linear equation.

Table 3. Lead-acid summary

Intercept		Slope		Adjusted R-Square
Value	Standard Error	Value	Standard Error	
-1.36766	0.38776	0.04791	0.00461	0.964

Table 4. Lithium-Ion summary

Intercept		Slope		Adjusted R-Square
Value	Standard Error	Value	Standard Error	
-2.47064	0.4862	0.05417	0.00578	0.956

Furthermore, Equation (1) shows the relationship between the voltage drop and the user's weight on an electric scooter using a Lead-acid battery. In comparison, Equation (2) shows the relationship between the voltage drop and the user's weight on an electric scooter using a Lithium-ion battery.

$$Voltage\ Drop = 0.04791 \times Weight - 1.36766 \qquad (1)$$

$$Voltage\ Drop = 0.05417 \times Weight - 2.47064 \qquad (2)$$

Based on the data in Table 5, the average difference in the percentage of the voltage drop between Lead-Acid and Lithium-ion is 25%. In this case, the average voltage drop across Lead-acid is 25% higher than that across Lithium-ion.

Table 5. The average voltage drop of Lead-acid and Lithium-ion data

Weight (Kg)	Lead-acid (V)	Lithium-ion (V)	Difference (%)
60.25	1.37	0.90	34.1
70.60	2.23	1.37	38.8
83.20	2.63	1.73	34.2
95.40	3.10	2.83	8.6
103.75	3.63	3.20	11.9

This difference can be caused by load and terrain conditions. As stated by S. Dhawan et al., experiments for different load conditions and varying terrains show a rise in discharge with increasing load, low discharge for concrete, and the largest discharge for rocky terrain [11]. Imbalanced internal resistance should be avoided when using the Lithium battery. It causes on drop in voltage of the LiFePO4 battery system connected in parallel [12]. In the battery management system equipment installed on the scooter, it is necessary to apply adaptive control technology to be able to estimate the state of the battery, such as its state of health (SOH), state of power (SOP) and state of charge (SOC) [13, 14]. Rest time affects both types of batteries. For the Lead-acid battery, the relationships are mostly monotonic. For the Li-Ion battery, the relationships are more complex and demonstrate some oscillations before reaching a steady state [15].

Conclusion

This study proves that the voltage drop on the Lead-acid and Lithium-ion batteries has a linear relationship to the weight of an electric scooter user at a distance of 1.07 km with a 36V 400-watt BLDC motor load. The linear equation has an intercept value of -1.36766 and a slope value of 0.04791 for the Lead-acid battery, while the linear equation has an intercept value of -2.47064 and a slope value of 0.05417 for the Lithium-ion battery. The average voltage drop across Lead-acid is 25% higher than that across Lithium-ion.

Acknowledgments

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