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Android-Based Bus Vehicle Maintenance Application Design at PT. Sumber Jaya Trans Tangerang

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ABSTRACT

The bus vehicle maintenance procedure at PT. Sumber Jaya Trans still uses paper-based manual reports that must then be manually entered into the ledger. This is one of the company's biggest issues. This process leads in less structured data storage and requires a lot of time. This study uses the PIECES analysis approach to create an Android-based bus vehicle maintenance application. Several data gathering techniques were employed in this study, including observation, interviews with PT. Sumber Jaya Trans, and literature review. The PIECES study results revealed issues with application security, performance, information, economics, efficiency, and service, which were then fixed. In order to replace manual labor, Android was chosen as the mobile operating system due of its popularity in Indonesia. The findings of this study show that the PT Sumber Jaya Trans Tangerang bus vehicle repair system still relies on paper-based manual techniques, which wastes time and causes disorganized data storage. In summary, the result of this study show that the bus vehicle maintenance process, however, may be made more effective and efficient as well as provide better organized bus vehicle maintenance data reports by using an Android-based application.

1. INTRODUCTION

Due to the fast growth of science and information technology, progress is now being made in all spheres of human existence, making information crucial. The existence of Android offers several advantages for people in doing tasks, both simple and complicated. Support for smartphones is now expanding quickly and with a wide range of features. Android smartphones are in high demand right now [1]. Because Android can make human jobs easier, it has become a very fundamental requirement for people. Android's presence is highly beneficial for fixing issues, especially concerning data processing. To accomplish objectives and find ease in carrying out business processes, particularly those requiring a lot

of data and parties, Android may also be utilized as a tool. Because the Android operating system is open source, developers can create applications that make use of its benefits [2]; [3]; [4]. Nearly all organizations, both public and private, employ Android applications, and even small and medium-sized firms have benefited from them. In designing a system, it is necessary to know the things that will support the system, to facilitate data processing later [5]; [6]; [7]. Because PT. Sumber Jaya Trans Tangerang's manual bus vehicle data processing system still uses paper report forms to submit damage reports to bus vehicles when the mechanic manages damage data and information, which makes it difficult for superiors to view or check data, the system is still not ideal. To enable the functioning of the linked mechanism, software or application design is required that gathers and distills the volume of data to be conveniently accessed. There is a problem at PT. Sumber Jaya Trans Tangerang with the management of maintenance data for bus vehicles that are still manually operated. Mechanics who have repaired bus vehicles record maintenance reports on a form and then enter them in a ledger where a lot of information needs to be written, starting with vehicle engine maintenance data like vehicle parts, vehicle engine maintenance (tune-up), checking vehicle interiors, from seats to windows, and bus cleaning.

2. LITERATURE REVIEW

The development of mobile applications for vehicle maintenance management has gained significant attention in recent years. This paper aims to explore key themes and findings relevant to the design of an Android-based bus vehicle maintenance application, with a specific focus on the context of PT. Sumber Jaya Trans Tangerang.

2.1 Current Practices in Vehicle Maintenance

Highlights the persistence of manual, paper-based reporting systems in the transportation industry, leading to inefficiencies and data disorganization [8]. This underlines the need for digital solutions. According to a report by Statista, the adoption of mobile applications for business processes, including maintenance management, has surged globally, with Android being a dominant platform choice [9]. This shows that mobile application being trend for vehicle maintenance application.

2.2 Security in Mobile Applications

Weichbroth and Lysik emphasize the importance of robust security measures in mobile applications, particularly those handling sensitive data, as data breaches can have severe consequences [10]. Research by Mouratidis illustrates that the transition from manual to digital maintenance processes can yield substantial cost savings and improved operational efficiency [11]. Kim and McFadden discuss the significance of user-friendly

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UI/UX design in mobile applications, suggesting that a well-designed interface can enhance user adoption and satisfaction [12].

2.3 Database Design and Management

Studies by Zhao and Balagué emphasize the importance of structured database design for efficient data storage and retrieval in maintenance applications [13]. Work by Hort underscores the need for performance optimization in mobile applications, especially when dealing with large datasets, to ensure smooth operation [13].

3. RESEARCH METHOD

The research method used by the author uses the following methods:

3.1 Method of collecting data

Observation is a data collection technique by making direct observations at the research location if it is under the research objectives, to obtain accurate data.

Interviews, namely obtaining data by communicating directly with stakeholders of PT. Sumber Jaya Trans. The purpose of conducting this interview is to obtain accurate and relevant information and data.

Literature study The method used to support the observation and interview methods that have been carried out. The collection of information needed to complete the data is obtained by reading and studying books, journals, browsing, and literature reviews that are related to the problem being studied.

3.2 System Analysis Method

The PIECES analysis method researchers use to identify problems, then an analysis must be carried out on performance, information, economy, application security, efficiency, and service. From this analysis, several main problems are usually found, this is important because usually what appears on the surface is not the main problem, but only a symptom of the main problem [14].

The advantages of the PIECES method are that there are reports at the end making it easier to supervise, and easy to do documentation, making it easier to trace back business needs and the PIECES method can be used to analyze the level of user satisfaction with the information system used [15].

The reason why the researchers used the PIECES method in this study was to improve performance in bus maintenance data management system activities to get better and to reduce errors in the process of handling bus maintenance data management systems.

3.3 Program Design Analysis Method

The program design analysis method will be made using UML (Unified Modeling Language) and flowcharts because UML is a tool that is widely used to document object-

oriented modeling [16] and flowcharts are a way to explain the stages of problem-solving by representing certain symbols. easy to understand, easy to use, and standard [17].

3.4 System Design Method

In this study, the authors used a design method using flowcharts and object-oriented models in the form of UML (Unified Modeling Language) the flexibility of diagrams in UML which are many and varied [18]; [19], which uses visual paradigm software in making 3 (three) types of diagrams which consist of use case diagrams, activity diagrams, and sequence diagrams which are carried out through 4 (four) stages, namely:

a. Review of the active system.
b. Evaluation of survey results.
c. Using elicitation tools in 4 (four) phases, stage I covers all system requirements, stage II groups needs using the MDI (Mandatory, Desirable, Inessential) technique, stage III uses TOE (Technical, Operational, and Economic), and stage IV is the final step [20].

The programming language used is Dart using the Flutter framework. Restful Web Services for exchanging data between applications or systems using the Laravel framework and the database used is MySQL, while the supporting software used in making this program is Visual Studio Code (text editor) which is used to write the programming language to be created and Laragon is (tools) that provide software packages into one package.

3.5 System Development Method

Android-Based Bus Vehicle Maintenance Application Development at PT. Sumber Jaya Trans Tangerang uses the Extreme Programming (XP) method or model. The reason for using the extreme programming method is the nature of the system to be developed quickly which includes the planning phase, design phase, coding phase, and testing phase [21] As for the stages in this Extreme Programming (XP) method or model:

User story creation is the first planning activity. The Extreme Programming (XP) team members then evaluate each narrative and calculate the cost expressed in development weeks [22]. Together, the customer and the Extreme Programming (XP) team select how the next group narrative (software development) release will be created by the XP team. The Extreme Programming (XP) team will create stories if a commitment has been made to do so.

a. All stories are implemented immediately (within a few weeks).
b. The story with the highest value will be moved from the schedule and implemented first.
c. The story with the highest risk will be implemented first.

This stage serves to make specifications regarding program architecture, interfaces, and supporting elements [23]. The CRC Card is used in extreme programming to manage object-oriented classes under software increments.

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It is preferable to create unit tests for each story that will be part of the software increment before developing any code. To enable real-time issue resolution and real-time quality assurance, Extreme Programming (XP) advises that two individuals work together on a computer workstation to code one narrative (pair programming). The code is merged with other activities (continuous integration) when pair programming is finished.

The black-box approach was used in this study's testing to ascertain the system's functioning [24]. System integration and validation may be done daily utilizing the produced unit tests, which must be put into a universal testing suite and implemented using a framework. The client does the customer test (acceptance test), which concentrates on the general features and functionality of the system. Customer stories that have been integrated as part of a software release serve as the basis for acceptance testing.

3.6 Testing Method

Blackbox Testing is used in the study's testing and implementation techniques. enables programmers to build sets of input circumstances that will train a program's whole functional set [25]. This technique can detect interface flaws, data structure errors, faults in external database access, performance errors, startup mistakes, and termination errors in a system. Utilizing the Blackbox Testing approach has the following benefits [26]:

a. A programming language-specific expertise is not required of testers.
b. User-centric testing is done to assist in identifying any ambiguities or inconsistencies in the requirements specifications.
b. Both the programmer and the tester rely on one another.

4. RESULTS AND DISCUSSION

Based on the analysis of the system running on the related parts of PT. Sumber Jaya Trans Tangerang, it is known that the current maintenance system for bus vehicles is still unable to meet the needs because processing the data still takes quite a long time and makes it difficult to find maintenance data when needed. Several procedural proposals aim to improve and perfect the current bus vehicle maintenance system, namely changing the current bus vehicle maintenance process still using manual into an Android-based bus vehicle maintenance application.

The design of the proposed system is made using flowcharts and UML (Unified Modeling Language) diagrams using Visual Paradigm 15.2 Community Edition software to describe Usecase Diagrams, Activity Diagrams, Sequence Diagrams, and Class Diagrams. Meanwhile, for making Android applications using the Dart programming language using the Flutter framework. Restful Web Services for exchanging data between applications [27] or systems using the Laravel framework and the database used is MySQL, while the supporting software used in making this program is Visual Studio Code (text

editor) which is used to write languages programming to be made and Laragon is (tools) that provide software packages into one.

The proposed system procedure consists of several steps to be followed. Firstly, the user must log in to the Android application. After successfully logging in, the homepage will be displayed. From there, the user can access the bus vehicle maintenance type menu, which will display all the relevant data. The user can also access their profile menu and the bus vehicle maintenance menu. In the bus vehicle maintenance menu, the user can input data related to the maintenance of the vehicle. Once the data has been inputted, it will be displayed on the system. Finally, the user can access the logout menu to exit the application. Overall, these steps ensure a streamlined process for managing bus vehicle maintenance data.

The second part of the proposed system procedure is aimed at providing the manager with an efficient way to manage the bus vehicle maintenance data. The manager can log in to the website and access the dashboard. From there, the manager can view the bus vehicle maintenance report data. Additionally, the manager can filter and export the data as a PDF file.

To ensure that the maintenance work is carried out efficiently, the system allows the manager to register mechanics' accounts. This allows the mechanics to access the data page for the type of bus vehicle maintenance and the bus data page. Moreover, the manager can access the driver, conductor, and mechanic data pages to oversee their work. Finally, the manager can access the logout menu to exit the system. In summary, this system provides an effective way for the manager to manage the bus vehicle maintenance data and ensure that the maintenance work is carried out efficiently.

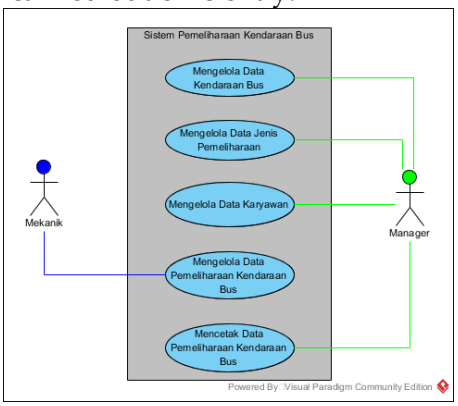

Figure 1. Usecase Diagram of the Proposed System

Based on Figure 1, the Use Case Diagram above contains:

a. 1 (one) The system covers all bus vehicle maintenance activities at PT. Sumber Jaya TransTangerang.
b. 2 (two) actors who carry out activities including Mechanics and Managers.
c. 5 (five) Use Cases that are usually carried out by actors, including:

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1) Use Case Name: Managing Bus Vehicle Data, Actor: Manager, Scenario: Login to the Website to manage bus vehicle data.
2) Name of Use Case: Managing Maintenance Type Data, Actor: Manager, Scenario: Login to the Website to manage Maintenance Type Data for bus vehicles such as engine, chassis, body, and electric.
3) Use Case Name: Managing Employee Data, Actor: Manager, Scenario: Login to the Website to manage Employee Data such as Driver, Kernet, and Mechanic Data.
4) Use Case Name: Managing Bus Vehicle Maintenance Data, Actor: Mechanic, Scenario: Login to the Android application to manage bus vehicle maintenance data such as engine, body, chassis, and electric maintenance.
5) Use Case Name: Print Bus Vehicle Maintenance Data, Actor: Manager, Scenario: Login to the Website then filter the bus vehicle maintenance data according to date, month, and year after that select Export PDF to print bus vehicle maintenance data.

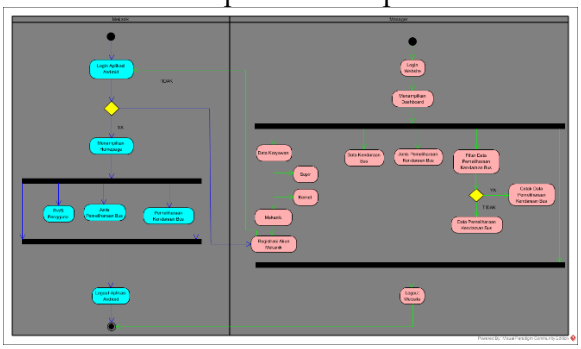

Figure 2 Proposed System Activity Diagram

Based on Figure 2 Activity Diagram above, it consists of:

a. 2 (two) Initial nodes, as initial objects
b. 2 (two) Decision nodes, to make decisions
c. 19 (nineteen) actions, a system that reflects the execution of action including Android Application Login, display homepage, User Profile, Type of Bus Maintenance, Bus Vehicle Maintenance, Logout Android Application, Website Login, display dashboard, Employee Data, Driver, Kernet, Mechanics, Mechanic Account Registration, Bus Vehicle Data, Bus Vehicle Maintenance Types, Bus Vehicle Maintenance Data Filters, Vehicle Maintenance Data, Print Bus Vehicle Maintenance Data and Logout Website.
d. 1 (one) final node, the object that ends.

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4.1 Sequence Diagram of the proposed system

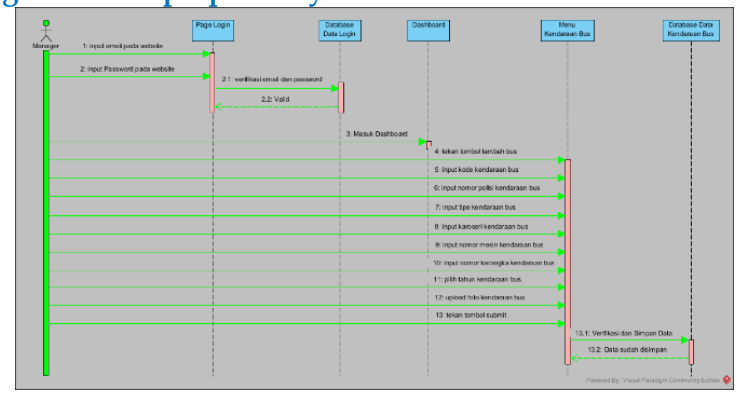

Figure 3 Bus vehicle data

Based on Figure 3 of the Sequence Diagram above, there are:

a. 1 (one) actor who carries out activities, namely the Manager
b. 5 (five) Lifeline interfaces that interact with each other
c. 15 (fifteen) messages the relationship between one object and another has value.
d. 2 (two) reply messages.

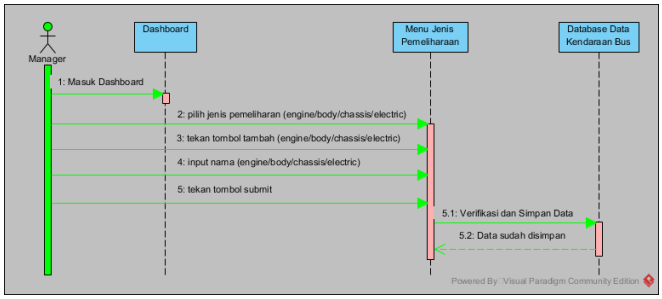

Figure 4 Maintenance type data

Based on Figure 4 of the Sequence Diagram above, there are:

a. 1 (one) actor who carries out activities, namely the Manager
b. 3 (three) Lifeline interfaces that interact with each other
c. 6 (six) messages the relationship between one object and another has value.
d. 1 (one) reply message.

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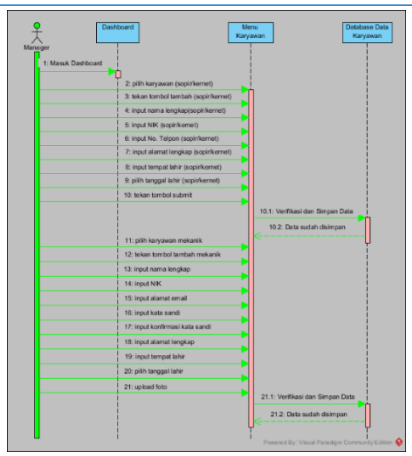

Figure 5 Employee data

Based on Figure 5 Sequence Diagram above there are:

a. 1 (one) actor who carries out activities, namely the Manager
b. 3 (three) Lifeline interfaces that interact with each other
c. 23 (twenty-three) messages the relationship between one object and another has value.
b. 2 (two) reply messages.

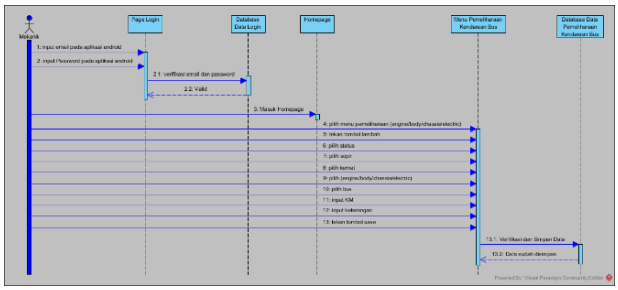

Figure 6 Bus vehicle maintenance data

Based on the Figure 6 Sequence Diagram above there are:

a. 1 (one) actor who carries out activities, namely the Manager
b. 2 (two) lifeline interfaces that interact with each other
c. 5 (five) messages the relationship between one object and another has value.
d. 2 (two) reply messages.

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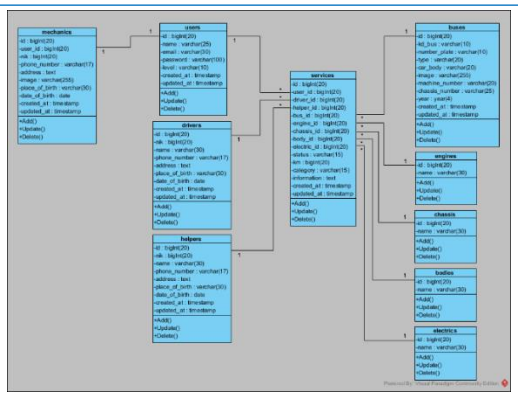

Figure 7 Class diagram of the proposed system

Based on the Figure 7 Class Diagram above there are:

a. 10 (10) classes, a collection of objects that share the same attributes and operations including mechanics, users, drivers, helpers, buses, engines, chassis, bodies, electrics, and services.
b. 9 (nine) multiplicity, the relationship between one object and another object that has value.

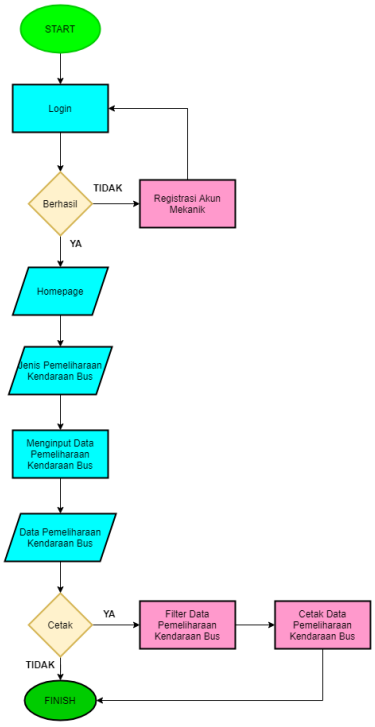

Figure 8 Proposed system flowchart

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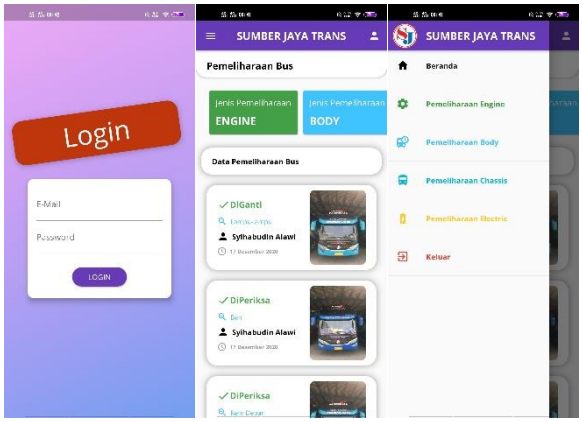
Based on figure 8 of the Flowchart Program above, it consists of:

a. 2 (two) flowchart symbols, which act as "start" and "finish" in the program flowchart process flow on the proposed bus vehicle maintenance system.
b. 3 (three) data symbols, which indicate the input or output process regardless of the type of equipment, namely: “Homepage”, “Type of Bus Vehicle Maintenance” and “Bus Vehicle Maintenance Data”
c. 5 (five) process symbols that state an action (process) performed. The process symbols are “Login”, “Mechanic Account Registration”, “Inputting Bus Vehicle Maintenance Data”, “Bus Vehicle Maintenance Data Filter” and “Print Bus Vehicle Maintenance Data”.
d. 2 (two) decision symbols, as symbols to indicate a step in making a decision.

4.2 Program view



(9) **(10)** **(11)**

Figure 9-11 Android display

a. Figure 9 (Login Page)
On this page, it is enabled to enter the homepage by entering the email and password that was created.
b. Figure 10 (Homepage)
This Homepage is the start page that displays drawer menus, user profiles, types of bus vehicle maintenance, and bus vehicle maintenance data.
c. Figure 11 (Drawers)
In the Drawer, there is a menu for maintenance of bus vehicles (Engine, Body, Chassis, and Electric) and a menu for exiting the application (Logout)

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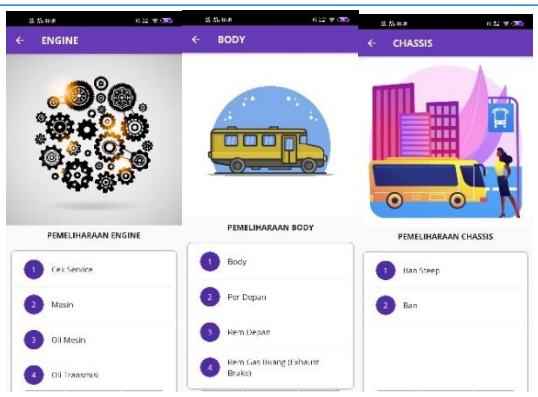
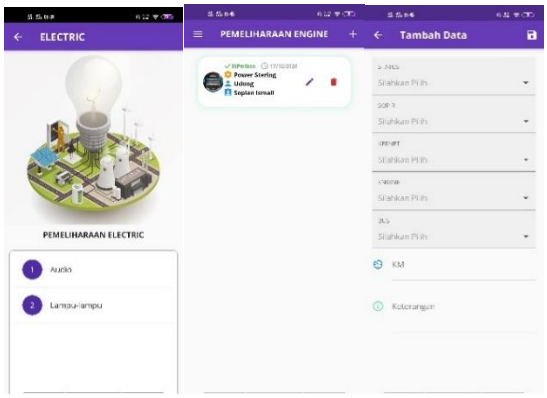


(12) **(13)** **(14)**

Figure 12-14 Android display

a. Figure 12 (Types of Engine Maintenance)
   On this page, there are types of bus engine maintenance.
b. Figure 13 (Types of Body Maintenance)
   On this page there are types of bus vehicle body maintenance.
c. Figure 14 (Types of Chassis Maintenance)
   On this page, there are types of bus vehicle Chassis maintenance.



(15) **(16)** **(17)**

Figure 16-18 Android display

a. Figure 15 (Electric Maintenance Types)
   On this page, there are types of maintenance of electric bus vehicles.
b. Figure 16 (Engine Maintenance)
   On this page, there are menus for adding, modifying, deleting, and detailing data for bus engine maintenance.
c. Figure 17 (Add Engine Maintenance Data)
   This page serves to add bus engine maintenance data.

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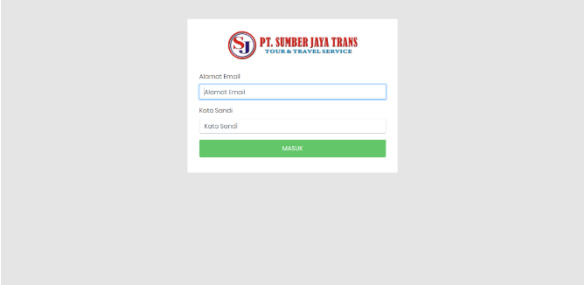

Figure 18 Login Page

On this page, it is enabled to enter the Dashboard by entering the email and password that was created.

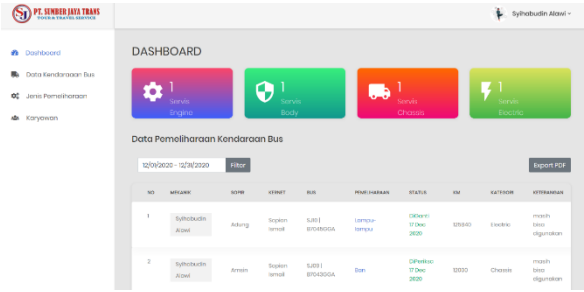

Figure 19 Dashboard

On this dashboard is the start page that displays a menu of repaired maintenance amounts, maintenance data filters, bus vehicle maintenance data, export PDF, and Logout.

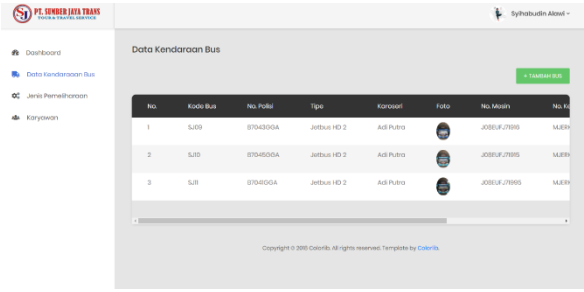

Figure 20 Bus Vehicle Page

On this page, data for bus vehicles registered at PT. Sumber Jaya TransTangerang.

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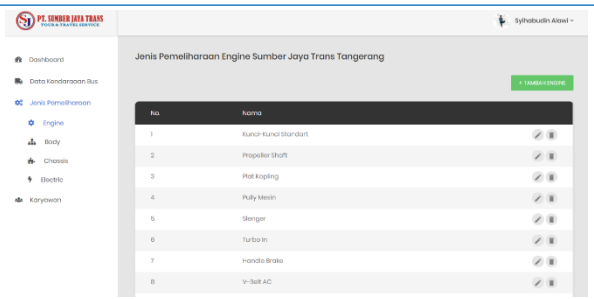

Figure 21 Engine Maintenance Type Page

On this page, Kernet data registered with PT. Sumber Jaya TransTangerang

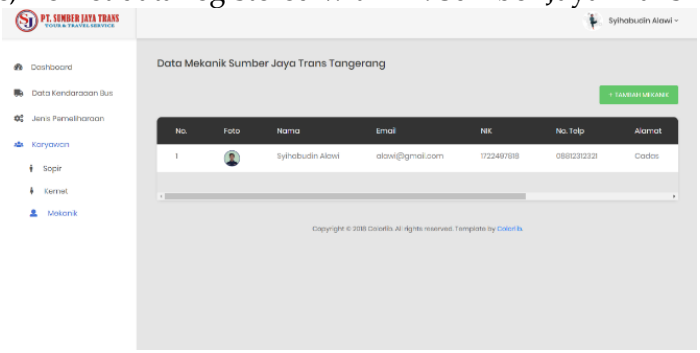

Figure 22 Mechanical Data Page

This page is used to register a mechanic's account and display Mechanical Data registered with PT. Sumber Jaya TransTangerang.

After testing the system with the Black Box Testing method which is done by providing some inputs on the program form. If when filling out the data form is incomplete, the system will display a message and deliver a message that helps users find errors when filling out incomplete data forms or incorrect data forms, which will then be processed according to their functional requirements and can produce the appropriate output.

The development and implementation of an Android-based bus vehicle maintenance application emerge as a practical and effective solution. This application would offer a dedicated data storage platform, mitigating the risk of data loss and streamlining the entire bus vehicle maintenance process. Its potential to enhance the efficiency and effectiveness of maintenance operations cannot be overstated.

However, as we embark on this transformative journey, it is crucial to acknowledge that several areas warrant further exploration and research. These encompass usability and user acceptance, efficiency gains, security and privacy, long-term sustainability, cross-platform comparisons, IoT integration, cost-benefit analysis, customization, regulatory compliance, user training and support, user feedback, and cross-industry applicability.

Future studies and research endeavors in these areas will not only contribute to the refinement and optimization of the Android-based bus vehicle maintenance application but

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also provide valuable insights into its broader impact on the operations of PT. Sumber Jaya Trans Tangerang and the potential for its adoption in analogous industries. By addressing these facets, this research can pave the way for a more streamlined, efficient, and data-driven approach to bus vehicle maintenance, ensuring that PT. Sumber Jaya Trans Tangerang remains at the forefront of innovation and operational excellence.

3. CONCLUSION

The conclusion that can be drawn is firstly, the current bus vehicle maintenance system at PT Sumber Jaya Trans Tangerang is done manually using paper forms, which are then compiled into a ledger. This manual method leads to the use of more time and less organized data storage. Secondly, the existing bus vehicle maintenance system at PT Sumber Jaya Trans Tangerang still relies on the manual method, resulting in wasted time and less organized data storage. These challenges primarily revolve around the reliance on paper-based manual reports and the subsequent manual entry of data into ledgers. The study aims to modernize and optimize this maintenance process by developing an Android-based bus vehicle maintenance application. To address these issues, an Android-based bus vehicle maintenance application can be developed. This application will have a data storage area to prevent data loss and facilitate the process of maintaining bus vehicles and generating reports on bus vehicle maintenance data. The results indicate that through the adoption of the Android-based application, issues related to security, performance, information management, economics, efficiency, and service quality were addressed or had the potential to be resolved.

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