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Mobile Application Development of Iot-Based Broiler Chicken Feeding System

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ABSTRACT

In this research, an Android application was developed using the React Native framework, integrated with Firebase, and the Arduino Mega 2560 microcontroller with built-in Wi-Fi to control and monitor the automated, scheduled, and real-time feeding and cleaning processes for chicken waste. This setup allows the utilization of an ultrasonic sensor to detect feed capacity and real-time scheduling. Additionally, a servo motor is used to automate the feeding system. The application enables farmers to monitor the feeding schedule adherence. Therefore, features such as feed system monitoring, alarm system, automatic cleaning system, and system status monitoring are included in this application. The test results demonstrate that this Android application functions well and provides accurate information to farmers. Users can remotely control the system, monitor the system's condition, and efficiently manage the feeding schedule. With the implementation of this application, it is expected that farmers can enhance productivity and efficiency in broiler chicken farming.

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1. INTRODUCTION

The expansion of the poultry farming sector has brought about new challenges in the management and maintenance of chicken enclosures. With the growing demand for poultry products, there is a need for efficient and cost-effective solutions to address the challenges faced by farmers. The current deep litter system, although widely used, proves to be both expensive and labor-intensive[1]. To overcome these challenges and improve efficiency, there is a growing interest in implementing a mobile application system that can seamlessly integrate with poultry farms.

By developing an Android application using the React Native framework, farmers can gain control, monitoring, and scheduling capabilities for the feeding and cleaning systems in their poultry farms. This application will enable them to efficiently manage the feeding process and automate the cleaning of chicken waste compartments, thus optimizing resource utilization and reducing labor requirements. The integration of such a mobile application system with poultry farms is crucial for enhancing cost efficiency and providing convenience for farmers [2], ultimately leading to more streamlined operations and better overall performance of the farming venture.

In this research, we aim to explore the development of a mobile application system integrated with poultry farms using the React Native framework. This system will enable farmers to remotely control, monitor, and schedule the feeding and cleaning processes in their chicken enclosures. By providing real-time data and automation features, this application aims to improve the overall efficiency of poultry farming operations,

providing a user-friendly interface for farmers to manage their chicken enclosures effectively. The integration of modern technologies like mobile applications with poultry farming holds great potential for increasing productivity, reducing costs, and improving the overall sustainability of the industry [3].

2. THEORETICAL BASIC

2.1. Internet of Things

IoT (Internet of Things) is a concept that encompasses a network of interconnected physical objects capable of collecting and exchanging data through the internet [4]. These objects can include electronic devices, sensors, vehicles, household appliances, as well as animals or humans. The rapid growth of the internet has led to significant transformations in human interactions, revolutionizing various aspects of work processes. The Internet of Things (IoT) has played a crucial role in enhancing everyday tasks and activities. By integrating IoT into daily life, individuals now have seamless control and remote access to a wide array of devices and systems [5].

One practical application of IoT is the implementation of a mobile application-based control and monitoring system for scheduled and remotely controllable automated feeding and cleaning processes in chicken coops [6]. Through sensors and internet-connected devices, coop owners can monitor and regulate the cleaning process in real-time [7]. Notifications and alerts can be received in case of any issues, ensuring efficient operations, nutritional health, cleanliness within the coop, and preventing the spread of diseases among broiler chickens [8].

2.2. React-Native

React Native is a popular framework for building mobile applications that allows for cross-platform development, meaning the application can run on both Android and iOS devices [9]. By utilizing React Native, the developers can create a single codebase that can be shared between different platforms, saving time and effort in development. This ensures that the mobile application developed for controlling and monitoring the feeding and cleaning processes in the chicken coop can be accessed by a wide range of users, regardless of their device preference.

React Native also provides a rich set of UI components and allows for efficient and responsive user interfaces. This means that the mobile application can have a visually appealing and user-friendly interface, making it easier for the farmers to navigate and interact with the system. Furthermore, React Native integrates well with other technologies and libraries, making it compatible with the backend systems and services required for the functioning of the application, such as Firebase for real-time data synchronization.

Overall, React Native enables the development of a robust and efficient mobile application system that can effectively control and monitor the feeding and cleaning processes in the chicken coop, providing farmers with a seamless and user-friendly experience.

2.3. Firebase

Firebase is a comprehensive mobile and web application development platform provided by Google that offers a wide range of backend services and tools [10]. In the context of the system, Firebase is integrated to provide real-time data synchronization between the mobile application and the backend server. This allows for instant updates and notifications, ensuring that the farmers receive timely information about the feeding and cleaning processes in the chicken coop. Firebase also offers a NoSQL cloud database, which is used to store and retrieve data related to the feeding and cleaning schedules, as well as other relevant information. This ensures that the system can access and manage the data efficiently, providing accurate and up-to-date information to the farmers. Additionally, Firebase provides authentication and security features, allowing for secure user authentication and access control. This ensures that only authorized users, such as the farmers or farm managers, can access and control the system.

Overall, Firebase provides a robust and scalable backend infrastructure for the system, enabling real-time data synchronization, secure authentication, efficient data management, and cloud storage capabilities. Its integration enhances the functionality and reliability of the mobile application system for controlling and monitoring the feeding and cleaning processes in the chicken coop. The Firebase service mentioned in this paper is the Firebase Realtime Database. This cloud-hosted database service enables data storage in JSON format and facilitates real-time synchronization with users connected to mobile or web applications.

2.4. RobotDyn Arduino Mega 2560 WiFi Built In

Arduino Mega 2560 WiFi Built-In combines the advantages of Arduino Mega 2560's high capacity and flexibility with the convenience of integrated WiFi connectivity [11]. Its built-in WiFi module allows easy internet access without the need for additional modules. With sufficient I/O pins and accessible memory, it can

accommodate various expansions and modules for project development. The integrated WiFi capability enables remote control and monitoring features, allowing for quick and efficient software and feature updates.

In conclusion, Arduino Mega 2560 WiFi Built-In offers strong flexibility and connectivity for project development and changing application demands. It provides an easy way to add or remove features as needed and allows remote control and monitoring through internet connectivity. With these capabilities, it is an excellent choice for projects that require reliable performance and adaptability.

3. METHOD

The purpose of mobile application development on iot-based broiler chicken feeding system is to enable real-time control, monitoring, and scheduling of the system running on the microcontroller. With this system, the application can perform user authentication using Firebase and modify each data variable in the database in JSON format.

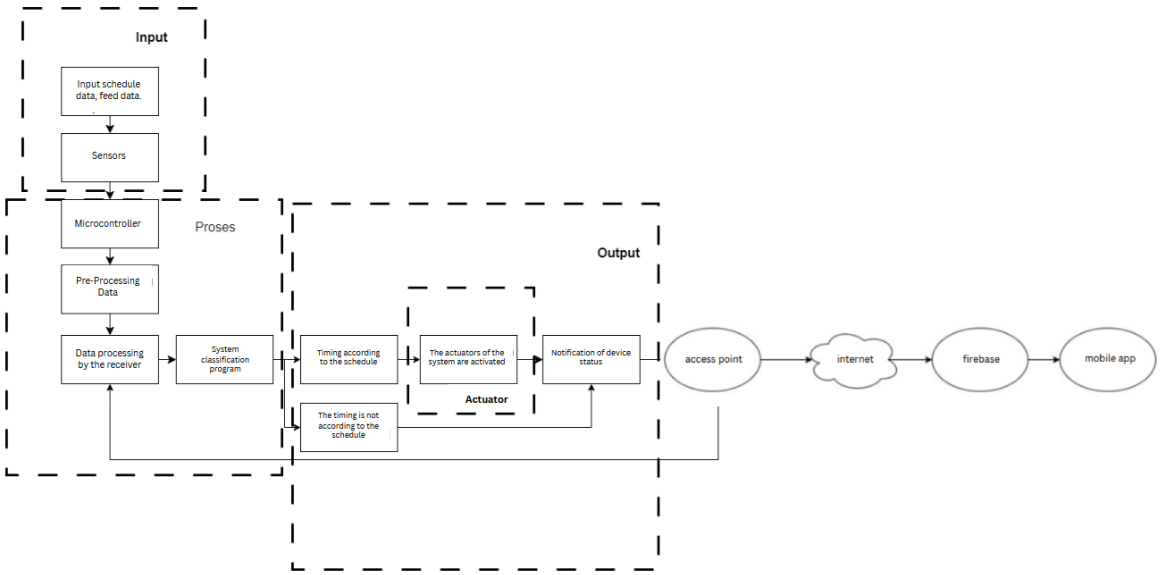

Figure 1 Block Diagram System

PaYot is a livestock feeding application that is integrated with the concept of the Internet of Things (IoT). The application aims to control and monitor the feeding system of broiler chickens based on IoT. The application is private, meaning that only specific users are allowed to use the application. The overall system operation can be seen in the block diagram in Figure 1, The system starts when input data sets of schedules, feed data, and data from each sensor are provided. The ping sensor will control the feed capacity system, while the schedule input can be adjusted by the end user through the Android application. These data will be classified into several subsystems, and subsequently, they will be processed along with the data from the Transmitter, which is processed by the receiver, namely the microcontroller. The microcontroller will carry out the process to classify data, including chicken feed capacity, feeding schedule, cage cleaning schedule, and other variables used as system output indicators. There are two types of data classification: Schedule-Compatible Time and Non-Schedule-Compatible Time. If the output of the data processing results in a Schedule-Compatible Time, the actuator will operate, and the system status on the device will change accordingly. If the time is not compatible, the output of the time process will remain unchanged, and the runtime status will continue without the need for any warning.

Next, each output of the process will be sent through the built-in communication module (Wi-Fi) with the Arduino Mega 2560 microcontroller to be forwarded to the database via connectivity with communication devices. The microcontroller will send the output data through the gateway and be received by the database. Data from the database can also be sent to the microcontroller through the gateway and communication devices to control the system notification status. Furthermore, data from the database can be displayed on the Android application connected through an API, allowing the end user to monitor it remotely.

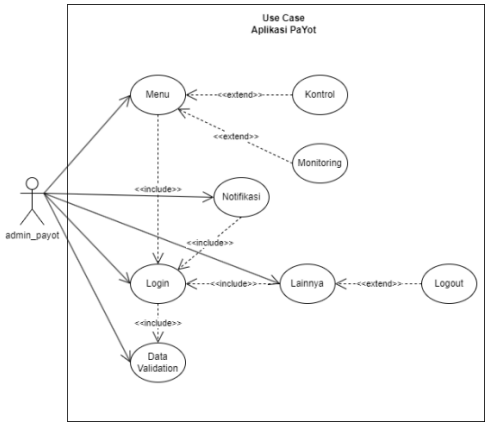

Figure 2 Use Case of PaYot Apps

Figure 2 depicts the use case of the PaYot application. The use case illustrates the functionality and interactions of the application in a specific scenario. It provides a visual representation of how users can utilize the PaYot app to control and monitor the feeding system of broiler chickens based on the Internet of Things (IoT) concept. The use case diagram highlights the various actors involved, such as the admin_payot user, and showcases the different actions they can perform within the application. This reference serves as a guide to understand the flow and capabilities of the PaYot app in managing the feeding process of broiler chickens efficiently.

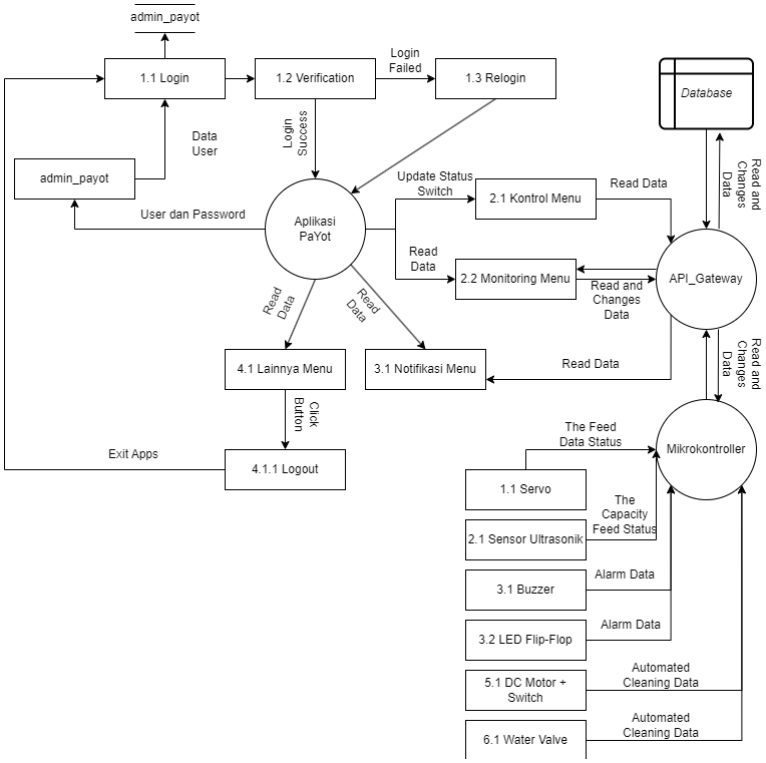

Figure 3 Data Flow Diagram PaYot Apps

In Figure 3, admin_payot is a user of the PaYot application. admin_payot is a registered user in the application's Payot database. During the application startup process, admin_payot is presented with a splash_screen, followed by the login UI interface. admin_payot, who is already registered, logs in using the email (adm.payot@gmail.com) and password (adm_p@y0t). After clicking the login button, a second splash screen appears, leading to the main menu, which includes the kontrol and monitoring interface. In the Kontrol menu, users can manually control the feeding system, alarm, or alert system [12], and the cleaning system, including opening or closing the chicken waste compartment. Users can also monitor the status of the system, whether it is functioning properly or not. In the Monitoring menu, if the Feed Capacity is less than or equal to 10%, the system status is labeled as “buruk” and the feed system condition is labeled as “low”, triggering an

alarm, and displaying a warning message. If the feed capacity is in the range of 11% to 75%, the system status is labeled as “normal”, and the feed system condition is labeled as “average”. If the feed capacity is in the range of 76% to 100%, the system status is labeled as “aman”, and the feed system condition is labeled as “good”. Furthermore, there is a Notifikasi menu that allows users to monitor the current system time and view a table of historical changes in data variables made by users via the application, based on the current system time. The current system time follows the UTC+7 time zone in a 24-hour format. The last feature is Lainnya menu, which includes information about the author's credits for developing the PaYot application and a Logout button for the application.

4. RESULTS AND DISCUSSION

In this section aims to provide a clear and informative overview of the research outcomes, facilitating a deeper understanding of the PaYot application's performance, functionality, and potential implications.

The functionality of the splash screen was tested by the first running apps. The purpose of this testing was to determine SplashScreen is loading in 5 seconds. Then the result can be seen in Figure 4. Based on the test results, it can be observed that the splashscreen is running in first open.

Figure 4 PaYot SplashScreen

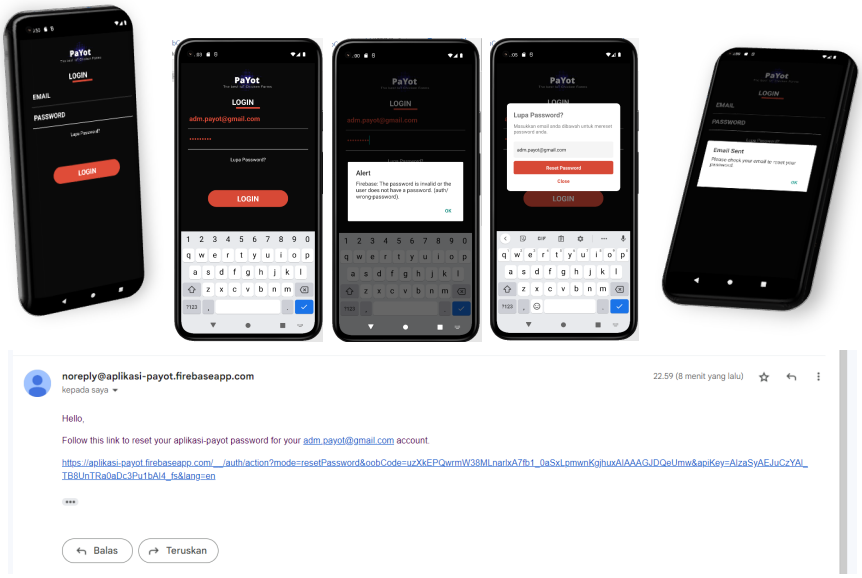

Figure 5 PaYot Authentication System

Based on description before, The next flow UI Application in Figure 5. Following the splash screen, users are presented with a login form where they can input their authorized email and password, which are registered within the Firebase platform. In case users forget their password, they have the option to provide their associated email address. They will then receive a password reset link sent to the provided email. If users enter an incorrect email or password, an alert or warning message will appear, indicating a failed authentication attempt.

This authentication process ensures that only authorized users with valid credentials can access the PaYot application. By leveraging the secure authentication capabilities of Firebase, the application safeguards

user accounts and sensitive data from unauthorized access. The alert or warning message serves as an additional layer of security, promptly notifying users when authentication fails due to incorrect login information.

The next flow UI Application in Figure 6, After successfully logging in using the pre-set Firebase account, the application proceeds to display a loader screen for 5 seconds. It then navigates to the main menu page.

Figure 6 PaYot Loader Screen

The Sub Menu Kontrol in the PaYot application allows users to have control over various aspects of the chicken feeding system. Users can manually control the feeding process, set alarms or notifications, and manage the cleaning system, including opening or closing the chicken waste compartments. Additionally, users can monitor the status of the system to ensure its proper functioning. The Sub Menu Kontrol provides a convenient interface for users to manage and monitor the feeding system efficiently. The flow UI Application in Figure 7.

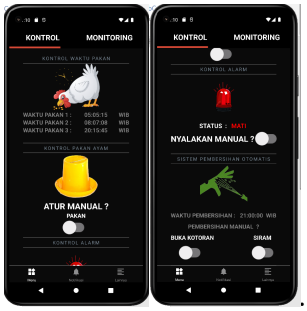

Figure 7 PaYot Kontrol Menu

For the control menu, testing is conducted when changing the feed, setting alarms, opening waste compartments, and irrigating in the ON condition. This will modify the data in Firebase. The test is in Figure 8.

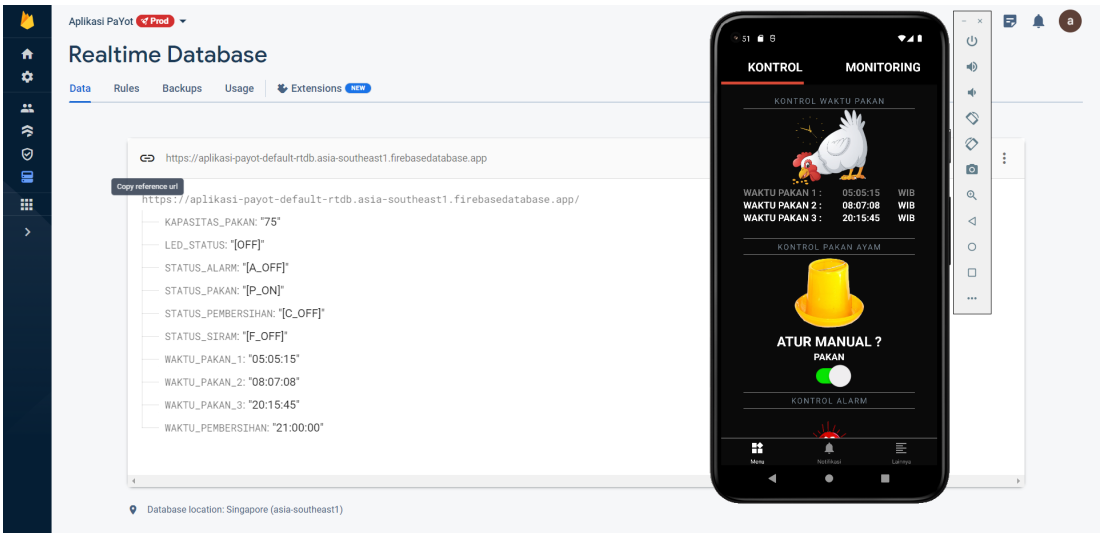

Figure 8 Switch Kontrol Test

The Monitoring submenu in the PaYot application provides real-time monitoring of various system parameters related to the broiler chicken feeding process. Users can view and track important information such as feed capacity, system status, and any potential issues or alerts. This submenu enables users to have a comprehensive overview of the system's performance and make informed decisions based on the data presented. The flow UI Application in Figure 9.

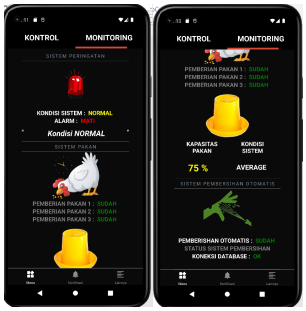

Figure 9 PaYot Monitoring Menu

In the monitoring menu, users can only view the status of the system's condition as it operates. For example, in Figure 10, if the feeding time 1 has passed the current time, the status will change to "SUDAH" (already) and the text will be displayed in gray color.

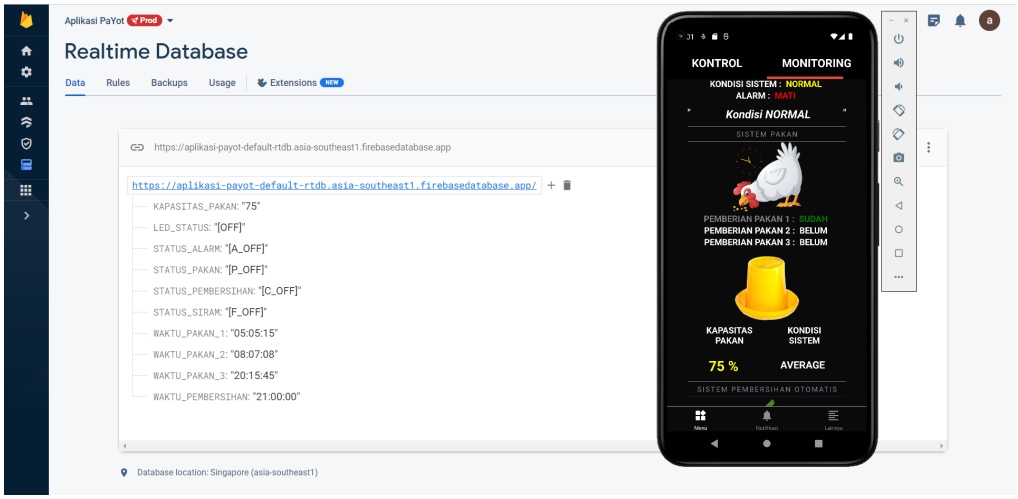

Figure 10 Monitoring Feeding System Test

The Notification Menu in the Payot Application displays the current time in the ID 24-hour format, UTC +7. It also includes a Clear button to delete or reset the data in the table. The history table records all the changes made by the user in the application, capturing all the data modifications in the Firebase database. The flow UI Application in Figure 11.

Figure 11 PaYot Notifikasi Menu

For the notification menu, here is the testing display of the set feeding time 1, feeding time 2, and feeding time 3 that change the time data in Firebase. Additionally, there is a table that serves as an application

log. It will display the log history table in the application runtime. Here are the testing results shown in Figure 12.

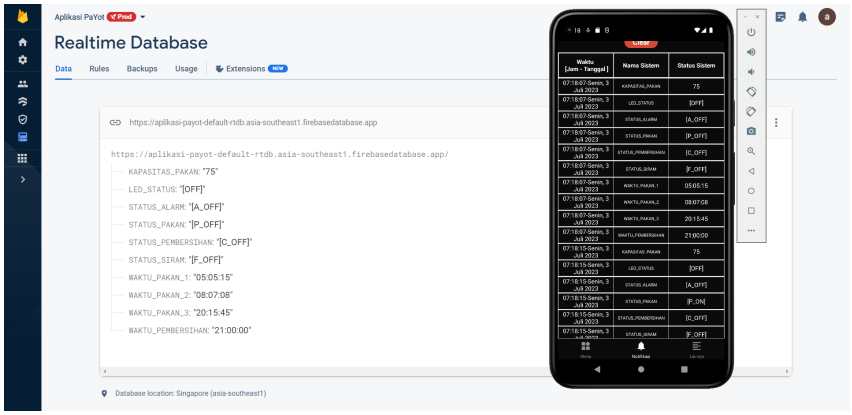

Figure 12 Tabel Notifikasi Test

The "Lainnya" Menu in the PaYot application provides additional features and options for the users. It includes functionalities such as credit information about the application's creators and developers, and a Logout button that allows users to sign out from the application. This menu serves as a convenient hub for accessing miscellaneous features and information related to the PaYot application. The flow UI Application in Figure 13. For a summary of the design results of this application, please refer to Table 1.

Figure 13 PaYot Lainnya Menu

Table 1 Summary Application Results provides an overview of success testing outcomes, including test cases, expected results, and actual observed results. It serves as a reference to assess performance, ensuring it meets specifications and user expectations. Success testing boosts developers' confidence in the application's core features and functionalities.

Table 1 Summary Application Results

Test Case	Input	Result
SplashScreen	Open First Apps, Logout	Success
Authentication	Wrong Email or Password	Alert Fail
	Send Email Reset Password	Alert Success
	Wrong Email Reset Password	Alert Failed No Data
	Correct Email and Password	Success
Main Page Menu	The Manual Feeding System Switch ON – OFF	[P_ON] – [P_OFF]
	The Manual Alarm System Switch ON – OFF	[A_ON] – [A_OFF]
	Opening or Closing the Chicken Waste Compartment ON – OFF	[C_ON] – [C_OFF]
	Flush The Chicken Waste Compartment ON – OFF	[F_ON] – [F_OFF]
	Set Time Manual for Feed 1, Feed 2, Feed 3, Cleaning	Success
	The Overall System Monitoring Features Encompass Feed Capacity, Alert Status, Feed Status, And Cleaning Status	Sucess
Notifikasi Menu	Current Time, Log Data Showed	Success
Lainnya Menu	Showed Credit Information and Logout	Success

In Figure 14, For the analysis and to assess the convenience for farmers in using the application, a survey method was employed with 18 respondents. One of the questions posed was, "Is the appearance or user interface of the PaYot application easy to understand?" The results indicated that 22.2% of the respondents rated it as easy, while 77.8% rated it as very easy.

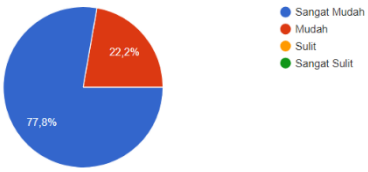

Figure 14 The graph represents the results of the application survey

5. CONCLUSION

In conclusion, the development of the PaYot application aligns with the expectations set forth in the introduction. The implementation of IoT-based features in the application has successfully enabled users to control and monitor the feeding system for broiler chickens. The integration of technologies such as Firebase and React Native has proven to be effective in achieving real-time data synchronization and providing a user-friendly interface. The results and discussions presented in this study indicate that the PaYot application has shown promising outcomes in terms of enhancing the efficiency and convenience of managing broiler chicken feeding. The menu options, including Control, Monitoring, Notifications, and Others, provide users with comprehensive control over the feeding process and allow for effective monitoring of the system's status. These findings indicate that the user-friendly design of the application has been well-received by the users.

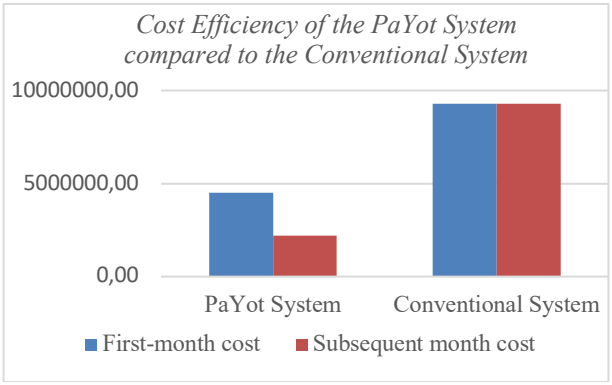

Figure 15 Cost Efficiency Graph of PaYot System compared to Conventional System

Based on Figure 15, the PaYot system shows better cost efficiency, with initial costs less than half of the conventional system. Despite the PaYot system's fixed cost in the following months, it remains more economical than the conventional system due to its lower usage cost in the long term.

Looking forward, there are several prospects for further research and development in the *field* of IoT-based poultry farming applications. This includes exploring advanced analytics and machine learning algorithms to optimize feeding schedules and detect anomalies in real-time. Additionally, expanding the application's compatibility with a wider range of IoT devices and sensors can further enhance its functionality and usefulness for farmers. Overall, the development of the PaYot application and the research findings highlight the potential of IoT-based solutions in improving poultry farming practices. Further studies and advancements in this area hold promise for increased productivity, cost efficiency, and sustainability in the poultry industry.

ABBREVIATIONS

Apps : Application
IoT : Internet Of Things
WiFi : Wireless Fidelity
PaYot : Pakan Ayam IoT
UI : User Interfaces
JSON : JavaScript Object Notation
NoSQL : Not Only Standard Query Language
UTC : Universal Time Coordinated

API : Application Programming Interface
ID : Indonesia

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