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Development of mobile billing application system for PAMDES water meter data logging

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Abstract — Along with the growth of Sindangsari's population, the water consumption in this village has increased. So, the drinking water company (PAMDES) in this village must be able to manage the available water to meet the necessities of public life. Now, the water company is still collecting and recording water meters manually. It is risky to consider the water condition in the village because an officer can make a human error while recording the water meter's value. If the water meter recorder is damaged, the officer estimates the water meter's value. The solution is that it can work without the internet when recording water meters, be applied to conventional analog water meters, and adjust the system when the water meter is blurry. The waterfall method is one of the models of software development or often called Software Development Life Cycle (SDLC). This method is one of the popular traditional methods because it is easy to apply. This method's principle emphasizes the steps carried out systematically from top to bottom. This research consists of requirement analysis, Design, Development, Testing, and maintenance. Based on beta testing conducted using an online questionnaire scenario, it shows excellent user experience feedback. 71.4% of respondents said the application was for the user's need. 85.7% of respondents said that the application's appearance is easy to understand by users. 71.4% of respondents said the response speed when accessing the application was fast, so the application can be said to have been implemented in the management of PAMDES Sindangsari. Therefore, this system can be said to have been following the needs of PAMDES Sindangsari. So that digital transformation efforts in Sindangsari Village can work optimally to solve problems in the village, especially in PAMDES Sindangsari.

Keywords – digital transformation, mobile apps, PAMDES, website application

I. Introduction

Water demand continues to increase, in line with people's growth. In Indonesia, water is managed by PDAM (state-owned water corporation) with a city-scale coverage. Besides that, some local water sources are managed locally by PAMDES. PAMDES is a business entity owned by the village government that manages water distribution to villagers. One of the villages whose water needs are managed by the PAMDES is Sindangsari Village. Sindangsari Village is located in Cikoneng, Ciamis, West Java. The daily water needs of the Sindangsari Village community are obtained from water sources managed by PAMDES. All water sources in PAMDES Sindangsari came from local water sources in the village which can meet the needs of the village community. A drinking water company is a company that does pursue not only profit but also community service because it is socially oriented [1]. The performance of drinking water companies can be judged by the discipline and quality of their services [2]. Providing the best service is one of the tasks of every company [3] and drinking water companies are continuously encouraged to utilize and develop technology so that drinking water assets can be managed effectively and efficiently and improve services to the community [4]. However, the customer information system, water meter recording, and administration of PAMDES Sindangsari are still done manually using

physical books, which are very vulnerable to damage or loss. Good management and information systems can improve the performance and quality of services for rural communities [5].

The meter recording process starts by manually recording each customer's water meter. The officer records the water meter because the conventional water meter is still the most widely used device in the water transmission system. The monthly water meter is the basis for billing for the following month. Related research on water distribution with IoT-based microcontroller technology [6], [7]. IoT-based microcontroller aims to monitor water distribution in real-time with the internet. However, this research is very dependent on the suitable internet. The water meter recording system does not work when the internet connection is lost.

Other research records water meters with a neural network [8], [9]. Unlike an IoT-based microcontroller using a neural network, reading water meters can work without an internet connection, but initially takes a technique in optical character recognition. Another study aims to predict the amount of water production [10] while using artificial intelligence with the backpropagation method [11].

Research that aims to detect water leaks using the ensemble outlier method detects by determining the threshold for each water meter, then the water meter that experiences a leak will cause an anomaly because it passes the predetermined water meter threshold [12]. Then another study used a smart meter which aims for each customer to determine how many liters of water to use. If it exceeds the usage limit, the smart meter will automatically close the valve on the water meter pipe [13]. As for those who use big data to create an uncertainty detection system for meter readings, such as broken meters, leaking meters, and others, by reading water usage patterns for each customer [14].

Related research is doing meter reading using the ORB algorithm to substitute inspection robots [15]. Another research uses a mobile device without the internet for meter reading but a digital meter [16]. Finally, the analog water meter is converted digitally using a 433MHz wireless transceiver [17]. However, the condition is that many pipes have already been installed underground, so it is not easy to install a water metered converter from analog to digital.

Research [18] uses digital image processing methods or water images to read water meters. The same method is also carried out by research [19], [20], but this study uses a mobile device whose results are sent via the internet to get the results of water meter readings but using a mobile device to get water images has a weakness, namely conventional water meters are blurry. In Indonesia, many still use old water meters where the glass on the meter is blurry or not visible when checked.

This research was conducted in Sindangsari Village, Cikoneng, Ciamis, West Java. This study proposes recording meters following existing conditions, namely recording and managing them, which are still manual. The solution is that it can work without the internet when recording water meters, be applied to conventional analog water meters and adjust the system when the water meter is blurry. This application is applied for digitizing and developing PAMDES information systems.

II. Research Method

The waterfall method is one of the models of software development or often called Software Development Life Cycle (SDLC). This method is one of the popular traditional methods because it is easy to apply. This method's principle emphasizes the steps carried out systematically from top to bottom, as in Fig. 1.

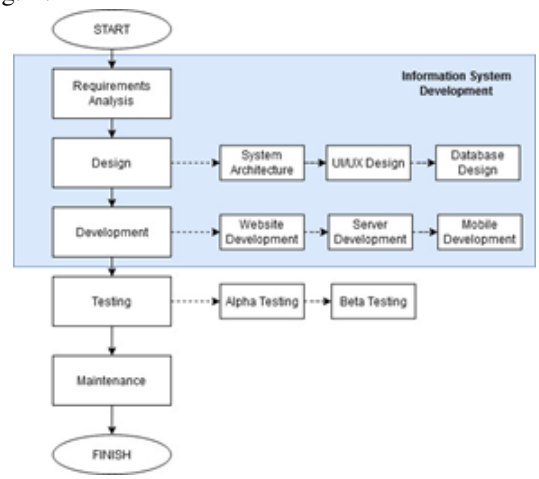

Fig. 1. Waterfall method diagram used in research.

The first stage of the waterfall method is the requirements analysis stage. At this stage, the data collection is based on the existing conditions of all system requirements. This stage is fundamental in this research so that the results follow the research objectives. This stage done discussion with PAMDES officers about developing the system as needed. The requirements in this stage include system process diagrams, inputs and outputs, features, *etc*. The results of this stage are system flow, data sources, features, models, system architecture and customer mapping.

The second stage of the waterfall method is the Design stage. This stage is a continuation of the first stage. This stage processes the information in the requirements analysis stage to create a system design, including system architecture design, application UI/UX design, and database structure design.

After the design stage is complete, the next stage is the development stage. This stage is carried out

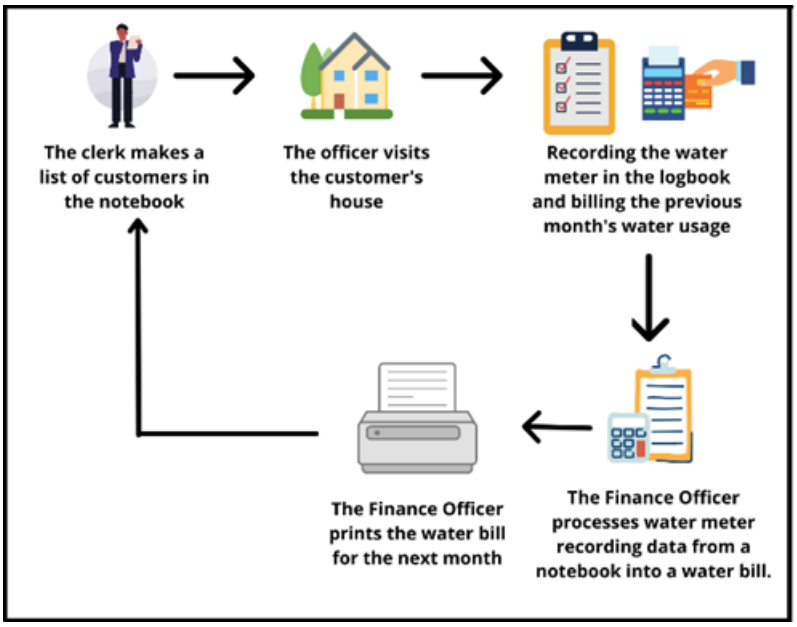

Fig. 2. The existing condition of billing management and recording of water meters at PAMDES.

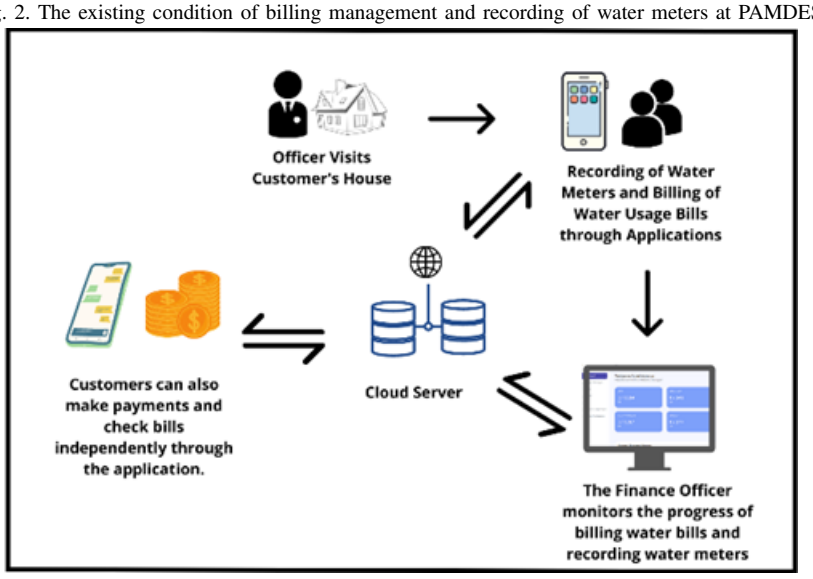

Fig. 3. System flow is used in billing management applications and water meter recording.

based on the designs made at the design stage. The development carried out includes the development of UI/UX, website, and mobile applications. The three parts are related, but developing the UI/UX first following the previous stage design results. Then, the other two parts, website development, and mobile apps development, can be carried out in parallel. This stage results in a website-based billing management application and application for recording water meters value and paying water bills. The results of this stage are mobile and website applications that have been completed in the development stage and will be tested.

The next stage after the development stage is the Testing stage. Some application testing is done at this stage to ensure no bugs or system errors. This test is also carried out to ensure that the application follows the predetermined specifications and that each feature runs according to its function. At this stage, alpha and beta testing are applied, as well as system performance testing based on network connections. The results of this stage are the results of testing whether the system is appropriate or not.

The last stage in the waterfall method is the maintenance stage. At this stage, periodic system maintenance is carried out to ensure the system always functions properly during implementation. In addition, this stage aims to ensure information system development following SDLC principles.

III. Result

This research produces a solution based on the research method used, which is based on the waterfall method. The results obtained are a combination of each step taken, as follows.

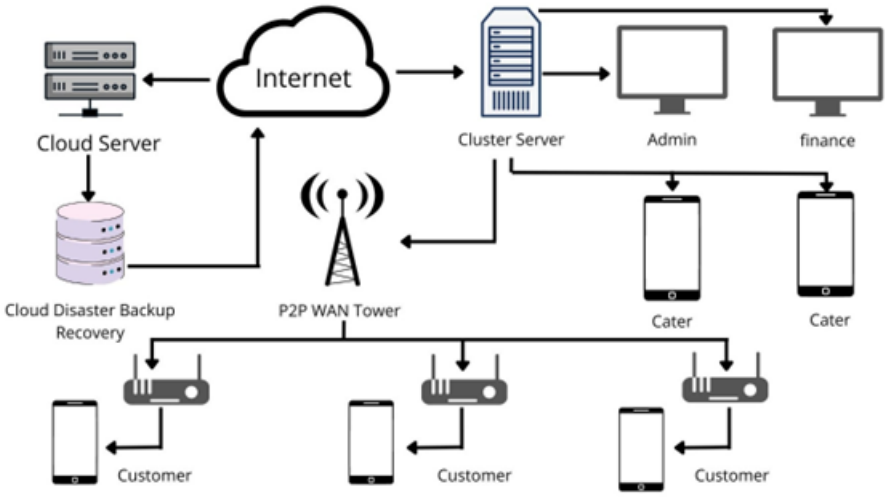

Fig. 4. PAMDES application system architecture.

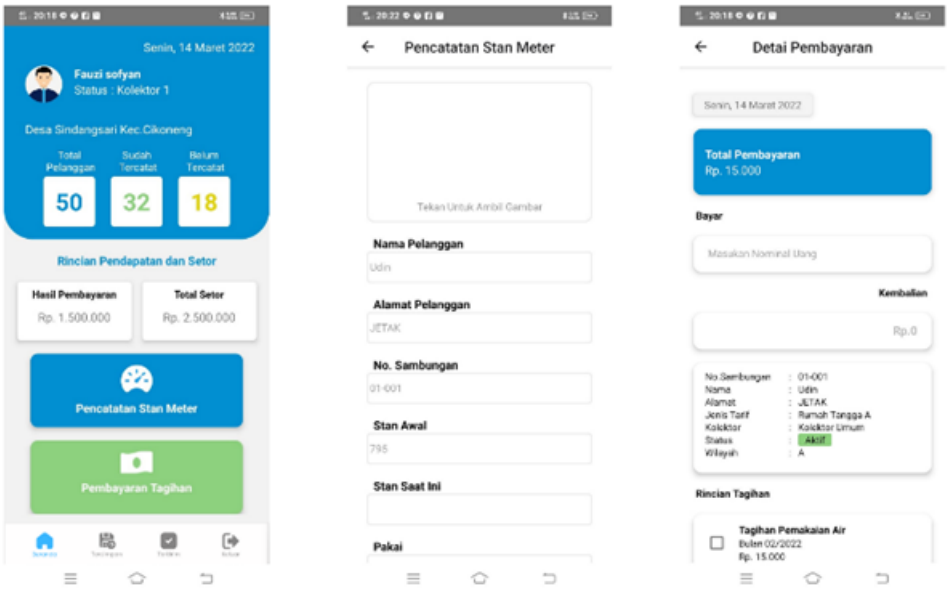

Fig. 5. The application for recording and paying PAMDES water bills based on android mobile appears.

A. *Requirement Analysis*

This research produces a solution based on the research method used, which is based on the waterfall method. The results obtained are a combination of each step taken, as follows. Fig. 2 describes the initial conditions carried out by PAMDES to record the meter until it becomes a water bill. Unfortunately, this process can take more than 10 days from recording the water meter to the water bill for the following month. That is one of the problems that must be found alternative solutions.

Based on the discussion results, alternative solutions were obtained to increase the efficiency of PAMDES working time for recording water meters and making bills, as shown in Fig. 3. Based on the process diagram, PAMDES officers can save time in the billing process. That is because by using a system that will be developed after the recording process is complete, the bill will immediately be made on the same day. So PAMDES officers need to check and print invoices to be sent to customers.

B. *Design*

After the requirements analysis is complete, a design is made, including system architecture design and application UI/UX.

Fig. 4 above describes the system architecture that is designed for the process of running the application to be made. The system architecture shows communication between mobile applications, web applications, and servers based on cloud servers. For example, officers will use the mobile application to record water meters and customer payments. In addition, the website-based application will be used for financial officers and PAMDES secretaries to manage administration and reports.

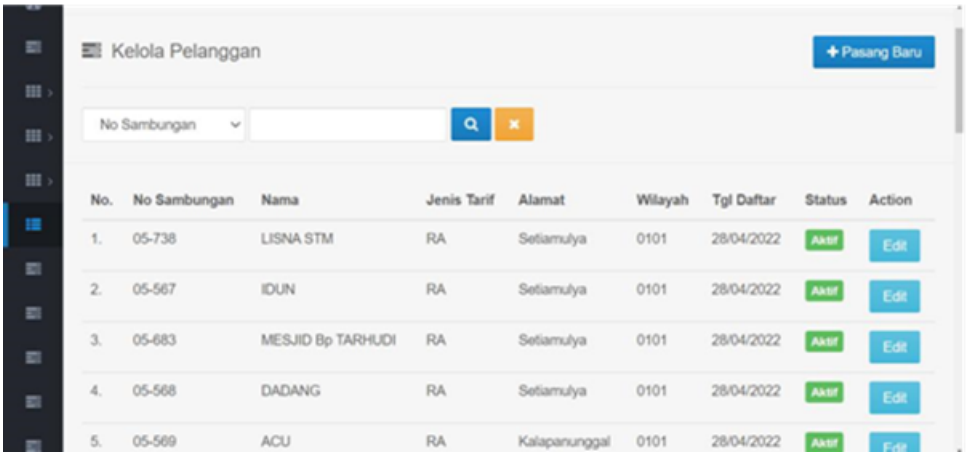

Fig. 6. Display the customer data of the website-based PAMDES billing management applications.

Fig. 5 above is a UI/UX design of a mobile application made using Figma. The display design of this application is tailored based on user experience and age, ranging from 30 years and over. It is intended vthat the application is easy to use by PAMDES officers in recording water meters and processing water bill payments through officers.

In addition to mobile applications, there are other applications developed to complement mobile applications. For example, as shown in Fig. 6 is one of the display designs on the customer data features. This website application focuses on managing data sent by mobile applications to the cloud server so that officers can perform administrative management according to the data received by the server.

C. Development

At the development stage, produce two integrated applications. The first, Android mobile application as a tool for recording and paying air bills through officers. The second of main system is website-based application. Website-based application is also produced as a support for the Android mobile application. The website-based application's primary function is to manage the administration and management of PAMDES.

D. Testing

The testing stage is the stage of testing the temporary results of applications that have been developed, namely an Android mobile application that functions as a tool for recording and paying water bills. This stage uses two tests, namely alpha testing and beta testing.

E. Alpha Testing

Alpha testing aims to test the functionality of the application. Alpha testing is designed so that applications that have been made can run by the applications that have been developed. Before the user uses this application, this test can also identify errors and errors that were not found during the development stage. Alpha testing is done using Blackbox testing. Blackbox is a test based on application details, such as the application's layout, functionality and flow. Below are the results of Blackbox testing.

The results obtained in alpha testing using Blackbox for mobile applications are:

1) The user has successfully logged in with the account that has been saved in the database.
2) The user has successfully seen the dashboard application display in the form of total customers, total water meter recorded, total water meter not recorded, payment results, and total stores.
3) The user has successfully viewed and searched for customer data. Then captured and recorded the water meter to send or save the results.
4) The user has successfully viewed and searched for customer data. Then the user can see a list of the customer's monthly bills and print a proof of payment receipt.
5) The user has successfully seen a list of the recorded history of the water meter stored from the recording feature and can send the results of the recording of the water meter.
6) The user has successfully seen a list of the recorded history of the water meter sent from the recording feature or saved feature.

F. Beta Testing

Beta testing is an objective test that measures the availability of the application system. This test involves the response of application users, namely PAMDES officers. This test uses an online questionnaire to fill in the user's response to the use of the application from the system aspect, user aspect, and interaction aspect. This beta test contains six questions related to application usage responses.

The scale used to assess the response to the questions has four parameters. Parameter number 1 is the worst and number 4 are the best, as shown in Table 1.

Beta testing was carried out using the scale parameter in table 1 by asking several questions about the user experience after trying the system. This

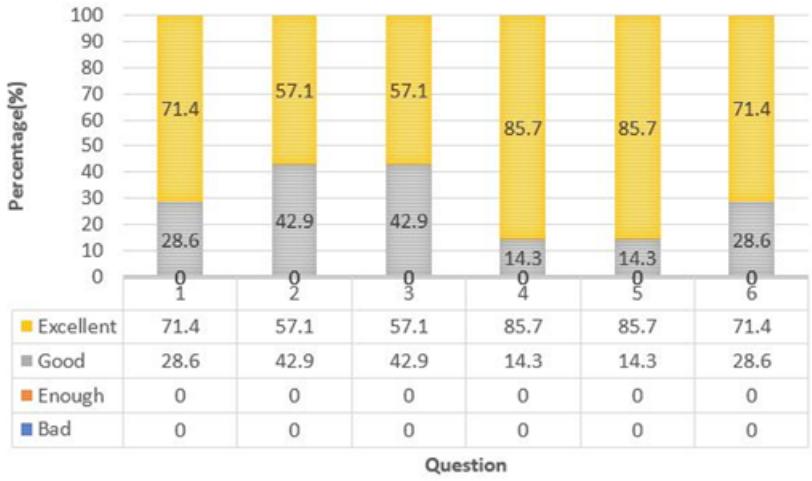

Fig. 7. Beta testing result graph.

Table 1. Table of Scale Value

Parameter Scale	Value
1	Bad
2	Enough
3	Good
4	Excellent

questionnaire was conducted directly by PAMDES Sindangsari officers based on each user's experience. The questionnaire resulted in several assessments of the applications made as follows.

On Fig. 7, the questions carried out in beta testing are as follows:

1) Are the features of the application following what the user needs?
2) Is the application efficient when used?
3) Does the app look good to the user?
4) Is the appearance of the application straightforward for users to understand?
5) Does the function of each button on the application run smoothly?
6) Is the application response to the server smoothly?

Based on the graph in Fig. 7, as much as 71.4% of respondents said that the application features followed the user's needs. Then, as much as 57.% of respondents said that the application is very efficient. As much as 57.1% of respondents said that the application's appearance is excellent. Furthermore, 85.7% of respondents said that the application display is easy to use by users. As much as 85.7% of respondents said that the function of the application button could run very smoothly. And then, as much as 71.4% of respondents said that the application response to the server was very smooth.

G. Maintenance

The last stage is the maintenance stage. At this stage, it indicates that the application is ready and has been used by PAMDES officers in recording and paying bills. Maintenance on the application is carried out at the beginning of every month after the PAMDES officer closes the book on the previous month's recording. This maintenance phase aims to ensure that the application functions correctly at the implementation stage. This maintenance also fixes bugs if they are found in the application. It is possible to develop a PAMDES information system by doing all the stages.

IV. Discussion

Information systems are one way to overcome administrative management problems that are still in use. That is because each application is based on the need to answer these problems in developing information systems.

PAMDES Sindangsari is one of the beneficiaries of the use of information systems. Initially, all Sindangsari PAMDES data was stored in several administrative books, which were easy to lose or damage, and if PAMDES officers wanted to find old data, it was not easy to find. However, after using this application, PAMDES Sindangsari officers can efficiently perform administration of both report administration, making water bills, water meter usage data, and other administration carried out in the same system.

Several tests are carried out to measure whether the application is in accordance with existing needs, including alpha and beta testing. Alpha testing is done to test the function of each feature in the application. Based on the alpha test results, all features follow their functions and can be used by PAMDES Sindangsari to record water meters and make payments through officers. In addition to alpha testing, beta testing is also carried out to measure user satisfaction and the application's security. Beta testing is done by using an online questionnaire so that it can be filled out individually without the intervention of others who can affect the questionnaire results.

There are six questions given to users as test parameters. These questions cover aspects of the system, users, and interactions between the system and users. The beta testing results show that the application can function according to initial requirements during the requirements analysis process. That is evident from the questions given to get excellent scores in all aspects. As in Fig. 7, 71.4% of respondents said the application was for the user's need. In addition, in Fig. 7, as many as 85.7% of respondents said that the application's appearance is easy to understand by users. Then as many as 71.4% of respondents said the response speed when accessing the application was fast, so the application can be said to have been implemented in the management of PAMDES Sindangsari.

The last stage must be regular system maintenance so the system can continue functioning at all times according to its function. In addition, the system must continue to be developed so that application performance can continue to be improved over time and in line with other problems that appear from time to time. So that digital transformation efforts in Sindangsari Village can work optimally to solve problems in the village, especially in PAMDES Sindangsari.

V. Conclusion

Based on the research results, we can conclude that the information system is one way to overcome administrative management problems that are still in use. PAMDES Sindangsari is one of the beneficiaries of the use of information systems. Initially, all Sindangsari PAMDES data was stored in several administrative books, which were easy to lose or damage, and if The PAMDES officers wanted to find old data, it was pretty challenging to find it. After using this application, PAMDES Sindangsari officers can efficiently perform administration of both report administration, making water bills, water meter usage data, and other administration carried out in the same system.

The system created consists of a website application as an administrative management system for PAMDES Sindangsari and an android mobile application as a water meter recording system and water bill payment. The two applications are interconnected with each other to form a complete system. The system has been tested to determine whether the application meets the needs. The test is carried out using beta testing.

Based on beta testing conducted using an online questionnaire scenario, it shows very good user experience feedback. A total of 71.4% of respondents said that the application was in accordance with the wishes of the user. In addition, as many as 85.7% of respondents said that the appearance of the application is easy to understand by users. Then as many as 71.4% of respondents said that the response speed when accessing the application was very fast.

That the system can be said to have been following the needs of PAMDES Sindangsari. In the future, this system must continue to be developed so that application performance can continue to be improved over time and in line with other problems that arise from time to time. So that digital transformation efforts in the village of Sindangasari can work optimally to solve problems in the village, especially in PAMDES Sindangsari.

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