

Design and Build Monitoring System for Pregnant Mothers and Newborns using the Waterfall Model

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Abstract— In Indonesia, the problems of pregnant women and newborns have not been resolved. The reason is that there is no monitoring system for pregnant women and newborns. This study aims to build a monitoring system for pregnant women and newborns. The monitoring system that will be made is mobile-based that can monitor and provide information about the health of pregnant women and children. The model used to create an information system uses the waterfall model. Meanwhile, to test the system built using the Blackbox test model. The plan that was created was tested directly to the user. As a result, the sequence in the waterfall model is proven to build a monitoring system for pregnant women and newborns. The black box model also showed if the built system did not have errors and was ready to be used. Combining the waterfall and BlackBox models results in a monitoring system for pregnant women and newborns whose entire menu can be used properly. The test was carried out on 25 pregnant women users, and it was found that the accumulated ratings were 89, 87, 88, and 89%. In this case, it is classified as Very Eligible.

Keyword— Waterfall, Blackbox, Pregnant Mother, Newborn, Android Studio



I. INTRODUCTION

Indonesia has approximately 250 million people [1] [2]. Problems that have not been resolved are related to pregnant women and newborn children [3] [4]. The rate of maternal deaths is 305 mothers for every 100,000 pregnant women who give birth. For newborns, 29 newborns die for every 1000 births. From 2013 to 2017, a total of 4100 pregnant women died. There were 269 children from 2013 to 2017 [5] [6]. In the performance report of the ministry of health in 2020, the achievement of handling maternal mortality cases contained only 9.7% of the targeted 16%, for prevention of newborn children dying reached 11.6% of the targeted 24.1% [7]. It is an unfortunate situation, and a solution must be found. Executive leaders in all regions of the country must be held accountable for minimizing the conditions.

Factors that cause pregnant women and newborn children to die, among others: lack of nutritional intake, heart problems, hypertension during pregnancy, asthma, stomach acid, bleeding, kidney failure, and anemia (lack of blood). For newborns, there are different causes, such as infection, imbalance in nutritional intake, lack of vitamin intake, and nutritional deficiencies [8]. Many cases occur, namely ignorance of pregnant mothers and mothers who have just given birth, related to the principles of health care for pregnant women, and mothers who have just given birth to nutritional intake and patterns of care for newborns. The reason is that the distance from where life is to the health center is far [9]. Indifference to the health of the womb and newborns. Lack of socialization by the government through the health department. Lack of media as a reference in preparing health intake [10].

Pregnant women and newborns must be considered. Mortality rates, nutritional imbalances, and lack of health knowledge must be minimized. Children are the nation's future, whose birth, growth, and development must be considered. Every mother experiences pregnancy, and the mother is obliged to give the best attention and care to her womb. Nine months pregnant is not easy. The lack of supervision of the womb and the lack of knowledge from themselves and their husbands about their needs during pregnancy are obstacles for prospective mothers to undergo pregnancy. The problem is compounded by mothers who rarely check their content with health workers. So the problem is often not detected. Therefore, the handling of pregnant women during pregnancy is essential to reduce the risks during pregnancy, childbirth, and after birth. Therefore, monitoring is needed to handle and reduce the existing risks appropriately. Accurate data is required not to increase the risk that threatens pregnant women and babies to be born.

Monitoring starts from handling the mother's womb and the management information on the risk of pregnancy for the community. Health workers need to be appropriately managed to produce knowledge about the handling of pregnant women so that the risk of the mother's womb

can be reduced by taking appropriate actions to handle pregnant women based on the information data obtained [11]. An information system is needed to produce precise and accurate [12] [13]. According to the GFK research institute, in 2016, there were more than 88 million internet users in Indonesia. 93% of these internet users access information through their smartphones [14]. 65.09% of these users are women [15]. Thus, a system with smartphone media can provide information and a means of monitoring pregnant women and newborns [16].

Research [17] said that Android-based mobile media was maximally used to provide pregnant women and children health information. The study used android studio with the waterfall model and BlackBox test. All application testing and development stages went smoothly, and all available menus could be run properly. However, the application is only one party. It does not provide a forum for asking questions about pregnant women. Research [18] found that mobile applications offer complete information on the health of pregnant women and children—study by building Android-based mobile applications. SDLCC stages are used to build applications. Testing the system to users of 26 pregnant women and the result is that pregnant women who use the system are served their information needs from the system that was built. However, the application is difficult to access because the memory capacity is enormous, so that it takes up quite a large device memory and causes inconvenience.

Research [19] built an application in the form of a brilliant book to provide measurable and reasonable information to new mothers. Through the built application, mothers giving birth can understand strategies for caring for their newborn babies. In addition, nutritious foods are also served as an intake for newborns. Application is built with android software with android studio application. The stages use input design, output design, database, and context diagrams. However, in its implementation, the nature of the application is only one way. There is no interaction and communication service. So the mother is just waiting for the information provided by the application. Research [20] built a medical record application for pregnancy counseling carried out by pregnant women. So every mother who uses the application will have recorded data, so it is easy to track down when there is a health problem for pregnant women. The application is built based on android mobile. The application's appearance tends to be challenging to understand because the colors are less friendly to the eye. Even languages are complex for pregnant women unfamiliar with computers to interpret.

Research [21] used an application with android to monitor the stages of a mother's pregnancy. They are using the fuzzy method in its design and application development. However, the apps built are only for analysis. Without providing information and advice that should be important for pregnant women. Research [22] uses an android-based application to digitally serve pregnant women's complaints. Each complaint will be stored in the database. To then be followed up by

Public health center employees and doctors on duty at the Public health center. The system design stage is used to prepare and build the design. However, its implementation is only for the data collection on pregnant women; there is no information sharing. Research [23] is based on the importance of health applications intended for pregnant women as a reference to maintain their health. Android-based applications are used. The application is built with the waterfall stage. However, there are pages whose contents are not yet available in the built application. So only a few menus can be accessed and used.

This study aims to build a monitoring system for pregnant women and newborns with a combination model. The combination model in question is the waterfall model used to create the system and the BlackBox model to test the built system. When the search was carried out, research was found whose purpose was to monitor pregnant women and newborns. However, the research is separate. It means that the application that was built handles one case. Not simultaneously handling two cases as was done in this study. In addition, the application used is also one-way. It is different from the current research, where the built applications are interactive. In other words, application users can communicate both ways. Another difference is that previous research does not directly test the system built for direct users, particularly pregnant women.

Meanwhile, the current research directly tests pregnant women and mothers who have just given birth. Another difference is that the built application can be used anywhere, anytime, and connected. It is hoped that this research will overcome the delay and lack of information related to the needs of pregnant women and newborns. In addition, it is a solution to the incomplete data collection of pregnant women and newborns and monitoring of pregnant women and children approaching the day of birth.

This research must be done immediately because of the high level of problems for pregnant women and mothers who have just given birth. This research is essential to do because of the high rate of maternal mortality due to not knowing information about the health patterns of pregnant women. This research is vital to be done immediately because of the high rate of malnourished babies due to mothers' lack of knowledge about the composition of the right food for newborns. This research is also essential because of the importance of government assistance in minimizing problems related to pregnant women and newborn children.

II. RESEARCH METHOD

Quality information will determine the effectiveness of decisions. So we need a good and structured research stage to produce it. The stages of structured research will ensure the validity and accuracy of the research carried out. The stages of the research carried out are as visualized in Figure 1 [24] :

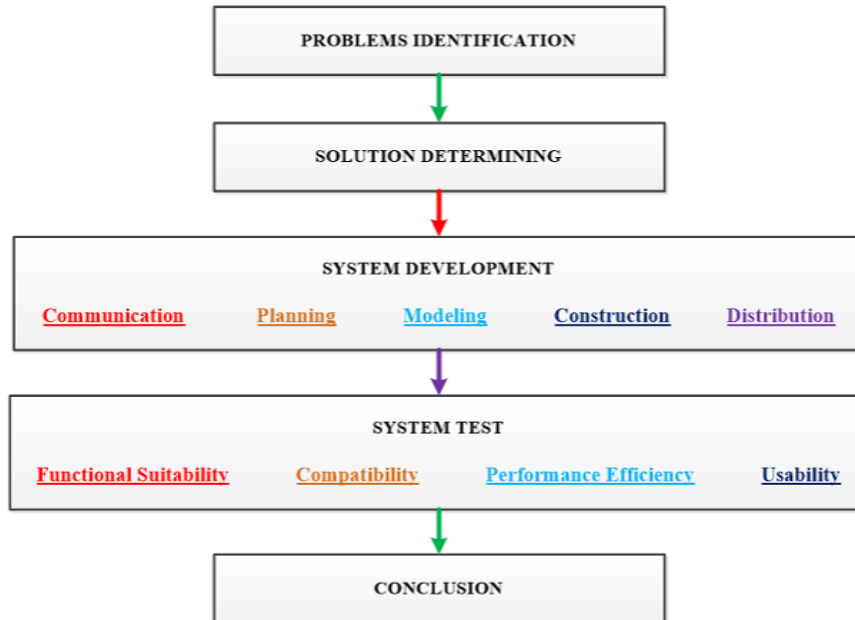


Figure 1. STAGES OF RESEARCH METHODS

The information from Figure 1:

1. Problem Identification

Identify to detect what are the problems related to pregnant women and newborns. This step is directly through the observation process to 5 maternal and child health centers in Medan.

2. Determine the Solution

After determining and identifying the problem by the findings during observations, it is determined what the solution is to answer each problem found. In this case, the key is to build an application for monitoring systems for pregnant women and newborns.

3. Developing System

After deciding the solution to answer the existing problems, steps are taken to develop the system. This stage is carried out by a combination of models in system development. Namely the waterfall model and BlackBox model. The waterfall model in the order [25]:

a. Communication

Similar to problem identification, to ensure the solution provided is on target and accurate. It is done by interview and direct observation.

b. Planning

It is done by laying out the stages of completion, considering the possible risks that may occur, and developing a workable strategy.

c. Modeling [26]

Modeling includes architectural design, interface design, and database design. Architectural design is carried out using the Unified Modeling Language (UML) modeling language, containing Use Case Diagrams, Sequence Diagrams, and Activity Diagrams. Interface design is done by describing the appearance depicted on each Android activity. Finally, database design is done by creating tables that will later be used for data storage in the application.

d. Construction

Activities in this stage build applications. Build applications using Android studio integrated with databases.

e. Distribution

Deliver the application to the user. To evaluate the presented product and provide feedback based on that evaluation. The Blackbox model to see if the system is running well.

4. System Test

The following system testing stage is carried out after the Blackbox model test. Testing this system refers to the ISO standard for information systems. The stages carried out include functional suitability, Compatibility, Performance Efficiency, and Usability [27].

5. Conclusion

Conclusions are drawn after all stages have been carried out. When there are no more errors and the system built is as expected. In other words, the system built is ready to be used by users, particularly pregnant women and health personnel related to pregnant women and newborns [28].

III. RESULT AND DISCUSSION

This study aims to build a monitoring system for pregnant women and newborns using the waterfall model and test the system built using the BlackBox model. The stages carried out include medical testing, meaning an alignment between the system to be made and the actual situation in the field connected with health problems for pregnant women and newborns. Medical testing results are then used as the basis and foundation for building the system. Next is creating a scenario where one of the stages uses a use case. The use case design is visualized in Figure 2.

Following the visualization of the use case diagram in Figure 2, the user has full authority in the use of the application. The application consists of registration, seeing when to predict when to give birth, inputting data for pregnant women, adding data for pregnant women, changing data

for pregnant women, and deleting data for pregnant women. Next, there is a menu that accommodates data collection for newborns. It includes inputting data for newborns, adding data for newborns, changing data for newborns, and deleting data for newborns. After that, there is an information menu in which there is a menu of information related to existing applications, information about pregnant women, information about healthy foods, information about the characteristics of pregnant women and newborns that are important to pay attention to, as well as information about the needs of pregnant women as well. With a newborn. In this application, there is also a question-and-answer menu.



Figure 2. VISUALIZATION OF USE CASE DIAGRAM DESIGN

Users can fill in questions on the form provided, the officer in control of the application will answer the question. For a complete description of the visualization of Figure 2, in table 1:

Table 1. USE CASE DIAGRAM SCENARIO

| Identification | | | | |
|----------------|-----------------|--|--------------------------------------|---|
| Name | Goal | Description | Actor | Action |
| Login | Login to System | Stages to be able to use the Application | Pregnant Women and Application Admin | - Entering Username and Password following respective Authorizations - Use the application as needed - Perform input operations, update, add, and delete data |

After knowing the existing menus and who has the authorization to build the system, the next step is to design the menu display. The menu display is designed:

1. Visualization of the Initial Menu Design

In the initial menu design, two menus will appear sequentially. The menu is the start menu and the menu to enter the username and password., as seen in Figure 3.



Figure 3. INITIAL MENU DESIGN

2. Visualization of the Design of the List Menu and the Home Menu

This visualization displays the design of the list menu and the font menu, which is the main menu of the system being built, as shown in Figure 4:



Figure 4. DESIGN OF LIST MENU AND FRONT MENU

3. Visualization of Maternal Data Menu Design and Search Data

This visualization displays data on pregnant mothers and finds data for pregnant mothers. For visualization in Figure 5:



Figure 5. DATA MENU DESIGN AND SEARCH DATA FOR CONTAINING MOTHERS

In addition to the visualization of the menu design displayed in the application, there is also a menu of complete profile data for pregnant mothers and newborns. There is also a menu to add, delete, update, and save data, whether for pregnant mothers or for newborns. The application is connected to the network, making it possible to track with the google maps facility. With a note, when the application is operated, the telecommunications equipment used is connected to the internet network.

Every information system, which essentially has a function and uses the public, is integrated with a database. It is also the case with the Monitoring System for Pregnant Mothers and Newborn Children. For the maximum integration to occur as expected, a visualization of the database design is first made. The database consists of tables that reflect every view that exists in the system that is built. The existing tables are connected or integrated, linked by the primary key. The form of database visualization is as shown in Figure 6.

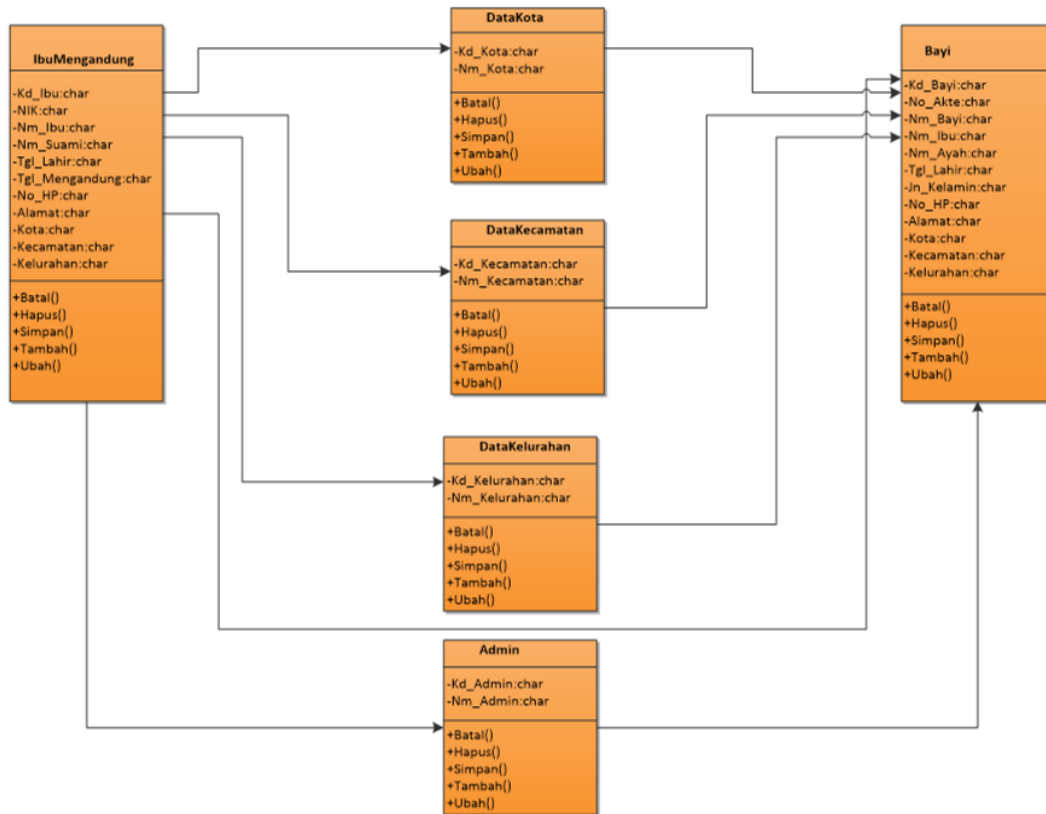


Figure 6. DATABASE MENU DESIGN

Figure 6 can be classified if the system has six tables: the pregnant mother table, the baby table, the admin table, the city table, the sub-district table, and the village table. Each table is connected through the primary key contained in each table.

After designing, the steps taken are to build a system with a programming language. In this case, the programming language used is the Android Studio programming language. The view of the system that was built is:

1. Home Menu Display

In the initial menu display, two menus will appear sequentially. The menu is the start menu and the menu to enter the username and password. As seen in Figure 7:



Figure 7. START MENU DISPLAY

2. Display List Menu and Home Menu

This view displays the list menu and the front menu, which is the main menu of the system being built, as shown in Figure 8.



Figure 8. DISPLAY LIST MENU AND FRONT MENU

3. Menu Display of Pregnant Mother's Data and Search Data

This display displays data on pregnant mothers and finds data for expectant mothers. For visualization in Figure 9:



Figure 9. DISPLAY THE DATA MENU AND FIND DATA FOR CONTAINING MOTHERS

The next step is to test the system that has been built. According to planned and design, the goal is to see if all the existing menus have gone well. The testing process is carried out using the Blackbox model. The test results are as in table 2.

Table 2. TESTING WITH BLACK-BOX MODEL

| Trial with Black Box Model | | | | | |
|----------------------------|---------------------------|--------------------------------------|---|-------------------------------|---------------------------|
| No | Test Scenario | Test Case | Rating result | Decision | Information |
| 1. | Login | Entering Username and Password | When Username and Password are entered correctly, login is successful | According to what was planned | According to Expectations |
| 2. | Opening the Home Menu | Pressing the System Home Menu | When the button is pressed, the application automatically switches to the system home menu | According to what was planned | According to Expectations |
| 3. | Open the Home Menu | Pressing the Home Button | When the button is pressed, the application automatically switches to the home menu. | According to what was planned | According to Expectations |
| 4. | Opening Data Input Menu | Pressing the Data Input Button | When the button is pressed, the application automatically switches to the Input Data menu. | According to what was planned | According to Expectations |
| 5. | Open the Show Data Menu | Pressing the Show Data Button Knob | When the button is pressed, the application automatically switches to the Show Data menu. | According to what was planned | According to Expectations |
| 6. | Open the Search Data Menu | Pressing the Search Menu Button Knob | When the button is pressed, the application automatically switches to the Search Data menu. | According to what was planned | According to Expectations |

Black box testing is carried out by table 2, all running as specified. Everything went well, as expected, from testing logins for user names and passwords, accessing menus, inputting information, accessing information, and using existing menus. The system that was built was running well and as expected. No more errors or menu buttons that cannot be accessed or used.

After testing the application with the black-box model and all the menus on the system can run well, the subsequent trial is carried out with users. Users, in this case, are mothers who are pregnant. The number of pregnant women who were allowed to do a trial was 25 pregnant women. The test method is to ask pregnant women to use the system first. Then every mother who has used the system that has been built is requested to check the paper containing the question sentence. The interrogative sentence includes questions related to the application, including the quality of the system built, the quality of the system menu, the interactive level of the system, and the ease with which the system is used. The accumulated trials are as shown in table 3:

Table 3. ACCUMULATED USER RATING (%)

| Accumulated User Ratings | | | | |
|--------------------------|----|--------------|-------|----------------|
| Amount | 25 | Accumulation | Total | Classification |
| System Quality (%) | | 89 | 88 | Very Worthy |
| Menu Quality (%) | | 87 | | Very Worthy |
| Interactive Level (%) | | 88 | | Very Worthy |
| Easy to Use (%) | | 89 | | Very Worthy |

Following the results of accumulated tests with users in table 3, it can be visualized in the form of a graphic diagram in Figure 10 :

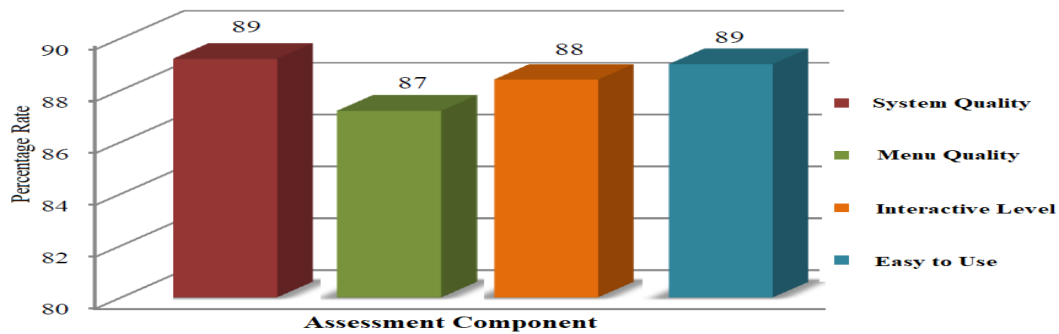


Figure 10. GRAPH OF USER VALUE ACCUMULATED DIAGRAM

The graph diagram, which is the accumulation of user values, further emphasizes the exposure of table 3 that overall based on direct assessments from users, the system built is classified as a Very Feasible system, with component values in an average of 89, 87, 88, and 89%.

IV. CONCLUSION

Utilization of the Combination Model can produce a monitoring system for pregnant women and newborns. The sequence in the waterfall model has proven convincing that it can be used to build a monitoring system for pregnant women and newborns. The combination with the BlackBox model can produce a monitoring system for pregnant women and newborns whose entire menu can be used correctly and with expectations. So that when a direct test is carried out on users, the average value obtained is in the Very Eligible classification. Thus, the monitoring system for pregnant women and newborns is indeed by the expectations of pregnant mothers and is suitable for monitoring newborn children. The test was carried out by 25 users who were pregnant, with an accumulated rating of 89, 87, 88, and 89%. This monitoring system for pregnant women and newborns will be able to accommodate the needs of pregnant women in terms of information related to handling the health of pregnant women and newborns. The system was built based on testing, proved to be interactive, and easy to use. The composition of the menus in the created system answered the problems of pregnant women and newborns previously unavailable. This new system will help pregnant mothers and newborn children to consult their needs for good information.

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