

A Monitoring Application for Screening or Early Detection of High-Risk Pregnant Women Using Spring Boot and Flutter Frameworks

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Abstract

Pregnancy is still a major health issue at present. Statistics demonstrate an annual increase in pregnancies. Monitoring pregnant women involves undergoing regular checkups to verify the fetus's health. However, many midwives still manually enter data in ledgers. Therefore, this study designed an application to assist midwives in saving and displaying data to monitor the health of pregnant women, allowing the stored data to be easily obtained and saving midwife storage space. This application is exclusively accessible to midwives due to the restricted periodic health checkups for pregnant women. This application was developed using the spring boot and flutter frameworks. In the final stage, testing was performed on the designed features.

Keywords: *Application, Monitoring, Pregnant Women, Recording, Examination.*

1. Introduction

Pregnancy remains a significant health concern nowadays. Statistics unveil the rising annual pregnancy rate. The Central Statistics Agency reported a rise in the pregnancy rate of 87.91% in 2020, increasing 1.97% from the previous year, a positive indicator of the mother's and fetus' health. This rise is of paramount importance to ensure a successful pregnancy and delivery. Pregnant women must conduct regular checkups to ascertain their unborn children's health—called monitoring pregnant women. The goals of this monitoring are to observe the fetus's health as it grows, monitor the progress continuously, identify any issues that may arise with the fetus, and establish a regular report.

However, many midwives in this modern era remain conducting manual monitoring by recording in ledgers. A midwife named Nurmala Dewi, working in Berau, East Kalimantan, is one of them. Midwives who work independently typically utilize paper records to monitor their patients' pregnancies. The examination results are recorded and made available during the subsequent examination. Since the record books can quickly get stacked, making the midwives' room less comfortable, and making it difficult to look for data on the history of pregnant women, this recording is not beneficial if it is consistently implemented. Therefore, midwives require an application that can store and display data to monitor the health of pregnant women in a way that is both accessible and expands their capacity for storing such information.

Researchers performed entitled "Development of the Health Monitoring Application for Pregnant Women and Children Integrated" with system development goals which is able to provide immunization schedule reminders for people parents as well as providing services monitoring the development of the period pregnancy and child development [1]. Researchers performed entitled "Application Design Monitoring the Health of Android-Based Pregnant Women" with the aim to ease app creation through deep overview the

form of a digital diagram for monitoring the health of pregnant women on independent midwife practice [2]. Research performed entitled "Application Mobile Smart Birth for Monitoring Pregnant Women" with the aim create an application with a new concept in the form of monitoring and mapping Health of pregnant women in an area [3]. Researchers performed entitled "Monitoring Application Pregnant Women's Weight" with the aim of making android applications that serves to maintain the weight of pregnant women during pregnancy thereby reducing LBW (Low Birth Weight) [4]. Researchers performed entitled "Utilization of the System Mobile Information for the Health of Pregnant Women and Children" with the aim provide information on alternative information that is complete for health of pregnant women and children using the Mobile application along with the guide [5].

1.1. Monitoring of Pregnant Women

Researchers performed Monitoring pregnant women is a decision making for the patient to follow up on the incident beforehand, such as monitoring or fetal development if any the possibility of abnormal development so that it can be treated [6].

1.2. Application

Researchers performed Application is a software unit that is deliberately made to meet the needs of various activities or jobs, such as trading activities, advertising, community service [7].

1.3. Android

Researchers performed Android is an operating system used on Linux-based touch screen phones and tablet computers [8]. The Linux kernel is an open source Android operating system thus allowing developers to always create applications Android based.

1.4. Flutter

Researchers performed Flutter is a Mobile App SDK (Software Development Kit) developed by Google to develop applications Android and iOS from one high-performance codebase, Flutter can be easily learned because it uses the Dart programming language. The goal is to enable developers to deliver high-performance application that feels natural on different platforms. Apart from that flutter also includes a reactive-functional framework, engine 2D rendering, ready-to-use widgets and development tools [9].

1.5. SpringBoot

Researchers performed spring boot has a function to make the spring application development process more simple. In its use, Spring boot has several the advantages include supporting MVC, providing RESTful features Web service and has a database connection. There are dependencies injection in the spring framework also supports ease of use configuration and make the application development process easier. In addition, the Aspect Object Programming (AOP) function on every spring framework makes spring framework simply have functionality needed for app development but not related to the functionality in the application. So the application can focus to the core business of the application while other functions such as logging, resource pooling, catching, security issues and application performance management is aided by AOP [10]. Researchers performed Another advantage in spring boot is having a server tomcat which can be used by running directly [11]. Spring boot also supports using maven ie tools that facilitate application development with their presence Automatic creation of folders and files.

2. Method

The application development for monitoring the health of pregnant women utilized the spring boot and flutter frameworks. The development underwent four stages: requirement analysis, design, manufacture, and testing. Figure 1 illustrates the research stages.

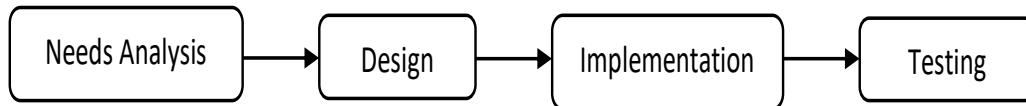


Figure 1 Research Stages

2.1. Requirement Analysis

This application development required information on data to display and features to create. The required information was obtained from a midwife named Nurmala Dewi in the form of screening or early detection of high-risk pregnant women (“Poedji Rochjati”) with a pdf file. This analysis revealed several needs for the application.

Therefore, the application would have the following features.

- a. Login and logout for midwives
- b. Adding patients by midwives
- c. Patient list
- d. Adding patient screening by midwives
- e. Screening list
- f. Screening results

2.2. Design

2.2.1. System functional design

The requirement analysis resulted in the system’s functional requirement design depicted in the following use case diagram. The user could log in, add pregnant woman patients, identify registered pregnant woman patients, screen for registered pregnant woman patients, discover the screening results, and log out.

2.2.2. Entity Relationship Diagram

An entity relationship diagram (ERD) was employed to develop an application for monitoring the health of pregnant women using the spring boot and flutter frameworks.

User (midwife): midwife_id, name, email, identity number, employee index number, password, and username; midwife_id is the primary key

- a. Role: role_id and role_name; role_id is the primary key
- b. Pregnant women: pregnant_women_id, name, age, occupation, address, pregnancy_parity, education, village, last menstruation, and estimated delivery; pregnant_women_id as the primary key
- c. Period: period_id, name, gestational age, and place of delivery; period_id is the primary key
- d. Screening: screening_id, name, and score; screening_id is the primary key
- e. Province: province_id, province_name, province_code, and information; province_id is the primary key
- f. Regency: regency_id, regency_name, regency_code, and information; regency_id is the primary key
- g. Sub-district: sub-district_id, sub-district_name, sub-district_code, and information; sub-district_id is the primary key
- h. Village: village_id, village_name, village_code, and information; village_id is the primary key

The spring boot and flutter frameworks were applied to develop this application. Subsequently, the MySQL database design was utilized to create the system’s functional requirements, as portrayed in the following inter-table design modeling.

2.2.3. Inter-Table Design

Demonstrates several relationships of the designed database.

- a. The user or midwife table had a many-to-many relationship with the role table because more than one user or midwife could have more than one role.
- b. The user or midwife table had a one-to-many relationship with the pregnant woman table since one midwife could have many pregnant woman patients.

- c. The pregnant woman patient table had a many-to-one relationship with the period table because each pregnant woman had one period.
- d. The period table had a many-to-many relationship with the screening table since multiple periods could have multiple screenings.

2.2.4. Interface Design

Figures illustrates the class diagram for developing the application for monitoring the health of pregnant women using the spring boot and flutter frameworks.



Figure 2 Login page



Figure 3 Homepage

Figure 2 exhibits the login page display, containing the application title, logo, email or username input form, and password input form. Figure 3 is the homepage display depicting the midwife's data, logo, list of pregnant woman data, and the button to add pregnant woman patients.

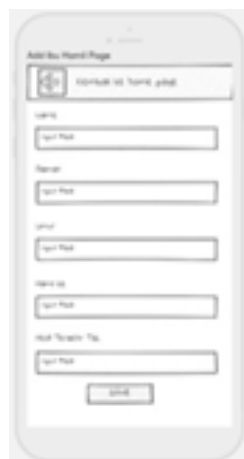


Figure 4 Page of Adding Pregnant Woman Patients



Figure 5 Page of Pregnant Woman Patient Details

Figure 4 is the page display for adding pregnant woman patients, portraying the input form for the patients' data and the save button. Figure 5 depicts the display page for pregnant woman patient details, covering pregnancy category data, a button to add screening, and screening result data.



Figure 6 Page of Pregnant Woman Patient Details



Figure 7 Screening Page (Examination)

Figure 6 is a design interface for detail page pregnant women showing pregnancy category data, button added screening, and outcome data screening. Figure 7 demonstrates the display page for the pregnant woman patient examination, containing the input field form, the risk factor checklist form, and the save button.

2.3. Implementation

Application Results

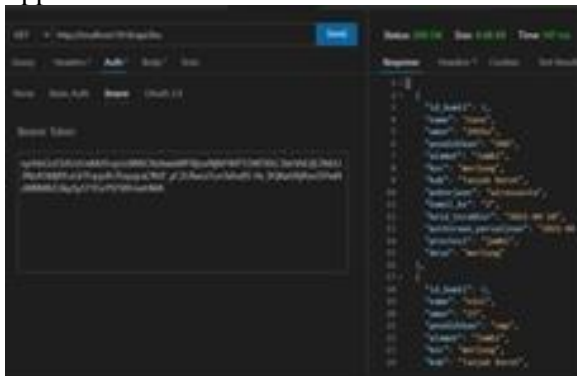


Figure 8 Back-End Coding Results

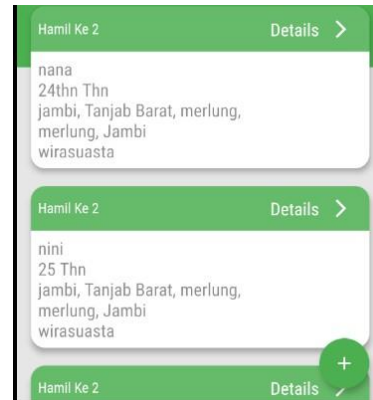


Figure 9 Front-End Coding Results

Figure 8 denotes the results of back-end coding, where the API results took the form of json data. Figure 9 represents the front-end coding results, generating the data list.

2.4. Testing

Black box testing was performed on the developed application. It tested the fundamental aspects of the application without paying attention to its internal logical structure. It aimed to discover if the application could work properly.

Table 1 Black Box Testing on the Application

Test Case	Expected Results	Results Obtained	Status
Log in to the application using email or username and password	The user will successfully enter the application.	The user successfully entered the application.	Succeed
Adding new pregnant woman patients	New patient data will be successfully added.	New patient data were successfully added.	Succeed
Selecting pregnant woman patient details	Screening results will appear.	Screening results appeared.	Succeed
Screening pregnant woman patients	Screening data will be successfully added.	Screening data were successfully added.	Succeed
Does the color of the total screening score category fit the provisions?	The color of the total screening score fits the provisions.	The color of the total screening score fitted the provisions.	Succeed
Clicking the logout button on the homepage	The application will close the homepage and return to the login page.	The application closed the homepage and returned to the login page.	Succeed

3. Results

3.1 Results and Discussion

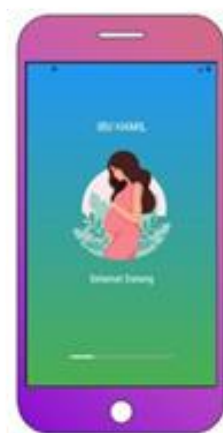


Figure 10 Initial Page

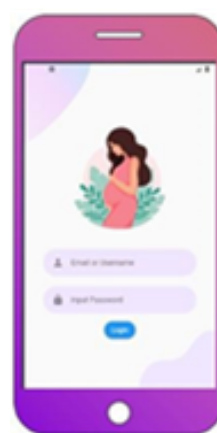


Figure 11 Login Page

3.1.1. Initial Page

The initial page appeared when the midwife opened the application for monitoring pregnant woman patients, as displayed in Figure 10 This initial page beautified the application by containing only a logo and a loading screen.

3.1.2. Login Page

Figure 11 exhibits that the login page emerged after the initial page, functioning as the application's security. The user must enter a valid username, email, and password to access the homepage.



Figure 12 Homepage



Figure 13 Page of Adding Data

3.1.3. Homepage

The homepage illustrates a list of registered patient data, followed by information about the logged-in midwife. At the bottom right was a button to add newly pregnant patients. Figure 12 displays the homepage display.

3.1.4. Page of Adding New Pregnant Woman Patient Data

Figure 13 exhibits the page for adding new pregnant woman patient data, appearing whenever the midwife pressed the add data button at the bottom right of the homepage. The midwife must enter new patient data on this page, including their name, age, education, pregnancy parity, address, occupation, and expected due date. The save button at the bottom should be clicked to save the data.



Figure 14 Page of Pregnant Woman Patient
Details

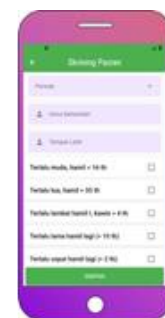


Figure 15 Screening page
Details

3.1.5. Page of Pregnant Woman Patient Details

The page of details for pregnant woman patients exhibited their health check history. This page contained data on the health of pregnant woman patients previously checked. In the top view, the application provided three score categories

obtained by patients when checking their pregnancy: Low-Risk Pregnancy with a total score of 2, High-Risk Pregnancy with a total score of 6 to 10, and Very High-Risk Pregnancy with a total score of greater than 12. The Low-Risk Pregnancy category entailed data of care: midwife, referral: not referred, place: not referred, helper: midwife, and had a green color. Meanwhile, the High-Risk Pregnancy category encompassed data of care: midwife and doctor, referrals: public health extension midwife, place: public health extension *polindes* (hospital), helpers: midwife and doctor, and had a yellow color. In addition, the Very High-Risk Pregnancy category contained data on care: doctor, referral: hospital, place: hospital, helper: doctor, and it was in red. Figure 14 portrays the displays of pregnant woman patient details. Figure 15 demonstrates the screening page, displaying patients' health checks to identify pregnancy disorders.

Table 2 implies that the application succeeded in passing all the test cases.

Test Case	Expected	Test Case
Selecting SSI surveillance in the dropdown on the side panel	The system will display a table and line graph of the SSI surveillance data.	Succeed
Selecting an antibiotic in the dropdown on the side panel	The system will display a table and bar graph of the antibiotic data.	Succeed
Selecting ASA Class in the dropdown on the side panel	The system will display a table and a line graph from ASA class data.	Succeed
Selecting SSI surveillance in the dropdown on the side panel	The system will display a table and line graph of the SSI surveillance data.	Succeed
Selecting an antibiotic in the dropdown on the side panel	The system will display a table and bar graph of the antibiotic data.	Succeed
Selecting ASA Class in the dropdown on the side panel	The system will display a table and a line graph from ASA class data.	Succeed

4. Conclusion

After developing an application to monitor pregnant patients using the spring boot and flutter frameworks, the results and discussion led to the following conclusions. The application for monitoring pregnant woman patients was successfully developed and ran well. This application helped the midwife check the health of pregnant woman patients. This application facilitated the midwife to acquire the total score from the first period of pregnancy to delivery because it conducted the score calculation. This application could speed up the screening results as it categorized them automatically following the provisions.

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