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Design of Mobile Digital Healthcare Application For Pregnant Women Based on Android

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ABSTRACT

Regulations for reducing mobility during the Covid-19 pandemic have become a problem for pregnant women. Pregnant women are a group with a high risk of being exposed to the virus. In addition, regular visits to health service centers or Puskesmas are also limited. Then the reduction in routine visits causes the health condition of pregnant women to be unable to be monitored. In this paper, to overcome this problem, information technology is used. Information technology is the design of an android application called Salute Bidan. This application is like digitizing some of the midwife's tasks consisting of related matters during pregnancy and measuring the level of risk pregnancy using 30 risk criteria developed from Poedji Rochyati's scorecard in the form of self-screening. The design of this application uses a software development method, namely the Experiment and Revision Collaboration (ERC) part of the Rapid Application Development (RAD) software development. The results in two platform implementations are android applications and websites. In addition, the results have been tested using the BlackBox technique of Use case Testing.

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1. INTRODUCTION

The pattern of life has changed since the Covid-19 pandemic which began to hit Indonesia in March 2020. During the pandemic, everything related to human activities is limited, one of which is the mobility. The limited mobility is also experienced by pregnant women who are vulnerable to various diseases. The existence of restrictions on mobility makes a lot of pregnant women delay their visits to the health service centers or in Indonesia also known as Puskesmas. Whereas the health of pregnant women during pregnancy is the first thing that they need to know as basic knowledge. This is because they are the ones at the most risk. According to WHO, pregnant women belong to a group that is so vulnerable to being exposed to the Covid-19 virus [1] that they still need to consult their wombs to healthcare workers such as handled by a midwives, where in Indonesia also known as Bidan [2]. Scheduled consultation visits for pregnant women have been summarized in the Maternal and Child Health Book (KIA) or known as the pink book. The visits based on the KIA book are carried out 4 times, namely once before 3 months of pregnancy, once at 4-6 months of pregnancy and twice at 7-9 months of pregnancy [3].

Consultation visits are useful to know the condition of pregnant women and the womb, more specifically, to determine the risk of pregnancy experienced so as to reduce the Maternal Mortality Rate (MMR) and Infant Mortality Rate (IMR). In the study [2], only 26.7 % of mothers had received antenatal care (ANC) since the Covid-19 pandemic. This shows a decrease in visits by pregnant women to the health centers or puskesmas due to the restrictions on mobility as part of the rules during the pandemic. In addition, the use of KIA handbooks as a guide for educating pregnant women during their pregnancy is still underutilized by them as in the research [4].

It is, therefore, necessary to have facilities that can overcome mobility problems and to use KIA Handbooks during the Covid-19 pandemic. In this study the use of the information technology could be used as a solution to these problems. The information technology that could be used was presented in the form of software applications which in this study were designed and proposed in the form of web applications and mobile applications. Prior to the Covid-19 pandemic, there were several studies that used the information technology for pregnant women which were included the research [5, 6]. Software applications in general can monitor the condition of pregnant women as a history of pregnancy. Long before the pandemic, the use of technology such as mobile devices to provide android applications related to the health of pregnant women included monitoring applications for pregnant women's visits to a health service center [5]. In this study, the visit of pregnant women can be controlled in the application, where the application has a visit schedule feature accompanied by the online registration and can display the information on the health of pregnant women. In research [6], where the research resulted in an application of maternal and child health information (KIA) that can display information articles related to the pregnancy, danger signs and the existence of a fertile period calculator. The research on a mobile application called ELISA [7] can monitor the history of the journey of pregnant women from the beginning to the time of delivery in the form of a calendar.

There are also studies devoted to the users, namely the healthcare workers as in the research [8], an android application was designed for ASHA healthcare workers in India. The study aims to reduce the mortality rate of pregnant women (maternity) which is called Smart ASHA. In addition, the research on the effectiveness of using software applications by the users of pregnant women was carried out in the research [**?** 9]. In research [8] and [9] the perception of pregnant women was measured from the user experience of an application called AMILA which is designed to support the daily routine activities of pregnant women and can be monitored every week. In addition, the research on an application for monitoring pregnant women based on User Experience was carried out in research [10].

The risk or danger of pregnancy is a contributing factor to the Maternal Mortality Rate (MMR) and the Infant Mortality Rate (IMR). To be able to determine the level of risk in pregnant women, the Poedji Rochyati scorecard [11] can be used which divides the score into three categories, namely low, high and very high based on 23 scoring criteria. Research [12] Poedji Rochyati's scorecard was used as an indicator to determine the risk category for pregnant women which was implemented in an application called e-iANC. Then in research [13] the development of the Poedji Rochyati score in the form of an independent screening was with an additional 7 criteria to be 30 scoring criteria, where one of the additional criteria was related to Covid-19. The scoring resulted in 3 groups which were marked by colors, namely the Low Risk Condition (KRR) in green, the High Risk Condition (KRT) in yellow and the Very High Risk Condition (KRST) in red. Beside the addition of 30 criteria, the information on Pregnancy Counseling/Safe Delivery -Planned Referral-Programs of Delivery Planning and Complication Prevention (P4K) was added with the Emergency Complications Prevention (PKK). Then on the patients [14] an early detection of pregnancy risk was made on a website based on the body mass index before pregnancy.

The development of the information technology applications for the health of pregnant women is still a research opportunity. Moreover, previous studies that became the reference for this research still did not utilize the KIA book as the application content and there was also no application that displayed the level of risks for pregnant women adjusted to the Covid-19 pandemic. The objective of this paper is to design an application that can be a guide to pregnant women during the pregnancy period in pandemic covid-19.

This application has the advantage of being able to inform the activities of pregnant women whose information is adopted from the 2021 version of the KIA book [3], chapters of pregnant women, pages 16-22 and can measure the level of pregnancy risk based on the Poedji Rochyati scorecard which has been developed into 30 risk criteria [14]. The designed software application will be presented in a website application and a mobile application called "Salute Bidan". This software is expected to digitize the duties of a midwife or Bidan as a consultant for pregnant women. The research method used in this study was the ADDIE Framework and the software development method used was the Experiment and Revision Collaboration (ERC), which is a part of the development method of the Rapid Application Development (RAD). The application design process quickly used the webview model, which produced a web application which was then converted into an android mobile application.

The organization of this paper is as follows: the related work in section 2. The discussion of the method carried out is presented in the section 3. The basic principles of the developed platform are presented in section 4. The application structure are proposed in section 5 and for the prototype result in section 6. Conclusion and Future Works are discussed in section 7.

2. RESEARCH METHOD

The method in this research is based on the ADDIE framework model consisting of five parts, namely analysis, design, development, implementation and evaluation [14, 15]. The ADDIE framework model is as presented in Figure 1, and more fully in Figure 2.

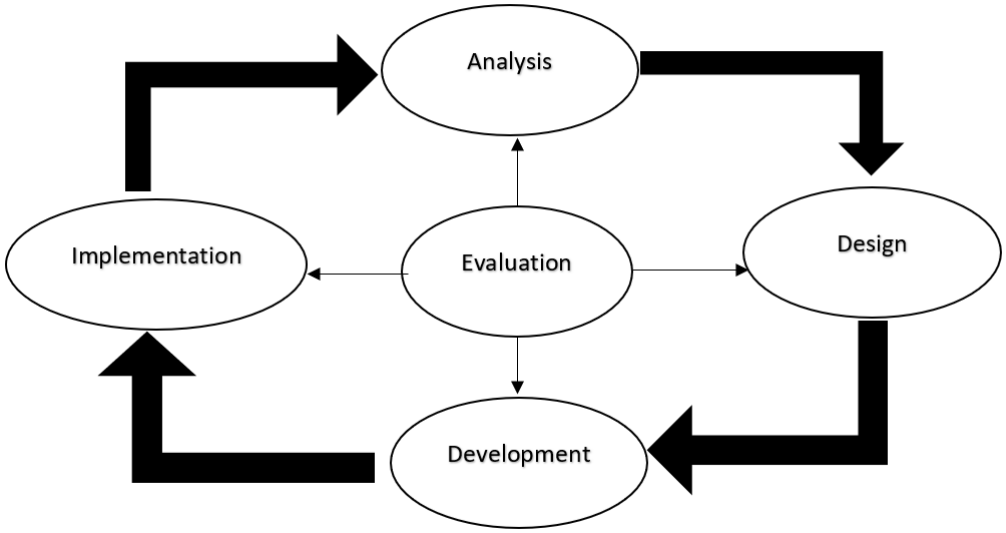

Figure 1. ADDIE Framework

2.1. Analysis

Based on the ADDIE framework model on Figure 1, the first stage of this research method is analysis. This stage begins with data collection using survey and observation techniques. The survey and observations carried out were direct surveys on five health centers located in the city of Depok, West Java province, Indonesia, namely Cinere, Cimanggis, Beji, Sukmajaya and Pancoran Mas. The survey focused on how to see the activities and found the complexity of the problems experienced by midwives and pregnant women. Then, a literature study was carried out to learn the accurate method as a solution to solve the existing problem from various literature sources. The next stage is to formulate the problem to determine the right method and to collect the data in order to determine the framework and the application design, and then to analyze the system requirements based on the user needs. The requirement analysis is divided into a functional requirement analysis consisting of service features presented in the application for users and a non-functional one consisting of the behavior of the system towards the users. From the survey and observation stages to requirement analysis are summarized in the analysis stage as shown in Figure 2, steps 1 to 4.

2.2. Design and Development Application

The system design stage, number 5 in Figure 3, was carried out by designing the application system using UML diagrams to determine the workflow pattern of the application. Furthermore, at the development stage, number 6 in Figure 3, an android application was made using the rapid prototyping method as shown in Figure 3. The last stage, namely the testing and implementation of number 7 in Figure 3, was carried out on the results using function testing in the form of black-box testing.

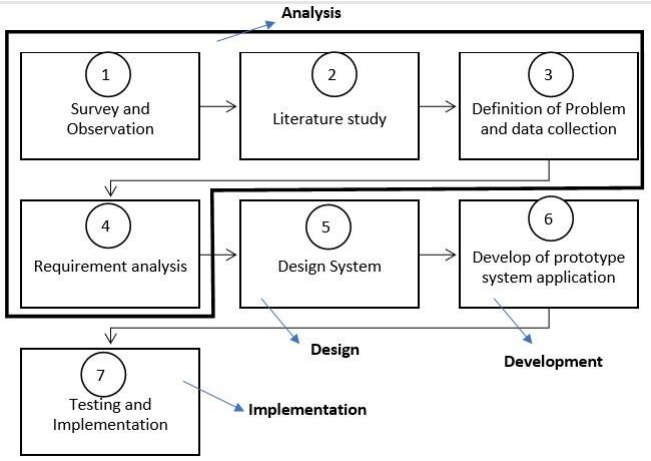

Figure 2. Research Method

The Rapid Prototyping (RP) method was used as a method of developing and making the applications in this study as shown in Figure 3. This RP method is based on the method of the Rapid Application Development (RAD) [16] [17]. The RP method is good at overcoming the communications between the application developers and the users so that the application creation process becomes fast. We call this stage the Experimentation and Revision Collaboration.

This method is excellently used to overcome the problems of misunderstanding between the users and the analysts that arise because the users cannot define their needs clearly.

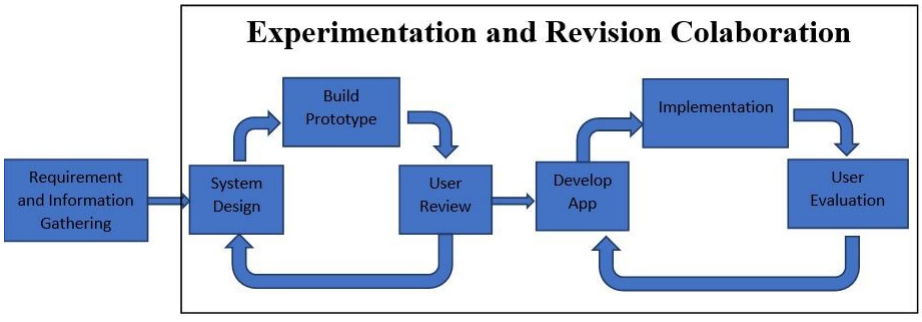

Figure 3. Rapid Prototyping Model

1. Requirements and Information Gathering Block

This stage is the beginning of the RP method. Some information is needed to determine the requirements of the system. In the process of getting the information, the midwives were interviewed to find out the expected functions of the application system for pregnant women. The system requirements include input and output systems, system interfaces, service features and databases.

2. Experiment and Revision Collaboration Block

This stage becomes 70-80% of the application-making process of the entire research process. At this stage it was divided into two cycles, namely prototype and implementation. In the prototype cycle, design arrangements were made which consisted of a data design, a system flow and a user interface. During the prototype cycle phase the user was involved to assess the prototype while the development process continued to follow the information changes from the users. After the prototype was approved by the user, the implementation cycle by launching the application was carried out with a direct implementation to the user during the implementation, the input and suggestions from the users would be used as performance improvements and platform maintenance.

2.3. Implementation

1. Principle of Application Design

Architectural design for a commonly used mobile application system is cloud service [18]. Figure 4 shows the design architecture of this application. This application architecture uses a service-oriented cloud base to make it easier to use the application on the user side. All services and processes are on the hosting server then data is received and sent to the server by the user.

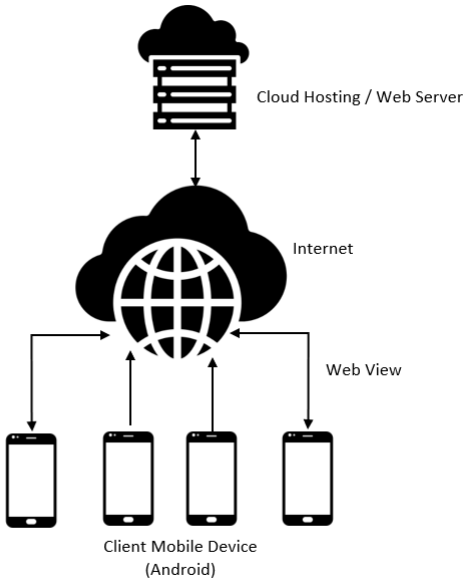

Figure 4. Design Architecture System Application

This design carried out with two design strategies, namely making a base website and creating a mobile application running on the Android smartphone devices. The application design strategy can be seen in Figure 5 in the flow of design process strategy. Referring to the design process [19] it includes the designs of both the server part and the client part. In this study the same things were done but not done in parallel. The design website was then hosted for online first, and then converted into a smartphone application. The website design as a server consists of an architectural design, a function design, a data design and a user interface design. The smartphone application design as a client consists of a function design and a rendering. As an initial step in the form of a prototype, the website and the application will be run together as an implementation.

The main target in this research is an application on an Android smartphone, so in order to speed up an application creation, the application is designed with a web view technology. The advantages of using web view technology, beside speeding up the design process, can also produce two applications, namely websites and smartphone applications.

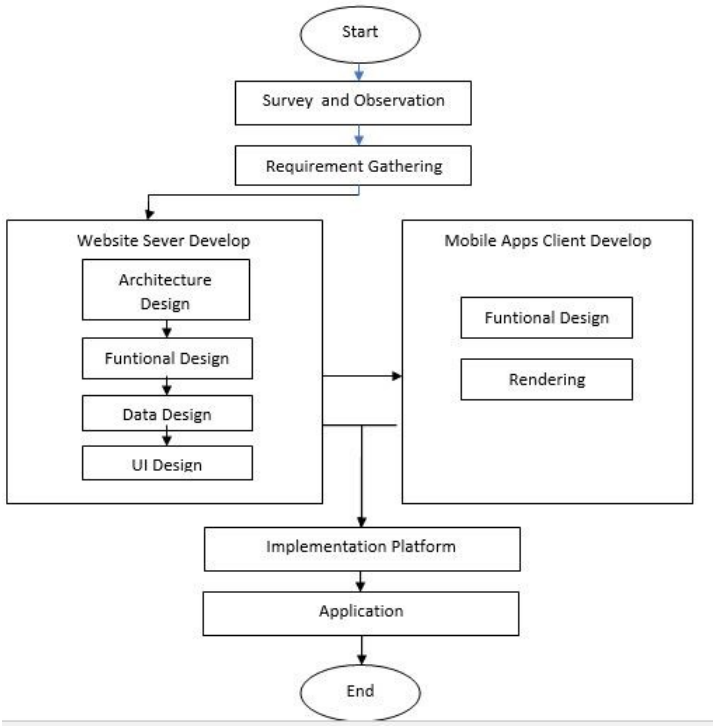

Figure 5. Strategic Design Flow

This application modeling technique uses the Unified Modeling Language (UML) approach. For the graphics used in the Use Case and Class Diagram.

2. Use Case Diagram

The users in this application consist of User and Admin. The user is woman pregnant and admin is administrator. A user can access this application, if the user does not have an account yet, then a new user is required to register first to log in to the system. Then registered users can access 7 features, namely: chat with midwives, consultation with puskesmas, self-screening, pregnancy calculator, articles, and profiles. The login case What users can do in this system can be seen more clearly in the following Figure 6.

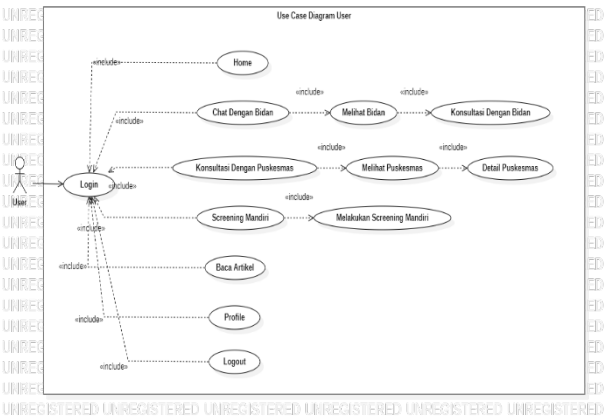

Figure 6. Use Case Diagram User Use Case

Based on Figure 6, the user login case uses the ”include” relation, which means that if the user as an actor logs in, the user can access the seven features. For example, in Figure 6, if a user wants to consult with a midwife, then the user can log in first and then use the midwife chat. The midwife chat includes the feature of selecting a midwife and consulting.

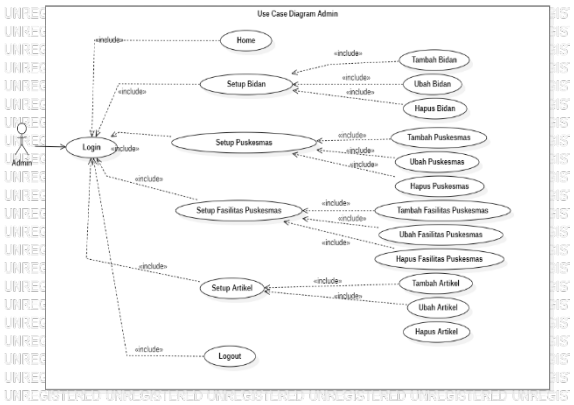

Figure 7. Use Case Diagram Admin Use Case

Based on Figure 7, the administrator is an actor and uses the ”includes” relation. After logging in, the administrator can access six features. For example, if the administrator wants to manage midwives, then the administrator can access the midwife setup menu. The midwife setup menu includes adding midwives, changing midwife data, and deleting midwife data.

3. Class Diagram

The relationship between classes is related to the database. In this application, the database involves 14 tables. In this application, the database involves 14 tables as shown in Figure 8. Of the 14 tables, the user table has a 1-n relationship to the table riwayat checkup or check-up history, survei history and screening history.

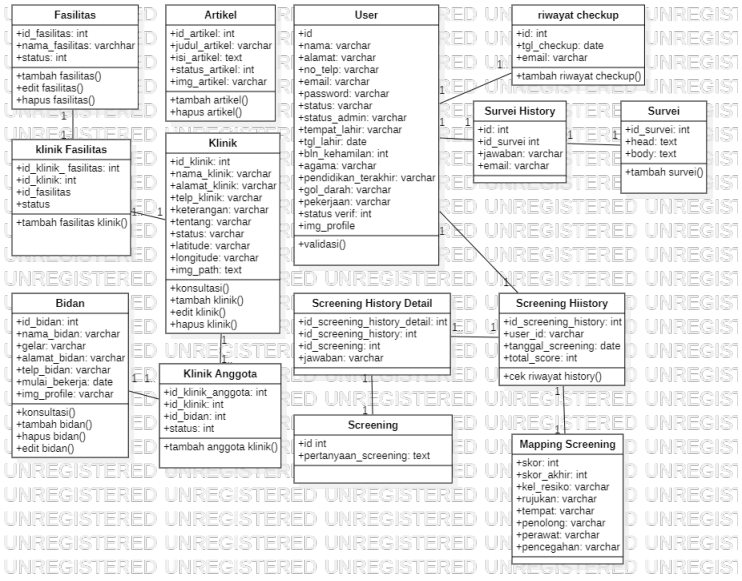

Figure 8. Class Diagram Structure

4. Proposed Application Structure Design

The application scheme proposed in this study can be seen in Figure 9. The main users of this application are pregnant women. They can access the applications installed on the smartphones or through a web browser with a predetermined url address. The supporting users, namely healthcare workers, in this case, are midwives at the puskesmas who have collaborated. The pregnant women and the midwives can share this application together, but for midwives it is limited to certain features. The application is arranged and managed by the administrator.

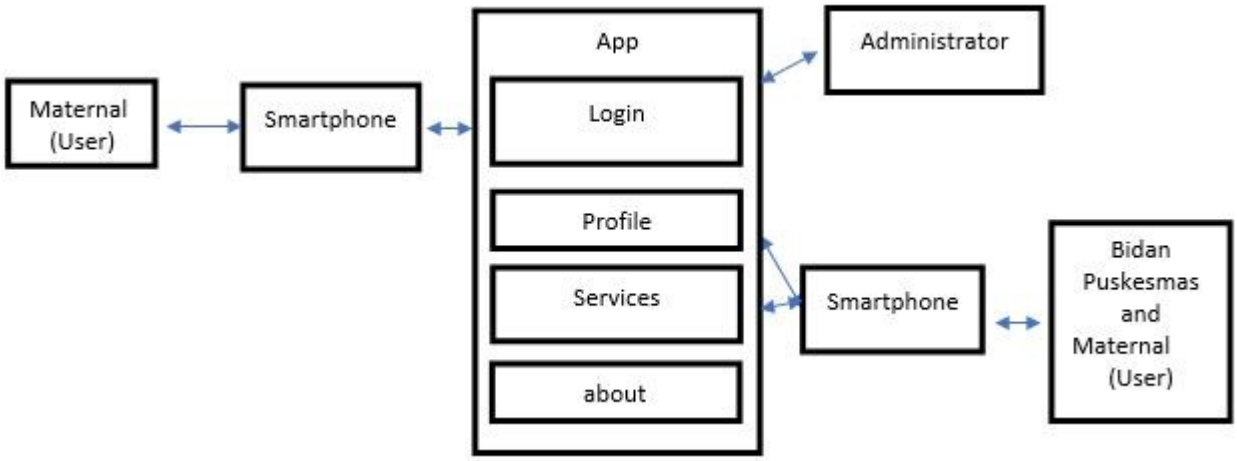

Figure 9. Proposed Scheme Application

2.4. Profile

In the profile section there are several features, namely check-up history, completing profile and taking surveys. The check-up history will record all check-up activities carried out at the puskesmas. Completing the profile is used to add the necessary details of personal data. Taking a survey contains guidance materials for pregnant women which are adopted from the pink book or KIA pages 16 to 22 [2]. The survey is used as a sign that pregnant women have understood the guidance materials for pregnant women which are adopted from the pink book or KIA.

2.5. Services

The types of services provided in the application consist of several features, namely consultation with health centers, chatting with midwives, Pregnancy Calculator, Self-screening and articles. Consultation with the puskesmas contains the detailed address information of the 5 collaborating health centers, namely Cinere, Cimanggis, Beji, Sukmajaya and Pancoran Mas. The midwife chat feature through the midwife's cellphone chat number is used as a suggestion for direct consultation of pregnant women with the midwifes. Pregnancy calculator is based on Naegel's formula [20]. To determine the risk of pregnant women, the self-screening feature that has been developed from research [12] is used. The pregnant women fill in the self-screening feature, where the results of the screening can later be a reference for the risk conditions of pregnant women at that time. More details can be seen in Figure 10 the navigation structure.

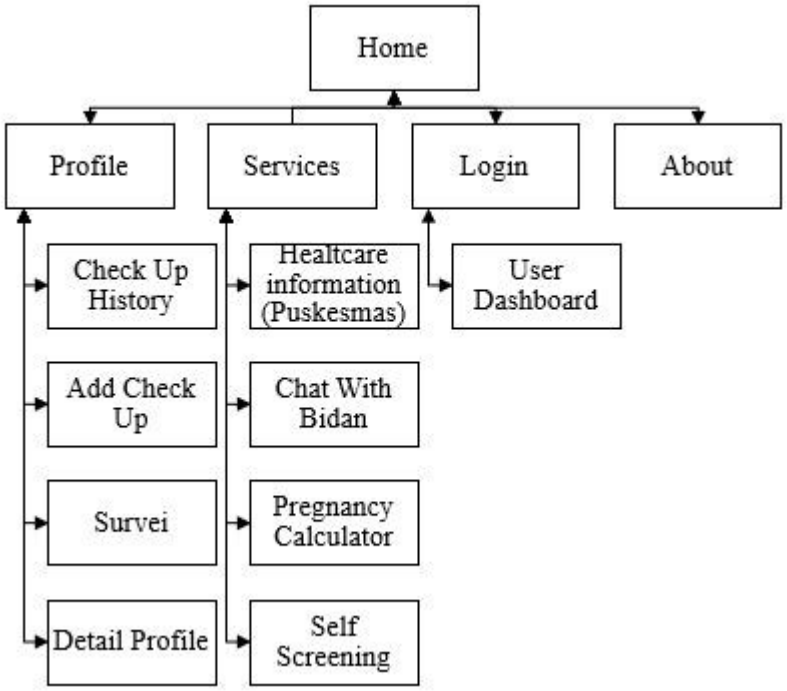

Figure 10. Navigation Structure User Interface Application

3. RESULT AND ANALYSIS

A prototype of User interface (UI) application is as a result of the design. The prototype can be run as a web application as well as an android application. The UI prototype for the web application in Figure 11 and the android application is in Figure 12.

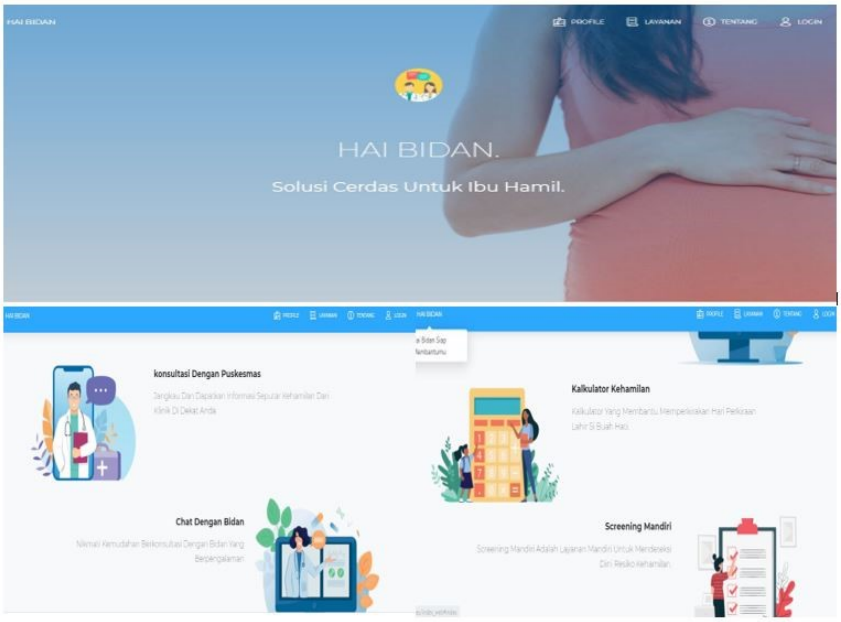

Figure 11. Result UI Application in Website interface

This prototype salute bidan inf figure 11 can access in url: http://haibidann.com/http://haibidann.com/ for and for android app in Figure 12 available with haibidan.apk. The results of the User interface display on Android mobile devices and the web display do not look the same although all features can be displayed properly. That is different because of the method of use. Access via a web browser with a URL will be displayed in the website view directly on cloud hosting and access via an application installed on an android device will be displayed in the application view. However, with web view technology and cloud hosting, accessing and using the application becomes easier because users only send and receive data from cloud hosting.

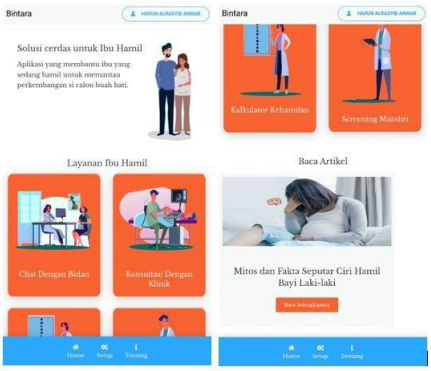

Figure 12. Result UI Application in Android Smartphone interface

This application has been tested using the Blackbox software testing technique approach. The type of BlackBox technique used is Use Case Testing. The use case is based on the previously created UML modeling. In the test case, the user login is used. There are 4 test conditions represented by test case ID Login 01 to 04. Each test case uses different scenarios and test data, namely:

1. Enter Valid Username and Valid Password
2. Enter Valid Username and invalid Password
3. Enter Invalid Username and Valid Password
4. Enter Invalid Username and invalid Password

The results obtained from the four test ids all passed the test with the suitability of the expected results with the actual results. This result shows that the user login function is running well according to the design. Use Case test results are shown in Table 1.

Table 1. Use Case testing for User Login

Test Case ID	Test Scenario	Test Case	Pre Condition	Test Steps	Test Data	Expected Result	Post Condition	Actual Result	Status (Pass/Fail)
Login_01	Verify The Login	Enter Valid Username and Valid Password	Need a Valid Email	1. Enter UserName 2. Enter Password 3. Click Login Button	Valid UserName Valid Password	Succesful Login	Send to Email Inbox	Succesful Login	Pass
Login_02	Verify The Login	Enter Valid Username and invalid Password	Need a Valid Email	1. Enter UserName 2. Enter Password 3. Click Login Button	Valid UserName Invalid Password	Show Message ”Email dan password tidak cocok”	-	Message Is Shown	Pass
Login_03	Verify The Login	Enter Invalid Username and Valid Password	Need a Valid Email	1. Enter UserName 2. Enter Password 3. Click Login Button	Invalid UserName Valid Password	Show Message ”Email dan password tidak cocok”	-	Message Is Shown	Pass
Login_04	Verify The Login	Enter Invalid Username and invalid Password	Need a Valid Email	1. Enter UserName 2. Enter Password 3. Click Login Button	Invalid UserName Invalid Password	Show Message ”Email dan password tidak cocok”	-	Message Is Shown	Pass

4. CONCLUSION

The application design for pregnant women's guidance has been discussed. An application design has been produced that can be used by pregnant women. The application design consists of a web application and a mobile application. The design using the rapid application development method can speed up the application development process supported by the use of the web view design model for android mobile applications. The design content of this platform has also adopted a part of the pink KIA under pregnant women and has included a self-screening that can detect the risk of pregnant women during pregnancy. The testing based on use case test shows login function is working properly. In future, the next step of this design will do a testing and will be realized as a platform that will be ready to be implemented by the users.

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