Blood Pressure Mobile Monitoring for Pregnant Woman Based Android System

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Abstract. Currently, at least 18,000 women die every year in Indonesia due to pregnancy or childbirth. It means that every half hour a woman dies due to pregnancy or childbirth. As a result, every year 36,000 children became orphans. The high maternal mortality rate was put Indonesia on top in ASEAN. The main causes of maternal mortality are high-risk pregnancy. Mothers who have diseases like high blood pressure, pre-eclampsia, diabetes, hyperthyroidism, and already over 40 years old and infectious diseases such as rubella, hepatitis and HIV can be factors that lead to high-risk pregnancy. This paper will discuss the development of a blood pressure monitoring device that is suitable for pregnant women. It is based on convenience for pregnant women to get the equipment that is flexible with her presence. Results indicate that the equipment is in use daily support for pregnant women therefore, one of the causes of maternal mortality can be detected earlier.

Keywords—pregnancy, maternal health, mortality, blood pressure, detected earlier.

1. Introduction

The main indicator in determining maternal health is maternal mortality rate (MMR). Maternal mortality rate shows how far pregnant women get the maximum health services in containing up to childbirth. Unfortunately, Indonesia occupied the top rate in Southeast Asia in terms of MMR. Supriyanti [1] in her paper said that at least 18,000 women die every year in Indonesia due to pregnancy or childbirth. That means every half an hour a woman dies due to pregnancy or childbirth. As a result, every year 36,000 children under five are orphans. The high maternal mortality rate was put at the top of Indonesia in ASEAN in it. Household Health Survey 2001 says Indonesia's maternal mortality rate 396 per 100,000 live births. The number was increased compared to the 1995 survey results, which is 373 per 100,000 live births. The maternal mortality rate in Indonesia is even worse than the country of Vietnam. The maternal mortality rate in the neighbouring country in 2003 was 95 per 100,000 live births. Other ASEAN countries, Malaysia recorded 30 per 100,000 and Singapore 9

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per 100,000 [1].The main causes of maternal mortality are high-risk pregnancy. High-risk pregnancies, yet all of them realized by pregnant women when these conditions clearly threatens the health of pregnant women and the *fetus*. There are several key factors, among others, the mother uterus and *fetus*. All play a role and require particular attention so that high-risk pregnancies can be avoided. Mothers who have diseases like high blood pressure, *pre-eclampsia*, diabetes, hyperthyroidism, and already over 40 years old and infectious diseases such as rubella, hepatitis and HIV can be factors that lead to high-risk pregnancy. While in the uterus with a distorted position can cause miscarriage, premature birth and also may not be able to give birth. In addition, note the condition of the *fetus*, whether single or twin *fetus*, because it will affect the formation of organ abnormalities at an early stage if not known [2]. In this paper we will emphasize on one of the causes of death in high-risk pregnancies, namely hypertension, especially in the development of blood pressure monitoring applications.

Hypertension is a disease that occurs due an increase in blood pressure. Classifiable into two types, namely primary or essential hypertension, the cause is unknown and hypertension. The secondary can be caused by kidney disease, endocrine disease, heart disease, disorders of children kidney, etc. Hypertension often does not cause symptoms, while blood pressure continuously high in the long term can lead to complications. Therefore, hypertension needs to be detected early that with blood pressure checks periodic [3]. While hypertension in pregnant women are the most dangerous type of hypertension, because of hypertension can lead to pre-eclampsia in pregnancy or also called the pregnancy poisoning. *Pre-eclampsia* is a type of disease that appears with signs of hypertension, edema and proteinuria during pregnancy, usually other terms also called pregnancy poisoning. Hypertension causes of pre-eclampsia. It is indicated by an increase of 30 mm Hg systolic or 140 mm Hg, and diastolic blood pressure increase of 15 mm Hg or 90 mm Hg. Table 1 described classification of hypertension according to Joint National Committee (JNC) [4]. In this paper we focused on designing a mobile application that is easy and can be used universally for storing recording blood pressure periodically, and may provide information to the user in the form of predictive blood pressure conditions as a reference for further medical follow.

Research in the field of health regarding the diagnosis of blood diseases, especially diseases of hypertension ranging from characteristics, triggers and relations between them have been carried out. Sigarlaki[3]describing the distribution relationship causative factor for hypertension. Related to the distribution relationship of the factors mentioned. The limitation of his research is only limited to the presentation of data that can be developed into a monitoring application. Kuswardhani [4] in her research Inform the importance of treatment of hypertension in the elderly and also apply the blood pressure targets, changing lifestyle / non-pharmacological interventions pharmacologic therapy. However, it is still have limitation, that is Suggestions and recommendations are merely contextual, yet implemented on mobile applications. While in the android system field, to the best of our knowledge, there has been no research to develop a blood pressure monitoring device.

Table1. Hypertensin Classification according to JNC VII

Category	Systolic Blood Pressure	Diastolic Blood Pressure
Prehypertension	120-139 mmHg	80-89 mmHg
Hypertension Stadium1	140-159 mmHg	90-99 mmHg
Hypertension Stadium2	>= 160 mmHg	>= 100 mmHg

Source: Kuswardhani [4]

However, in the android system field, we found some researchers are developing a mobile based devices, though not related to blood pressure monitoring. Junaidi [5] created a mobile

application monitoring for the parents to see the development of their children in school and also implementation of the Android-based smartphones and basic utilization for android and SQLite. Kurniawan [6] focus on recording and consulting blood sugar and applied in mobile based on Android. Applications designed using eclipse. Dongdong [7] described a mobile health monitoring system which consists of a portable multifunctional physiological parameters detecting 3AHcare node and a mobile program for real-time data telemetry based on the smartphone with the Android operating system. Abhisek [8] described an intelligent Monitoring System which is based on android platform gives facility to access monitored parameters quickly on mobile handsets anywhere from the world. According to some of the facilities and usefulness, in this paper we propose an easy and simple way in monitoring blood pressure with android-based making it easier to monitor the condition of pregnant women and can provide an estimate of the necessary medical treatment in case of an abnormality in blood pressure

2. Research Method

The method used in this research consists of four main stages. First is planning. At this stage, which is performed is to develop the features required by the system, estimates and scheduling time to design applications to be created. Second is modelling. At this stage, simulating analysis design based on the results of the previous stage using Unified Modelling Language (UML) as described in Figure 1. Third is design. At this stage, arrangement of block event application on app inventors based planning and modelling to produce the design features that are owned by the application. And the final stage is examination. At this stage, testing an application that has been successfully built. The goal is to test and verify again that the features that have been designed to run as expected. In general, flow chart of blood pressure monitoring system is shown in Figure 2.

This application is designed specifically for monitoring blood pressure of pregnant women on a regular basis. The concept is to define the conditions that provide the output of predictive blood pressure. Users simply input nominal systolic pressure and diastolic pressure to be stored as a database.

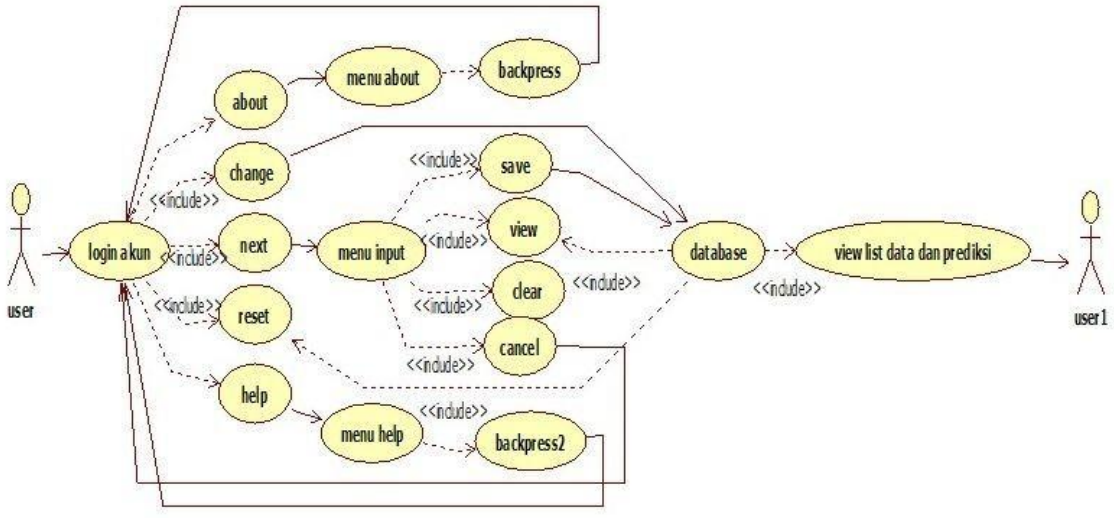
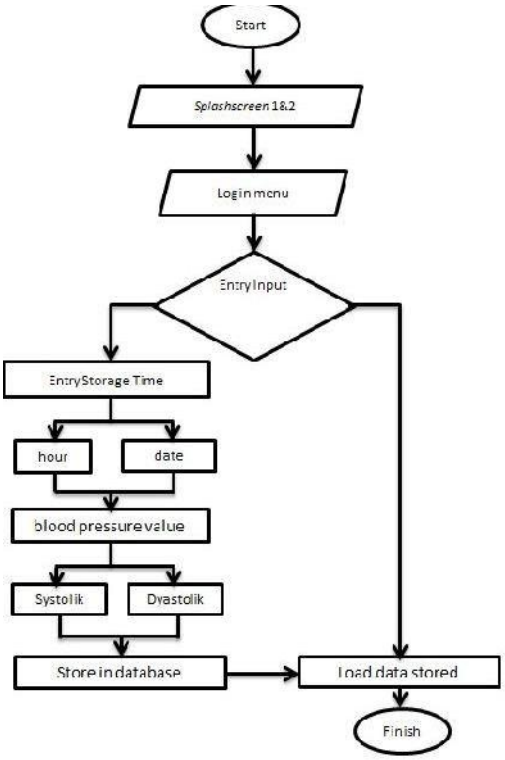


Fig 1. Use case diagram of application

Hypertension monitoring application is designed using building web app inventor2. In our design, the first time application starts, it will display the *splash screen* which indicates that the application is in the process of loading where its interface is illustrated in Figure 3.

After displaying *splash screen*, the user will be asked to log in name and password at the login

screen, then proceeded to enter the recording time and the blood pressure value on the input screen. Finally, the application will display a table of data storage on the view screen if the user wants to access it. *Splash screen* is an image that appears as a condition to describe a feedback that the application is in the process of loading in order to go to the main screen. We provide two kinds *splash screen* in this application. *Splash screen* first as a loading indicator which does not require user action to generate feedback while *splash screen* both as introduce screen that gives a bit of definition in this case of hypertension where this screen requires user action to provide feedback into the next screen.



Login screen is designed to give protection to the user data, as well as *unlock screen* to go the next screen where the user is required to fill in username and password. Input screen is a screen that contains a textbox that should be given input by the user in the form of a deposit that will be carried out, the blood pressure value. Data that has been entered by a user is stored into the database. Users can access it on the view screen where the data will be presented in the form of text that are arranged to form a table. Help screen is a screen that displays application usage instructions. About screen is a screen that displays information about the properties of the application.

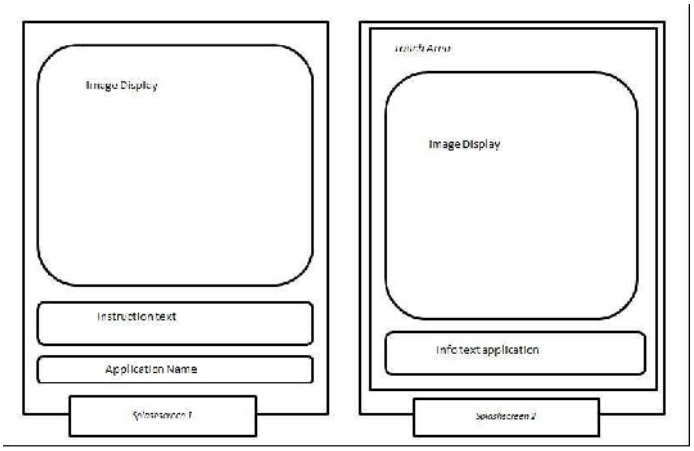


Fig 3. Scetch of GUI *Splashscreen* 1&2

This application is a mobile which will be installed on smartphones with Android operating system-based specifications, therefore when compiled on the App inventor2 automatically packaging of this application is made extension ".apk" which is a type of file that can be recognized and executed by Dalvik Virtual Machine on android. This application named "TD Monitoring.Apk".

3. Results and Discussions

The parameters in this application is quite simple: refers to the normal conditions of human blood pressure, based on the main parameters of systolic pressure and diastolic pressure. Therefore the concept is fairly simple application, i.e. by comparing the value of the input by the user with the value of the parameter is set in accordance with Table 1.

In designing this monitoring mobile applications, we chose to use App Inventor 2 for Android, which is building a web application provided by the Massachusetts Institute of Technology (MIT). Although its design is done online, the use of this application will keep using the internal memory (local) device (device android) for its database storage. Therefore the user does not have to be connected to the internet to be able to use this application, except to download the application in the app store. The functionality of this application is to provide information to the user in the form of outcome prediction program on comparative value input from the user to set the parameters of the program. In addition this application also as user data recording media to remind once a reference to determine further medical follow to do with the condition of blood pressure. In order to test the reliability of the system that we have developed then, we do some testing as described in Table 2 to Table 7.

Table2. Testing of Incoming Application

No	Scenario	Result	Status
1	Push button "*Aplikasi*" on *device*	Shown *splash screen* 1, after 3 seconds appears *splash screen* 2	Success
2	Push *image* on *splashscreen* 2	Enter to menu *login screen*	Success
3	Push *back* on *device* android	Close Application	Success

Table3. Testing of Menu *Login Screen*

No	Scenario	Result	Status
1	Push *textbox username*	Shown *keyboard* to entry *username*	Success
2	Push *password textbox*	Shown *keyboard* to entry *username*	Success
3	Push *button next* after all data fullfilled	Enter to Menu *Input screen*	Success
4	Push *button next* after all data not full filled yet	Shown notification *"Anda lupa memasukkan username/password*	Success
5	Push *button Reset pass*	Shown notification *"Password anda telah di reset..."* and *password textbox1* ask to entry word "admin"	Success
6	Push *button change*	Shown *passwordtextbox* 2 to entry new *password*	Success
7	Push *button Help*	Shown menu *help screen*	Success
8	Push *button About*	Shown menu *about screen*	Success
9	Push *back* on *device* android	Close application	Success

Tabel4. Testing of Menu *Input* (Blood Pressure) *Screen*

No	Scenario	Result	Status
1	Push *button* Time Picker	Shown dialogue *popup* current clock	Success
2	Press to set the clock popup	Shown *textbox* clock including desired hour	Success
3	Push *button* Date Picker	Shown dialogue popup current date	Success
4	Press to set date popup	Shown *textbox* Date including desired date	Success
5.	Push systolic *textbox*	Shown *keyboard* to entry systolic pressure value	Success
6	Push diastolic *textbox*	Shown *keyboard* to entry diastolic pressure value	Success
7	Push *save button*	Shown notification of data stored if all input data full filled accompanied with notification of prediction result	Success
8	Push *save button*	Shown notification to complete input data if there is one who has not been charged	Success
9	Push *clear button*	All data input and display a notification erased "*Data telah dibersihkan"*	Success
10	Push *cancel button*	Back to menu *login screen*	Success
11	Push *view button*	Enter to menu *view screen* and shown notification "*tunggu sebentar"*	Success
12	Push *back* on *device* android	Close application	Success

Tablel5. Testing of Menu *View Screen*

No	Scenario	Result	Status
1	Push *Down Button*	Table as scrolling and display the data previously stored subsequently are not displayed	Success
2	Push *button* back to input	Back menu input *screen*	Success
3	Push *back* on *device* android	Close Application	Success

Tabel6. Testing of Menu *Help Screen*

No	Scenario	Result	Status
1	Screen scrolling	Screen move upwards and downwards	Success
2	Push *back* on *device* android	Back to main *splash screen*	Success

Table7. Testing of Menu *About Screen*

No	Skenario	Hasil	Status
1	Screen Scrolling	Screen move upwards and downwards	Success
2	Push *back* on *device* android	Back to main *splash screen*	Success

Eligibility terms Technology. In the technology may already be monitoring application that can be downloaded for free in the Google store, but after trace application monitoring for hypertension have not the authors found. Operational Feasibility terms, Easy to operate so that anyone can access without restriction of age and gender as well as special skills long as they have an android phone. Economic Feasibility terms, implementation of applications do not require relatively high cost because it can be downloaded and installed for free on android phone which is now used almost everyone.

4. Conclusions

The principle of the application is to predict the condition of the user based on input blood pressure systolic and diastolic pressure values then provide follow-up advice to do the user. The application can be installed and operated on android platform without limitation version of the operating system since most android device most widely used operating system version above has a 2.3 or gingerbread. These applications provide convenience to the user, especially pregnant woman with hypertension in the register and control blood pressure by improving the conditions of life pattern in accordance with the advice given. Applications can ensure that the necessary data certainly filled by the user as if no instruction storage into the database cannot be done. App inventor is an app builder

provided by Google labs to create applications that run on the Android operating system with design principles requires no coding for the visual block-based programming. To be able to generate the application from the App inventor that both the interface and functional, things that need to be mastered is the basic programming capabilities, the ability to analyze the logic and imagination broadest.

Further research, this application can be optimized functionality as an expert system or decision support systems not only as a system of monitoring and recording only. As a follow up on this application can be added features that are capable of sending a message to a personal physician in order predictions and suggestions generated application can be consulted directly. Applications can be developed simply by adding predictability hypotension category so not only hypertension alone. Design layout to make it more attractive this application can be corrected by treating the block editor in App Inventor uses the basic capability of programming. The output of this application will be more informative and efficient when displayed in graphical form a relationship.

5. Acknowledgment

This work is supported by Directorate General of Higher Education through Hibah Unggulan Perguruan Tinggi fiscal year 2015.

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