

Pregnancy Monitoring Mobile Application User Experience Assessment

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Abstract—Pregnancy or fetal monitoring is an important medical examination of health issue. Hospital in a certain area is responsible for monitoring pregnant women to ensure their condition during pregnancy. Regular assessment in health facilities by a medical doctor has to be performed to measure some parameters, such as blood pressure, weight, baby movement, and other criteria. Nowadays, as mobile phone develops rapidly, it embeds many sensors. Those sensors help the medical practitioner to observe some of the parameters automatically. This research, therefore, proposes a mobile application to automatically record pregnant women mobility and the facility of image processing to read the weight of the scale. This paper aims to discuss the user experience in the implementation of the mobile smart birth monitoring application. The user's experience is measured by user experience questionnaire (UEQ) from 30 pregnant women in one of the districts in Central Java. According to the user responses, user experience shows that 5 out of 6 dimension of UEQ consider to be above average. Novelty and efficiency of the smart birth application need major improvement.

Keywords—Mobile Health, User Experience Questionnaire, Mobile Pregnancy Monitoring, User Experience Assessment

I. INTRODUCTION

The Internet and smart mobile phone has a great influence on human interaction and social systems, such as healthcare, education, and trading system. It has undergone massive changes due to internet adoption, especially in information gathering and dissemination. The development of smartphone embed many sensors such as camera, geo positioning system (GPS), gyro and accelerometer. Therefore smartphone enable a sensing user activity. Moreover, the adoption of smartphone grows rapidly. According to [1] smartphone user in Indonesia grows rapidly. In 2017 the penetration rate recorded at 24%, while in 2019 grows to 28%. Due to the price drops and technology development, low income citizen are able to afford the low end smart phone.

A Smart city enables improvement of citizen participation in producing data, giving feedback, and critics. Therefore, the city becomes smarter with active public involvement. The government, on the other side, become more precise in governance activity and finer decision making including effective budgeting. Moreover, city space will be a more effective and better living condition. [1]. One important aspect of city management is health services. In

the context of a smart city, an implementation information technology is important to improve health service management. Smart health is an important platform in a smart city. Smart health aims to improve health service quality to city inhabitants[2].

There are many research and industry develops smart health in many areas. A deep review on mobile health and comparison between USA and European approach discusses in [2]. [3], [4] reviews many mobile applications to help patient with diabetes type 1 and type 2. [5] discuss about the evolution of mobile application to support asthma, they found that between 2011 to 2013, in the market exist 191 mobile apps for helping asthma patient. [6] propose an application to help mental health sufferer. Deeper review on the mobile apps for mental health in morocco problem can be read in [7].

Pregnancy and child care has been important issue in health services. Some effort has been dedicated by researcher around the world to help pregnant women and young parent manage their children. [8] Propose a text for baby application. Their approach is to send a message to the pregnant women to deliver health promotion and disease prevention among the target group. They found that the application is promising. [9] observed pregnant women preferences in accessing information. They found that the mobile mediated health promotion is promising but it need better understanding of information and communication technology (ICT) for the health practitioner. [10] Conduct their research by observing pregnant women user behavior. They study reviewed 47 mobile application used by pregnant women. They found that applications related to pregnancy, birth, and child care have become an important information source for pregnant women. In order to satisfy the user expectation, credible applications should be developed and managed by qualified healthcare professionals.

This research propose a mobile application to monitor pregnant women. According to [10], credible application should be developed and managed by qualified health professional. Therefore we work closely with regional health centre. Refer to [5] that 25% of mobile application withdraw from the market. We performs an user experience evaluation on smart birth mobile application.

User perception plays an important role in a successful mobile application success. Researchers, therefore, develop

some measuring tools to understand user perception and expectation upon information systems. An instrument to measure user experience effectively was proposed [11], [12]. Their instruments called as user experience questionnaire (UEQ) with 26 questions in 6 dimension. We employs the UEQ questionnaire to assess our current user. They have been use the application for three months.

II. METHOD

A. Research Design

This research is divided into four main steps, which are mobile application development, mobile application implementation, qualitative user experiment evaluation, data analysis and conclusion drawing. Figure 1 below, present the main step, instrument and outcome from each step.

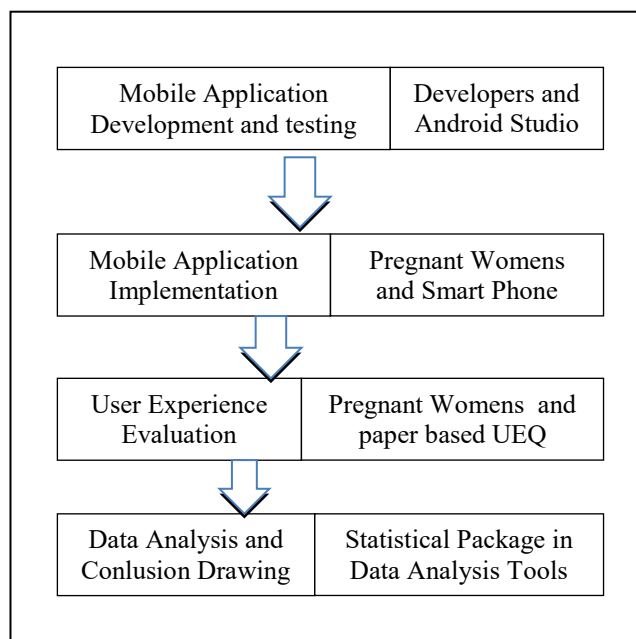


Figure 1 Research Design

The mobile application design and code implementation has been pass white box and black box testing. The implementation to end user as a pilot study has been conducted in a district in central java for 30 pregnant women. After three month usage, the user experience questionnaire deliver to the end user in paper based form. The tabulated result then analyzed using standard UEQ data analysis.

In the smart birth application which is concerned about weight monitoring and mobility of pregnant women, the retrieval of the data in the process of this study concentrates on the performance of the application to obtain the data based on the chronological order, body weight, and mobility of mobile application in pregnant women.

1. Documenting the Mobility of Pregnant Women

This application conducts real-time recording on the mobility or phases of pregnant women who have registered at the local *posyandu*. Record mobility utilizes an accelerometer sensor which is embedded in an android smartphone. The daily mobility data of

pregnant women is presented in detail in this application. To make it easier for pregnant women to see the recorded phases in pregnancy, graphical output is also available.

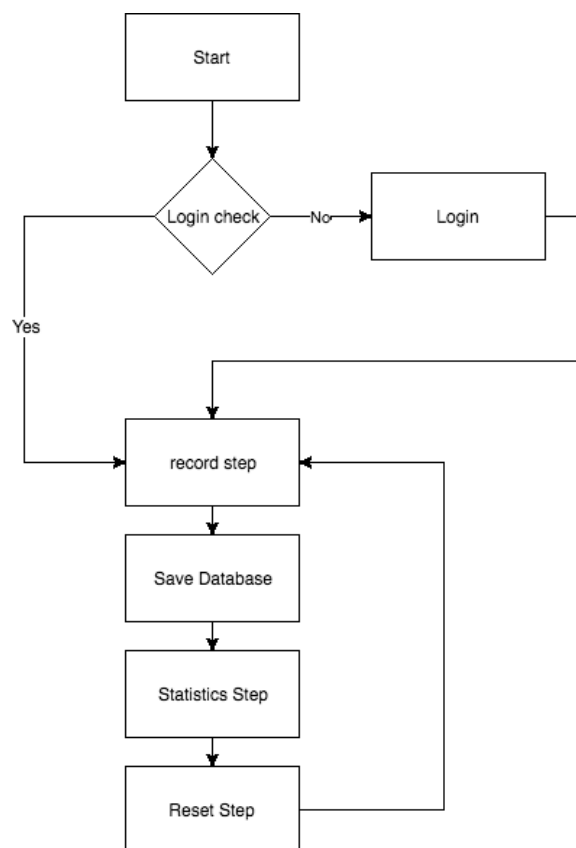


Figure 2 Step Record Mobile Apps

2. Documenting the Body Weight of Pregnant Women

The weight recording image utilizes Google Vision API mobile library in the process of recognizing and converting images into string data, then it is stored in a local database on smartphones for several times until the synchronization of the data is carried out, which is when pregnant women arrange health visit to the *posyandu*. Pregnant women can monitor the development of recorded data in detail as well as the history and graphs of body weight development.

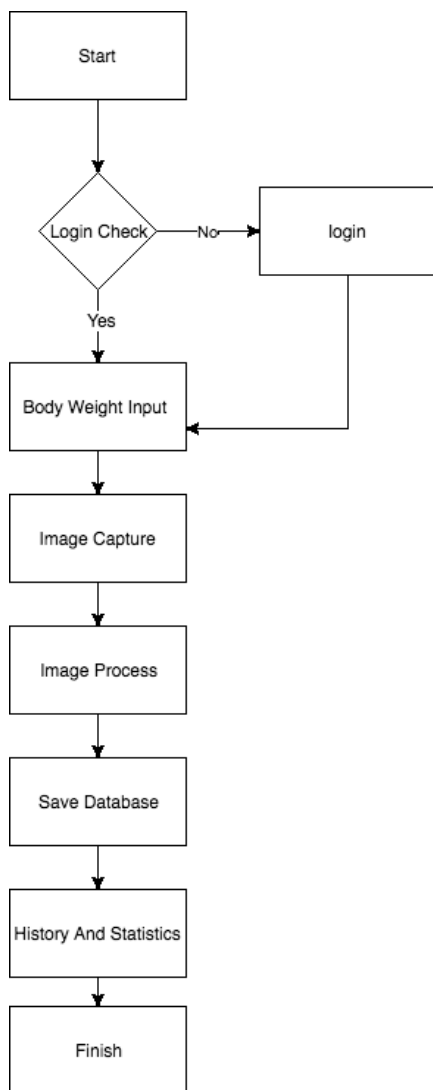


Figure 3 Body Weight Record Mobile App

B. Smart Birth Application

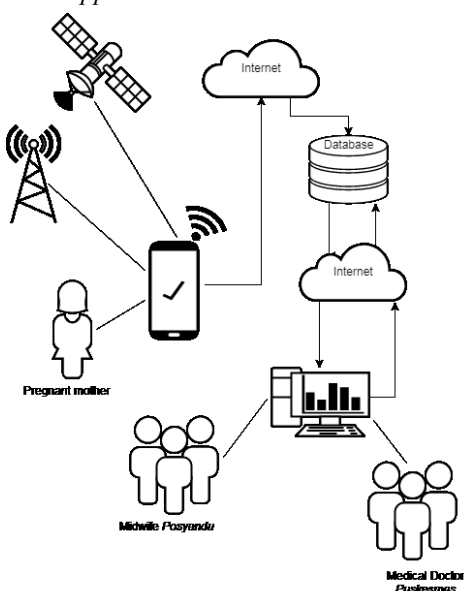


Figure 4 Mobile smart birth Architecture

Figure 4, shows the complete architecture of smart birth system. The stake holder of smart birth involves pregnant women, health practitioners in local health center (in village level) called *posyandu*. The database hosts the mobile apps

data from pregnant women and the periodic check up data from local health center called *puskesmas*.

This pregnant monitoring system is a mobile application runs on Android platform. By utilizing the accelerometer-Based Sensor and Mobile Google Vision API on smartphones, the system sends real time data which are recorded on the pregnant women application. A-GPS record end user location in real time. Recording is done every day and recorded data will be stored in the database. The data on mobility and weight stored in the database. The information will be displayed both on *posyandu* and health center (*puskesmas*) monitoring application on the thematic Geographics Information Systems (GIS).

Due to the requirements of regular data transfer from mobile application to the server, internet connection has to be available in end user smartphone. In case of connection failure, pregnant women can transfer the data manually to the application available in local health centre. Figure 2 and 3 show the user interface of the smart birth mobile application.



Figure 5 The user interface of Smart Birth Application

End user need to register their self as a user in local health centre. They required to fill in their personal information on to obtain a username and password.



Figure 6 User Activity Statistic

which are pragmatic and hedonic quality. The complete structure and indicator words are presented in figure 5.

The Perception of the technical aspect is measured in pragmatic aspect. Technical aspects focus on achieving goals of the product, system, and services. Three dimension of pragmatic aspect consists of efficiency, perspicuity and dependability. Efficiency measure the appropriateness, speed and efficiency. Perspicuity dimension responsible for measuring the comprehensiveness of the product. The dependability dimension, on the other hand, asses the level of control of the user toward the mobile application.

Emotional engagement between user and the application fall under hedonic aspect. The hedonic aspect comprises motivational pleasure (stimulation dimension) and renewable design (novelty dimension). In order to measure every aspect, the user would have to choose the indicator word. In every question, the user had to choose a score between low and high quality word. Figure 4 shows the structure of UEQ, aspects, dimension and indicator words. In order to ensure respondent understanding, we

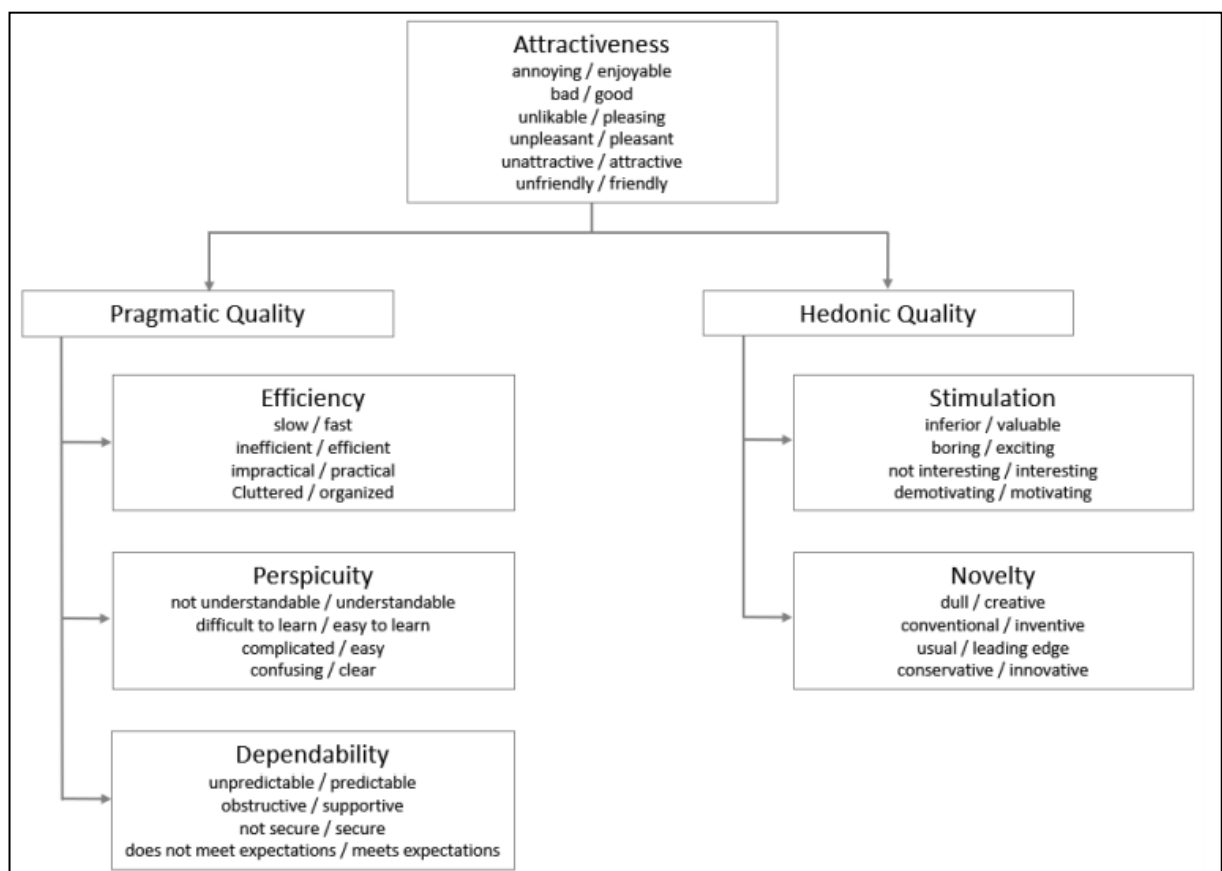


Figure 7 User Experience Questionnaire structure and indicator words

With regards to figure 4 pregnant women could see a graph of the development of their body weight and mobility or steps by utilizing the accelerometer and gyroscope sensors found on the smartphone in real time, to find out about the records performed by the smart birth application during pregnancy.

C. User Experience Questionnaire (UEQ)

User Experience Questionnaire (UEQ) is an instrument to assess how satisfied users during their experiences in using the application[17]. UEQ measures two major aspects

use Indonesian language version of UEQ.

III. RESULT AND DISCUSSION

Evaluation of Smart Birth application was conducted using UEQ, in the form of a questionnaire with 26 impression questions on products given to pregnant women. Mobile application end users are asked to answer spontaneously, within 25 to 30 minutes. The number of pregnant women who filled out the questionnaire was 30 people. Each question has a rating scale of 1 to 7. The answer form all respondent is the

average out and converted into new scale. The score 1-7 is transformed into -3 to 3 by using the conversion rule. The following sequences are pairs of scales and weights: (1, -3), (2, -2), (3, -1), (4, 0), (5, 1), (6, 2), (7, 3). Table 1 shows the score average and variance after conversion. The average answer of each dimension plotted in figure 5.

Table 1 Mean, Variance, and Standard deviation of each Questionnaire item

Item	Mean	Variance	Std. Dev.	No.	Left	Right	Scale
1	1.6	1.3	1.1	30	annoying	enjoyable	Attractiveness
2	1.4	2.2	1.5	30	not understandable	understandable	Perspicuity
3	0.8	2.8	1.7	30	creative	dull	Novelty
4	1.6	2.5	1.6	30	easy to learn	difficult to learn	Perspicuity
5	2.1	1.7	1.3	30	valuable	inferior	Stimulation
6	0.7	2.6	1.6	30	boring	exciting	Stimulation
7	0.6	1.6	1.3	30	not interesting	interesting	Stimulation
8	0.5	2.6	1.6	30	unpredictable	predictable	Dependability
9	1.1	2.9	1.7	30	fast	slow	Efficiency
10	0.6	3.3	1.8	30	inventive	conventional	Novelty
11	1.5	1.2	1.1	30	obstructive	supportive	Dependability
12	2.0	1.8	1.3	30	good	bad	Attractiveness
13	1.0	3.7	1.9	30	complicated	easy	Perspicuity
14	0.6	1.6	1.3	30	unlikable	pleasing	Attractiveness
15	0.0	2.9	1.7	30	usual	leading edge	Novelty
16	1.3	1.4	1.2	30	unpleasant	pleasant	Attractiveness
17	2.0	0.9	1.0	30	secure	not secure	Dependability
18	1.5	1.4	1.2	30	motivating	demotivating	Stimulation
19	0.7	1.1	1.1	30	meets expectations	does not meet expectations	Dependability
20	1.4	1.6	1.2	30	inefficient	efficient	Efficiency
21	1.5	2.6	1.6	30	clear	confusing	Perspicuity
22	1.1	2.6	1.6	30	impractical	practical	Efficiency
23	0.7	1.1	1.0	30	organized	cluttered	Efficiency
24	1.1	1.5	1.2	30	attractive	unattractive	Attractiveness
25	1.2	1.5	1.2	30	friendly	unfriendly	Attractiveness
26	1.2	1.2	1.1	30	conservative	innovative	Novelty

Out of the 30 respondents' answers for each question, the mean, variance, and standard deviation was calculated. The color code on the right side of the table indicate the group score of the answer. The scale columns indicate the dimension of each rows.

Table 2 UEQ mean and Variance

UEQ Scales (Mean and Variance)		
Attractiveness	1.267	0.70
Perspicuity	1.400	1.95
Efficiency	1.100	0.97
Dependability	1.167	0.67
Stimulation	1.225	1.16
Novelty	0.675	1.02

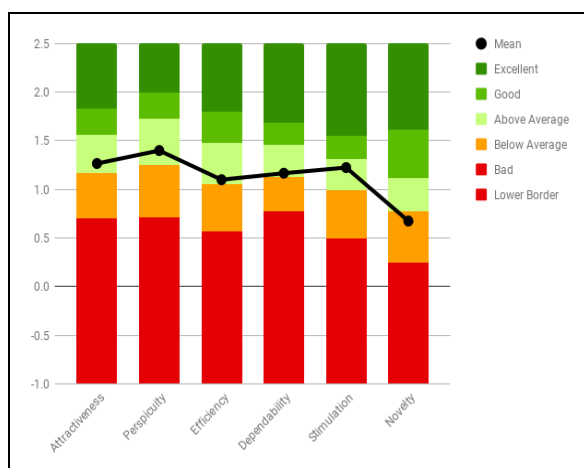


Figure 8 Average result compare to benchmark

As can be seen in figure 5, no dimension achieve good category. The highest score is achieved in perspicuity at 1.40 and consider as above average. The worst score recorded on novelty at 0.675. According to the result a major improvement still need to be done in all dimension of the application. The second lowest is the efficiency at 1.100, the score is just slightly above the lowest border of above average. Therefore, efficiency is also need attention to be improved. More detail result is presented in table 2.

With regards to the novelty score, there are 4 item represents novelty which are number 3 (creative – dull), number 10 (inventive – conventional), number 15 (usual – leading edge) and 26 (conservative – innovative). Among four items, question about usual leading edge recorded score 0, which is bad. Considering that the user has been intensively use this application for three months, this score is far for satisfying. Let consider figure 3 and 4, the user interface is consider as usual design, therefore a massive change in the design needs to be performed.

Efficiency come second least score and just in the border between below average and above average category. There are four items on this dimension which are number 9, 20, 22 and 23. Among four question 23, (cluttered – organize). The score of this question at 0.7, therefore an improvement of tidy design need to be done. User also still feel that the application is slow according to question number 9. Generally speaking the user experience shows many improvement needed for the application success in the future.

IV. CONCLUSION

This research present an mobile application for pregnant monitoring. The application has been working properly, however, there are many corrections obliged to be carried out in order to ensure the successful implementation of the application in the real implementation. It is noted that hedonic aspect especially novelty recorded as the lowest score, particularly for the design since it is still regarded as typical. The second dimension with low score is efficiency. General speaking, all aspect of the user interface should be enhanced.

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