Addis Ababa University

School of Information Science and School of

Public Health

M.Sc. In Health Informatics Programme

Designing Information Support System for Maternal and Child Health Care: Using Participatory Approach

By: Addisalem Bogale

A Project Submitted to School of Information Science and School of Public Health in partial fulfillment of the requirement for the Degree of Master of Science in Health Informatics

Addis Ababa, Ethiopia

June 2017

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DEDICATION

This project work is dedicated to my beloved husband Mesfin Wondimu, my beloved son Dawit Mesfin and the rest of my family, for their wonderful support of my work that provided me strength, and for their patience when I have been devoted to my work for long time.

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Addisalem

June 2017

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ABBREVIATION

ACK	Acknowledgement
AMREF	African Medical and Research Foundation
ANC	Ante Natal Care
CHAI	Clinton Health Access Initiative
CHW	Community Health Worker
EDHS	Ethiopia Demographic Health Survey
EDD	Estimated Date of Delivery
FMOH	Federal Ministry of Health
FP	Family planning
GOe	Global Observatory for eHealth
GSM	Global System for Mobile Communications
HIV/AIDS	Human immune deficiency virus Acquired Immune Deficiency Syndrome
HSTP	Health Sector Transformation Plan
ICT	Information Communication Technology
MAMA	Mobile Alliance for Maternal Action
MNCH	Mother Neonate and Child Health
mhealth	Mobile Health
MMR	Maternal Mortality Rate
MOH	Ministry of Health
MoTeCH	Mobile Technology for Community Health
OO	Object Oriented

PDA	personal digital assistants
PHCU	Primary Health Care Unit
PHR	Participatory Health Research
PNC	Post Natal Care
PR	Participatory Research
SDG	Sustainable Development Goal
SMS	Short Message Service
TEMACC	Technology Enabled Maternal and Child health Care
UN	United Nations
UNICEF	United Nations International Children's Emergency Fund.
UML	Unified Modeling Language
WASH	Water Sanitation and Hygiene
WHO	World Health Organization

ABSTRACT

Background: In Ethiopia maternal and child mortality rate is higher due to mother's lower access to maternal and child health care services which intern is due to their lack of information. So many mhealth initiatives have been conducted in order to address the problem of maternal and child health care. However, most of the projects are short lived, and the failure may be because of absence of participation of professionals and concerned stakeholders.

Objective: The objective of this project was to design mobile application information support system for maternal and child health care services.

Method: The study followed qualitative research in participatory approach to engage mothers and MNCH workers in the process of the project. Primary data was collected through in depth interview and focused group discussion during the process of the project. Secondary documents were analyzed to obtain user requirements. Purposive sampling was used to select health centers, mothers and MNCH coordinators. The project use selected artifacts of an object oriented system analysis and design technique to design the low fidelity prototype.

Result: The study showed that pregnant mothers at the study area have been accessing maternal and child health care information from national media, health related brochures, education and advice of health workers.

Conclusion: The information support system was designed in Amharic (local language) so that it is easy for mothers to read and understand the maternal and child care information that addresses maternal and child health issues.

Key words: participatory approach, information support system, maternal and child health care

CHAPTER ONE

INTRODUCTION

1.1 Background

The Health Sector Transformation Plan (2015) (1) states that Maternal and child mortality remains a major challenge worldwide, though, much efforts have been undertaken for many years to address the issues. Maternal and child health care issues are still a global health agenda. According to United Nation report (2016) (2) one of sustainable development goals (SDGs) is accelerating the progress made to date in reducing newborn, child and maternal mortality by ending all such preventable deaths before 2030. This goal aims to reduce the global maternal mortality "to ensure healthy lives and to promote well-being for all at all ages''.

According to Status Report on Maternal New born and Child Health (2015) (3) 35% of neonatal deaths worldwide are caused by preterm birth complications, 24% are caused by complications during labor and delivery and 15% are because of sepsis. In sub-Saharan Africa and Southern Asia many deaths are caused due to preventable infectious diseases. The Status Report on Maternal New born and Child Health (2015) (3) also mention many neonatal deaths could be avoided with simple, cost-effective and high-impact interventions that address the needs of women and newborns across the continuum of care, with an emphasis on care around the time of birth. The report by World Health Organization (WHO) (2016) (4) added, the majority of these deaths are preventable with affordable interventions. The interventions are all women need access to ante natal care in pregnancy, skilled care during child birth and care and support in the weeks after child birth.

It is indicated in Hiwot (2014) (5) mHealth in Ethiopia can be used to reduce maternal mortality, because mHealth applications could allow exchange of basic health information. By using mobile application we can improve the health of pregnant mothers by providing necessary information about Ante Natal Care (ANC), safe delivery, Post Natal Care (PNC), danger signs and complications in pregnancy, and inform her when to go to health center. It can also use for other

services such as family planning, child immunization, and diagnosing and treating common childhood illnesses.

The WHO report (2011) (6) states that governments are expressing interest in mHealth as complementary strategy for strengthening health systems and achieving the health-related Sustainable Development Goals (SDGs) in low and middle income countries. The Federal Republic of Ethiopia Ministry of Health (2013) (7) states that combining Information and Communication Technology (ICT) with health is one of the tools to support the health sector.

This Research project was, therefore, aimed to design mobile based information support system using participatory approach for maternal and child health care. It helps to create awareness to improve maternal and child health.

1.2 Statement of the Problem

The Ethiopia Demographic and Health Survey (EDHS) report (8) identified that Ethiopia is one of the countries that have the highest maternal and child mortality rates in the world. The maternal mortality rate of the country in the year 2016 was estimated as 353 deaths per 100,000 live births, whereas, overall under-5 year child mortality rate was estimated as 67 per 1,000 live births in the same year. The major causes for higher maternal mortality rate of the country have been complications during pregnancy, delivery or postpartum period. As stated in FMOH (2015) (9)over two-thirds of childhood deaths in Ethiopia are caused by few and easily preventable conditions; mainly infections, neonatal conditions and malnutrition.

The Ministry of Health (2015) (10) reported that inadequate ante natal care is one causes of poor outcomes of pregnant women in Ethiopia. Furthermore EDHS (2011) (11) mention that ANC coverage and skill delivery of the country is very low with 34% and 10% respectively. According to Tesfahun (2014) (12) PNC coverage of the country is also low with only 5 % of mothers received PNC within the critical first 2 days after delivery. This indicates that in the country there are significant obstacles in terms of access to and provision of maternal care service such as ante natal care (ANC), postnatal care (PNC), family planning (FP), and Immunization. As mentioned in WASH fact sheet (13) hygienic problem is also the cause of maternal morbidity and mortality in the country by exposing them to post-partum complication and sepsis. Because of low awareness about hygiene children are affected by diarrhea and vomiting that lead to several complication and death.

As states in the Ministry of Health (7) factors that prevent women from receiving or seeking care during pregnancy and child birth are lack of information, inadequate services and cultural practices. Other factors such as illiteracy, absence of access to technology or not being technology friendly and other factors tend to hinder women‘s health information exposure and usage. On the other hand, information about maternal and child health care in the country are not easily accessible due to inefficient usage of Information Technology (IT).

Challenges and opportunities of mHealth in Ethiopia indicate that (14) in Ethiopia so many mhealth initiatives have been conducted in order to address the problem of maternal and child health care. However, most of the projects are short lived, because of lack of community and concerned stakeholders involvement. Moreover, Most of the activities conducted to transfer message on mhealth have been provided in English. This resulted in lack of understanding of the message by mothers.

Therefore, this project used participatory approach to design search and retrieval mobile application information support system that can be easily used by mothers to access important information related to ante natal care, post natal care, sick baby, and personal hygiene.

1.3 Objective

1.3.1 General Objective

The major purpose of this project is to: -

- ❖ Designing information support system for maternal and child health care.

1.3.2 Specific Objectives

The specific objectives of this project are to: -

1. To identify the current sources of maternal and child health care information.
2. To specify the requirement of mothers.
3. To design the mobile application information system for maternal and child health care.
4. To test the usability of the design.

1.4 Significance of the project

The proposed project would benefit mother's families to provide appropriate care both for herself and for her baby. It would help Government and policy makers while preparing policy and programs related to women and children. Besides, the project would contribute towards improving the health and wellbeing of women, infants, children, and family. Moreover, it serves as a base for further study of technology use to reduce maternal and child mortality.

1.5 Scope

The scope of the project is limited to design of mobile application that provide awareness about ANC, PNC, hygiene and child care using local language (Amharic) for mothers in Addis Ababa, Addis Ketema sub city, specifically at five selected health centers.

1.6 Organization of the project

This project is organized in seven chapters. Chapter one is the introduction part and it covers the background the study, statement of the problem, objectives of the project, significance of the project and scope of the project. Chapter two is the literature review; in this chapter publications related to the use of mobile technology in health care, especially in maternal and child health care was revived. Chapter three is about methodology used to develop this project. Chapter four is findings and requirement analysis. Chapter five is system analysis and modeling; which talked about the design. Chapter six talks about testing and evaluation .Chapter seven are conclusion and recommendation.

CHAPTER TWO

LITRATURE REVIEW

2.1. Maternal, Newborn and Child Health (MNCH) service utilization

According to Philbrick (2013) (15) Maternal, Newborn and Child Health (MNCH) refer to abroad health issue related to maternal and child health. Maternal health includes sexual and reproductive health; family planning; Ante natal, perinatal, intra partum and postnatal care; delivery (midwifery); maternal depression (psychological issues) maternal mortality (Hemorrhage, Hypertensive disorder, HIV, Sepsis/Infection, Abortion, obstructed labor, Anemia, Ectopic pregnancy, etc. Whereas newborn and child health includes all health conditions related to neonates, newborn, and children less than five years of age. Most of global maternal and child morbidity and mortality has been related to lower women's access MNCH services. Maternal health and newborn health are closely linked, timely management and treatment can make the difference between life and death for both the mother and the baby.

The World Health Organization (WHO) (4) recommends a minimum of four ante natal care visits during pregnancy to ensure the well-being of mothers and newborns. At these visits, women should receive at least a basic care package, including nutritional advice. They should also be alerted to warning signs indicating possible problems during their pregnancy and get support in planning a safe delivery. Central Statistical Agency also states (2016) (8), Ante natal care from a skilled provider is important to monitor pregnancy and reduce morbidity and mortality risks for the mother and child during pregnancy, delivery, and the postnatal period. WASH fact sheet (13) explain that access to adequate, safe water and sanitation is important throughout pregnancy, and significantly contributes to the well -being and health of the mother and newborn. There are many ways in which water and sanitation contribute towards good health during pregnancy.

As mentioned in Navaneetham (16) the effect of various socio- economic, cultural and programmatic factors are influencing the pattern of maternal health utilization in developing countries. Lower utilization of maternal health care services among higher parity women could be due to time and resource constraints faced by those with larger families and the greater experience

of higher parity women with pregnancy and child birth. Female education is a strong predictor of use of maternal health care services. It is expected that among educated women, the decision making power within the household, awareness, knowledge and acceptance of modern medical treatment and health care institutions vary by their level of education.

As stated in Molla (2015) (17) in Ethiopia, maternal mortality and neonatal deaths is high. This is mainly due to women's lower utilization of maternal and child health care services as a result of their very low literacy levels. In addition women have been exposed to high workloads even during pregnancy and immediately following child birth. They have low status in the household as well as in the community. Most women have little understanding of how to take appropriate measures to deal with prevalent diseases and health issues. Women's access to information from mass gatherings or the mass media were limited. On the other hand, women's desire to gain access to modern health services is hampered by difficult access (long distances and lack of transportation), poor social status (lack of access to family money and restricted mobility), poor organization of health services (lack of cultural sensitivity, insufficient communication, long waiting times, bribes and verbal abuse), and Many of the rural health institutions are understaffed and lack appropriately trained and experienced manpower. Rural women are surviving through a series of transitions related to economic, socio-political, and demographic changes that increasingly compromises their social and health status.

2.2. Information Communication Technology and health care

Helath states that (18) the role and importance of Information and communication technologies (ICTs) in health care have continue to expand technological progress, expanding networks, falling prices and growth in applications and content. ICT is the use of varies information and telecommunication technologies such as computer, mobile phone, electronic medias, satellite etc. for storing, sharing and retrieving data through internet, mobile phones, etc. ICTs have been used for a wide array of purposes in the current global development. The use of ICTs in health care which is called electronic health (eHealth) used to address different health care issues. eHealth facilitate fast, reliable and cost effective health care services.

As mentioned in Tamrat (2012) (19), the global explosion of mobile technology has generated a new tool to address public health challenges and shift the paradigm of health care access and delivery. According to Kumar (2012) (20) the increase in mobile network coverage and the wide

expansion of low cost, and easy to use mobile phone raised the hope of accessing better health care services even in poor regions where there is inefficient health facilities and people lack finance for health care services. Kay (2011) (21) added, quality care and up-to-date health data are essential for identifying health needs. Quality care means safe, effective, Patient-centered, timely, efficient and equitable. This could be easily addressed by using technologies. The use of technology in health care are to enhance the quality of services provided, particularly for communities in rural and remote areas. Mobile technologies are an opportunity to improve quality of health care for women. Furthermore, Qiang (22) states that Mobile technology has the power to upgrade the Quality of health service especially for low income society.

According to Mechael (2009) (23) the term mobile health or mHealth, describes the use of mobile telecommunication and multimedia technologies to meet the objectives of health care services. At first, many eHealth initiatives in developing countries focused on computer based health information systems and on using the Internet to promote then organization of and access to health-related information. Now a shift is occurring towards an ecosystem approach to using ICT for health; this approach considers the widespread application of mobile phones. The functional and structural properties of mobile phones make them attractive to the health sector in low- and middle-income countries. The phone's most notable feature is its capacity to communicate and transfer information within both literate and illiterate populations. With the development of health-related software applications, mobile communication technologies can provide real-time feedback, pre-programmed automated services, and support to increasingly decentralized health systems.

Meeting Health Needs (2011) (24) states that growing number of developing countries are using mobile technology to address health needs. There is also a pressing need to improve communication among different health units to facilitate more efficient patient care, diagnostics and treatment support are vitally important in health care misdiagnosis or the inability to diagnose a condition could have serious, even fatal, ramifications. mHealth applications in this area are designed to provide diagnosis and treatment advice to remote health care workers through wireless access to medical information databases or medical staff. With mHealth enabled diagnostics and treatment support, patients are able to receive treatment in their villages and homes, averting the need for expensive hospital visits, which are beyond reach for many. According to (mHelth Compendium) the wide spread of mobile network in Africa has been addressing the health problems of Africans. mHealth programs in Africa have contributed to innovative solutions to health system challenges

including: disparities in access to health services; inadequacies of health infrastructure; limited human resources for health; cost to the individual of accessing health services; and challenges in health financing.

2.3. mHealth application for Maternal Newborn and Child Health

United Nation Foundation (25) indicated that reaching mothers and families with simple messages about the importance of early and exclusive breastfeeding, keeping the baby warm and dry, recognizing the danger signs of sick newborn and avoiding practices that are harmful to newborns can halve the rate of newborn deaths.

According to Philbrick (2013)(15) most of mHealth programs on MNCH are focused on maternal health innervations, particularly remainder for ante natal appointment compared with newborn and child health care innervations; short electronic massage (SMS) to improve health seeking behavior; and mobile application for data collection. The review also added that most mHealth interventions targeted improving skill of frontline health workers by connecting them with experienced health professional. However, proceeding said using SMS in society where illiteracy rate is greater like Ethiopia since it is difficult for illiterate Mothers to understand it.

Tamrat (2012) (19), reviewed 34 articles and reports of mHealth projects related to MNCH and identified their four focus areas as emergency medical responses (urgent care during obstetric referral) , point-of-care-support (provide maternal health care support by community workers by communicating with skilled and experienced health professional) , health promotion (providing information for expecting mothers through short messages) , and data collection and management . The review showed that the use of mobile technology in the most of project areas resulted in improved prenatal and neonatal care. It also identified that most of mHealth projects are mainly focused on emergency care during delivery and few projects are used to intervene at multiple points of MNCH continuum of care. Moreover, the review identified that mHealth projects designed using local langue by involving concerned stockholders are more effective than others.

Though, there is wide expansion of mobile network in Ethiopia, utilization of mobile technology to support health care services is minimal. It is also identified that the use of eHealth in country, especially in rural area limited due to inefficient internet access, lack of computer and skill of computer use by health workers (Proceeding). However, if these issues are addressed mHealth can

be used by health workers since they have mobile and mobile internet access is available in the country.

2.4. Related work

2.4.1 MAMA (Mobile Alliance for Maternal Action)

MAMA mobile health application is launched in Bangladesh, South Africa and India in 2012 (26). It is innovated and supported by public-private partnership between USAID, United Nation Foundation, M-Health Alliance and baby center. The MAMA application is designed to reduce under-five child and maternal mortality. MAMA Bangladesh has also created a unique service specifically for husbands, which reinforces messages provided to their wives and encourages their involvement in decision-making on pregnancy, birth and infant care. Prior to the national launch in December 2012, MAMA Bangladesh conducted detailed formative research and the results indicated that almost 60% of women who subscribed to the service had their own phone, with the remaining women enrolling in services through gatekeeper or family member phones. Messages directed to household decision makers enabled improved household practices with respect to nutrition, ante natal care visits and preparation for delivery. It uses text massaging to deliver information. New and expectant mothers receive message every week throughout pregnancy up to baby's first year life. The text massage is based on their local language.

2.4.2 Mwana

MWANA is a pilot project in Malawi and Zambia supported by UNICEF and collaborating partners to strengthen health services for mothers and infants in rural health clinics, with particular focus on improving Early Infant Diagnosis of HIV and improving post-natal care for mothers and their children developed by Lemaire (2011) (27). The project focuses on maternal and newborn child health. It uses Rapid SMS technology to develop the project. One of the causes to increase under-five mortality rate is infants that are infected with HIV in the womb, at delivery or when breastfeeding. In developing countries no good care and support are provided to those infants. The aim of this project is to facilitate secure delivery of infants HIV test result to the clinic. HIV test for infants need special type of HIV detection test which is not standard HIV detection test for adults.

Moreover, the project provides free-text chat for health workers to strengthen communication and patient tracing.

2.4.3 I'm Expecting

This system is one of the M-health applications that are initiated to the society to educate and create awareness developed by Bogan (2009) (28). This application was developed by Med Help that is the world largest medical community. The application is deployed for the Android phones and the iPhone mobile platform. The application let expectant mothers to post question and get answer about pregnancy symptoms and weight gains. The- system has many components. Some of them are weeks, symptom, question, calendar and so on. Generally this application is one of the free top ten applications, but it uses only English language as a medium. However, it gives more emphasis on what is going on with the mother and the baby body change inside her. In this application, expert advice that is related to new born baby information is not included.

2.4.4 Text4baby

Text4baby is a mobile information service that is developed by Parker in 2012 (29). The system is designed to promote maternal and child health through text messaging. It is a free service and uses two languages: Spanish and English. Text4baby is a program designed to provide education to pregnant women and new parents regarding their baby. Text messages are sent three times a week with information on how to have a healthy pregnancy and a healthy baby. The text messages were timed to their due date or their baby's birth date, from pregnancy and up until the baby's first birthday. The system helps keep mothers and their babies healthy by giving important health tips. It supports to create awareness how to take care of pregnant woman and children. The advice message, including topic related to nutrition, breastfeeding, signs of labor, prenatal and postnatal care and so on. In addition to that, through the convenience of texting, pregnant women and new mothers can receive personalized appointment reminders and health alerts. In each month, users receive at least one alert message related to breaking news of child and maternal health issues and emergency outbreak.

2.4.5 Mobile Midwife

The “mobile midwife” program that was launched by Philbrick in July 2013 (15) in Ghana enables pregnant women and other caregivers to receive text or voice messages that offer time-specific information about different stages of their pregnancy. These messages include alerts and reminders, advice and educational information in English and in the user’s native tongue. In Ghana, there was a mobile phone-based health education program for pregnant women and recent parents which was sponsored by Mobile Technology for Community Health (MoTeCH) is a multi-part project that uses mobile technology to send ante natal and postnatal health information to Ghanaian's and allows community health workers to collect and share health data. Women register for the program and receive either SMS or voice messages with health information. The messages were designed to tell women what to expect during pregnancy, dismiss tradition and cultural practices, and provide general health information.

2.4.6 Safe pregnancy and birth

Hesperian (2013) (30) Provides maternal health knowledge to both expectant mother and health care provider by giving information to pregnant women on how to stay healthy during pregnancy. It has also appointment reminder and how to recognize prenatal health concerns and what to do in an emergency situation.

2.4.7 Afghanistan Mobile phone

Vision (2013) (31) stated that Afghanistan Mobile phone is used to counsel pregnant women about ante natal and postnatal care; birth preparedness (transportation, saving money, coordination with health facility for delivery, essential newborn care items); danger signs during pregnancy, labor, and delivery; benefits of facility deliveries; and caring for a newborn; as well as an algorithmic tool to prompt CHWs to identify emergencies that require referral.

2.4.8 ENAT Messenger

Developed by Clinton Health Access Initiative (CHAI) (2011) (32) the System runs text-based confirmation and transmission services via an automated message manager and a web-based application with a database. HEWs sent ANC data from their health post to the nearest health center. The health center entered the data into the Enat system manually. Based on the data entered,

the system automatically calculated the expected delivery date (EDD) and sent text message reminders to the respective HEWs. The aim of this project is to increase access to and uptake of skilled delivery in primary health care units in Ethiopia via improved tracking and referral of pregnant women.

2.4. Participatory approach

As mentioned by Bergold (2012) (33) Participatory research (PR) is a participative and collaborative research approach that not only engage scientists/academicians/ who study a particular society/situation but also others such as people who are the subject of study and are affected by the research process and result, practitioners, community, funders, police makers, and other stakeholders in the research process of :-

- planning and design
- data collection and analysis
- execution of research and
- research findings,
- Communicating the result etc.

The aim of PR is bringing positive social changes.

According to Wright (2013) (34) the use of participatory research in health is called Participatory Health Research (PHR). It is a process of involving health professionals, funders, academicians, community, especially people who are the subject of study and whose life are affected by the process and the result of the research, etc. to bring social change in the interests of people's health such as changing the way health professionals are educated, health care institutions work, health care is provided, in general changing the politics and policies affecting the health of society.

There are a wide variety of PHR conducted using varied techniques depending on the actual specific social situation, time and conditions to address a wide variety of issues. It has wide characteristics. The main characteristics of PHR are:-

1. PHR is Participatory

The main aim of PHR is to increase the level of engagement of those people whose life is studied and affected by the process and the result of the research. The Participation of people who are the

subject of study and whose life is affected by the intervention is the most important base of PHR. This makes PHR unique to other health research approaches. Besides, participation of concerned health professionals, funders, community, academicians and other stakeholders is crucial in PHR depending on the health problem to be addressed. Commitment, cooperation, and collaboration among the participants are the fundamental elements that determine the quality of PHR. This requires good facilitation skill to create mutual understanding among those involved.

2. PHR is locally situated

PHR use local stories, experiences, and skills to create new knowledge and theory. That means local dimensions impact the choice of research focus, methods used, the process of learning and its result. Local knowledge and experiences are used to close the gap between people's life reality, science and question of policy. However, it doesn't mean that PHR is limited to local situation. There are PHRs that in used local knowledge to generalize in wider perspective.

3. PHR is Collective Research Process.

Unlike non participatory health research approach in which responsibility of controlling, supervising and facilitating of the research processes are conducted by only one or more academician/s, in PHR the responsibility is taken collectively by those involved in the process. In the process of undertaking PHR the collective participation of academicians, community, and other stakeholders is important. One or more of the participants may take the initiative to conduct the research, control and facilitate the process etc. all are researchers. To be a core searcher participation in the process of the research is enough. Not only academic researcher takes the responsibility of researchers. The participants in the research process including the academician represent a group that directly and indirectly benefit from the process and the result of the research.

4. PHR is owned collectively

The team that participates in the process of undertaking the research project own PHR. on the study. The team decides how to report the finding of the result of the research to meet objective.

5. PHR aims for transformation through human Agency

In PHR process social change in health services would come through the interaction and reflection among those concerned participants. Individuals act differently to their perceived norms, values,

behaviors and assumptions related to health issues when they are empowered to act and reflect with others. This resulted in the participant's positive change towards positive health care services. The quality of PHR is supporting the transformation to bring sustainable health of the society. The level of participation of concerned stakeholders affects the level of positive health change to come.

2.5. Summary of literature review

From the foregoing, we observed that mobile application are being used in MNCH activities and they are found to improve health care services including in remote and less resource areas. The use of mobile technology to improve health care services has been increasing including in remote and less resource areas. This is due to wide spread of less cost mobile phones that can be used by less literate people. Different types of mhealth applications are developed and used in different countries to address maternal and child health problems. Most mHealth projets are not designed to address multiple areas of maternal, newborn, and child health at the sometime. Besides, most of them are using short text message to educate mothers and community health workers. However, most of mothers in developing countries like Ethiopia have difficulty of reading text message.

In Ethiopia, maternal mortality and neonatal deaths is the biggest killer due to women's lack of maternal and child health care accesses. In the country, women access to modern health care services is limited due to lack of health care information as a result of their lower access to education due to their lower social, political, and economic status in the society. In the country, there are mhealth applications developed to address maternal and child health. According to mHealth in Ethiopia: challenges and opportunities (14), most of them are short lived due to less engagement of mothers and other concerned stakeholders in design and development of mhealth. mHealth initiates that are designed by engaging stakeholders are more effective. Participatory approach is effective approach to engage the people that are the subject of study like mothers and others stake holders to solve their problems through collaboration and learning.

In this project Participatory approach was used to design mobile application information support system related to maternal, newborn, and child health care services by engaging mothers and MNCH coordinators in the process.

CHAPTER THREE

METHODOLOGY

The study followed qualitative research in participatory approach to engage mothers and MNCH workers in the process of the project. Primary data was collected through in depth interview and focused group discussion during the process of the project. Secondary documents were analyzed to obtain user requirements. Purposive sampling was used to select health centers, mothers and MNCH coordinators. The project use selected artifacts of an object oriented system analysis and design technique to design the low fidelity prototype.

3.1 Study design

Selected artifacts from an Object Oriented (OO) design approach was used to design as well as to develop the low fidelity prototype. Object Oriented (OO) analysis and design is used for requirement analysis and design which has an iterative and incremental nature which helps to improve the system step by step in a cyclic way until it satisfies the users. This methodology makes the process of developing system more flexible, easily maintainable and scalable.

3.2 Situational analysis

During the initial phase, information was gathered using cross sectional study design that employee qualitative research approaches to assess mothers from where get health information and knowledge of using mobile technology. The interview helped to identify the following.

- Traditional source of information on maternal and child health
- Problems and constraints regarding access to information
- Awareness level of mothers regarding maternal and child health information
- Participant usage of mobile phone and for what purpose
- Culture of mothers to share health information

3.3 Study area and period

The project was conducted in Addis Ababa, Addis Ketema sub city. Addis ketema sub city is one of the 10 sub cities in Addis Ababa city administration. It is located in the northwestern area of the city, with a total area of around 898 hectare and with a total population of 271,503. Out of the total population 132,657 are males and 138,466 female. It borders with Gulele sub city in the north, Lideta sub city in the south, Arada sub city in the east, and Kolfe keranio sub city in the west. Under this sub city there are 10 health centers. The project was conducted from December 2016 to May 2017 GC in five selected health centers.

3.4 Source and Study population

The source population was pregnant mother, mothers with fewer than five year children and health professionals who coordinate MNCH department in Addis Ketema sub city. The study participants are 25 mothers were selected using purposive sampling technique and 5 health professionals who are MNCH department coordinator were participating on the preliminary survey.

3.5 sampling techniques

Purposive sampling technique was used to select health centers, MNCH coordinators and mothers. First, five health centers purposely selected the one used to work in before joining the master's program and four other nearest health centers from ten health centers in the sub city for ease data access, good communication and team work during the project. Then, five MNCH coordinators 1 from each health centers assuming that they have better knowledge and experiences related to maternal and child health care issues were purposively selected. Finally, twenty five mothers selected five from each selected health centers some of them are expectant mothers and the rest having child less than 5 years old.

3.6 Data collection instrument

Interview and document review were used as the main tools to collect data.

3.6.1 Interview

The actual data collection took place by way of interview with mothers and health professionals in Addis Ababa, Addis ketema sub city. Data were collected using interview guide which are semi structured and open-ended. The interview was conducted with 30 selected individuals from the selected 5 health centers. The participants were mothers and MNCH coordinators. Prior to answering the questionnaire the respondents were briefly introduced about the purpose and the nature of the study, what the study focuses on and the benefits of the findings.

In each health facility, mothers were identified, and informed consent was obtained prior to the beginning of the study. They were interviewed using interview guide specifically designed for the study. The interview guide has several sections to collect data required for the study. The first section assesses demographic information about participants, the second assesses maternal and child health information access of mothers; and the third section assesses their exposure to information technology tools. Their responses were used as an essential input for defining the requirements which is important for designing of information support system for maternal and child health.

3.6.2 Document Review

Information was gathered from different governmental institutions. In addition experts who works on the area of maternal and child health were consulted, also Health extension package document which was prepared by FMOH (2015) (35) was reviewed to develop the content. The data gathering process was held by the researcher.

3.7 Data collection procedure

Individual interview session was conducted face-to-face in selected health center. The data collected mainly using semi structured interview and document review. Besides, discussion among participants and the researcher was used in the process of the project work. First, awareness was provided for mothers and MNCH coordinators about participatory approach and the purpose of project. Second, semi structured interview was used to collect mothers' access to information of maternal and child health care services. Third, MNCH coordinators awareness of the use of mHealth for maternal and child health care and their use of mobile was accessed. Fourth, after the

user requirement was identified and the first draft design was prepared then mothers and MNCH coordinator discussed and comment on the design. Discussion was held in the whole process of the project among mothers, MNCH coordinators and the researcher. Every response of the participants were recorded in audio and short notes and used in the design process. Finally, usability test of the final design was tested by participants.

3.8 Data analysis

An inductive approach was used to analyze the data collected through interview because this approach is comprehensive and suitable where little or nothing is known about the study phenomenon. Creeswell (2010) (36) states that inductive analysis is the most common approach to analyze qualitative data. The analysis is done to identify the common issues that happen again across the entire data collected using semi structured interview. Then the results in each identified themes are presented in table and narrative form.

For the designing of participatory based information support system for maternal and child health care Object Oriented software design methodology and iterative and incremental Object Oriented Analysis was used. The object-oriented methodology uses a set of diagrams or models to represent various views and functionality of a system and is commonly known as Unified Modeling Language (UML). This modeling language is selected because it increase reusability and modification, it is easy and understandable and it is fast system developing approach.

During design the UML was used for modeling the components of the system. As software tools, Microsoft Visio2013 were used for drawing various modeling diagrams and Justinmind software was used to design the interface.

3.9 Low fidelity prototype design

The mobile app information support system for maternal and child health care is designed after conducting qualitative study and analyzing the respondents input from the collected data using the interview guide. The development of the low fidelity prototype is done using paper prototype. The contents of the system were collected from guide of health extensions package progrrame and by consulting experts in the maternal and child health.

3.10 Testing and evaluation

After designing the system, low fidelity prototype was developed and usability assessment of the systems were carried out with mothers .The question of usability test is designed to determine the users' acceptance and functionalities of the system. For this process user acceptance test checklist was used.

3.11 Ethical clearance

Ethical clearance was obtained from Addis Ababa University School of Public Health to conduct this project and official letter was provided to Addis Ketema sub city health office from School of Public Health and school of Information Science of AAU. In addition to this information sheet and consent forms were delivered along each interview and all interviewees have been asked their willingness to participate in requirement gathering; and verbal consent were also obtained from all study participants prior to giving any information for the requirement collection. Besides, the convenience, confidentiality, privacy and comfort of the participants were considered.

3.12 Methods of dissemination of results

After the study is completed it will be presented in Addis Ababa University as a partial fulfillment of Master's degree in health informatics, the report will be forwarded to FMOH and TEMACC project that support as an advisers or cooperators in my project.

CHAPTER FOUR

RESULT AND REQUIREMENT SPECIFICATION

4.1 Result

This chapter discusses the finding that emerged from the data analysis and interpretation of the data obtained through data collection instruments. The findings are presented according to the sequence in the questionnaire and are presented as follows. The first section discussed the finding of socio-demographic characteristics of mothers, the second, mothers source of maternal and child health care and the third, mothers information technology access and their use of mobile; fourth, MNCH coordinators awareness of mHealth initiative related to maternal and child health care.

4.1.1 Socio-demographic characteristics of mothers

The respondents were asked for their mother language and the report shows eighteen of them speak Amharic, three of them speak Afan Oromo, three of them speak Gurage and one of them speak Silte. The interview indicates that most of respondents speak Amharic.

Regarding their educational status, four of them are degree holder, three of them have a diploma, ten of them have secondary school education, three mothers are primary school education, and the rest four were illiterate. The interview indicates that most of the respondents are at the level of high school education.

Table 1: Socio-demographic, language and educational status of respondents

Characteristics	Years	Number (N)
Age	15-19 yrs.	2
	20-24 yrs.	6
	25-29 yrs.	11
	30-34 yrs.	4
	35-49 yrs.	2
Language	Amharic	18
	Afan Oromo	3
	Gurage	3
	Silte	1
Educational status	Degree	4
	Diploma	3
	Illiterate	3
	Primary school	3
	Secondary school	11

4.1.2 Source of information on maternal and child health care

The researcher asked mothers whether there are problem of information during pregnancy. Out of 25 interviewed mothers 12 of them said they encountered problem of information while 13 said they did not encountered problem of information during pregnancy. Among those who said they did not encountered problem of information 11 of them consulted health facilities, 1 of them consulted both family and friends to get information during pregnancy. Only 1 mother was said she had been using internet to check the status of her pregnancy.

Regarding information about the health of their child 20 of them requested while 5 of them did not requested information about health of their child. Among those who requested their child health information 13 of them consulted health workers, 6 of them consulted family and neighbor and one of them used internet to get information related to child health.

The researcher asked mothers to explain what method they were using to get health related information and for what purpose was they were go to health facilities .Out of 25 participants 23 mothers said that they got health related information orally while the rest of them said from written document. From all of participants 18 of them were going to health center for ANC follow up and the rest 7 for to get different health care advices.

4.1.3 Information technology access

The use of information communication technology of mothers was also assessed. Accordingly, all interviewed mothers said they have personal mobile. Twenty one of them have higher mobile operation skill whereas the rest have medium mobile operation skill. However, most of them have been using their mobile for communicate with their families and friends through voice call, whereas some of them have using it to communicate through social media like Facebook, viber, etc. Of all those interviewed only 5 of them were using their mobile to search information about maternal and child health care. There were only 8 mothers who knew the availability of mobile application that has been in use to get different types of health care information. All respondents interested to use mobile application to access health care information for the future. This implies that designing a mobile application will have a positive reception among the respondents. Also, because of their experience with other mobile applications, training them to use a mobile application will not need a large amount of effort.

4.1.4 Interview with MNCH coordinators

All the 5 MNCH coordinators knew the availability of mobile application that provide maternal and child health care information and can be used by mothers that was One of the mhealth application for ANC appointment reminder developed by African Medical and Research Foundation (AMREF), but nowadays it is not functional. All of them agreed that health education was provided in their health centers by health workers every morning, and one of the topics was dealing with maternal and child health care. However, most of the mothers come let for ANC follow did not attend the morning health education. 3 MNCH coordinators said that they were encountered mothers who came to their health centers for delivery without attending ANC, and children who did not take vaccine within the schedule. One of the MNCH coordinator explained that she encountered one mother who lives with HIV/AIDS and not attending ANC due to lack of information as a result she

delivered HIV infected child. From these the researcher identified that the availability of such sources make the higher the utilization of the maternal and child health care services.

4.1.5 Discussion of result

According to Philbrick (2013) (15) Maternal, Newborn and Child Health refer to abroad health issue related to maternal and child health. Most of global maternal and child morbidity and mortality has been related to lower women's access MNCH services.

From mother interview the researcher identified that most of the mothers were getting maternal and child health care related information from health centers, neighbors and friends. Most of them were going to health center for ANC follow up and to ask health related information about their children. This showed that mothers were sharing information among themselves. Then if the information is captured using mobile technology it will be easily accessible by the community and help to reduce mortality rate and improve quality of maternal health. So, this project address the problem through preparing search and retrieval mobile application information support system for maternal and child health care using local language (Amharic).

Qiang (22) states that Mobile technology has the power to upgrade the Quality of health service especially for low income society.

All respondents interested to use mobile application to access health care information for the future.

Tamrat (2012) (19), reviewed 34 articles and reports of mHealth projects related to MNCH and identified their four focus areas as emergency medical responses (urgent care during obstetric referral) , point-of-care-support (provide maternal health care support by community workers by communicating with skilled and experienced health professional) , health promotion (providing information for expecting mothers through short messages) , and data collection and management . The review showed that the use of mobile technology in the most of project areas resulted in improved prenatal and neonatal care.

From interview the researcher identified that the availability of mhealth application make the higher the utilization of the maternal and child health care services by providing updated health information to mothers.

4.2 Requirement analysis

To identify the requirement, several visits to Addis Ketema sub city health centers have been conducted and documents reviewed and situational analysis were performed. Object oriented analysis and design methodology is suitable to use UML modeling. The main reasons for using UML are increased customer involvement/understanding of the system. Based on this methodology, the researcher tried to identify basic functional and non-functional requirements of the system.

4.2.1 Functional requirements

As stated in Sarnath (37) a functional requirement is a description of activities and services a system must provide. Functional requirements is help to deal with explaining on what has to be done by identifying the necessary task, action or activity/ and functionalities the system should provide to users and the tasks that must be accomplished. They describe all the input and outputs to and from the system as well as information concerning how the input and outputs are interrelated. The system should be able to provide the following main functional requirements of mobile based information support system for maternal and child health care.

The proposed system is expected to provide the following functionalities:

1. The system must enable the user to browse maternal and child health information.
2. The system must enable the user to read ANC advice.
3. The system must give PNC advices.
4. The system must enable the user to give advices on sick child.
5. The system must enable the user to read information on hygiene.

4.2.2 Non-functional Requirements

As stated in Ribeiro (2016) (38) the ability to access the system using mobile phones would be considered a nonfunctional requirement. The nonfunctional requirements correspond to the process of explaining the features, characteristics, attributes, and constraints of the information system used to limit the boundaries of the proposed solution.

The following are the non-functional requirements:

A. User interface

The system is easy to learn and use by end users. When we talk about the mobile application, simple and attractive user interface will allow user to access different application tools such as read advice and for better service, the user interface will have Amharic language font.

B. Security

Any user can download the application to access on their phone.

C. Reliability

The ability of a system to perform its required functions under stated conditions for a specific period of time.

D. Availability

The system shall be available all the time when needed by the users.

Proposed system

Based on the above functional and nonfunctional requirements the proposed system which allows the involvement of the various users and their interaction majorly concerned on the providing of information for maternal and child health.

CHAPTER FIVE

DESIGN OF SYSTEM

5.1 Analysis model

As stated in Priestly (39) Modeling is an important in everyday human activity. Models help us to understand a complex world by focusing on those properties of "reality". The goal of modeling is to develop as simple as possible model of the reality that still correctly reflects all important and interesting aspects. In object-oriented modeling, we focus on the types of objects manipulated by the software systems. The UML is a language for specifying, visualizing, constructing and documenting the artifacts of the systems. Those models are: use case model and sequence diagram.

5.1.1 Use case modeling

According to Jacobson (2011) (40) a use case describes a certain piece of desired functionality of an application system. Use cases make it clear what a system is going to do and by intentional omission what it is not going to do. It is constructed during the analysis stage. It shows the interaction between an actors, which could be a human or a piece of software or hardware and the system. It does not specify how the system carries out the task**.** The system has two major with their respective identified tasks.

5.1.2 Actors of the System

Actor represents a person or an organization that has a major role on the overall process of the organization. The main Actors identified in the system are as follows

Table 2: List of Actors and their Description of information support system for MNCH

Actor	Description
System Administrator	A system administrator is a person who is responsible for updating the application
Mother	A user is any person who accesses features of the system. It can be expectant mother or her Family member.

5.1.3 Identified Use Cases

1. Browse

2. Read ANC advice

3. Read PNC advice

4. Read sick child advice

5. Read hygiene advice

6. Update the application

7. Login

5.1.4 Use case diagram

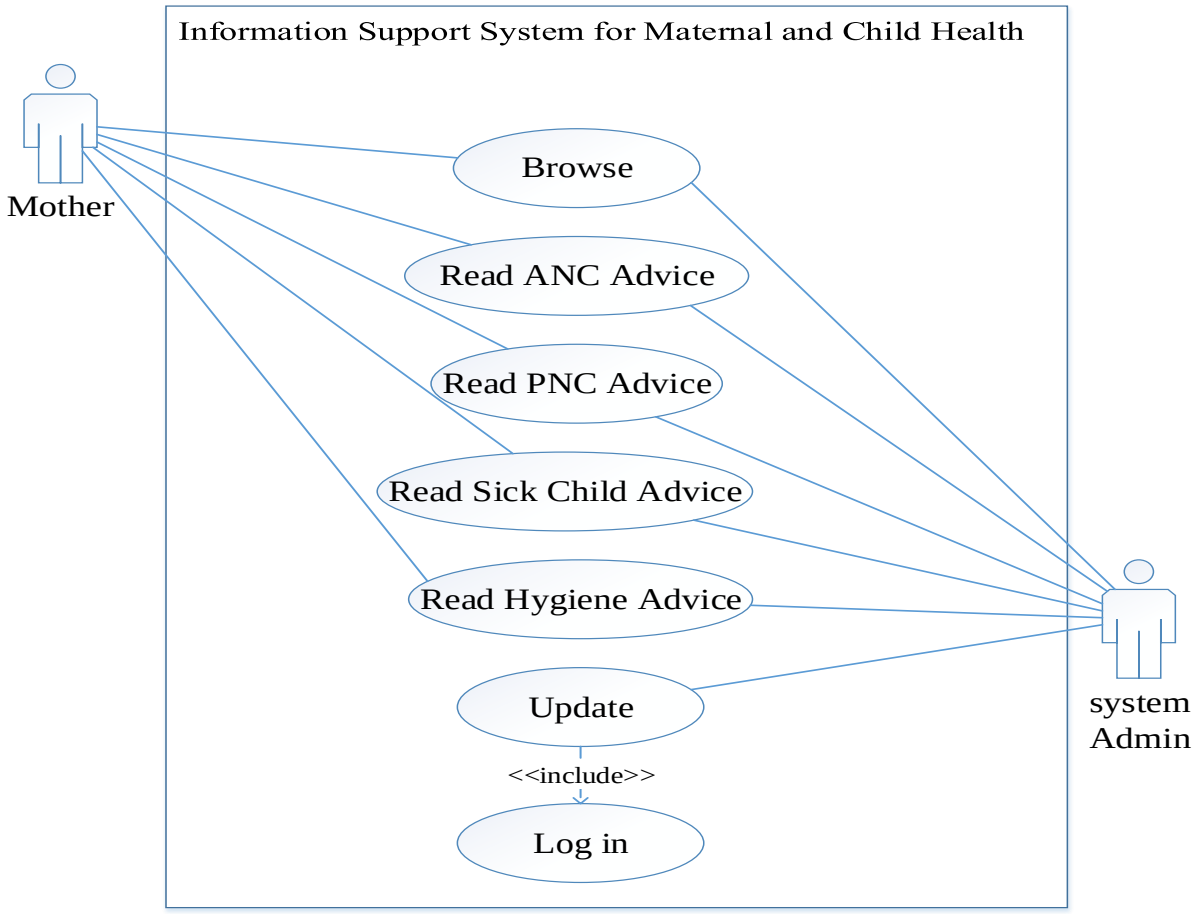


Figure 1: Use case diagram of information support system of maternal and child health

5.1.5 Use Case Description

Use case narratives are the next and most important modeling standard, which describes each use case in detail as a path traversed through the system to meet a requirement. For the later technical steps, use case narrations play the role of where to start. So, the more precise and complete a use case narration is, the more accurate will be the later designs like class diagrams and sequence diagram.

Use case narration is a textual representation of the course of events encountered when an actor is interacting with the system. The description of each use case are listed below

Table 3: Description of the "Browse" use case

Name	Browse
Identifier	UC-001
Description	Browse information from the listed topics.
Actors	Mother
Pre-condition	She must have the application
Post-conditions	System displays lists under the topics
Include	None
Extend	None
Basic Course of Action	1. The mother wants Information on a specific topic 2. The mother select the application 3. The system displays list of topics 4. The mother select topics 5. The system display the list under the selected topics 6. The use case ends
Alternative Course of Action A	

Table 4: Description of “Read ANC information" use case

Name	Read ANC Advice
Identifier	UC-002
Description	In this use case, User can Read ANC advices
Actors	Mother
Pre-condition	Select the topic
Post-conditions	System displays the information
Include	None
Extend	None

Basic Course of Action	1. The mother wants Information on a specific topic 2. The mother selects what she need from the lists and search 3. The system displays the information 4. The mother read the information 5. Use Case Ends
Alternative Course of Action A	

Table 5: Description of “Read PNC information" use case

Name	Read PNC Advice
Identifier	UC-003
Description	In this use case, User can Read PNC advices
Actors	Mother
Pre-condition	Select the topic
Post-conditions	System displays the information
Include	None
Extend	None
Basic Course of Action	1. The mother wants Information on a specific topic 2. The mother selects what she need from the lists and search 3. The system displays the information 4. The mother read the information 5. Use Case Ends
Alternative Course of Action A	

Table 6: Description of “Read Sick Child information" use case

Name	Read Sick Child Advice
Identifier	UC-004
Description	In this use case, User can Read Sick Child advices
Actors	Mother
Pre-condition	Select the topic
Post-conditions	System displays the information
Include	None
Extend	None
Basic Course of Action	1. The mother wants Information on a specific topic 2. The mother selects what she need from the lists and search 3. The system displays the information 4. The mother read the information 5. Use Case Ends

Alternative Course of Action A	

Table 7: Description of “Read Hygiene information" use case

Name	Read Hygiene Advice
Identifier	UC-005
Description	In this use case, User can Read Hygiene advices
Actors	Mother
Pre-condition	Select the topic
Post-conditions	System displays the information
Include	None
Extend	None
Basic Course of Action	1. The mother wants Information on a specific topic 2. The mother selects what she need from the lists and search 3. The system displays the information 4. The mother read the information 5. Use Case Ends
Alternative Course of Action A	

Table 8: Description of “Update" use case

Name	Update
Identifier	UC-003
Description	Used to allow system administrator to update the content in the system.
Actors	System administrator
Pre-condition	Must login to the system.
Post-conditions	Successfully update new maternal and child information
Include	UC-004
Extend	None
Basic Course of Action	1. The system administrator wants to update maternal and child health information. 2. The system administrator opens the Update maternal and child health Information Page. 3. The system administrator updates maternal and child health information. 4. The system saves the new maternal and child health information to the database. 5. The system displays “maternal and child health information successfully updated” Text for the system administrator.

	6. The system directs the system administrator to the next page 7. The use case ends
Alternative Course of Action A	If update the information failed 5. The system displays “maternal and child health information update unsuccessful” and informs the system administrator to Re update maternal and child health Information. 6. The system administrator returns back to step 3 to update maternal and child health Information.

Table 9: description of "Login" use case

Name	Login
Identifier	UC-004
Description	Used to allow Actors of the system to get in to page with Authentication.
Actors	System administrator
Pre-condition	User must have a user account
Post-conditions	User Successfully Logged in
Include	None
Extend	None
Basic Course of Action	1. The system administrator wants to login to the system. 2. The system presents the login page. 3. The system administrator enters username and password in the login page. 4. The system authorizes the system admin. 5. The system displays access text for the allowed system administrator 6. the system directs user to the next page 7. The use case ends
Alternative Course of Action A	If Login Failed 5. The system displays username or password is incorrect and informs the user to enter the correct username and password. 6. The user returns back to step 3 to correct login information.

5.1.6 Sequence diagram

As stated in Booch (41) Sequence diagram is a diagram that shows object interactions arranged in time sequence. To show interaction between object, we used sequence diagram. In particular, it shows the objects participating in an interaction and the sequence of information exchanged. Following is a set of sequence diagrams from MNCH.

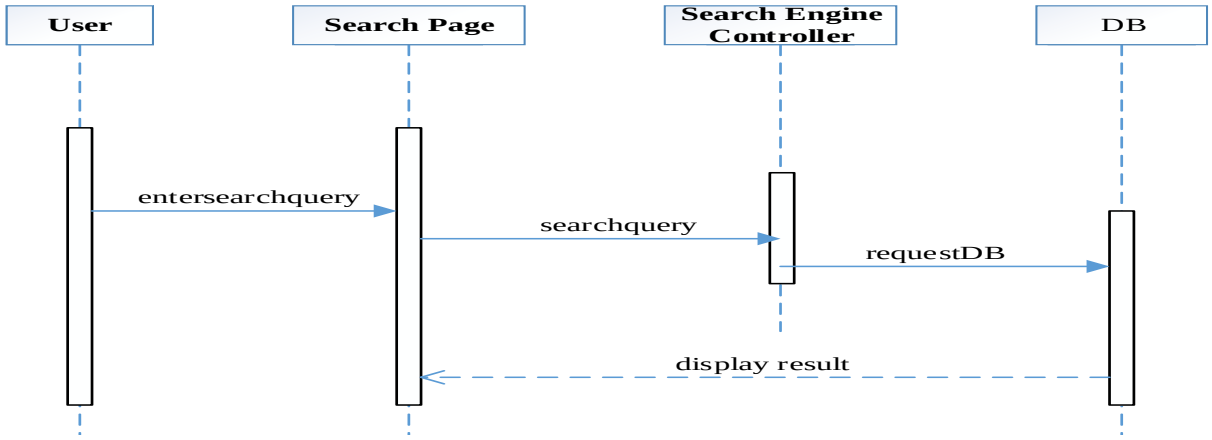


Figure 2: Search sequence diagram of information support system for MNCH

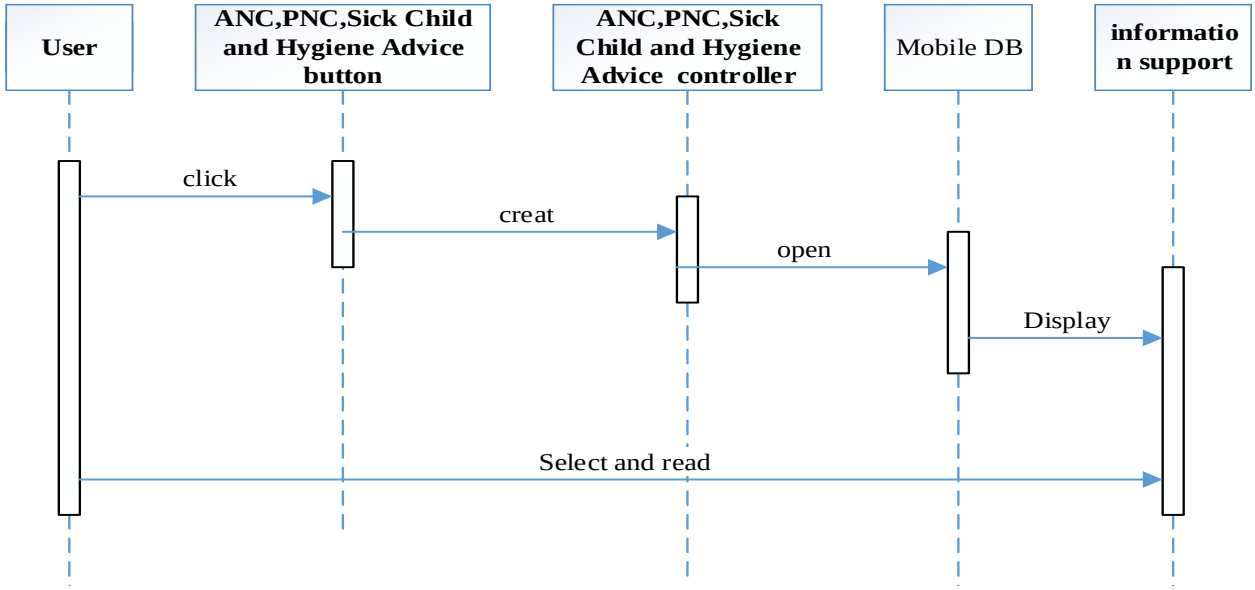


Figure 3: Information support sequence diagram of information support system for MNCH

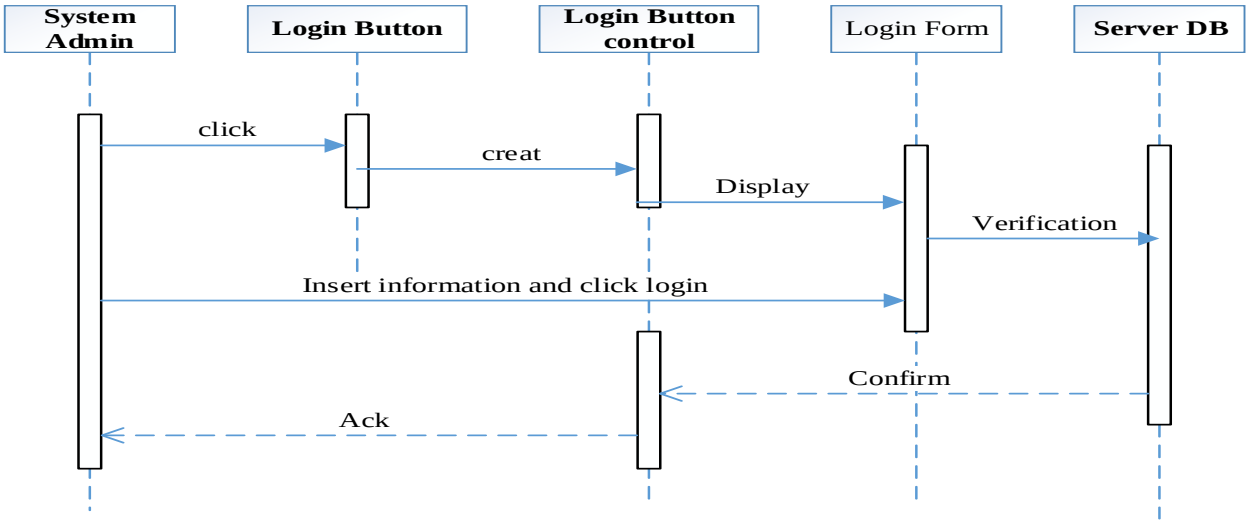


Figure 4: Login sequence diagram of information support system for MNCH

5.1.7 Design model

According to Sarnath (37) the UML has been chosen as the standard tool for describing the end products of the design activities. The documents generated in this language can be universally understood. System design model is one of the formal ways of designing the data that are used and created by any business system. This shows the objects or people, the places, or things about which information is captured and the relationship among each other. Object-Oriented approach is used for analyzing and designing the system.

5.1.8 Class diagram

Class diagram is an integral part of the unified modeling language. This diagram shows the object classes in the system and the associations between these classes. Class diagrams are used when developing an object-oriented system model to show the classes in a system and the associations between these classes. It can be used as to provide a general overview of the system objects and their interactions. An association is a link between classes that indicates that there is a relationship between these classes. Consequently, each class may have to have some knowledge of its associated class (attribute) and the actions that class performs (operations). These attributes, operations are found together in a single block of box during the designing of the class diagram.

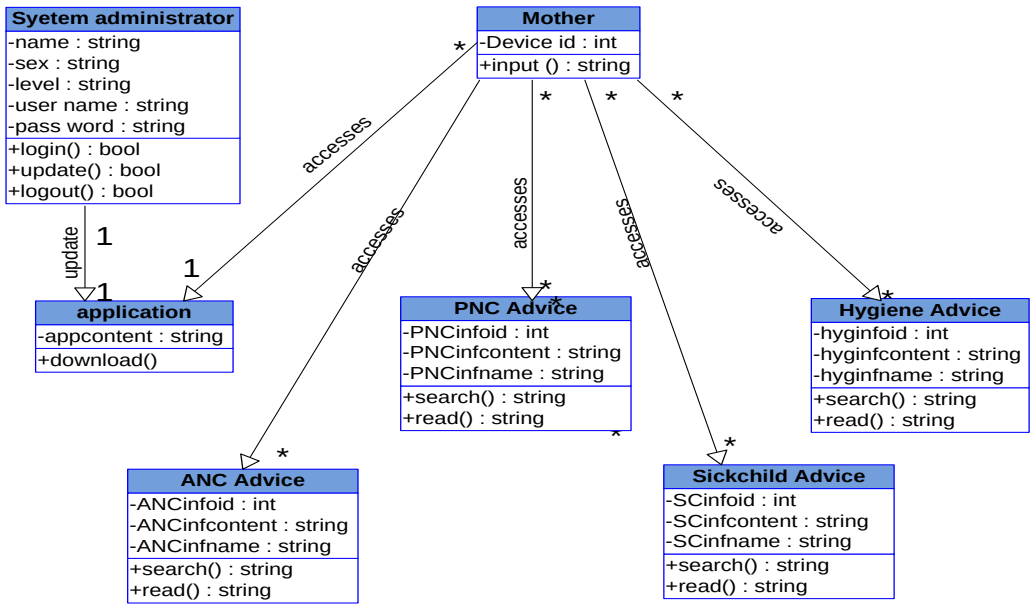


Figure 5: Class diagram of information support system for MNCH

5.2 Design Goals

The following are the list of goals that we tried to achieve in the process of system design. It shows the quality of system. Among many issues to address we found the following to be of a higher priority.

1) User Interface

UI focuses on the interaction of user and the system. The mobile side application should be simple to understand by user.

2) Availability

If power is available, the system should be up 24/7. The system should have a maximum up time.

3) Security

The system should be designed in such a way that system administrator should be authenticated to update the system. Authentication is insuring by using username and password.

4) Portability

User can install the mobile application of the system on a mobile platform.

5.2.2 System Architecture

This system architecture is core of design that shows the overall organization of software system and interaction of the user and the system.

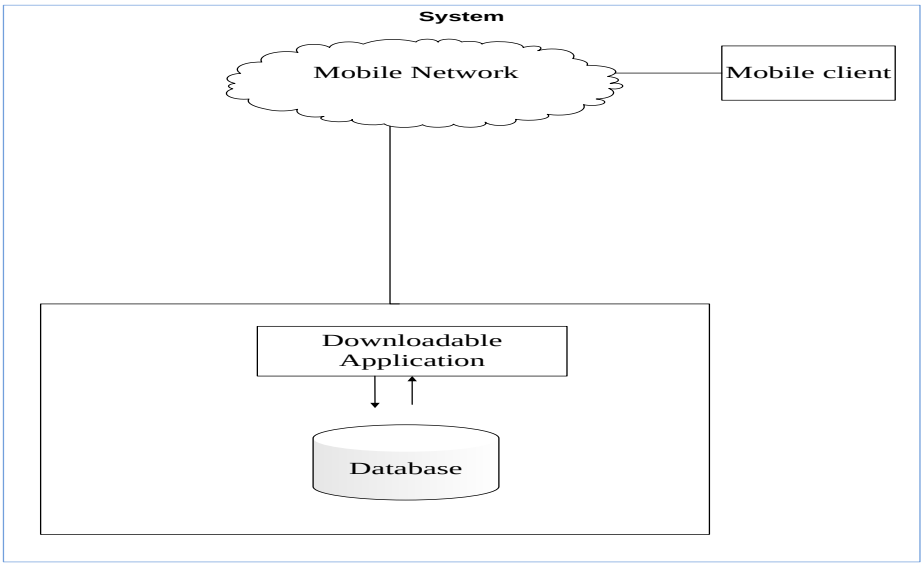


Figure 6: System Mobile Phone Client

5.2.3 Persistent Data Management

This system has objects that need to be stored in persistent data storage. Hence this section discusses the data that is stored persistently. Database system is designed to store data about the information transmitted to the mothers/ users. Figure 9 describes the different tables, attributes and their relationship.

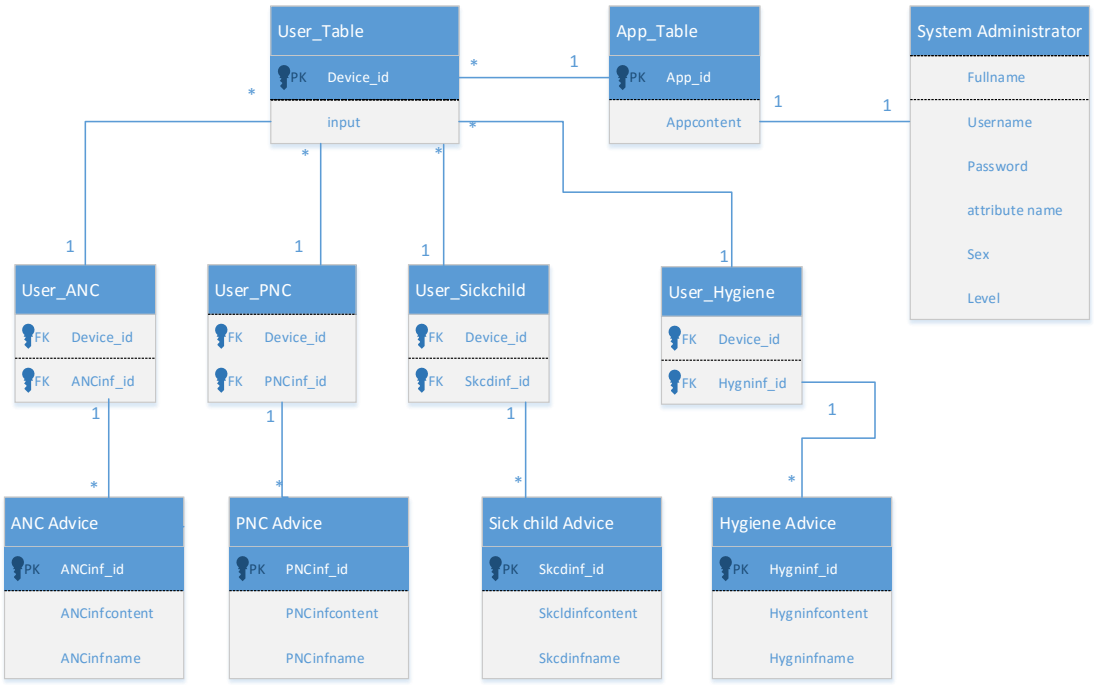


Figure 7: Identified Tables and their Relationships of MNCH

5.3 The low fidelity prototype

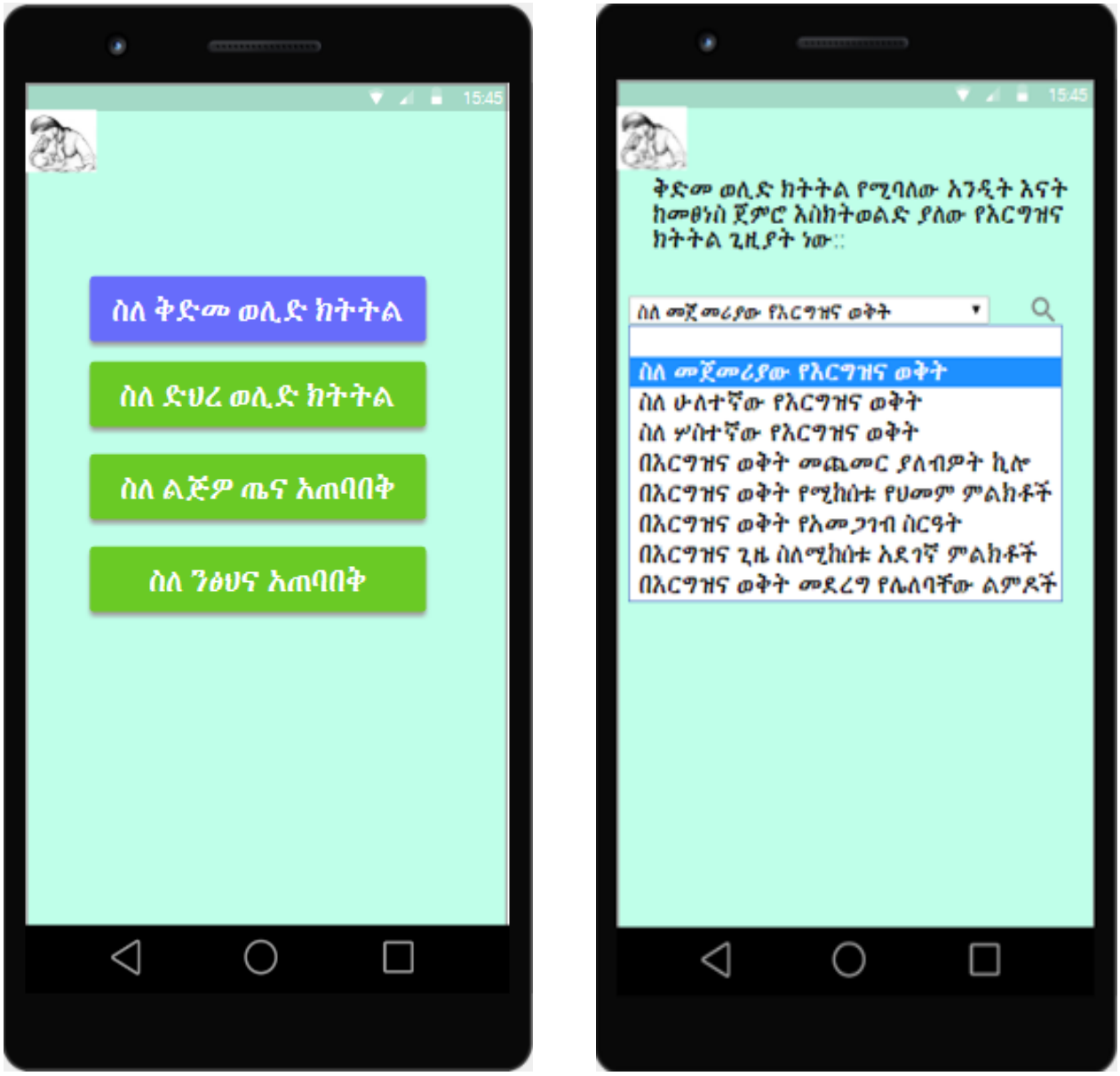
As mentioned in MOBGEN (42) low-fidelity prototype is a quick and easy tangible representation of a concept, a use flow, or an information structure created for getting quick feedback and improving the product. These prototypes are generally characterized by low technology implementation and can use a variety of materials, including sheets of paper, cardboard, glue, straws, and Lego blocks, among many others. A prototype that is sketchy and incomplete, that has some characteristics of the target product but is otherwise simple, usually in order to quickly produce the prototype and test broad concept.

(A) (B)

Figure 8: The application icon (A) The menu interface (B)

Fig 9 A: Shows when the application installed on the mobile the selected icon will appear.

Fig 9 B: Shows the available topics in the application.

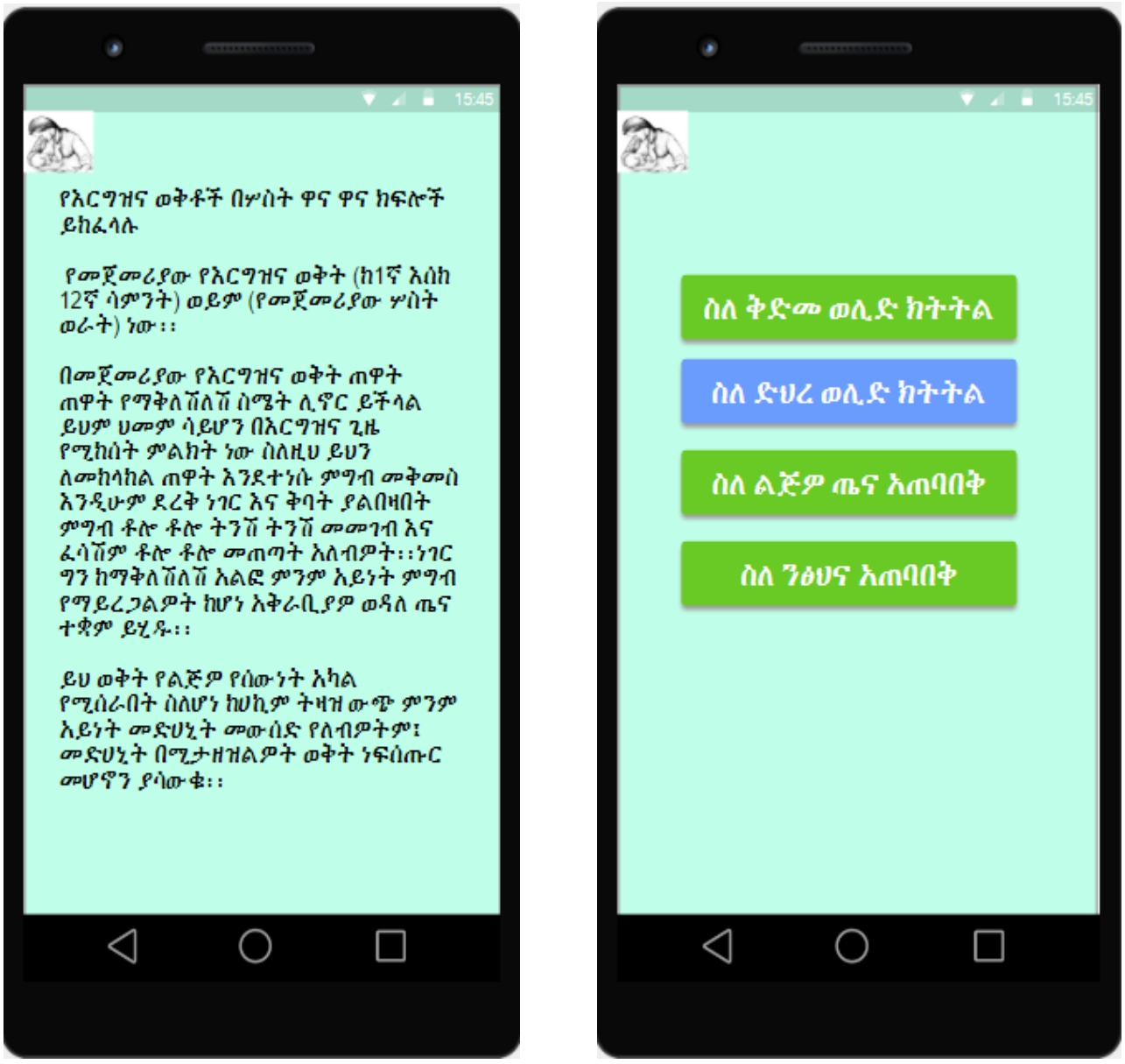


(A) (B)

Figure 9 : Menu interface (A) Drop down interface (B)

Fig 10 A: Shows when the mother select ANC information from the listed topic.

Fig 10 B: Shows the available information listed under ANC.

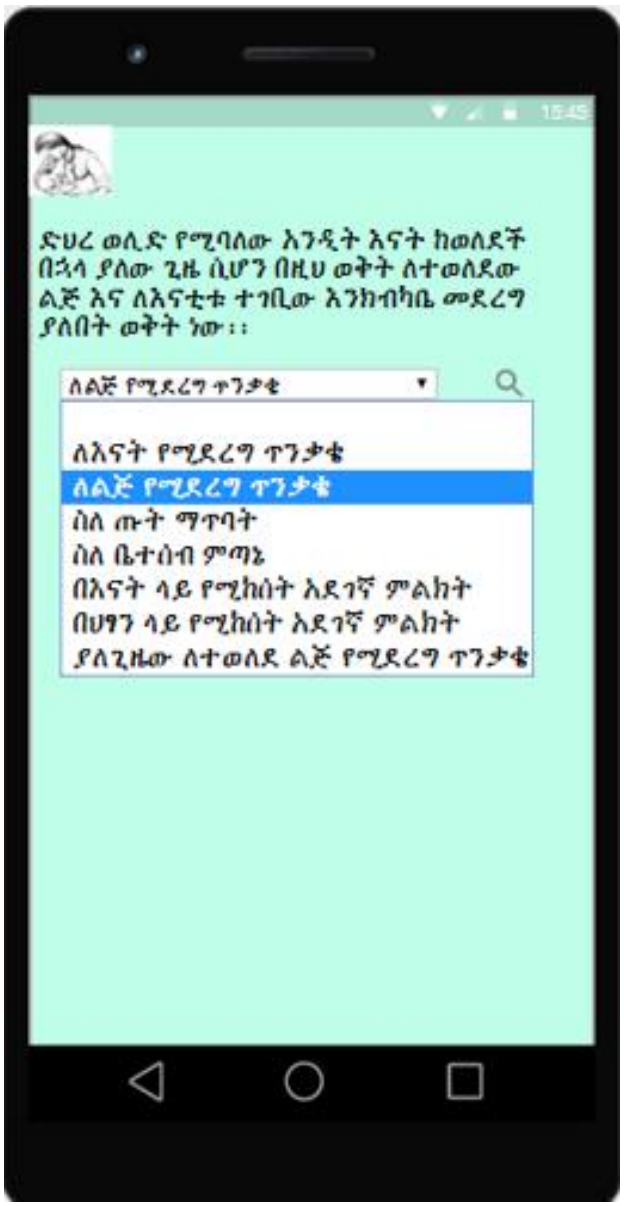


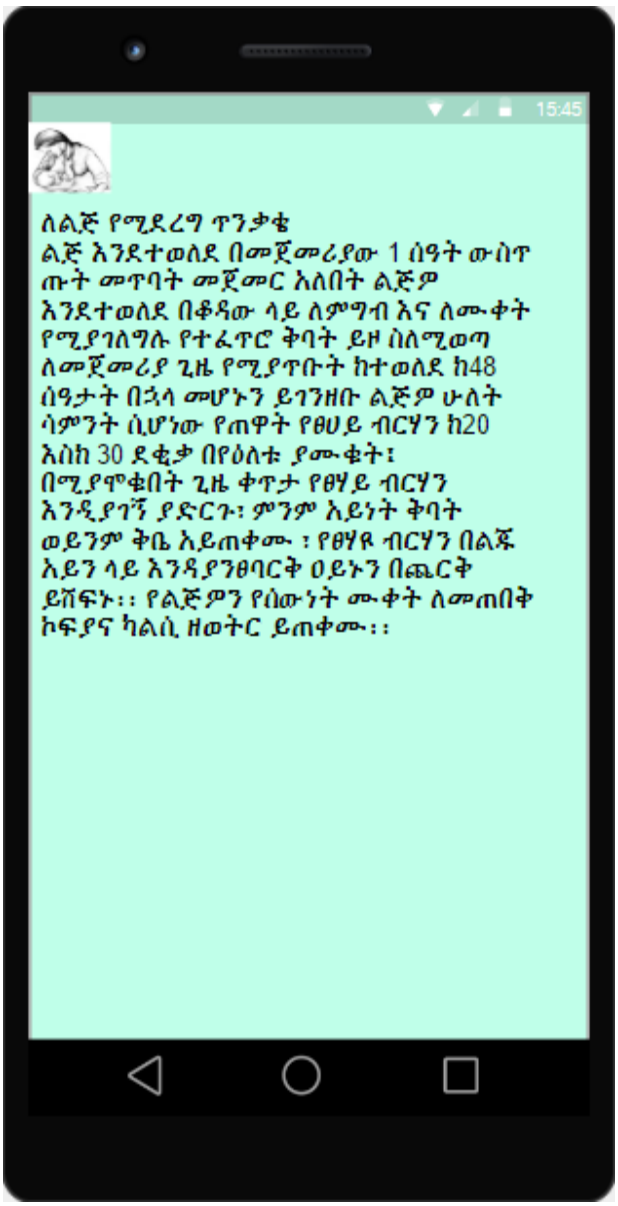
(A) (B)

Figure 10 (A) Information about first trimester (B) Menu interface

Figure 11 A: Shows the information about 1st trimester linked to ANC.

Figure 11 B: Shows when the mother select PNC information from the listed topic.





(A) (B)

Figure 11: Drop down interface (A) Information about care for child (B)

Fig 12 A: Shows the available information listed under PNC.

Fig 12 B: Shows the information about care for child linked to PNC.

(A) (B)

Figure 12: Menu interface (A) Drop down interface (B)

Fig 13 A: Shows when the mother select child health information from the listed topic.

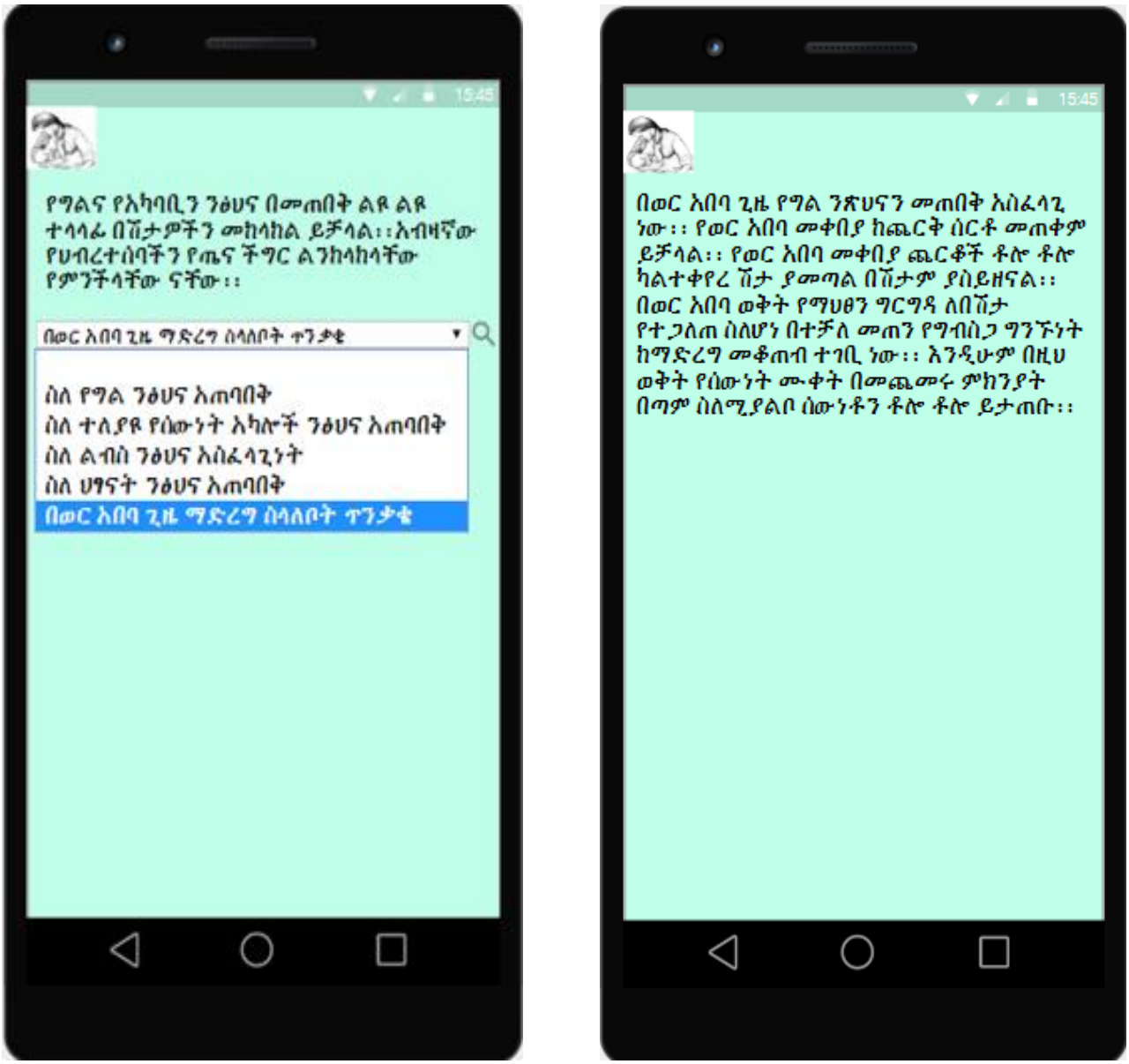
Fig 13 B: Shows the available information listed under child health.

(A) (B)

Figure 13: Information about care for child (A) Menu interface (B)

Fig 14 A: Shows the information about danger sign for child linked to care of child.

Fig 14 B: Shows when the mother select hygiene information from the listed topic.



(A) (B)

Figure 14: Drop down interface (A) Information about care during menstrual period (B)

Fig 15 A: Shows the available information listed under hygiene.

Fig 15 B: Shows the information about care during menstrual period for child linked to care of child.

CHAPTER SIX

TESTING AND EVALUATION

6.1 Introduction

According to Bentley (43) testing is a technique used in user-centered interaction design to evaluate a product by its on users. It helps to check how much the low fidelity prototype designed fits the requirements that identified at the design stage. This can be seen a unique usability practice, since it gives direct input on how real users use the system. It is conducted to evaluate the low fidelity prototype with the perspective of the mother. This is in contrast with usability inspection methods where experts use different methods to evaluate a user interface without involving users. Usability testing usually involves systematic observation under controlled conditions to determine how well people can use the low fidelity prototype and how much the design is attractive enough and to evaluate how the low fidelity prototype is helpful to educate the society.

As mentioned in Jackson Dom (44)Usability tests are a way to gather useful feedback on the interface, from a select sample of typical users. The evaluation often refers to the question of how well users can understand the system functionality. The evaluation of the interface usability is an important aspect of software design and development. This will then provide sufficient evidence yto make changes to an interface in order to make it more usable.

6.2 User profile

Regarding the user profile, there are two types of evaluators; user and health professionals. In this evaluation, 5 mothers and 5 health professionals are selected as end users to evaluate the low fidelity prototype usability to check whether the system can create adequate awareness to them.

6.3 Test environment and equipment requirements

The testing is done in Abyssinia health center which is found in Addis Ketema sub city health office. Sheets of paper, cardboard, glue and straws were used.

Task List

1. A 5-point scale based evaluation questionnaire was prepared.

2. Evaluators are given adequate time to see and use the low fidelity prototype before they start to evaluate.

3. The questionnaire is distributed to evaluators so that they can fill their evaluation.

4. One person was assigned to guide them how to access the low fidelity prototype.

An interview was conducted using the questionnaires found on Annex IV with the help of the researcher mimicking the system, to validate whether the system can give adequate awareness for mothers. Furthermore the interview is also needed for the betterment of the low fidelity prototype by gathering user's advice and comments. Thus, 5 mothers and 5 health professionals were selected to involve on the low fidelity prototype test. After the users have used all the functionalities and features of the low fidelity prototype, the respondents were asked to evaluate the system using likert scale.

6.4 Results of the Evaluation

Table 10: low fidelity prototype evaluation of MNCH

No.	Question of evaluation	Strongly agree	agree	neutral	disagree	strongly disagree
Information in the application						
1	Do you think the information is clear, concise and educational to the mother?	7	3			
2	Do you think all subjects are covered in complete manner?	6	4			
3	Do you think the information for each topic encourages reading to ask more advice?	6	4			
4	Do you think all topics are cover with perspective of maternal and child health?	8	2			
5	Do you think Advice is clearly distinguished from factual information?	6	4			
6	Do you think the system can make change to the society?	6	4			
7	Do you think it designed for all level of users?	8	2			
Screen						
1	Do you think organization of the screen is simple?	8	2			
2	Do you think the character of the screen is readable?	7	3			
3	Do you think the sequence of screens is clear?	8	2			
	Total	7	3			

After collecting the questionnaires, we have got the above outcome from the participants. The values of the responses are taken based on the Likert scale. The questionnaires are 5-point scaled and word-based. Strongly agree, agree, neutral, disagree and strongly disagree are equivalent to 5, 4, 3, 2, 1 respectively. According to the result of low fidelity prototype among 10 participants 7 are strongly agree and 3 are agree that the low fidelity prototype has a good and clear informational and functional explanation regarding the major functionalities of the system.

CHAPTER SEVEN

CONCLUSION AND RECOMMENDATIONS

7.1. Conclusion

The study showed that mothers and children are vulnerable to maternal and child health problems due to mothers lower access to maternal and child health care services which intern was due to their lower information access about the issue. On the other hand, mother's mobile usage and their interest to use their mobiles to access maternal and child health care information were promising. The expansion of mobile networks and the growth in mobile phones ownership offers an innovative way to deliver timely information to improve awareness of maternal and child health care services. Mobile phones can play great role to improve health care service since they are accessible to many and they can serve as a medium of information delivery. Mobile phones applications help to disseminate information quickly and easily. The designed mobile application information support system in this project was easy to read and use, by mothers. Mothers would use it to access information related to maternal and child health care services and attend prenatal and neonatal care. This would resulted in minimized maternal and child morbidity and mortality in Ethiopia.

7.2. Recommendation for further work

This study designed to disseminates health related information for maternal and child health by making the information easily accessing by mothers. The researcher recommends

- An extended work towards the identification of the required information by the mothers.
- The system should be upgraded to the full-fledged application
- To reach the illiterate women with maternal and child health care information easy to use, audio information should be used to providing the information.

- ❖ Further study need to be conducted for better mobile application information support system of child and maternal care.

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Annex I Information sheet

Thank you for taking the time to complete this survey. My name is Addisalem Bogale, I am a student at Addis Ababa University in Health Informatics, graduate studies. The title of my project is "in Designing Information Support System for Maternal and Child Health Care; Participatory Approach.**" .**The aim of this data collection is to assess the existing source of information, access and awareness level of mothers about maternal and child health information.

This project will support the intervention of maternal and child morbidity and mortality due to lack of information. Mothers, the community, thegovernment at large are expected to benefit from the results of this project.Your cooperation in this interview is much appreciated. Your responses will be used as an essential input for the defining of requirements which is important for designing of the mobile application for maternal and child health information support system.

This interview will take you approximately10-15 minutes to complete the survey.

As a participant of this survey, please note the following: You may seek clarification on any of the questions and you may withdraw from the interview at any time you wish to.

Your responses will be kept absolutely confidential. The results collected from the interview will be used for the purposes of the research only.

Once again, thank you for your kind cooperation.

Yours sincerely,

<u>መረጃ መስጫ ቅፅ</u>

ጤና ይስጥልኝ ስሜ አዲስዓለም ቦጋለ ይባላል፡፡ከአዲስ አበባ ዩኒቨርሲቲ የድህረ ምረቃ ፕሮግራም ለእናቶች እና ለህፃናት ጤና ጠቃሚ የሆነ መረጃ ለማቅረብ የሚያችል ጥናት ለማድረግ ነው የመጣሁት፡፡

የመጠይቁ ዋና አላማ በእናቶች እና በህፃናት ጤና ላይ መረጃዎችን በምን አይነት መንገድ እንደሚያገኙ እንዲሁም እናቶች ለሞባይል ቴክኖሎጂ ያላቸው ግንዛቤ ምን ያህል እንደሆነ ለማወቅ ሲሆን፡የምትሰጡንም መረጃ ለእናቶች እና ለህፃናት ጤና በቀላሉ መረጃ ለማግኘት የሚያስችል የመረጃ ምንጭ ለማደራጀ ትከፍተኛ እገዛ ይኖረዋል፡፡

ይህ መጠይቅ ከ10-15 ደቂቃ የሚሆን ጊዚያችሁን ብቻ የሚወስድ ይሆናል፡፡ ስለ መጠይቁ ማወቅ የምትፈልጉትን ሁሉ መጠየቅ ትችላላችሁ፡፡ እንዲሁም መጠይቁ አሰልቺ ከሆነባችሁ ማቋረጥ ትችላላችሁ፡፡

የምትሰጡን ምላሽ ሚስጥራዊነቱ የተጠበቀ ሲሆን ከዚህ መጠይቅ የሚገኘው መረጃ ለሚደራጀው በእናቶች እና ህፃናት የጤና መረጃ ማስተላለፊያ ተግባራዊነት ከፍተኛ እገዛ ይኖረዋል፡፡

ስለ ትብብራችሁ በቅድሚያ አመሰግናለሁ፡፡

Annex II Consent form

I the undersigned have been informed that this interview is part of the study that explore maternal and child health information requirement analysis . I have been told that the study will help to develop mobile application for maternal and Child health information support system , which enables mothers to access maternal and child health information easily . And also have been told about the time it took to complete the interview i.e. approximately 10-15 minutes.

Therefore, I am consented to participate in the study by signing this form.

The Study participant's

Signature _____

Date_____

Investigator

Name_____

Mobile Number_____

<u>የስምምነትቅፅ</u>

ይህ መጠይቅ ለእናቶች እና ለህፃናት ጤና ጠቃሚ መረጃ ለማግኘት የሚያስችል የመረጃ ምንጭ ለማደራጀት የሚሰበሰብ መረጃ መሆኑን ተረድቻለሁ፡፡ እንዲሁም መጠይቁ የሚፈጀው ጊዜ ከ10-15 **ደቂቃ ብቻ እንደሚሆን ተነግሮኛል፡፡**

ስለዚህ በዚህ መጠይቅ ላይ ለመሳተፍ ተስማምቻለሁ፡፡

መረጃ ሰጪ

ስም_____

ፊርማ_____

ቀን_____

የመረጃ ሰብሳቢ

ስም_____

የስልክ ቁጥር_____

Annex III Interview

ቃለመጠይቅ

በእናቶች እናህፃናት ጤና ላይ እናቶች መረጃዎችን በምን አይነት መንገድ እንደሚያገኙ እንዲሁም ለሞባይል ቴክኖሎጂ ያላቸው ግንዛቤ ምን ያህል እንደሆነ ለማወቅ የሚረዳ መረጃ ማሰባሰቢያ መጠይቅ

ክፍል 1 : መረጃስለማግኘት

የተጠያቂዋ መረጃ

ዕድሜ 15-19 ☐ 20-24 ☐ 25-29 ☐ 30-34 ☐ 35-49 ☐

የትምርት ደረጃ ምንም አልተማርኩም ☐

የመጀመሪያ ደረጃ ትምህርት ተምሪያለው ☐

የሁለተኛ ደረጃ ትምህርት ተምሪያለው ☐

ሌላ_____

የአፍ መፍቻ ቋንቋ_____

ልጅዎችአሉዎት አዎ ☐ የለኝም ☐

ከሁለት ዓመት በታች ☐ ከሁለት እስከ አምስት ዓመት ☐ ከአምስት ዓመት በላይ ☐

1. በእርግዝና ወቅት የመረጃ ችግር አጋጥምዎ ያውቃል?

አዎ ☐ አያውቅም ☐

2. መልስዎ አዎ ከሆነ ስለገጠሞት ችግር መረጃ ለማግኘት ማንን ያማክራሉ?

ቤተሰቤን ☐ ጓደኞቼን ☐

ከመፀሀፍት ላይ መረጃዎችን እፈልጋለሁ ☐

ከጤና ተቋማት ትምህርት አገኛለሁ ☐

ሌላ_____

3. መልስዎ አያውቅም ከሆነ ስለ እርግዝና መረጃ ከየት ያገኙ ነበር?

_____

4. ስለ ሕፃን ልጅዎ ጤና መረጃ ጠይቀው ያውቃሉ?

አዎ ☐ አላውቅም ☐

5. መልስዎ አዎ ከሆነ መረጃውን ለማግኘት ማንን ያማክራሉ ?

ቤተሰቤን ☐ ጓደኞቼን ☐

ከመፀሀፍት ላይ መረጃዎችን እፈልጋለሁ ☐

ከጤና ተቋማት ትምህርት አገኛለሁ ☐

ሌላ_____

6. መረጃዎቹን በምን መልኩ ነበር ያገኙት?

በቃል ☐ በፅሁፍ ☐

ሌላ _____

7. በእርግዝና ውቅት ወደ ጤና ተቋም ሲሄዱ ምን አይነት መረጃ ማግኘት ይፈልጋሉ?

_____

8. ስለ እርግዝናዎ ከጤና ተቋሙ ምን አይነት መረጃ አገኙ?

_____

9. ልጅዎን ለማሳከም ወደ ጤና ተቋም ሲሄዱ ምንአይነት መረጃ ማግኘት ይፈልጋሉ?

_____

10. ስለ ልጅዎ ከጤና ተቋሙ ምን አይነት መረጃ አገኙ?

_____

11. ያገኙትን መረጃ ለሌሎች የሚያካፍሉበት ወይም እርስ በርስ መነጋገር የሚያስችሎት አጋጣሚ ነበር?----------ካለ ቢጠቅሱልን_____

ክፍል 2 : ስለቴክኖሎጂአጠቃቀም

12.የሞባይል አጠቃቀም ችሎታዎ በምን ደረጃ ላይ ይገኛል?

ዝቅተኛ ☐ መካከለኛ ☐ ከፍተኛ ☐

13.የሞባይል ስልክዎን ለምን ለምን ጉዳይ መጠቀም ይቀልዎታል?

_____

14.በሞባይል ስልክዎ መረጃዎችን ፈልገው ያውቃሉ?_____

ምን አይነት መረጃ ?_____

ለጤና ባለሙያዎች የተዘጋጀ ቃለ መጠየቅ

1. ለነብሰጡር እናቶች መረጃ የሚሰጥ ሞባይል አፕልኬሽን እንዳለ ያውቃሉ?

አውቃለው ☐ አላውቅም ☐

የሚያውቃቸው ቢጠቅሱልን

_____

_____

2. ነብሰ ጡር እናቶች እና ህፃናትን የሚመለከት ትምህርት በተቋሙ ይሰጣል?

ይሰጣል ☐ አይሰጥም ☐

3.መልሶ አዎ ከሆነ በምን አይነት መልኩ ነው ትምህር የሚሰጠው

በቲቪ ☐ በሬዲዮ ☐ በባለሙያ ☐

ሌላ_____

_____

4. በመረጃ እጦት ምክንያት ያለክትትል ለወሊድ የምትመጣ እናት አጋጥማቹ ታውቃለች?

አጋጥማናለች ☐ አላጋጠመችንም ☐

5. በመረጃ እጦት ምክንያት ልጅዋን ያለስከተበች እናት አጋጥማቹ ታውቃለች?

አጋጥማናለች ☐ አላጋጠመችንም ☐

6. በመረጃ እጦት ምክንያት እናት ላይ ወይም ልጅዋ ላይ የተከሰተ ችግር አጋጥማቹ ታውቃለች?

አጋጥማናለች ☐ አላጋጠመችንም ☐

7.ያጋጠማቹ ካለ ቢጠቅሱልን _____

_____

Annex IV low fidelity prototype Evaluation Questionnaire

The below mentioned table was developed to collect the required response from the stakeholders of the system to help in assessing and evaluating the user interface for the low fidelity prototype.

No.	አስተያየታችሁን በሚፈልጉት ቦታ ላይ የ (X) ምልክት ድረጉ	በጣም ተስማምቻለሁ	ተስማምቻለሁ	ምንም አስተያየት የለኝም	አልተስማማሁም	በጣም አልተስማማሁም
አፕልኬሽኑ ላይ ስላለው መረጃ						
1	የተመለከቱት መረጃ ግልፅ እና እናቶችን የሚያስተምር ነው					
2	የሚፈልጉት መረጃ አግኝተውበታል					
3	ያገኙት መረጃ የበለጠ እንዲያነቡ ያበረታታል					
4	የተጠቀሱት አርስቶች ለእናቶችና ለህፃናት የሚጠቅሙ ናቸው					
5	በጤና ተቋም ከሚያገኙት መረጃ ጋር አንድ ነው					
6	ይህ መረጃ በህብረተሰቡ ላይ ለውጥ ያመጣል					
7	ይህ መረጃ በተለያዩ የእውቀት ደረጃ ላይ ላሉ ተጠቃሚዎች ይጠቅማል					
ስለ ሞቢይሉ ገፅ እይታ						
1	መረጃውን ለመጠቀም ቀላል ነው					
2	መረጃውን ለማንበብ አያስቸግርም					
3	የመረጃው ቅደም ተከተል ግልፅ ነው					

Figure 15: Pictures when preparing paper proto type for testing low fidelity prototype.

Figure 16: Pictures of mother when doing the test.

Declaration

I, the undersigned, declare that this project is my original work and has not been presented for a degree in any other university, and that all source of materials used for the project have been properly acknowledged.

Declared by:

Name: __Addiasalem _Bogale_

Signature: _____

Date: ___June 2017_____

This research project has been submitted for examination with my approval as university advisor

	Name	Date	Signature
Advisor :	Rahel Bekele(PhD)	_____	_____
Advisor :	Robel Yirgu(MPH)	_____	_____

Addis Ababa, Ethiopia

June 2017