BUSITEMA UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER ENGINEERING

DESIGN AND IMPLEMENTATION OF AN ULTRASOUND SYSTEM USING A SMART PHONE

BY

ATWETA SHEILA

BU/UG/2012/56

JUNE 2016

Declaration

I Atweta Sheila BU/UG/2012/56 hereby declare that this project report is my original work except where explicit citation has been made and it has not been presented to any institution of higher learning for any academic award.

Sign: …….

Date: …….

Approval

The undersigned certify that i have read and hereby recommend for acceptance of Busitema University a Project report entitled DESIGN AND IMPLEMENTATION OF AN ULTRASOUND SYSTEM USING A SMART PHONE.

Mr. OCEN GILBERT

Department of Computer Engineering

Sign: ……..

Date: ……..

Acknowledgement

First and foremost I would like to take this opportunity to thank the Almighty Lord for providing protection and life to me. For it was through the health and strength I had that I was able to make it to this level.

Secondly I would like to thank my parents and family who have looked after my welfare and finances and ensured that I carried on my education successfully, may the good Lord award them abundantly.

Furthermore I extend my sincere gratitude to my supervisor Mr Ocen Gilbert who has tirelessly worked with me to ensure that all the work in this report are up to the recommended standards.

I thank Busitema University Department of Computer Engineering for rendering enough time for us to ensure that we learn a lot as computer engineering is concerned and this has made it possible for me to come up with this project.

Lastly I would like to convey my thanks to all my friends who stood by my side to help me do all that was required for my project and to make it to this level. I really do appreciate them for everything.

Abstract

According to the WHO, about 40% of pregnant women will experience delivery complications, while about 15% need obstetric care to manage complications which are potentially life threatening to the mother or infant. Women die as a result of complications during and following pregnancy. In the current health care system, millions of women do not receive routine screening and services related to reproductive and childbearing risks because they lack health coverage outside of pregnancy and/or have limited access to high-quality preventive and primary care. Maternal and infant health depends on the functioning of the entire health system hence; it is important to understand that about 15% of all pregnancies end up with life threatening complications; some of which cannot be detected or predicted during antenatal care due to poor or a complete lack of access to essential services like ultrasound scans and mothers may end fatally if not managed appropriately. Even though the government of Uganda has focused its effort on creating and increasing awareness of the benefits of ultrasound scan, a very big number of pregnant women have failed to comply due transport difficulties to the hospitals, thus this method has not been effective. This project was therefore aimed at designing and implementing an ultrasound system that uses a smart phone that would allow the pregnant women to carry out ultrasound scan from anywhere at their time of convenience. The work is arranged mainly in six chapters, Chapter one includes the introduction of the design of an ultrasound system. Chapter two discusses the literature related to the system, Chapter three illustrates the methodologies used in coming up with the working prototype of the system, Chapter four includes system design and analysis, Chapter five contains the implementation and testing of the system and chapter six contains the summary of the work, discussions and recommendations.

Table of Content

List of Tables

List of Figures

List of Acronyms

WHO	World Health Organization
USB	Universal Serial Bus
IDE	Integrated Development Environment
UID	User Identifiers
RISC	Reduced Instruction Chip Set
AVR	Advanced Virtual RISC
.apk	Android package

CHAPTER ONE

INTRODUCTION

1.1 Background

The World Health Organization (WHO) defines maternal health as the health of women during pregnancy, childbirth and the postpartum period [1]. All pregnant women face some level of maternal risk. According to the WHO, about 40% of pregnant women will experience delivery complications, while about 15% need obstetric care to manage complications which are potentially life threatening to the mother or infant. Women die as a result of complications during and following pregnancy [2].

Uganda's maternal mortality ratio appears to have declined over the past decade, measured at 505 deaths per 100,000 live births in 2000/01 and 435 deaths in 2006. According to the survey, "it is impossible to say with confidence that maternal mortality has declined."A datasheet of global estimates on maternal mortality published in 2010 calculated Uganda's maternal mortality ratio as 352 deaths per 100,000 live births in 2008. Over 5,000 Ugandan women die each year from maternal-related causes [3].

One of the most striking aspects of maternal health in Uganda is the discrepancy between the very high rate of antenatal care (ANC)—more than 90 percent of pregnant women receive at least one antenatal care visit—and the much lower rate of facility-based deliveries. Almost all women in developing countries have at least four antenatal care visits, are attended to by a skilled health worker during childbirth, and receive postpartum care. In contrast, only 47% of Ugandan women receive antenatal care coverage and only 42% of births are attended by skilled health personnel [4].

In the current health care system, millions of women do not receive routine screening and services related to reproductive and childbearing risks because they lack health coverage outside of pregnancy and/or have limited access to high-quality preventive and primary care. For example the case of the lady in some major hospital [5].

Maternal and infant health depends on the functioning of the entire health system hence; it is important to understand that about 15% of all pregnancies end up with life threatening

complications; some of which cannot be detected or predicted during antenatal care due to poor or a complete lack of access to essential services like ultrasound scans and mothers may end fatally if not managed appropriately [6].

Ultrasound imaging now forms an essential part of antenatal care around the world. Antenatal ultrasound is a safe technology that meets the WHO guidelines for the use of technology. The most prominent use of ultrasound imaging is to check for specific indications such as early detection and monitoring of conditions that give rise to fetal and maternal compromise thereby checking for fetal abnormalities and assessing fetal growth.

Unfortunately ultrasound service is nearly absent in many rural and urban facilities in developing regions due to several bottlenecks which range from inaccessibility, high costs involved in accessing the services, ignorance and poor attitude towards the ultrasound service.

Even though the government of Uganda has focused its effort on creating and increasing awareness of the benefits of ultrasound scan, a very big number of pregnant women have failed to comply, thus this method has not been effective.

There is therefore a need for a system that helps the pregnant women carry out ultrasound scan using smart phones from their places of convenience and at their time of convenience thereby saving them the challenge of travelling to the health centers.

1.2 Problem Statement

Every pregnant woman has to pay at least four antenatal visits to the health center where an ultrasound scan is carried out during these visits. It is through these ultrasound scans that the pregnant woman can verify that she does not have ectopic or tubal pregnancy, can check for fetal abnormalities if any and assess fetal growth. Most pregnant women fail to go for such checkups due to the difficulties in transport, since usually most health centers are far from people's homesteads. Due to this, there has been an increase in maternal mortality, miscarriages and many pregnant women have undergone cesarean during delivery, and therefore there is a need for a system that counteracts the identified problem.

1.3 Objectives

1.3.1 Main Objective

To design and implement an ultrasound system using smart phone.

1.3.2 Specific Objectives

- To review the existing current ultrasound systems.
- To analyze and identify the requirements for the design of an ultrasound system.
- To design the user interface module of the ultrasound system.
- To design the hardware module of the ultrasound system.
- To implement, test and validate the ultrasound system.

1.4 Justification

Due to the failure of going to health centers for regular checkups and antenatal care, there has been an increase in the number of pregnant women who undergo miscarriages. This occurs in 20% of clinical pregnancies equating to approximately 15,000 miscarriages per annum in Uganda [7]. Pregnant women need to be aware of any pregnancy complications and fetal abnormalities in case of any so that issues like maternal death and miscarriages are reduced or prevented from occurring. This justifies the need for a system that will help the pregnant woman carry out an ultrasound scan and be aware of any complications.

1.5 Scope

The scope covered design and implementation of an ultrasound system using a smart phone. It was be applicable to women with pregnancy of 16 weeks onwards in Uganda. The project was scheduled to last for seven months starting November 2015 to May 2016.

References

[1] World Health Organisation:Maternal Health.

[2] "04-03_Uganda.pdf,".

[3] http://www.who.int/reproductivehealth/publications/monitoring/9789241500265/en/.

[4] "Uganda Bureau of Statistics and Macro International Inc 2007,".

[5] "Ultrasound Scan Study in Rural Uganda-Luuka District,".

[6] "Addressing Women's health needs and improving Birth outcome,".

[7] "Kate-MN-NURS-July-2014,".

[8] Toshihiko Kawano, Takashi, Sugiyama,Tsuyoshi Mitake,Shinichiro Umemura Tsuyoshi Otake, "High-quality/High-resolution Digital Ultrasound,".

[9] (2015, June) RadiologyInfo.org for patients. [Online]. http://www.radiologyinfo.org/en/info.cfm?pg=pelvus

[10] Dr Monica Pahuja. (2015, February) InsideRadiology. [Online]. http://www.insideradiology.com.au/pages/view.php?T_id=72#.VxgD_RHAKYU

[11] (2005, June) Standards of Practice for Integrated MCH/RH Services.

[12] (2013) 120-year-old-method-fetal-monitoring-where-there-no-electricity. [Online]. http://maternova.net/blog/120-year-old-method-fetal-monitoring-where-there-no-electricity

[13] TitanServiceManual.pdf. [Online]. https://www.sonosite.com/downloads/TitanServiceManual.pdf

[14] M-Turbo_1.3_UG_P07662-03B_e.pdf. [Online]. https://www.sonosite.com/sites/default/files/support_docs/M-Turbo_1.3_UG_P07662-03B_e.pdf

[15] CMER. (2014) "Mobile Operating System Centre for Mobile Education and Research".

[16] Android.com. [Online]. http://www.android.com

[17] Patricia McDermott-Wells, "What is Bluetooth," Florida International University, Miami, 2005.

[18] Inigo Puy, "Bluetooth," Hochschule FurtWangen University, 2008.

[19] Hans-Petter Halvorsen, "Introduction to Arduino An Open-Source Prototyping Platform," 2013.

[20] Nivedita Sethy, "AVR MICROCONTROLLER," Rourkela, 2013.

[21] *Open Source Computer Vision Library Reference Manual*.: Intel.