BUSITEMA UNIVERSITY
Pursuing Excellence

P.O. Box 236, Tororo, Uganda
Gen: +256 - 45 444 8838
Fax: +256 - 45 4436517
Email: info@adm.busitema.ac.ug

www.busitema.ac.ug

FACULTY OF ENGINERING

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER ENGINEERING

FINAL YEAR PROJECT REPORT

IoT based vital pregnancy signs Monitoring system applicable in Rural areas: A Case of Uganda

BY FARUKU TOAH

Reg No.: BU/UG/2019/031

Email: farukutoah709@gmail.com

Tel: 0785058226/0760605128/0756890019

SUPERVISOR: Mr. LUSIBA BADRU

A REPORT SUBMITTED TO DEPARTMENT OF COMPUTER ENGINEERING IN THE FULLFILMENT FOR THE AWARD OF BACHELOR OF SCIENCE IN OMPUTER ENGINEERI

September 2023

DECLARATION

I FARUKU TOAH, hereby declare that this report, written in partial fulfilment of the requirement of the award of a Bachelor of Computer Engineering degree at Busitema University, is my very own work and the content of this document has never been submitted before to the Department of Computer Engineering of Busitema University and any another institution of high education.

Signature..... Date..9/25/2023.....

FARUKU TOAH

APPROVAL

This is to certify that the project proposal titled "**IoT based vital pregnancy signs Monitoring system applicable in Rural areas**" has been done under my supervision and is now ready for examination.

Signature.....

Date 25/09/2023

Mr. LUSIBA BADRU

Department of Computer Engineering

DEDICATION

I dedicate this report to my parents Toah Abubakar Ijoga and Ramula Ejovi Khemis, their encouragement has made sure that I give all it takes to finish that which I have started and all my family members. God bless them.

ACKNOWLEDGEMENT

I thank Almighty Allah for providing me with life and knowledge that helped me up to the completion of this project as well as my parents for their financial support and encouragement. Appreciation also goes to all my colleagues most especially Okwii Simon, Onen Bob Ochen, for their support through group discussions and advice when needed, my supervisor Mr Lusiba Badru, the Department of Computer Engineering for guidance and insight into concepts of research and project management as well as technical knowledge applicable in the design of the system

ABSTRACT

Uganda is a country in East Africa with a population of over 45 million people, of which approximately 80% live in rural areas. Rural areas in Uganda are often characterized by poor infrastructure, limited access to healthcare services, and high levels of poverty. These factors can have a significant impact on the health of pregnant women in rural areas, leading to higher rates of maternal and infant mortality.

One of the key challenges facing pregnant women in rural areas of Uganda is limited access to healthcare services. Many rural areas lack adequate healthcare facilities, and even when facilities are available, they are often understaffed and under-resourced. This can result in long waiting times which may lead to congestion, inadequate care, and a lack of access to essential medicines and treatments.

Heart rate, blood pressure, respiratory rate, oxygen saturations and temperature are key vital signs used to assess the clinical status of women presenting acutely throughout pregnancy, intrapartum, during anaesthesia and in the early postpartum period and therefore Vital signs in pregnancy refer to a set of physiological measurements that are routinely monitored to assess the health and well-being of pregnant women

Prenatal care is comprehensive medical care provided during pregnancy, labour and delivery. Services include screening and treatment for medical conditions and for behavioural risk factors associated with poor birth outcomes

LIST OF ABBREVIATIONS

IDE	Integrated Development Environment
LCD	Liquid Crystal Display
mm hg	millimetres of mercury
SpO2	peripheral capillary oxygen saturation
IoT	Internet of things
BP	Blood pressure
ADXL335	Accelerometer
AI	Artificial Intelligence
SD	Standard deviation

TABLE OF FIGURES

TABLE CONTENTS

CHAPTER ONE

BACKGROUND

Uganda is a country in East Africa with a population of over 45 million people, of which approximately 80% live in rural areas[1]. Rural areas in Uganda are often characterized by poor infrastructure, limited access to healthcare services, and high levels of poverty[2]. These factors can have a significant impact on the health of pregnant women in rural areas, leading to higher rates of maternal and infant mortality.

One of the key challenges facing pregnant women in rural areas of Uganda is limited access to healthcare services. Many rural areas lack adequate healthcare facilities, and even when facilities are available, they are often understaffed and under-resourced[3]. This can result in long waiting times which may lead to congestion, inadequate care, and a lack of access to essential medicines and treatments.

Another challenge facing pregnant women in rural areas of Uganda is poverty. Poverty rates in rural areas are generally higher than in urban areas, and many pregnant women in rural areas struggle to afford basic healthcare services, including prenatal care[4] that is, Prenatal care refers to the healthcare and medical attention provided to pregnant women before the birth of their baby which is due to high employment rate of their husbands[3]. This can lead to delays in seeking care, which can have serious consequences for both the mother and the baby.

According to the Uganda Demographic and Health Survey (UDHS) 2016, the Infant Mortality Rate in Uganda is 43 deaths per 1000 live births, while the Maternal Mortality Ratio is 336 per 100,000 live births according to Uganda bureau of statics[5]. These high rates of infant and maternal mortality are largely driven by the challenges facing pregnant women in rural areas, including poor infrastructure, poverty, and limited access to healthcare services.

According to [6], Heart rate, blood pressure, respiratory rate, oxygen saturations and temperature are key vital signs used to assess the clinical status of women presenting acutely throughout pregnancy, intrapartum, during anaesthesia and in the early postpartum period and therefore Vital signs in pregnancy refer to a set of physiological measurements that are routinely monitored to assess the health and well-being of pregnant women. These measurements provide valuable information about the functioning of various body systems during pregnancy.

REFERENCE

[1] "Significant regional disparities remain, with the central and western regions of Uganda showing better development indicators than Karamoja (poverty rate of 75%) and Northern Uganda (poverty rate of 40%).," pp. 1–15, 2014.

[2] UBOS, "Uganda Demographic and Health Survey 2016," *Udhs*, p. 625, 2016, [Online]. Available: www.DHSprogram.com

[3] N. Mukasa, "Uganda Healthcare system profile: Background, Organization, Polices and Challenges," *J. Sustain. Reg. Heal. Syst.*, vol. 1, no. 1, pp. 2–10, 2012, [Online]. Available: http://projektai.vu.lt/erasmusmundus/sites/default/files/u3/Regional Health Systems_Issue 1_Volume 1_May_2012.pdf

[4] M. C. Chames *et al.*, "UMHS Prenatal Care Guideline," *Guidel. Clin. Care Ambul.*, p. 18, 2018.

[5] N. H. Disparities, "Uganda".

[6] L. Loerup, R. M. Pullon, J. Birks, S. Fleming, L. H. Mackillop, and P. J. Watkinson, "Trends of vital signs with gestational age in normal pregnancies: A systematic review protocol," *BMJ Open*, vol. 6, no. 1, pp. 1–5, 2016, doi: 10.1136/bmjopen-2015-008769.

[7] Jordi Salaza and S. Silvestre, *Tech Pedia Internet Of Things*, vol. 14, no. July 2016. 2009. [Online]. Available: http://link.springer.com/10.1007/978-3-319-77492-3_16

[8] Schroder, "Part I Concepts and Perspectives," *Internet Things A to Z Technol. Appl.*, 2018.

[9] C. NUCCI, "Prenatal Care.," *Can. Nurse*, vol. 61, no. November, pp. 24–25, 1965.

[10] A. Marnoch, "An evaluation of the importance of formal, maternal fetal movement counting as a measure of fetal well-being," *Midwifery*, vol. 8, no. 2, pp. 54–63, Jun. 1992, doi: 10.1016/S0266-6138(05)80211-6.

[11] A. Kurjak, M. Predojević, M. Stanojević, A. Talić, U. Honemeyer, and A. S. Kadić, "The use of 4D imaging in the behavioral assessment of high-risk fetuses," *Imaging Med.*, vol. 3, no. 5, pp. 557–569, 2011, doi: 10.2217/iim.11.39.

[12] B. F. Bradford *et al.*, "A diurnal fetal movement pattern: Findings from a cross-sectional study of maternally perceived fetal movements in the third trimester of pregnancy,"

PLoS One, vol. 14, no. 6, pp. 1–15, 2019, doi: 10.1371/journal.pone.0217583.

[13] J. H. M. Informat and K. Maeda, "Health & Medical Informatics Fetal Movements," vol. 5, no. 3, 2014, doi: 10.4172/2157-7420.1000e115.

[14] P. Wipt and K. M. George, "基因的改变NIH Public Access," *Bone*, vol. 23, no. 1, pp. 1–7, 2008, doi: 10.1097/HJH.0b013e3283536319.Hypertension.

[15] J. Tooher *et al.*, "High blood pressure during pregnancy is associated with future cardiovascular disease: An observational cohort study," *BMJ Open*, vol. 3, no. 7, pp. 1–9, 2013, doi: 10.1136/bmjopen-2013-002964.

[16] P. Shruthi and M. Sharanya, "Iot Based Measurement of Body Temperature Using Max30205," *Int. Res. J. Eng. Technol.*, vol. 05, no. 03, pp. 3913–3915, 2018, [Online]. Available: www.irjet.net

[17] A. Bagwari and K. Gairola, "An Aid for Health monitoring during pregnancy," *2021 10th IEEE Int. Conf. Commun. Syst. Netw. Technol.*, pp. 805–809, 2021, doi: 10.1109/CSNT51715.2021.9509654.

[18] M. Sajjad *et al.*, "Internet of Things as Intimating for Pregnant Women's Healthcare: An Impending Privacy Issues," *Indones. J. Electr. Eng. Comput. Sci.*, vol. 12, no. 6, pp. 4337–4344, Jun. 2014, doi: 10.11591/TELKOMNIKA.V12I6.4227.

[19] P. K. Joshi and M. S. Chitale, "A comparative study of arterial oxygen saturation in pregnant and non-pregnant women," *Natl. J. Physiol. Pharm. Pharmacol.*, vol. 7, no. 10, pp. 1081–1083, 2017, doi: 10.5455/njppp.2017.7.0517722052017.

[20] L. J. Green *et al.*, "Gestation-Specific Vital Sign Reference Ranges in Pregnancy," *Obstet. Gynecol.*, vol. 135, no. 3, pp. 653–664, Mar. 2020, doi: 10.1097/AOG.0000000000003721.

[21] W. Behutiye, "Android Ecg Application Development," p. 36+6, 2012, [Online]. Available: https://publications.theseus.fi/bitstream/handle/10024/41688/Behutiye_Woubshet.pdf?sequence=1

[22] M. N. Sachin, B. Gagandeep, N. S. Aralikatti, B. O. Narendra, and R. Naseer, "SMART PRENATAL HEALTH CARE MONITORING SYSTEM FOR PREGNANCY WOMEN IN RURAL AREAS USING IOT," no. July, pp. 1781–1785, 2022.

[23] K. Sathesh, S. Rajasekaran, K. Likhitha, and D. Sai, “IOT Based Pregnancy Women Health Monitoring System for Prenatal Care,” vol. 4, no. 7, pp. 453–458, 2022, doi: 10.35629/5252-0407453458.

[24] S. Gayathri, T. Bharathi, D. J. Ar, and A. K. A, “Pregnant Women Health Care Monitoring System Based on IoT,” no. 1, pp. 11–14, 2018.

[25] W. Wu *et al.*, “IoT-based Smart Health System for Ambulatory Maternal and Fetal Monitoring,” vol. 4662, no. c, 2020, doi: 10.1109/JIOT.2020.3037759.

[26] A. V. Tiwari, G. Singh, U. S. Talele, and R. Chalke, “Health Monitoring IoT + Android Application for Pregnant Women,” pp. 2373–2379, 2021.

[27] M. F. Gomes, V. De La Fuente-Núñez, A. Saxena, and A. C. Kuesel, “Protected to death: Systematic exclusion of pregnant women from Ebola virus disease trials,” *Reprod. Health*, vol. 14, no. Suppl 3, 2017, doi: 10.1186/s12978-017-0430-2.

[28] A. Kempe, B. P. Sachs, M. Dph, H. Ricciotti, A. M. Sobol, and P. H. Wise, “Monitoring in the Prevention,” no. September 1997, 2016.