

ANTENATAL CARE MONITORING SYSTEM BASED ON INTERNET OF THINGS TECHNOLOGY IN NIGERIA

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ABSTRACT

The adoption of alternative channel for service delivery has becoming part of every sphere of human endeavour including the health care services. The reports on the rise of maternal mortality rate in Nigeria necessitated the search for alternative medium for sustaining the monitoring of antenatal mothers away from hospitals using technologies such as internet of things (IoT). Factors such bad or poor road network, poor medical facilities, limited numbers of medical professionals and cost antenatal care in Nigeria are some of the key factors leading to an improved means of delivering antenatal care. The Antenatal care Monitoring System Using IoT collects data from the sensors based electronic interface won by antenatal mothers at their different distances and display the data on the computer screen through a wireless means with internet connectivity. Hence by using IoT, long distance transmission of health data is achieved and medical decisions taken by appropriate professionals. The data collected on an antenatal mother can be sent from any distance to where it can be seen and further controlling action may be initiated if required. This study presents a new system design on internet of things-based Data mining Model and Cloud Integration for Antenatal care in Nigeria. A general background study on IoT vast opportunities with respect to devices capabilities, communication design and software application development were presented and from which the researcher proposes a framework for antenatal care monitoring and makes recommendations. The data collected on an antenatal mother can be sent from any distance to where it can be seen and further controlling action may be initiated if required. All the actors in IoT market must be proactive in developing preventive measures to reduce the impending danger of IoT.

Keywords—Antenatal care, IoT devices, network, sensors, Big data, Cloud Computing

INTRODUCTION

The motivation for the proposed study was triggered by the painful experiences that some people in Nigeria recount while receiving antenatal care. In Nigeria, a lot of Antenatal patients and medical professional experience delays in exchanging medical information that are necessary to take immediate decisions during treatments with little or no real time collaborations. These problems demand the development of another approach to achieve efficiency and reliability during antenatal care (Bikash & Saugat,2021). Application of internet of Things (IoT) Technology has been seen to provide real time communications while data mining provides selective search even in cloud integrated data. This will restore medical business in Nigeria especially antenatal and reduce heavy expenses by women travelling abroad just to have their babies. Data privacy, integrity and security will also be achieved through this proposed system. Clearly, the maternal mortality rate in Nigeria is increasing primarily due to the lag between when urgent care is needed and received due non-reliable means of transportation, bad roads, dysfunctional emergency system, and other challenges that affect timely maternal care. The absence of a well established information system to provide a real time management of the increasing volume of medical records, innovations and collaborations of medical experts in Nigeria has resulted in medical complications during antenatal cares and bringing medical business in Nigeria to a very low level of efficiency (Enao,Bhuiyan,Wang,Rahman, Wu & Atiquzzaman, 2018). This is basically because of

the weakness of the existing system which includes over reliance on manual Process and limited collaborations. Papers and files consume a lot of the office space, slow recording, processing and retrieval of patient details with high level of difficulty to maintain security of patients' records and data integrity. Accessing and sharing of information by different departments is difficult due to poor information management. Again, antenatal patients can have access to their medical data and doctors' appointments at any geographical locations of their choice (Bikash & Saugat,2021).

Manual and local handling of large volume of medical data that are constantly generated in hospital and medical outfits throughout Nigeria has not provided opportunity for much medical research and innovations when compared with other nations of the world. Antenatal mothers in the developing countries always face consultation challenges to meet with the qualified consultants in the health sectors and sometimes they find it difficult to retrieve their folders (data) due to inability of the hospitals to manage this stored data. Again, Due to the increasing population of these pregnant women, the health sectors could not provide enough resources to manage such big data and this also can result to data and information loss. Following the increases in medical complications during gestation period and the need for collaborations at real time by gynecologists who may be located at different states of Nigeria, an internet based real time update through internet of thing (IoT) technology becomes inevitable in the health sector. IoT in health care introduces and integrates remote diagnosis, tracking, real-time monitoring, examination and prescription to Electronic Health System (eHS) (Bikash & Saugat,2021). Data can be tampered with because of the truncated data backup, Cloud computing integration becomes a crucial technology to be applied to enhance the availability of these data files. IoT based data mining model for cloud integration becomes a backbone to serve as a convergence to solve this problem especially in Nigeria. Data mining is used to find out those useful patterns, correlations, and rules, which are not known initially by filtering through the large amount of data stored in the database (Borja, Wael, Enbo , Jose ,2017). Internet of Things (IoT) connects intelligent and unintelligent devices such as actuators, sensors, and other devices to the web. Internet of Things-Based Data Mining Model and Cloud Integration for Antenatal Care is a new technology-based research area that can provides an automated remote monitoring solution for collecting and consolidating near-real-time data from sensors in both remote and accessible locations. The data can be collected using a wireless network and then transmitted to a "private cloud" platform for analysis and retention. Today, many organizations have started to evaluate Industrial IoT as a yardstick for their business strategies and assessment (Bikash & Saugat,2021), (Saravanan, & Achsah,2019) through advanced data analytics in industrial domains. A core ingredient in such a system is the ability of heterogeneous devices to communicate adaptively. It demands that material objects acquire communications and computation capabilities and become able to automatically identify themselves through standard protocols and architecture, using the Internet open system as their foundation (Bikash&Saugat,2021). This is because of the IPv6 (IPv6) deployments (Enao,Bhuiyan,Wang,Rahman, Wu & Atiquzzaman, 2018).

The latest assessment of how the Nigerian communications infrastructure has benefited the health care sector according to (Jochan, Asti, Atul & Neeli, 2017), shows that the key challenge is to reduce maternal mortality rate through the use of advanced technologies that would allow for real time monitoring of the Antenatal mothers. It is against this backdrop that the study on Internet of Things in the development of the health sector has become eminent because it allows the integration of all the components of Antenatal care system to become part of an ICT network with each component having an Internet Protocol (IP) address. Industrial internet makes use of sensors, software, machine-to-machine collaboration and numerous technologies to collate and analyse data from the environment (Mohammed, 2020). Another impetus that informed the study is the magnitude of economic challenges/loss which seeking medical attention abroad has caused the nation has brought the need for a research into finding a cost-effective technology, condition and performance monitoring solution. Wireless networks bring with them a reliable, constant download and upload speed unaffected by the environment. As these networks are closed off and do not travel through the air, they are not susceptible to fluctuations in speed or

interference from other wireless devices. The objective of this study is to identify and reduce maternal mortality rate to the barest level by increasing efficiency of Antenatal care through the introduction of IoT technology. To do this, the study will investigate the performance of IoT in health care system to arrive at a cost effective design and identify limitations. can result to data and information loss as they are tampered with because of the truncated data backup. Cloud computing integration becomes a crucial technology to be applied to enhance the availability of these data files (World Health Organization mHealth,2011). Annually, an estimated 52,900 Nigerian women die from pregnancy related complications out of a total of 529,000 global maternal deaths. A woman's chance of dying from pregnancy and childbirth in Nigeria is 1 in 13, compared with 1 in 35 in Ghana and 1 in 2800 in develop countries(UNICEF,2009). The increase in mortality in Nigeria is primarily due to the lag between when urgent care is needed and received due to non- reliable means of transportation, bad roads, dysfunctional emergency system, and other challenges that affect timely maternal care. This is more pronounced in rural Nigeria where access to professional health care is limited and expensive. The research intends to introduce the monitoring of antenatal mothers anywhere and anytime using low cost medical IoT devices. According to (WHO,2004), about five million Nigeria women travel abroad annually to receive antenatal care resulting to drop in GDP of the country with other economic implications usually experienced alongside. This is triggered by loss of hope in the existing medical system especial for antenatal care.

METHODOLOGY

FIGARO TGS 822 gas sensor is used to detect the amount of gas in a person's breath. When the concentration of the gas increases, the resistance of the sensor is decreased. The decrease of resistance is depending on the three factors; gas concentration, humidity and temperature. In order to get an accurate concentration of a gas in a person's breath, humidity and temperature sensor (DHT11) is added. This is due to the sensitivity of the electrochemical gas sensor towards other gasses. As the reading from sensor is sent to Arduino, the data is shared to the database via Wi-Fi module ESP8266. ESP8266 gives Wi-Fi networking with TCP/IP protocol stack which can give Wi-Fi connection to Arduino board so that the data can be processed and shared to the cloud database. The interoperability of various IoT standards that the chipset supports, and vastly reduced dataflow bandwidth, will allow for the integration of a range of future monitoring sensors outside of the initial proof of concept scope. Data collection is interfaced to web page. The new system is expected to have a low power consumption which will have a significant positive impact on the maintenance requirements of an Electronic Health system.

The design for the new system adopted the following approaches:

Phase1: Literature Survey and Acknowledgement of problem statement

At this phase, a detailed literature survey on both electronic health management system, applications of IoT especially to health management system, data mining systems and antenatal care system was conducted to enable the development of the new system.

Phase 2: Design and Implementation

This phase began with the determination of the component and system architecture leading to the establishment of a reliable and efficient system. The right sensors, applications, database and power systems are determined. Also, capacity of the system was determined together with the data analysis model.

Phase 3: Validation

The new system was ran with test data for the purpose of evaluation. There was a parallel run with the old system. Data generated from the two are analysed in parallel.

Phase 4: Result and Summary

Discussion of the experimental results was done to determine the actual outcome of the new system. A summary was presented with recommendations for further studies.

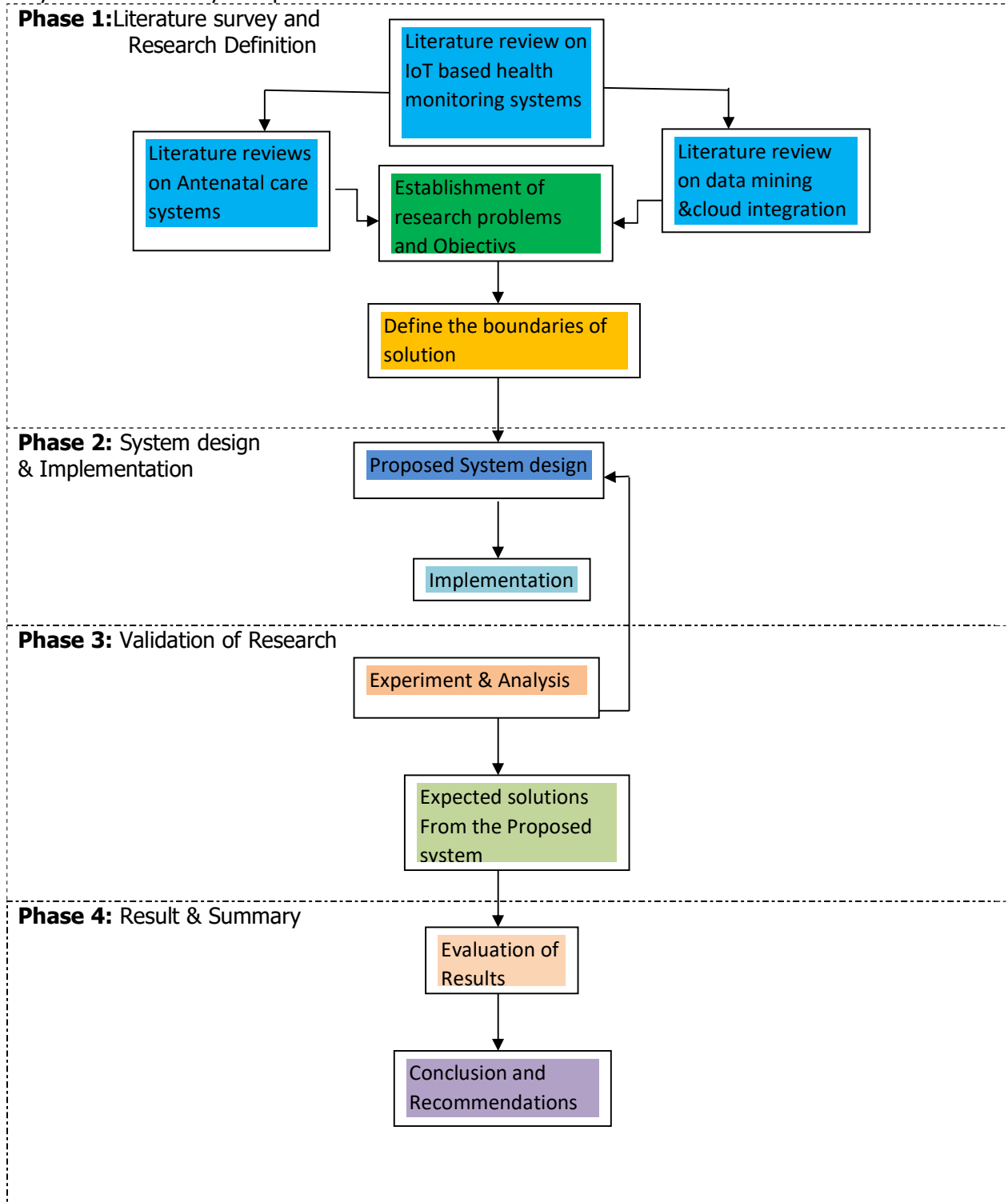


Figure 1.1: Research process of the study

Expected Outcome

The expected outcome of the research is a prototype of the new system which will be an innovative, cloud-supported technology attached to the exterior of the wearable device. An IoT based Antenatal care system in Nigeria will dramatically improve health monitoring rates, security and interconnectivity, as well as create fully integrated, reliable, secure medical care for antenatal mothers.

CONCLUSION

Based on the results, it can be concluded that the real time Antenatal care through transmission of vital signs such as blood pressure, body temperature, etc which aid medical professional to determine immediate health status of Antenatal mothers as there is a good correlation between the level of vital signs and the health status of any human being. The real-time monitoring system is expected to improve Antenatal health care with the function of Internet of Things (IoT) thereby reducing maternal mortality rate. The effectiveness of the new system will be demonstrated with accuracy of the system improved by having a better algorithm in calibrating the sensor. For future works the application of the Internet of Things can be further used by creating a mobile application for more efficient personal monitoring system. The mobile application can retrieve the data and information from the database and the professional can check their health condition in a more interactive display.

REFERENCES

- Bikash Pradhan and Saugat Bhattacharyya (2021), *IoT Based Applications in Healthcare Devices*, Journal of Health Engineering, volume 2021, ID 6632599
- Borja Ramis Ferrer, Wael M. Mohammed, Enbo Chen, Jose L. Martinez Lastra (2017), *Connecting web-Based IoT Devices to a cloud-Based manufacturing Platform*. www.ieee.org, 978-1-5386-1127/17/
- Enao Luo, Md Zakirul Alam Bhuiyan, Guojun Wang, Md Arafatur Rahman, Jie Wu and Mohammed Atiquzzaman (2018). *Privacy Protector: Privacy-Protected patient Data Collection in IoT-Based healthcare systems*, IEEE Communication Magazine
- Jochan wilden, Asti chandrakar, Atul Ashok and Neeli Prased (2017), *IoT Based Wearable Smart Insole*. www.ieee.org 978-1-5386-1098-5/17/\$31.00
- Mohammed Ismail (2020), *Self-powered IoT Soc platform for wearable Health Care*. www.src.org/program/src/ace4s
- Pavel D. Drobintsev, vsevolod P. kotlyarov, Igor G. Chernorutsky, lina P. kotlyarov, olga V. Aleksandrova (2017), *Approaching to Adaptive control of Technological manufacturing processes of IoT Metal working workshop*. www.ieee.org 978-1-5386-1810-3/17/
- Prajoona Valsalan, Tariq Ahmed Barham Baomar, Ali Huassain Omar Baabood (2020), *IoT Based Health Monitoring System*, journal of critical Review. Vol 8, issue 8, JCR.2020; 7(4):739-743
- Prashanth R. Marpu, Mukesh Jha, Alexandros Tsoupos Afshin, Peter Armstrong (2020), *Development of advanced microclimate and Urban Energy Analysis Modelling Environment and its validation by wide area sensor Network and remote sensing for future Adaptation of urban Infrastructure*. www.ieee.org

Ruhani Ab. Rahman, Nur Shima Abdul Aziz, Murizah Kassim, Mat Ikram Yusof (2019). *IoT-based Personal Health Care Monitoring Device for Diabetic Patients*, IEEE Journal 978-1-5090-4752-9/19

Saravanan, M. and Achshah Mary Marks (2019), *MEDIBOX – IoT Enabled Patient Assisting Device*. IEEE Journal 978-1-5090-4130-5/19

Shubham Puri, Tanupriya Choudhury, Nirbhay Kashyap, Praveen Kumar (2017), Specialization of IoT Applications in Health Care industries, International Conference on Big Data Analysis and Computational Intelligence (ICBDAC).

Sohail Shaikh, Dattatray Waghole, Prajakta Kumbhar, Vrushali Kotkar, Praffulkumar Awaghade JSCOE, PUNE (2019), *Patient Monitoring System using IoT*. IEEE Journal 978-1-5090-6593-6/19

Sapna Tyagi, Amit Agarwal and Piyush Maheshwari (2018). *Conference Paper*.
<https://www.researchgate.net/publication/305675463>

Sudhir, K. Routray & Sharath Anand (2017), *Narrow Band IoT for Health Care*, International Conference on information, Communication & Embedded Systems (ICICE), 978-1-5090-6135-8/17/

Srinivas, K. , Kavitha, B. and Dr. Govrdhan, A. (2010), *Applications of Data Mining Techniques in Healthcare and Prediction of Heart Attacks*|| International Journal on Computer Science and Engineering

Tommy Prayoga, Juneman Abraham(2016), *Health Capacity: the Representation of IoT in Health Domain among Jackartans*. www.ieee.org, 978-1-5090-4629-4/16/\$31.00

UNICEF(2009). *State of the World's Children 2009: Maternal and newborn health*. New York, NY: UNICEF; 2009

World Health Organization. mHealth: (2011) *New horizons for health through mobile technologies*. Geneva, Switzerland: World Health Organization,;

WHO(2004), *Beyond the numbers: reviewing maternal deaths and complications to make pregnancy safer*.
http://www.who.int/maternal_child_adolescent/documents/9241591838/en/

. Yeh K.H, "A Secure IoT-based Healthcare System with Body Sensor Networks," *IEEE Access*, vol. 4, pp. 10288-10299, 2016.

Zhuming Bi, Li Da Xu, and Chengen Wang (2018). *Internet of Things for Enterprise Systems of Modern Manufacturing*. IEEE Journal 1551-3203