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Kiosk for Maternal Health of Rural Mothers Using IoT

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ABSTRACT

Human resource is the backbone of developing and under developed nations. In most of the developing countries and in the smart cities medical system is not centralized for sharing the information. Mostly pregnant women are not able to do their regular check-ups at the early stage of pregnancy and this leads to higher mortality rate in case of infant and maternal in the rural areas. Due to these issues, the society is facing an immense health problem. In the existing method the people in the rural areas find difficult to travel over miles to have a doctor consultation if so, having a doctor consultation they are exposed to ultrasound scan and along with that some vital signs are measured, and it is processed by Bluetooth technology. In order to overcome these issues, various sensors are used to measure the vital parameters such as blood pressure, blood glucose level and heart beat rate. The aim is to develop a compact Near Field Communication (NFC) device for rural pregnant women in order to access the vital signs of maternal and foetus with low cost using recent sensors and IoT. Once the vital measures are read, the critical readings will be sent to the nearest medical centres along with the patient id. Thus, immediate treatments will be given to overcome the issues during the pregnancy.

KEYWORDS: Near Field Communication, Vital Sensors, Internet of Things, Maternal Health

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INTRODUCTION

The concept of the Internet of things became popular in 1999, through the Auto-ID Center at MIT and related market-analysis publications. Radio-frequency identification (RFID) was seen by Kevin Ashton (one of the founders of the original Auto-ID Center) as a prerequisite for the Internet of things at that point. Ashton prefers the phrase “Internet for things.”

The concept of the Internet of things became popular in 1999, through the Auto-ID Center at MIT and related market-analysis publications. Radio-frequency identification (RFID) was seen by Kevin Ashton (one of the founders of the original Auto-ID Center) as a prerequisite for the Internet of things at that point. Ashton prefers the phrase "Internet for things." If all objects and people in daily life were equipped with identifiers, computers could manage and store them. Besides using RFID, the tagging of things may be achieved through such technologies as near field communication, barcodes, QR codes and digital watermarking. In its original interpretation, one of the first consequences of implementing the Internet of things by equipping all objects in theworld with minuscule identifying devices or machine-readable identifiers would be to transform daily life. For instance, instant and ceaseless inventory control would become ubiquitous. The architecture of the IoT enabled systems is given in fig 1.

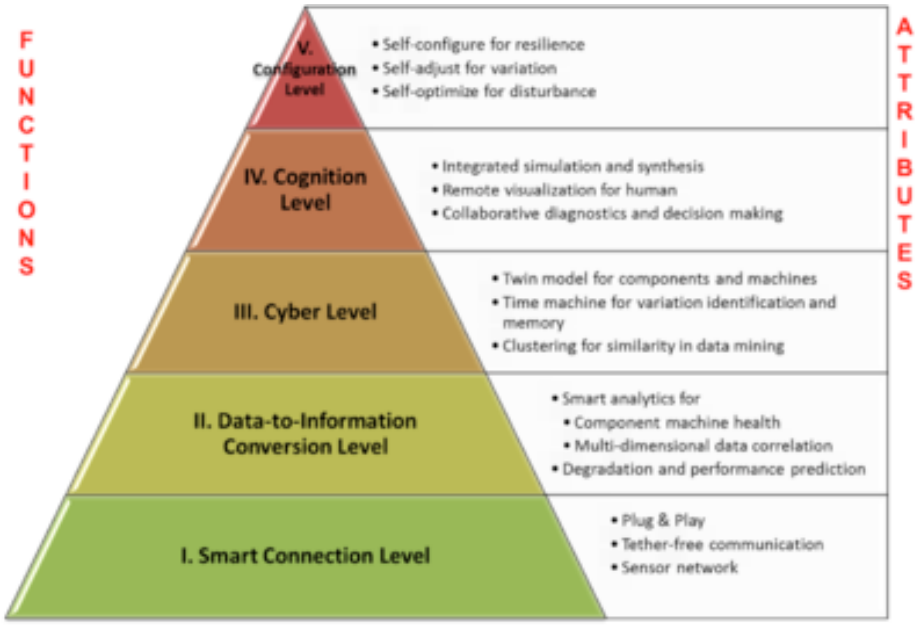


Figure 1. Design Architecture of Cyber-Physical Systems-Enabled Manufacturing System

The purpose of this paper is to summarize recent developments in the field of sensors and systems that are relevant to the field of maintaining maternal health.

LITERATURE REVIEW

This section deals about the existing systems in the field of maternal healthcare. The authors[1] developed a compact assist device for rural pregnant women in order to access the vital signs of maternal and fetus with low cost using recent sensors and IoT. This method used are accelerometer sensor, temperature sensor, heart sensor, IoT and Arduino controller. This project aimed at improving maternal health indicators in rural districts of Pakistan through health education to women and families and better training of LHW's (Ladies Health Worker).

Baseline survey comprised interviews with the ever- married women in the reproductive ages (15-49) years. Interviews were conducted by female interviewers having graduate degree. Team of three female interviewers worked under supervision of a male supervisor. Questionnaire designed included questions on 22 household characteristics, age, marital status and duration of marriage, education of eligible women and short birth history[2]. This project aimed at enhancing quality of healthcare of residents in the urban poor areas of Bangalore. Fieldwork conducted in KG Halli, a poor urban slum neighborhood in Bangalore. Data collected over a period of two years (2009-11).

Household census using a questionnaire on socio demographic interviews with healthcare providers, observational field notes, maternal health includes mapping of health facilities[3]. By taking the advantage of the sensors in smart phone, intend to acquire vital information about the health status of pregnant women. The data is processed using signal processing and analysis tools to evaluate the status of pregnant women by healthcare practitioner. It used biomedical instrumentation, signal processing, wireless transfer, heart rate sensor, Thingspeak – open source IoT platform for storing sensor data and retrieving wirelessly using http and used Naive Baye's model[4].

A low-cost portable, easy to use ultrasound system is designed specifically to enhance maternal health and to identify high risk conditions and to develop a well-equipped health care facility. It used portable ultra sound plus units, portable learning and user centered system[5]. This project aimed at IoT to use clinical care to monitor physiological status of patients through sensors by collecting and analyzing their data to evaluate, it also useful for normal people to check health status by using wearable devices with sensors.

Different types of single board computers (SBC) integrated with sensors and built in TCP/IP, Arduino, raspberry PI, Beagle Bone Black, radio-frequency identification (RFID)[6]. The project aimed to design a connected wearable healthcare device to monitor pregnant women health status and provide timely alert to family members and doctors through smart phones app over internet and can send mail. This device monitors the physical activity, sleeps quality, heart activity and the

temperature. It used optical heart rate sensor, respiration rate sensor, mems accelerometer sensor, Blynk app, Blynk cloud server, Wifi, ultrasound scan[7].

A project provided portable mobile health care system that helps in poor diagnosis at early stages of pregnancy thereby it helps in reducing fetal and maternity mortality rate. It used heartbeat sensor, temperature sensor LM35 and kick rate sensor[8]. It provided health care solution that combines web app and CC3200 techniques in a wireless sensor network to monitor the health condition of patient and provides a wide range of effective, comprehensive and convenient health care services. Various sensors like microcontroller CC3200, heartbeat sensor, temperature sensor, pressure sensor, wifi inbuilt in CC3200, power 23 supply circuit and software were embedded C[9] to propose a co-operative IoT approach for the better health monitoring and control of rural and poor human being's health parameters like blood pressure, blood sugar, hemoglobin, abnormal cellular growth in any part of the company etc.,.

Radio Frequency Identification (RFID), co-operative Communication (CWC)[10] are used to club maternal under the rural area and providing them notifications and hospital listing feature. It developed android application with two features such as notification module and support module[11]. This project presented a mobile monitoring solution using body sensors to identify the health status of pregnant women suffering hypertensive disorders. This mobile application uses Naïve Baye's classifier to identify hypertension by decision making.

The system which monitors the blood pressure disorders is used using semantic data model, Bayesian network used sensors, Naive Baye's classifier[12] to create a prototype system, the way of integrating health smart guard technology on computerized patient order entry. A desktop application[12] is used to reduce the mortality rate and provide an efficient system to record health parameters like heart beat rate, temperature, BP and movement of the fetus. The hardware model consisted of ultrasound scanning, heart beat rate sensor, BP using ECG, temperature sensor and MSDM (Mass Storage Device Model).

Mobile application module and desktop application for doctors[12] are used to provide primary maternity health care services where rural health sub centre is maintained. It used three tier client server architecture, in visiting rural sub centre for first time details like name, age, weight etc., of the patient to be submitted and it is fed to the server so that it provided further details till delivery[12]. By having the knowledge of existing studies, we have developed a system to monitor the health of rural mother using IoT enabled Kiosk.

METHODOLOGY

The aim of this work is to develop a compact Near Field Communication (NFC) device for rural pregnant women in order to access the vital signs of maternal and fetus with low cost using recent sensors and IoT. The proposed system is an IoT based kiosk which consists of hardware setup with various sensors and knowledge base. The system architecture is depicted in fig 2. The vital parameters like blood glucose, blood pressure, and heart beat rate are being considered and it is stored in the knowledge base. It is compared with the standard existing data collected from health analysts and if changes found it is been intimated to the user as well as the doctor concerned to the rural circle. If no changes found it is advised to take the regular diet and take the check up on regular intervals.

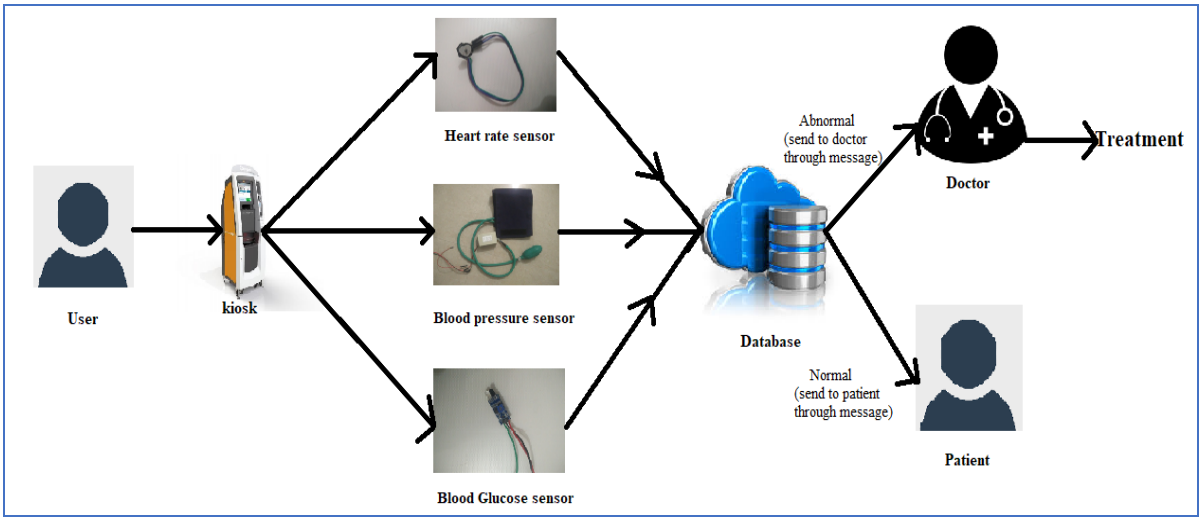


Figure 2. System Architecture

Proposed work mainly takes care of the pregnant women in the rural areas to help and reduce maternal mortality. The devices used in the hospitals are non-portable, sophisticated and expensive. The proposed work develops a compact Near Field Communication (NFC) device for the rural pregnant in order to access the vital signs such as weight, temperature, blood pressure, blood glucose and heart rate of the foetus. Medical care of pregnant women involves a lot of attention, proper and timely diagnosis, medication patients should undergo and of course all this cost a lot of money. People in rural areas rarely do proper check-ups during pregnancy. The proposed system attempts to give quality and timely medical care at very less expense.

RESULTS AND DISCUSSION

Heart Rate Sensor

The heart rate measure kit can be used to monitor heart rate of maternal. The result can be displayed on a screen via the serial port. It is designed to give digital output of heart beat when a

finger is placed on it. The entire system is a high sensitivity, low power consumption and portable. A sample heart rate reading is depicted in fig 3.

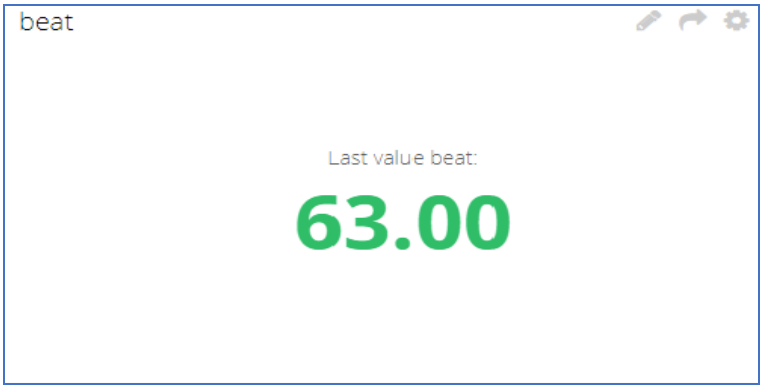


Figure 3. Heart Rate Result Value

When the heart rate sensor is working the beat LED flashes in unison with each heartbeat. This output can be connected to microcontroller directly to measure the beats per minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse. This sensor is used in this approach to check the pulse rate of the maternal. By means of using the heart rate sensors in our project, the information from the sensor is gathered and stored in the knowledge base for the various future check-ups for the patient. This sensor helps in monitoring the pulse rate of the pregnant women.

Blood Pressure Sensor

Blood pressure is a major concern for any human being. The blood pressure sensor used consists the same as of the medical kit where the sensor is connected to pump and air bag. Oscillatory devices produce a digital readout and work on the principle that blood flowing through an artery between systolic and diastolic pressures causes vibrations in the arterial wall which can be detected and transduced into electrical signals. With an oscillatory device, a cuff is inflated over the upper arm or wrist.

The new models use “fuzzy logic” to decide how much the cuff should be inflated to reach a pressure about 20 mm Hg above systolic pressure for any individual. When the cuff is fully inflated to this pressure, no blood flow occurs through the artery. As the cuff is deflated below the systolic pressure, the reducing pressure exerted on the artery allows blood to flow through it and sets up a detectable vibration in the arterial wall. When the cuff pressure falls below the patient's diastolic pressure, blood flows smoothly through the artery in the usual pulses, without any vibration being set up in the wall. Vibrations occur at any point where the cuff pressure is sufficiently high that the blood must push the arterial wall open in order to flow through the artery. The vibrations are transferred from the arterial wall, through the air inside the cuff, into a transducer in the monitor that

converts the measurements into electrical signals. A sample blood pressure sensor reading is depicted in fig 4.

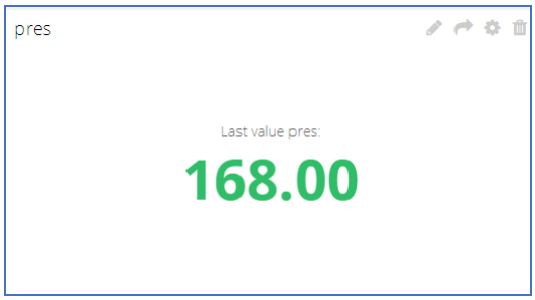


Figure 4. Blood pressure result value

Blood Glucose Sensor

The blood glucose sensor used measures the human blood non-invasively using the painless near infrared based optical technique. The designed system consists of LED emitting signals of 940nm wavelength. These optical signals are sent through the fingertip and reflected signals are detected by phototransistor placed beside the LED. The glucose concentration in the blood is determined by analyzing the variation in the intensity of received signal obtained after reflection. Continuous monitoring allows examination of how the blood glucose level reacts to insulin, exercise, food, and other factors. The additional data can be useful for setting correct insulin dosing ratios for food intake and correction of hyperglycemia. A sample blood glucose level is depicted in fig 5.

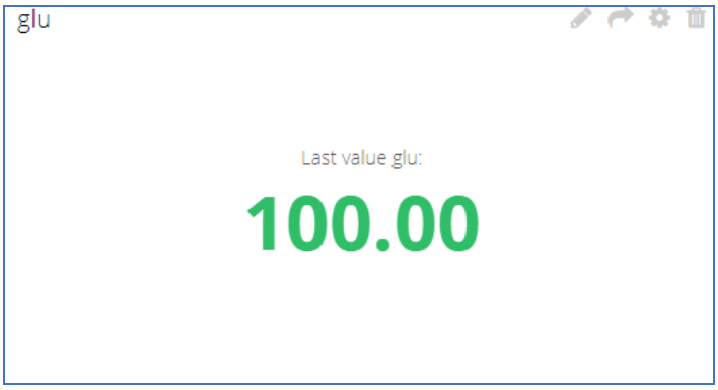
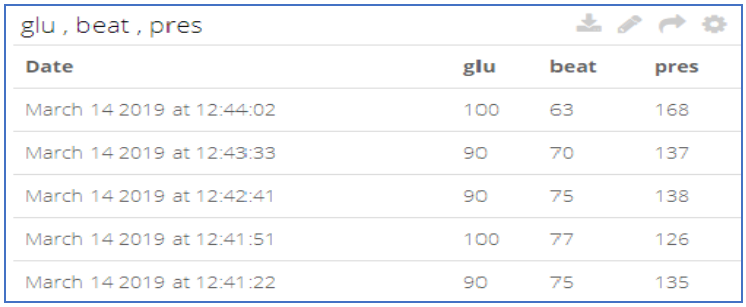


Figure 5. Blood Glucose Value

The sample vital measures read through sensors are stored in a mobile application. The sample screen reading of the viral measures are given fig 6.


glu , beat , pres

Date	glu	beat	pres
March 14 2019 at 12:44:02	100	63	168
March 14 2019 at 12:43:33	90	70	137
March 14 2019 at 12:42:41	90	75	138
March 14 2019 at 12:41:51	100	77	126
March 14 2019 at 12:41:22	90	75	135

Fig.6: Demo Patient Vital Measures

The information stored in the application can be shared with the local government hospital if the readings are significant threat to the rural mothers. The remedies will be taken care and necessary treatments will be given by the doctors based on these values. Thus, immediate attention will be given to the rural mothers.

CONCLUSION

Most studies of maternal mortality are hospital based. However, in developing and under developed countries, where many such deaths take place in the home, hospital statistics do not reflect the true extent of maternal mortality. highly sensitive even for small movements, thus preferred a home monitoring device. Regular monitoring the vital parameters of fetus and women in the rural area, the infant mortality gets reduced. IOT provides quality and timely health assistance for both fetus and women. Our system tries to provide quality and timely health assistance for pregnant women. Most studies of maternal mortality are hospital based.

However, in developing and under developed countries, where many such deaths take place in the home, hospital statistics do not reflect the true extent of maternal mortality. Furthermore, the socioeconomic and demographic factors and health behaviour affecting maternal mortality are rarely known. The complications of pregnancies and the births are found to be the leading causes of deaths and disability among women of reproductive age. Poor infrastructure and ineffective public health services are also responsible for low inadequate obstetric care.

Our system tries to provide quality and timely health assistance for pregnant women of both under developed and developing nations. It helps to get details about health condition of pregnant women in rural areas thus providing portable mobile health care system that helps in proper diagnosis at early stages of pregnancy thereby it helps in reducing fetal and maternity mortality rate.

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