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An Iot Based Kiosk for Maternal Health of Rural Mothers

Shanthi Selvaraj, K. Abarna, KP. Deepak Raj, N. Janapritha and T. Kalaikuamaran
Department of Computer Science and Engineering, SNS College of Technology, Coimbatore, India

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Corresponding Author:
Shanthi Selvaraj
Department of Computer Science and Engineering, SNS College of Technology, Coimbatore, India

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Abstract: Human resources 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 is 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 is measured and it is processed by Bluetooth technology. In order to overcome these issue, 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.

INTRODUCTION

The Internet of Things (IoT) is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators and connectivity which enables these objects to connect and exchange data.

History: The concept of the internet of things became popular in 1999, through the centre 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 Centre) as a prerequisite for the internet of things at that point. Ashton prefers the phrase “Internet for things”. The model includes the notion of the ternary universe consists of the physical world, virtual world and mental world and a multi-level reference architecture with the nature and devices at the bottom level followed by the level of the internet, sensor network and mobile network and intelligent human-machine communities at the top level which supports geographically dispersed users to cooperatively accomplish tasks and solve problems by using the network to actively promote the flow of material, energy, techniques, information, knowledge and services in this environment (Amala and Mythili, 2007; Midhet, 2007; Thriveni *et al*., 2012; Endo *et al*., 2017; Brunette *et al*., 2011 and Sumathi *et al*., 2017).

Objective and scope of project

Problem definition: The main objective of this system 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 internet of things for personalized care. Now a days almost all maternal deaths (99%) occur in developing countries. Everyday 830 women die due to pregnancy. In the majority of the developing countries and in the smart cities medical systems are not centralized for sharing of information. Most part of the pregnant

ladies may not be able to do their customary check-ups at the beginning time of pregnancy and these prompts higher death rate in case of infant and maternal in the rural areas.

Every day approximately 830 women die from pregnancy and childbirth. It was estimated roughly that 303, 000 women died during pregnancy and childbirth. Almost all of these deaths occurred in low-resource settings and most could have been prevented. Almost all maternal deaths (99%) occur in developing countries. Women die as a result of complications throughout pregnancy and childbirth. Most of those complications develop throughout pregnancy and it is treatable. Different complications could exist before pregnancy but they are worsened throughout pregnancy, particularly if not managed as part of the woman's care.

Therefore, necessary efforts should start right from providing timely and quality health assistance to pregnant ladies which will lead to the birth of healthy children. For instances, pregnant women should perform ultrasound scan at least two times during pregnancy period to know about the fetal growth. Moreover, proper and timely check-ups will ensure safe delivery. Women in the rural areas lack knowledge about importance of proper medication. Lack of knowledge leads to high mortality among the women living in the rural areas. Also, they suffer from various health issues such as anaemia, weakness and vomiting. ultrasound scanning method is mainly to check the growth of the baby in mother's womb.

Since, the ultrasound scanning method very expensive and there are objections for its long-term usage. The side effects of long-term ultrasonic exposure on the fetal are not completely clear and it is the reason that this method is not recommended for long hours monitoring. Hence, we use latest sensors which will not harm both the fetus and the maternal.

Overview of the project: The system demonstrates a scenario where information from the sensors is transmitted from the device to the knowledge base where the data have been stored for the further clarification by the specialist. In this methodology the heart rate sensor, blood glucose and blood pressure sensor are controlled by using an Arduino controller. The data from the sensors are being analyzed by this controller and the results are being simulated. The Arduino is a microcontroller board based on the ATmega328. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz crystal oscillator, a USB, a power jack an ICSP header and a reset button. Since, the value sensed from the sensor is in analog form, it can be directly connected to the analog input pin. ADC in this Arduino microcontroller will convert to digital signal before any further process can be done. The Arduino will process the signal and the output will be in digital signal voltage form. By means of using this approach with various sensors and also in order to reduce the complications for rural pregnant mother, a compact assistive device is designed and the vital parameters such as the temperature, pressure for women and heart rate of the foetus is measured by using different sensors.

The device is lightweight and highly sensitive even for small movements, thus, preferred as a home monitoring device. Regular monitoring of the vital parameters of foetus and women in the rural areas, reduces the infant mortality. The measured parameters are transferred through the IoT. It provides quality and timely health assistance for both foetus and women (Sumathi *et al*., 2017; Santhi *et al*., 2017; Husain and Hassan, 2016; Moreira *et al*., 2016; Long and Chang, 2009; Megalingam *et al*., 2013 and Mukherjee *et al*., 2012).

Existing system: The existing system is the direct approach to a doctor to check their maternal health during their maternity. It also consists of wearable Android technologies composed of microcontrollers to track the information of maternal women. A maternal women usually gets antenatal check-up at first level care and delivers at maternity home or in a hospital at tertiary level.

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 is 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.

Antenatal care is the systemic supervision of women during pregnancy to monitor the progress of fetal growth and to ascertain the well-being of the mother and the fetus. A proper antenatal check-up provides necessary care to the mother and helps identify any complications of pregnancy such as anaemia, pre-eclampsia and hypertension, etc., in the mother and slow/inadequate growth of the fetus. Antenatal care allows for the timely management of complications through referral to an appropriate facility for further treatment. It also provides opportunity to prepare a birth plan and identify the facility for delivery and referral in case of complications. Every pregnant woman need to have at least four antenatal check-ups. It should be emphasized that this is only a minimum requirement and that more visits may be necessary, depending on the woman's condition and needs. The suggested schedule for antenatal visits is as follows.

Timing of the first visit/registration: The first visit or registration of a pregnant woman for ANC should take place as soon as the pregnancy is suspected. Every woman in the reproductive age group should be encouraged to visit her health provider if she believes she is pregnant.

Antenatal care (care during pregnancy): This can be provided by a midwife, doctor or obstetrician. Regular appointments are important to monitor your pregnancy and the wellbeing of both you and your baby. This will include asking you about your health, checking your blood pressure and monitoring your baby's growth.

Domiciliary care (care received at home): Midwives may also visit you and your baby at home. Public patients may be eligible for one or two visits after they leave hospital. Private patients should check with their maternity hospital and their health fund for service eligibility and coverage. Your local maternal and child health nurse will be informed that you have arrived home and will come to visit you. Usually your doctor will also be advised that your baby has been born. Both these professionals are likely to be involved in offering you and your baby continuing care and support. Some rural hospitals do not offer antenatal or birth care. In such cases, we would go to a larger hospital to give birth, then receive postnatal and home visits from local services.

MATERIALS AND METHODS

Proposed system: 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 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 vital parameters like blood glucose, blood pressure and heart beat rate are being taken into account 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. 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 fetus. 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

Module description

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 (Fig. 1).

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 (Fig. 2).

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 has to 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.

Fig. 1: Heart rate sensor

Fig. 2: Blood pressure sensor

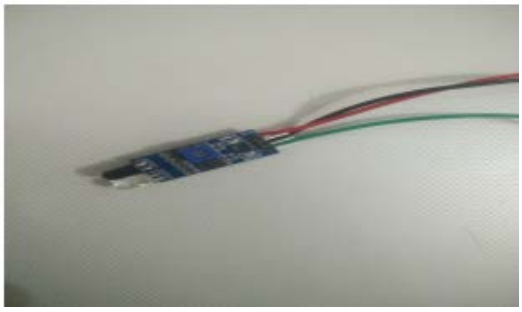

Fig. 3: Blood glucose sensor

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 940 nm 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 (Fig. 3).

System requirements

Hardware specification: The hardware used in the project comprises of various sensors used to detect the blood pressure, blood glucose and heart rate of the fetus.

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.

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Software specification: The Arduino language is merely a set of C/C++ functions that can be called from our code. We can run java SE Embedded or Java ME on a Raspberry Pi but the Arduino is a bit too constrained to run Java directly. However, with the help of serial port communication software, we can communicate with and control an Arduino from Java running on another computer.

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.

RECOMMENDATIONS

The modules which are developed are to be implemented into a large scale which becomes highly beneficial to the society particularly the women in the rural areas. In future, we also plan to continue our efforts to make our system easier to use by expanding the help system that can produce higher quality results at a low price point.

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