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Portable IoT based maternal health - fetal monitoring system using raspberry PI

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Abstract

The recent advancement in the IoT technology has enabled the medical devices to make real-time analysis that was not possible for doctors a few years ago. IoT healthcare devices, wearable technology and data access allows physicians to monitor patients with greater precision and provide better-informed treatment. Implementing portable IoT based maternal health and fetal monitoring in a convenient way at home. The pandemic conditions affecting everyday life may have a long-term influence on impaired fetal development and maternal health. This should be addressed in prenatal care. This paper talks about the work associated to appropriate determination of the sensor and programming which gives accurate motion and the size of the fetus. Ultrasound sensor will help pregnant women to measure the size of the fetus, movement of the fetus and to know the fetal heart rate. With the help of this newly developed equipment pregnant women can manage the prenatal care easily. For maternal health management the equipment provides vital sensors to the maternal's body temperature, heart rate and breathing rate. Weekly checkups can be done using this probe and the data will be intimated to the concerned gynecologist. By using raspberry Pi, the common working features of the tools will enhance the pace of the output. The predicted conclusion is an ultrasound sensor programmed with raspberry Pi which will determine the working characteristic of fetus and the maternal health, which can be referred to as Pregnancy health monitoring.

Keywords: Maternal health; Fetal monitoring; Raspberry Pi; Internet of Things (IoT); Biomedical sensors; Remote healthcare

1. Introduction

In India Human resources are greater in rural areas when compared to cities. Due to the unavailability of the hospitals in rural areas the humans are not concerned/aware about their health. The pregnant women even for their routine checkups have to journey longer distance each and every time. Due to this, many may ignore their early stage of pregnancy checkups. The routine checkups for pregnant women might also assist in lowering fetal mortality rate and it can also avoid the birth of handicapped children by early diagnosis. All over the world, about 800 ladies are dying each and every day due to preventable causes during pregnancy. Maternal mortality is growing day by day in female in rural areas, and where, pregnant female might also lack appropriate means to manage their physical and emotional well-being. Stress may also lead to adverse outcomes in health like pre-term delivery or low weight delivery at some stage in the pregnancy period. The rural neighborhood humans are not conscious of proper medicines but and they must be taught about technological development in the medical field.

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

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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. The major complications that account for nearly 75% of all maternal deaths are due to severe bleeding, infections, complications from delivery etc. Other factors that prevent women from receiving or seeking care during pregnancy and childbirth are Poverty, distance, lack of information, inadequate services, cultural practices. 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 checkups will ensure safe delivery. Women in the rural areas lack knowledge about importance of proper medication. Though India has made an appreciable progress in improving the overall health status of its population but it is far from satisfaction. Awareness and access to a health care center, equipped with modern maternity facilities has a significant positive impact on the health seeking behavior and pregnancy outcome of rural women. Lack of knowledge leads to high mortality among the women living in the rural areas. Also, they suffer from various health issues such as anemia, weakness and vomiting. Ultrasound scanning method is mainly to check the growth of the baby in mother's womb. By using this ultrasound scanning method we can detect many problems such as development anomalies, chances for miscarriage, confirming a pregnancy, multiple pregnancies etc. 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.

IoT-based systems can provide cost-efficient health monitoring services for pregnant women in everyday settings. Recent studies show that such remote health monitoring systems can improve health outcomes for both mother and baby during pregnancy and the postpartum.

Many attempts have thus far been conducted to provide remote health monitoring for pregnant women. Several studies leverage subjective methods, where mothers are inquired about their health and well-being.These methods are mostly restricted to scheduled phone-interviews and Internet-based questionnaires, which might be inaccurate. In other studies, various parameters such as blood pressure and weight are periodically collected from pregnant women at home. These works are also bounded to limited data collection. In addition, mobile applications and wearable electronics are utilized to continuously collect health parameters during and after pregnancy, targeting specific pregnancy-related issues such as sleep disturbances, physical activity and hypertension

2. Methodology

The decision of sensor performs a fundamental function in cautiously designin the fetal monitoring machine to get the correct measurement of the fetal and the distance of the fetal from the mom skin. Using the preceding technique, the motion of the fetal and the measurement cannot be precisely measured. To stop these errors, the authors have cautioned to use suitable sensor in the laptop for getting correct output. In this lookup paper, the authors recommend to use ultrasound sensor and proximity sensor to get the correct dimension and distance of the fetus from mother. The above advised sensor has excessive frequency, excessive sensitivity and excessive penetrating power, consequently it can without difficulty become aware of the inside fetal motion.

In the hardware setup distinct kinds of sensors have been used to measure the vital parameters such as temperature, coronary heart rate, blood pressure for the maternal and the motion of the fetus. Sensors are connected in the gadget hence it helps to take studying and it is displayed. IoT is increasingly allowing combining units successful of connecting to the Internet and supply records on the nation of health of patients and data in real time to docs who assist it. The following sensors are used.

2.1. Block diagram

Figure 1 shows the block diagram for the temperature sensor, heart rate sensor, and blood pressure sensor are managed by using the usage of a micro controller. The facts from the sensors are being analyzed by using this controller and the effects are being simulated. IoT/ refers to the inter-networking of physical devices. IoT will switch information over a Apart from requiring human-to-human or human-to-computer contact, a network. IoT used in this technology will be capable to switch the information for long distance.

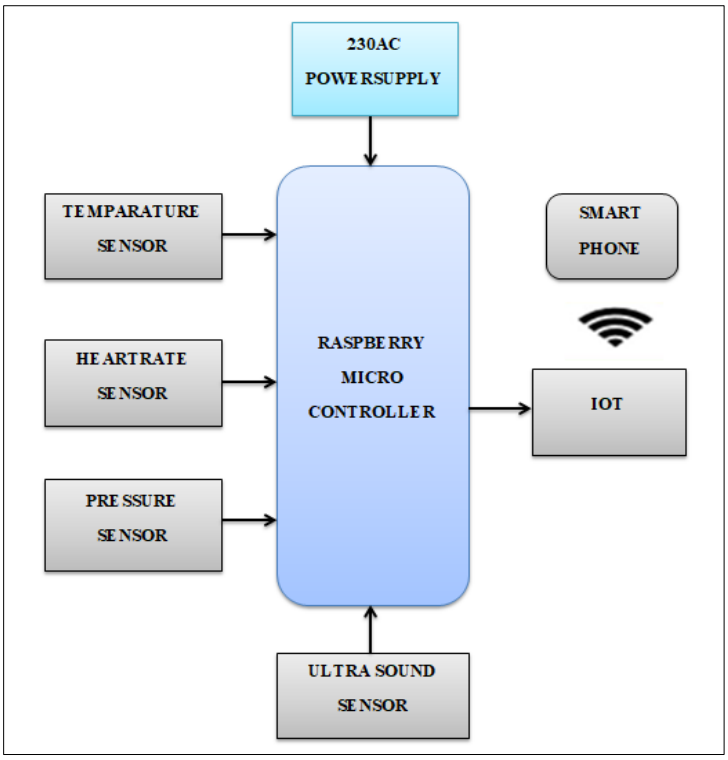

Figure 1 Block diagram

3. Hardware setup

The hardware set up is designed and the vital parameters such as the heat rate, temperature and pressure is measured using different sensor in addition the ultrasound sensor is placed to determine the distance of the fetus. The parameters are measured and the results obtained from the different sensor are transferred to the mobile phone through IoT.

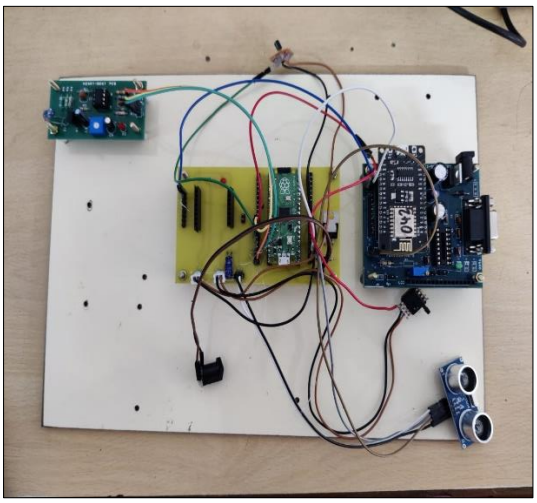

Figure 2 Hardware setup

Figure 2 shows the hardware set up of IoT based maternal health and fetal monitoring system using raspberry pi. It is designed to give a digital output of heartbeat of the maternal when a finger is placed on it. The temperature of the maternal can also be measured by placing the finger on temperature sensor. By exhaling of air through a tube in a silicon pressure sensor, pressure of the maternal can be measured.

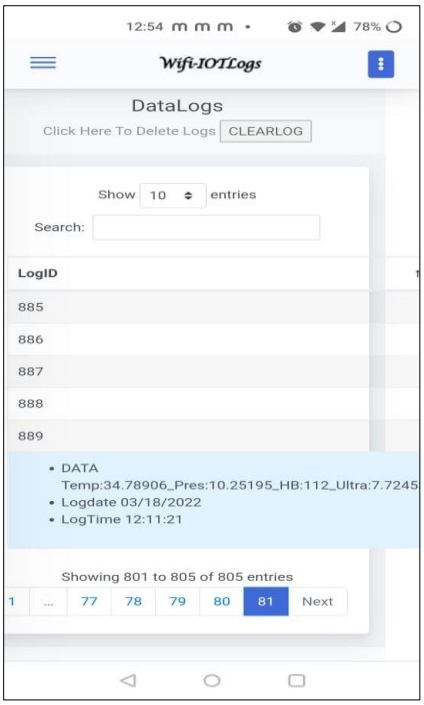

Figure 3 Displayed output of IoT, for the parameter measured

Figure 3 shows the displayed output or result for the measured parameter obtained from different sensors like heart rate, temperature and pressure and along with ultrasound sensor using IoT based monitoring system using raspberry pi.

4. Conclusion

In conclusion, the measured parameters can be transferred through IoT by connecting WiFi and viewed via mobile application. The result will indicate along with date and time. By using this approach, the pregnant women will be able to do their regular checkups on the daily basis.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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