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Smart Gestation and Foetal Strength Monitor

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Abstract— In developing countries, most people live in rural areas, and medical systems are not easy to access. The pregnant women do not easily do their normal checkups at the start of pregnancy time and this causes a higher death count in the case of newborns and mothers in rural areas as well as in urban. Due to this kind of situation, women are facing a vast medical issue. An accelerometer measures the count of kicks/force by the foetus. The dynamic movements of the developing fetus, along with crucial physiological parameters including blood pressure, heart rate, fetal kick count, and maternal body temperature, are meticulously monitored through an array of specialized sensor technologies. The measured parameters are transmitted by way of the Internet of Things and it is displayed in the respective system.

Keywords: - Temperature sensor, Heart rate sensor, Accelerometer sensor, blood pressure sensor, Internet of things.

I. INTRODUCTION

Pregnancy denotes the remarkable journey during which a fetus gestates within the maternal womb or uterus, typically spanning approximately 40 weeks, equivalent to just over nine months, calculated from the last menstrual period until childbirth. Healthcare practitioners divide pregnancy into three distinct trimesters, each characterized by pivotal milestones.

The First trimester, spanning from Week 1 to Week 12, initiates with conception, marked by the fusion of a sperm cell with an egg, leading to the formation of a fertilized egg, termed a zygote. This zygote embarks on a journey through the fallopian tube, eventually implanting itself into the uterine wall. Comprising a cluster of cells, the zygote subsequently develops into both the fetus and the placenta, a vital organ facilitating maternal-fetal exchange by providing essential nutrients and oxygen to support fetal growth and development.

Entering the second trimester, spanning from Week 13 to Week 28, marks a period of significant developmental milestones and emerging awareness. Around 18 to 20 weeks, an ultrasound examination becomes a pivotal tool for identifying potential birth defects, often coinciding with the exciting revelation of the baby's gender. By 20 weeks, maternal sensation of fetal movements may commence, offering a tangible connection to the growing life within. By 24 weeks, the fetus exhibits remarkable progress, with the formation of distinctive footprints and fingerprints, coupled with regular sleep-wake cycles. Research from the NICHD Neonatal Research Network underscores the evolving viability of babies born at 28 weeks, albeit with heightened susceptibility to respiratory and neurological challenges.

Transitioning into the third trimester, spanning from Week 29 to Week 40, brings further developmental refinement and critical considerations for optimal outcomes. By 32 weeks, although the fetal bones are soft yet nearly complete, the ability to open and close the eyes manifests, indicative of advancing sensory development. The classification of preterm birth, occurring before 37 weeks, underscores heightened risks for developmental, visual, auditory, and neurological complications. Further nuances emerge with the delineation of "late preterm" infants born between 34 and 36 weeks, alongside the redefinition of "early term" births encompassing the 37th and 38th weeks, now acknowledged for elevated health vulnerabilities. Emphasizing the significance of timing, infants delivered at 39 to 40 weeks are deemed full term, correlating with improved health outcomes attributed to optimal maturation of vital organs such as the lungs, brain, and liver. Hence, absent medical imperatives, favoring delivery at or beyond 39 weeks fosters the best prospects for infant well-being. Infants born between 41 weeks and 41 weeks and 6 days gestation are typically referred to as late term. However, once a pregnancy extends beyond 42 weeks, infants are considered post term. This distinction is important as it helps healthcare providers monitor the progress of the pregnancy and assess the potential risks associated with prolonged gestation.

Limited resources, including medical personnel and equipment, exacerbate the problem. Pregnant women, in particular, face difficulties in receiving adequate prenatal care due to the scarcity of healthcare providers and the long distances they must travel to access medical facilities. As a result, critical health parameters such as fetal movement, maternal vital signs, and prenatal complications often go undetected until they reach advanced stages, leading to adverse outcomes for both mother and child.

II. RELEVANT STUDIES

Amala et.al, (2018) proposed a method based on IoT health care monitoring system for rural pregnant women. 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 is not centralized for sharing of information. Most part of the pregnant ladies may not be able to do their customary checkups at the beginning time of pregnancy and this prompts higher death rate in case of infant and maternal in the rural areas. Due to these issues, the society is facing an immense medical issue. In the existing strategy ultrasound sweep of the pregnant ladies is performed and along with that some fundamental signs are estimated and it is handled by Bluetooth innovation. The disadvantage of the existing framework is that the ultrasound scan is costly and the Bluetooth innovation. In order to overcome this, in the proposed work Accelerometer sensor is made wireless and it is mainly used to measure the movement of the fetus and some vital parameters such as the temperature, heart rate and blood pressure for the women are measured by using different sensors. The measured parameters are transferred through IoT and it is viewed in the mobile phone. The proposed work concerns in developing 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 internet of things for personalized care [1].

R. Ettiyan et.al, (2020) proposed IoT guarantees safe and effective treatment for pregnant women because it fully removes the risks of pregnancy and adverse events by transferring vital parameters data to the respective doctor or caretaker [2].

R. K. Megalingam et.al, (2013) proposed healthcare system mainly takes care of pregnant women of rural areas who are in desperate need of help and assistance to reduce maternal and neonatal mortality rates and other complications during pregnancy. This system takes into account, some of the vital parameters of pregnant women like temperature, pressure, heart rate and ECG. To accurately predict complications of pregnant women, it must take into account more and detailed health details and past health records of the patient. Our mobile application is an assistive system aimed at helping the health care worker to know the critical condition of the patient. We were able to collect the normal and critical ranges of the parameters in our proposed system i.e. the test data and also some of the abnormalities that can be predicted from these collected data. Medical care of pregnant women involves a lot of attention, proper and timely diagnosis, medication patients should undergo and of course all this costs a lot of money. People in rural areas rarely do proper checkups during pregnancy. The proposed system attempts to give quality and timely medical care at very less expense [3].

A. Ahmed (2018) et.al, proposed a WBAN model is a remote health patient monitoring or health insurance system that is available for remote human health physiological parameter monitoring like human body temperature, pressure, and pulse rate/heartbeat. This module consists of different wireless body sensors which implemented for the physiological patient parameter monitoring like SEN 11574 pulse/heartbeat sensor and DHT11 temperature sensors are used in this work. This unit helps in the transmission of physiological parameters acquired from patient body area network to the cloud database. An android mobile web application is designed as a graphical user interface (GUI) for patients and medical dashboard for any related physiological parameters acquired from the wearable health device. The software programming was designed using Eclipse Kepler IDE integrated with the Android SDK. Also, a dedicated online database where patients' data are stored for future diagnosis is developed as an interface for patient's physiological parameters [4].

Alim et.al, (2023) presents a systematic review of these analyses oriented to (1) sensors and method of data acquisition; (2) processing methods of the acquired data; and (3) detection of the activities or movements of the fetus or the mother. Based on these findings, we discuss how sensors can help effectively monitor maternal and fetal health during pregnancy. We have observed that most of the wearable sensors were used in a controlled environment. These sensors need more testing in free-living conditions and to be employed for continuous monitoring before being recommended for mass implementation [5].

Ryu D. et.al, (2021) present introduce an innovative monitoring platform that capitalizes on advanced flexible electronics, seamless wireless connectivity, and broad compatibility with a myriad of cost-effective mobile devices. This cutting-edge system integrates three flexible, soft, and inconspicuous sensors, providing comprehensive monitoring of vital signs for expectant mothers and fetuses alike. Notably, these sensors enable synchronized operation, delivering a host of advanced parameters including continuous cuffless blood pressure monitoring, electro hysterography-based uterine monitoring, and automated classification of body position.The effectiveness of this integrated platform was validated through a series of successful field trials involving pregnant women at various stages of gestation, ranging from 25 to 41 weeks. Spanning both high-resource settings with 91 participants and low-resource settings with 485 participants, these trials underscored the system's exceptional performance, ease of use, and safety. This promising outcome highlights the potential of the platform as a valuable tool for enhancing maternal and fetal health monitoring across diverse healthcare environments. [6].

Introducing a novel framework for recognizing and monitoring physical activity during maternity, we address the critical need for continuous feedback regarding the intensity of these activities, given their potential to either promote or hinder maternal health at different stages of pregnancy. However, ensuring consistent monitoring throughout the entirety of maternity poses a significant challenge. Moreover, maintaining detailed records of each activity and its duration adds further complexity to the task.Our solution circumvents these challenges by leveraging wearable sensors strategically placed on various parts of the body, thus obviating the need for cumbersome smartphone integration, particularly during activities such as eating. Within our proposed framework, a wearable module equipped with a 3-axis accelerometer, 3-axis gyroscope, and temperature sensor captures time-series data, which is subsequently transmitted to a Raspberry Pi via Bluetooth Low Energy (BLE). This data undergoes analysis to derive various statistical features, forming feature vectors that serve as input for a supervised machine learning algorithm, specifically a classifier, tasked with identifying the type of physical activity. Upon successful recognition, the framework triggers a notification to the designated caregiver in the event of an adverse situation. We conducted extensive evaluations, experimenting with multiple well-established classifiers and varying window sizes for time-series data segmentation, using a unique dataset comprising 10 distinct physical activities performed by 61 subjects across different maternity stages.Our findings revealed a remarkable recognition rate of 89% on this dataset, underscoring the promising potential of our monitoring and feedback system. This achievement signifies a significant step toward developing a robust and reliable solution for monitoring physical activity during maternity, ultimately enhancing maternal well-being and ensuring timely intervention when necessary. [7].

Penders J. et.al, (2015) introduced a pioneering, portable, and non-invasive prototype based on electric potential sensing technology, tailored for monitoring both maternal and fetal heart activity throughout pregnancy. Demonstrating the efficacy of their technology, the study showcased its suitability for monitoring fetal heart development from the twentieth week onwards, a critical stage when the fetal heart is approximately one-tenth the size of an adult heart. Over a ten-week period, the study elucidated how fetal maturation influences changes in heart rate dynamics leading up to birth.A key advantage of their prototype is its ability to present electrocardiogram (ECG) information without requiring post-processing, eliminating the need for signal conditioning algorithms to distinguish maternal and fetal cardiac waveforms. The provided ECG trace enables the extraction of vital parameters such as heart rate, facilitating further diagnostic analysis. Notably, the device circumvents the need for conductive gels, thereby mitigating potential artifacts induced by movement. The prototype, comprising four dry electrodes, incorporates an electrometer in its circuit design, employing electronic feedback techniques to enhance input impedance and ensure stability. The sensor's voltage output undergoes analog filtering (0.5–100 Hz) and amplification before being fed into a National Instruments data acquisition system (DAQ NI USB 6008 card). Data acquisition, display, and storage are managed using a custom-designed graphical interface developed with LabVIEW software, which includes an algorithm for peak detection to determine heart rate values. This innovative technology holds promise for detecting potential heart-related congenital disorders during pregnancy, offering a reliable and convenient means of monitoring maternal and fetal cardiac activity without the need for invasive procedures or cumbersome signal processing techniques. [8].

Prance R. J. et.al, (2018) developed a portable and non-invasive, prototype based on electric potential sensing technology to monitor both: the mother and fetal heart activity during pregnancy. In this proof of principle demonstration, we show the suitability of our technology to monitor the fetal heart development starting at week twenty, when the fetus heart is approximately one-tenth the size of an adult's heart. The study was conducted for ten weeks to demonstrate how the maturation of the fetus leads to a change on the heart rate dynamics as it approaches birth. Importantly, electrocardiogram information is presented without any post processing given that our device eliminates the requirement of signal conditioning algorithms such as having to un-mix both, the maternal and fetal cardiac waveforms. The provided ECG trace allows extracting the heart rate and other heart activity parameters useful for further diagnostics. Finally, our device does not require any gels to be applied so movement induced potential is eliminated. This technology has the potential to be used for determining possible heart related congenital disorders during pregnancy. The prototype was designed using four dry electrodes. The circuit design incorporates an electrometer and utilizes the electronic feedback techniques in order to increase the input impedance and maintain stability. The voltage output from the sensor is fed to an analogue filtering (0.5–100 Hz) and amplification stage. This customized version of the sensor has been used for recording maternal and fetal ECG signals reported in this work. The analogue output is fed to a commercial National Instruments data acquisition system (i.e., DAQ NI USB 6008 card). The data was acquired on a laptop computer. Display and storage of the data is controlled using a custom designed graphical interface based on LabVIEW software including an algorithm for peak detection to determine HR values [9].

Gu A. et.al, (2022) proposes a portable ECG monitoring system to record the abdominal ECG (AECG) of the pregnant woman, comprising both maternal ECG (MECG) and fetal ECG (FECG), which could be applied to fetal heart rate (FHR) monitoring at the home setting. The ECG monitoring system is based on data acquisition circuits, data transmission module, and signal analysis platform, which consists of low input-referred noise, high input impedance, and high resolution. The combination of the adaptive dual threshold (ADT) and the independent component analysis (ICA) algorithm is employed to extract the FECG from the AECG signals. To validate the performance of the proposed system, AECG is recorded and analyzed of pregnant women in three different postures (supine, seated, and standing). The result shows that the proposed system can record the AECG in different postures with good signal quality and high accuracy in fetal ECG and heart rate information. Sensitivity (Se), positive predictive accuracy (PPV), accuracy (ACC), and their harmonic mean (F1) are utilized as the metrics to evaluate the performance of the fetal QRS (fQRS) complexes extraction. The average Se, PPV, ACC, and F1 score are 99.62%, 97.90%, 97.40%, and 98.66% for the fQRS complexes extraction, respectively. This paper shows the proposed system has a promising application in fetal health monitoring [10].

Kosma E. L. et.al, (2022) introduced a preliminary implementation of a system monitoring the fetus heart rate (FHR) has been designed and implemented as a mobile wearable measuring system with remote sensing. The proposed implementation turns out to be an efficient combination of simplicity and cost effectiveness and is accompanied with preliminary accurate measurements of the FHR. The proposed system uses a transceiver module and is capable of efficient data transmission to a remote server station using a IEEE 802.11 b/g/n based wireless network. The patients' data can further be monitored using a smart or satellite phone, or even any well-known internet browser connected to the specific network, thus complying with the health safety distance measures required due to various situations, including that of the COVID-19 pandemic [11].

Yang C. et.al, (2019) proposed a novel approach for detecting fetal heart rate (FHR) using seismo-cardiogram (SCG) and gyrocardiogram (GCG) recordings collected from abdominal inertial sensors. A proof-of-concept setup with commercially available sensor nodes is prepared. The FHR components are extracted from the fused cepstrum of recordings of all the sensors. The feasibility of the proposed method is evaluated with experiments on ten pregnant women under supine, seated, and standing positions. The results are compared with simultaneously-collected recordings of fetal cardiotocography (fCTG). The best position for collecting the signals is deemed to be the supine position, which reports best average root mean square error (RMSE) of 9.83 BPM and average positive percent agreement (PPA) of 84.44% for the SCG signal. The overall results of RMSE are 11.40 BPM from SCG and 12.08 BPM from GCG. The overall reliability from SCG is 75.02%, which is slightly lower than the value of

75.52% from GCG. In summary, the results are comparable between the two modalities, suggesting no significant difference between the usage of the two methods. Our results indicate that wearable inertial sensors could potentially be used to extract FHR outside the clinic with accuracy and reliability metrics comparable to other modalities such as fCTG [12].

Du Y. et.al, (2021) proposed The FM measuring method used a multi-point IMU to detect FM signals on the pregnant woman's abdomen. The FM signals were detected instantly by the energy evaluation, and the signal interval was extracted as the basis of analysis. All the signals received by the IMU passed through an Inter-Integrated Circuit (I2C), the hardware filter filters the 60 Hz noise, and the data were sent to the MCU. The signals from various channels were processed by a Kalman filter to reduce noise, and then the position, duration and relative force (RF) of the fetal movement were worked out from the signal interval generated by the energy evaluation. A triangular measurement shape was extended from a circle as the center point, and there was an IMU sensor at each of the three corners. The center circle included a related signal processing circuit, an IMU sensor, a rechargeable battery circuit and a secure digital (SD) memory card. The device could closely adhere to the pregnant woman's abdomen. The casing of the wearable device was made of a thermoplastic elastomer, and the triangulation point for measurement used flexible flat cable as a signal transmission line, thus enhancing the softness of the casing. The hardware circuit of the device was designed using an ARM Cortex-M0+ with a 32-bit MCU, an operating frequency of 48 MHz, a built-in 32 KB of flash memory and 256 KB of programmable memory, and a working voltage of 1.62-3.63 V. The IMU model was an MPU6050 (TDK, Japan), which included a triaxial accelerometer and triaxial gyroscope. The dynamic adjustment range of the accelerometer was ±2g, ±4g, ±8g and ±16g. The sensitivity range of the gyroscope was ±250°/s, ±500°/s, ±1000°/s and ±2000°/s. According to related studies, the abdominal perimeter was usually increased by 23~38 cm after 25 to 40 weeks of pregnancy. In our triangular arrangement sensing method, the side length was designed as 10 cm, so that the detection area could effectively cover the whole abdomen of a pregnant woman. Additionally, referring to the experimental method of previous researches we verified that the IMU adopted was still sensitive at a distance of 10 cm [13].

Matonia A. et.al, (2020) proposed Ten twenty-minute pregnancy signals and 12 five-minute labour signals. abdominal FECG and reference direct FECG were recorded simultaneously during labour. Reference pregnancy signal data came from an automated detector and were corrected by clinical experts. the resulting dataset exhibits a large variety of interferences and clinically significant FHR patterns. We thus provide the scientific community with access to bioelectrical fetal heart activity signals that may enable the development of new methods for FECG signals analysis, and may ultimately advance the use and accuracy of abdominal electrocardiography methods [14].

Clapp J F. et.al, (2020) introduced a method in which each subject used a portable heart rate monitor to obtain her pulse in the lateral position on awakening each morning for at least 1 month prior to conception and throughout pregnancy. All data were normalized to the date of the last menstrual period, and individual weekly averages were calculated. Pregnancies were dated by means of menstrual records and confirmed by j3-subunit assay for chorionic gonadotropin within 48 hours of the first missed menstrual period and early ultrasonic examination. Each monitor was precalibrated against an electrocardiographic trace and, at resting heart rate level, was within 2 bpm of the rate determined by electro-cardiography. The overall increase of 16 bpm observed in this study is in agreement with most of the published literature! However, the fact that the increase begins abruptly very early in pregnancy was unanticipated and suggests a hormonal mechanism not normally active during a menstrual cycle in which conception does not occur. From what is known in regard to the endocrinologic factors in early pregnancy, the initial change may be linked to the production of chorionic gonadotropin, with the later gradual increase being related to the vascular changes which accompany placental and fetal growth [15].

III. SYSTEM DESIGN

This chapter outlines the methods used in this Fig 3.1.: BLOCK DIAGRAM

project. The overview, setups, and design of this project are covered in this chapter. Besides, the hardware and software used in this project will be listed and explained. The block diagram and flowchart of the proposed system are shown in Fig.3.1and Fig.3.2, respectively.

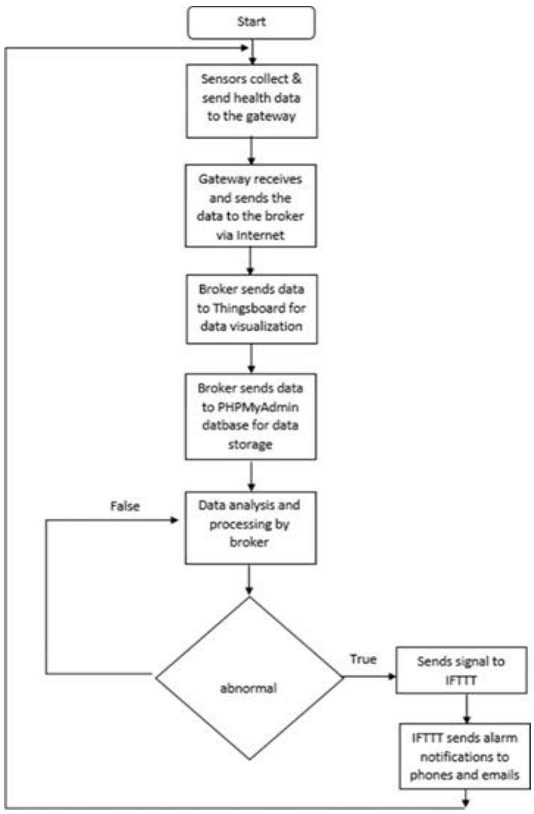


Fig 3.2: FLOW CHART

A. COMPONENTS

1) SPO2 Sensor

The Encoder Photoelectric Speed Sensor Module LM393 is a small module that includes an LM393 main chip and an encoder with a slot width of 10mm. It operates on a DC 5V voltage and has a compact size of 32mm x 11mm x 20mm. The module also features PCB mounting holes with a distance of 15mm and a screw size of M3. It is designed to detect the speed and direction of a rotating object through the use of an optical encoder.

2) Body Temperature Sensor

LM393 is a temperature sensor used to measure the user's body temperature in this project. The pinout consists of the positive terminal, negative terminal, and digital output pin.

3) Activity Monitor

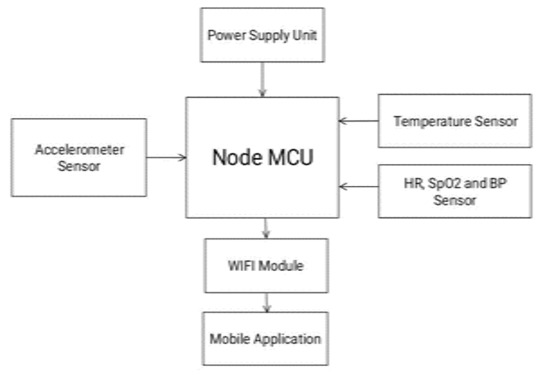
An ADXL345 accelerometer is also used to provide activity of the foetus. The technique of actigraphy is used to continuously record the motion data. Activity or inactivity can be quantified and shared with the doctor.

4) Blood Pressure Sensor

LM393 is a blood pressure sensor used to measure the user's blood pressure in this project. The pinout consists of the positive terminal, negative terminal, and digital output pin.

5) Heart Rate Sensor

LM393 is a hear rate sensor used to measure the user's heart rate in this project. The pinout consists of the positive terminal, negative terminal, and digital output pin.



B. HARWARE AND COMMUNICATION

Node MCU: Node MCU is used as a gateway that collects the health data from the connecting sensors in this project. The gateway communicates with the broker and Arduino UNO via MQTT protocol and UART serial communication. It sends the collected data to the broker for data processing. Node MCU is used to track the user location with geolocation. With the help of geolocation, the GPS tracker is no longer needed as the geolocation function can track the location of the user through the available wifi connection surrounding the user.

C. POWER SUPPLY UNIT

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others.

Power Adaptor 12 Volt 1 Amp Charger AC INPUT 100-240V DC OUTPUT 12V 1A.

D. SOFTWARE

1) Node-RED: Node-RED is an open-source vision tool that makes the programming process easier by wiring

different devices together. It simplifies the programming process by using different nodes without requiring lots of programming knowledge.

2) Mosquitto broker: Mosquitto is an open-source MQTT broker developed by Eclipse Foundation. Mosquitto broker is suitable to be used in this project since it provides a lightweight method of transmitting the messages with a sub/pub model which helps in power saving.

E. PLATFORM AND SERVICES

1) Thingsboard

Thingsboard is an open-source IoT data visualization platform. The data collected by the broker will be sent to Thingsboard via the internet for real-time visualization. Thingsboard allows users to perform real-time data monitoring through the internet.

2) Google Cloud SQL

Google Cloud SQL is a SQL based database that stores the users' health data in this project. Google SQL is one of the many services provided in the Google Cloud Platform. Google SQL database allows data to be stored in the cloud and reduces the risk of data loss.

3) PHPMyAdmin

PHPMyAdmin is an open-source administration for MySQL. PHPMyAdmin offers complete web-based management of MySQL servers and data, where it provides a basic MySQL database and table operations and internal relational system that maintain metadata for advanced features. The health data collected by the broker will be stored in the PHPMyAdmin database.

IV. EXPERIMENTAL RESUTS

The blood oxygenation is averaged by the SpO2 sensors placed on the index finger. Fig.4.1 shows the plot of SpO2.

Fig.4.1. Value of SpO2 Sensor with time.

The Heart Rate is measured along with Blood Oxygenation on the index finger. The readings are sampled every 0.5 second and averaged over a period of 10 secondsand sent to a server for every 10 seconds. Fig.4.2 shows the plot of heart rate.

Fig 4.2 Value of HR sensor with time.

The plot of accelerometer is shown in Fig.4.3. It detects the activity of the fetus.

Fig.4.3. Value of Accelerometer sensor with time.

The plot of body temperature is shown in Fig.4.4.

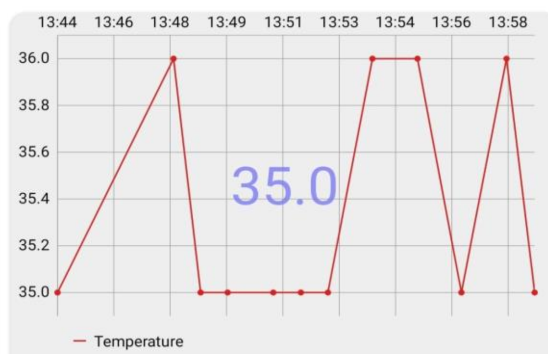


Fig.4.4. Value of Body Temperature sensor with time

The Blood Pressure Rate is measured along with Blood Oxygenation and Heart Rate on the index finger. The readings are sampled every 0.5 second and averaged over a period of 10 seconds and sent to a server for every 10 seconds. Fig.4.5 shows the plot of Blood Pressure rate.

Fig.4.5. Value of Blood Pressure sensor with time.

The Real systematic diagram of Smart Gestation and Foetal Strength Monitor is shown in Fig.4.6.

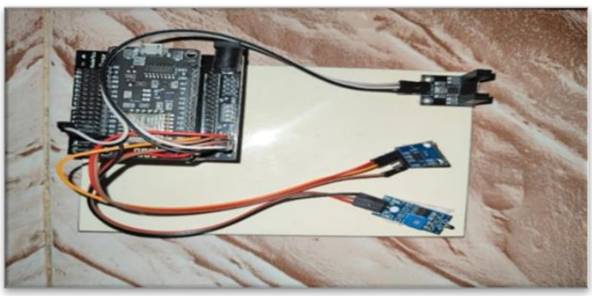


Fig.4.6: Real systematic diagram of Smart Gestation and Foetal Strength Monitor.

V. CONCLUSION AND FUTURE WORK

Conclusion

The project addresses a health concern by providing real-time monitoring of Pregnant women's SpO2 level, Blood Pressure, Body Temperature, Heart Rate and also the foetal kicks and potentially saving lives. Its use of innovative sensor technology and communication features demonstrates a proactive approach to Pregnant women and foetal safety and healthcare, making it socially relevant and impactful.

The system represents a pivotal advancement in the field of prenatal care, offering a comprehensive solution to address the challenges faced by pregnant women, particularly in rural and underserved areas of developing countries. Through the integration of Internet of Things (IoT) technology and sensor-based monitoring, the system enables continuous assessment of maternal and fetal health parameters, facilitating early detection of complications and enhancing overall healthcare outcomes.

In conclusion, the implementation of the proposed system holds immense potential to revolutionize the landscape of prenatal care delivery. By providing remote monitoring capabilities and real-time data analysis, it addresses critical gaps in the existing healthcare infrastructure, particularly in resource-constrained settings. The following discussion elucidates the significance and implications of the proposed system across various dimensions.

Recommendation for Future Work

A smartphone application can be proposed for pregnant women's wellbeing which can be promising. The envision of integrating advanced artificial intelligence algorithms to analyze the data collected from various sensors, providing real-time insights into the mother's health and the fetus's development can be done. Additionally, there can be development to incorporate features such as personalized health recommendations, virtual consultations with healthcare professionals, and community support forums to enhance the overall experience and support during gestation. The major goal is to revolutionize prenatal care by leveraging technology to empower expectant mothers and ensure the best possible outcomes for both mother and child.

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