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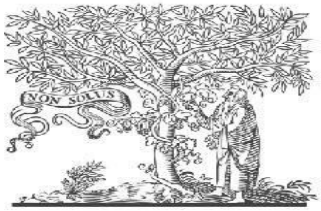

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IJIEMR Transactions, online available on 03th Apr 2023. Link :http://www.ijiemr.org/downloads.php?vol=Volume-12&issue=Issue 03

10.48047/IJIEMR/V12/ISSUE 03/100

Title **A NOVEL SYSTEM FOR MONITORING MOTHER'S AND BABY'S HEALTH**

Volume 12, ISSUE 03, Pages: 688-694

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A Novel System for Monitoring Mother's and Baby's Health

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Abstract:
This project is completely focussing on pregnant women and babies' health conditions. Every pregnant woman is eager to know the health condition of her baby and along with her health condition. Here, we are using a pressure sensor, Heartbeat sensor, and blood pressure sensor. The Pressure sensor is used to calculate the baby's kick rate for every minute inside the mother's womb to know the baby's status and it is fixed to the belt which is worn by the pregnant woman. The Baby's kick rate will be shown in the form of graphs on the website. The Heartbeat sensor and Blood pressure sensor are fixed to the wristband. The Heartbeat sensor is used to calculate the mother's heartbeat for every minute and the blood pressure sensor is used to calculate the blood pressure of the woman for every minute. The pregnant woman can use this belt and wristband twice a month. It will be useful for the doctor to treat the pregnant woman by seeing the graphs.

Keywords: Pregnancy women and Baby health care, Health Monitoring System, Blood Pressure Sensor, Heart beat Sensor and Pressure Sensor.

Introduction:

Related Work: 94% of all maternal deaths occur in low and lower-middle-class countries. Across India, if we talk about death rates of pregnant women it is and these are mostly seen in rural areas. The death pregnant woman may occur during the pregnancy period or after pregnancy and sometimes there will be loss of both the baby and pregnant woman after pregnancy. Even after everything goes on successfully, the woman is facing minor health problems. And also, teenage marriages are one of the reasons why we lose both sometimes. And there is another case, where the pregnant woman dies due to abortion or by taking abortion pills. For every 1,00,000 pregnant women, 30 women are dying if they take an abortion. This is because of gender bias. In 1900-2000 it is more; they give more priority to males than the woman. And Woman gets married when she reached the age of 18 years, she would not have a baby until she crosses 20 years. Pregnancy-related deaths are mostly seen in teenagers and less in a woman who go married at the age of 25-30. From 1900 to today teenage marriages had been decreasing.

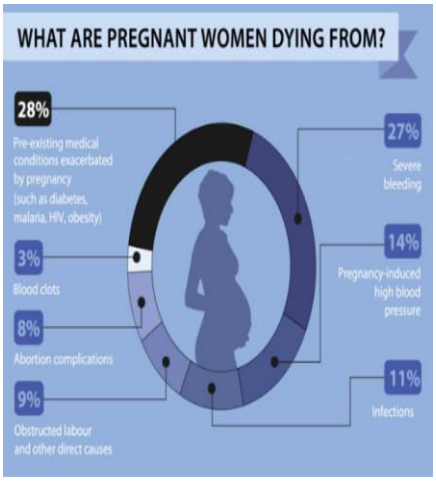

Fig: Causes for Pregnant Woman Death

This is because the Indian government has introduced a law against child marriages. To some extent maternal

deaths are reduced but since the ratio is more. The reasons why most pregnant women die according to the World Health Organisation (WHO) is that because Severe bleeding, Infections, Blood Pressure disorders, Unsafe Abortion, and some diseases like Anemia, Malaria, HIV/AIDS, Heart diseases, and Lung Infections.

Literature Review:

This is what the author [1] Abeywardhana refers to as foetal well-being. To prevent foetal death, it is crucial to monitor foetal movements. To identify the foetal movement patterns, expectant women' accelerometer data were analysed. Due to the presence of the mother's breathing patterns and laugh signals in the accelerometer data, foetal movements can be difficult to identify. By taking into account the Eighen values and Eighenvectors of the auto correlation matrix, the foetal motions were divided hierarchically.

Fetal motions have been utilised to identify pregnancy and show continuous sensed life, according to the author [2] Valerie Smith. They are regarded as a proximate indicator of the health and viability of the unborn life. They are regarded as an indirect indicator of the health and integrity of the foetal neurological system as well as a sign of foetal wellbeing. Reduced foetal movements (DFM) or a prolonged period without foetal movements are seen as signs of a foetus at risk. The use of "kick-charts" is considered formal foetal movement counting. Women quantify the number of movements felt over a predetermined length of time or at predetermined periods throughout the day using a predesigned chart that he utilises.

Fetal movement is a crucial sign of a healthy foetus, according to the author [3] Lvchen Zhao. The most common techniques for identifying foetal movements are ultrasound and pregnant women's subjective impression. Only hospitals have ultrasound equipment, which is inconvenient for expectant mothers. He suggests a wearable technology-based solution to quickly and precisely identify foetal movements. The system consists of an intelligent garment with several multi-scale sensors integrated into it, as well as a standardised cloud computing system with a built-in medical expert system. He suggests a technique combining wavelet analysis and a band-pass filter to extract pertinent characteristics on foetal movements based on the recorded data.

In order to more accurately define foetal movements, the author [4] Lowery states that their goal was to create an automated ultrasound-based foetal movement detection system. Fetal movements were monitored in 101 cases for a total of 20 minutes. Findings of Hewitt-Packard, maternal perception, and expert ultrasonography assessment were compared to those of movement detection by a single-transducer system and a two transducer fusion system. In terms of second-by-second foetal movement detection, the author represents a considerable advancement over the state-of-the-art methods.

Fetal movement (FM), according to the author PatharaNorasethasopon [5], is a sign for assessing the welfare of the unborn child. He began by saying that the Realtime foetal movement detector is four displayed. A pregnant woman's abdomen is intended to be wrapped around an air-pressurized bag. In order to measure the force applied to the uterine wall from any angle, it is attached to a pressure sensor. Before being uploaded into internet cloud services for real-time monitoring and remote access, the signal is processed.

Fetal movement counting is described in this article by the author [6] Tradele Debisa Deressa as a sign of foetal wellness and regular contact in the uterus of pregnant women during pregnancy. The author tries to make the point that we may predict high risk scenarios by analysing historical data. He has employed data mining technologies for the forecast.

Fetal movement counting, according to the author [7] M.J.Rooijakkers, can give important information about the health of the foetus because a sharp decline in the number of movements can be interpreted as a sign that the foetus is about to die. According to him, the maternal sense of foetal activity is crucial for the foetal movement counting method of assessing foetal health. Based on amplitude and shape changes in the abdominally recorded foetal ECG, he presented a simple technique for detecting foetal movement. The complexity of the algorithm reached by the author may allow for lower growth and continuous foetal movement detection.

This Fetal Movement Recorder (FMR), which uses an accelerometer-based movement measurement device, is described by the author [8] M.B. Malarvii. A proposed prototype gadget was created to gather the preliminary information on foetal movement. He attached a module with two-point sensors to the mother's abdominal wall for this purpose, and the data were recorded on a memory card. He then evaluated the accelerometer's functionality and the device's potential. According to the first findings, his technology may be the best option for measuring foetal movement because it is more accurate than the maternal perception technique.

The article's [9] author, Amirul Ridhwan Sazali, Rania AI-Ashwal, claims that technological advancements now enable devices with tiny sensors to detect foetal movements and monitor the foetus' health. They outline the creation of a foetal simulator to replicate the state of the foetus inside the womb. Arduino was used to assemble, programme, and control the motor that drives the rod that resembles a limb. The Movement exhibits a successful force simulation of the movement of a genuine foetus and is prepared for usage by sensors.

According to the authors [10] S.Kumaresh, M.Sambareesh, and R.Srihari, pattern matching is carried out using data from the user and database, and if a match is found, the appropriate message is generated. An alarm is produced and the collected packets are sent to the doctor for additional diagnosis if any pattern other than the expected pattern is detected. For a more thorough diagnosis, the doctor uses blood pressure. The metrics such blood pressure, foetal heart rate, and pulse rate are transferred to the user's handheld 5 devices using a Bluetooth module.

A new prototype of the foetal kick detecting gadget was shown by the author [11], Ranjeeta Mittal. A belt that the patient wears that is made of pressure-sensitive material and several sensors will be used to analyse the real-time monitoring of foetal kicks based on a machine learning mechanism. The outcomes are analysed later. Two techniques were put out by the author [12] Macro Altini to increase the precision of foetal kick identification using a single wearable device, with a focus on lowering false positives and raising positive predictive value (PPV) in the absence of reference accelerometer characteristics. He also merged electromyography (EMG) data with accelerometer data. Both methods are designed to provide greater context regarding maternal mobility while still utilising a single wearable device.

The author [13] NelGeusens carefully considers the trade-offs between sensor placement and number, the existence of reference accelerometers outside the abdominal region, and offers recommendations on how to handle class imbalance. We demonstrate that adding a reference accelerometer to the participant's back consistently enhances foetal movement detection ability regardless of the number of sensors used using a dataset of 15 measurements obtained using 6 three-axial accelerometers. They also demonstrate that two accelerometers are sufficient for optional results, along with a reference accelerometer. Fetal movement counts have long been employed as a gauge of foetal growth, according to the author [14] Dell Honey; Leesa Hooker. The authors proposed a variety of assessment

techniques that are combined with technological assistance, physician interaction, and automated technologies.

The adoption of a machine learning (ML) technology called support vector machine (SVM), or the recognition of patterns in a pregnant database, is suggested by the authors [15] Joel J.P.C Rodrigues and Guilherme A.B. Marcondes. This offers a method for a mobile DSSs that can improve the care given to women who run the risk of experiencing pregnancy-related issues. Consequently, by early identifying the danger of preterm birth, our effort can help to enhance the health of both pregnant women and their unborn children.

Background:

1) Pregnant Woman Health Monitoring System: It focuses on the heartbeat of a pregnant woman and monitors the temperature and temperature of the fetal heart. Here, they used Arduino, a temperature sensor, Heartbeat Sensor. In this, there is no blood pressure monitoring of pregnant women as it is one considerable factor for a pregnant woman.

2) Smart Health Monitoring for pregnant woman: It focuses on the Heartbeat rate and blood pressure of the Pregnant Woman. Here, they used Heart beat Sensor, and blood pressure sensor and display these graphs on the website. There is no baby's kick rate monitoring ie., whether the baby is alive or not.

The drawbacks of the two systems are identified. Here, we are using IoT, Blood pressure sensors, Heartbeat Sensors, Arduino, temperature Sensors, and Ultra Sound Sensors.

A pregnant woman is healthy if she has blood pressure in the range of 120/80. If there is a change in blood pressure i.e., an increase or decrease in blood pressure it will be a risk to the pregnant woman. If the blood pressure is low then she will be facing problems like dehydration, blurred vision, inability to concentrate, dizziness, and so on. And also high blood pressure causes Swelling of the face or hands, headache, rapid weight gain, vomiting, and so on. High blood pressure is one of the reasons that cause most pregnant woman's death. To avoid these risks she should consult a doctor and maintain a normal blood pressure range she used to take the preferred diet given by the doctor as per reports generated by the blood pressure sensor.

We are also using a pressure sensor to calculate the kicks of a baby inside the mother's womb to know the baby's condition. Fetus status is very important as it decides the mother and baby's health. There is a situation where the woman doesn't know the movements of the fetus, if there are no movements means the fetus is dead and it causes severe bleeding for the pregnant woman, and are many risk factors associated with that.

Next, we have to concentrate is the Heartbeat rate of the woman. Heartbeat rate may be faster, slower, or in the normal range. The pregnant woman does exercises to make herself and her baby healthy by doing exercise. During Resting time heartbeat rate is in the normal range and during exercise the heartbeat rate increases. A Pregnant woman's heartbeat rate should not exceed 140bps (beat per minute).

All the data related to pregnant women calculated by the blood pressure sensor, Heartbeat sensor, and pressure sensor is sent to the website in the form of graphs. We are using a software IoT platform called Thingspeak to display the data.

Methodology:

In the proposed system, the vital parameters of pregnant women like blood pressure, heartbeat rate, and baby kick rate count are measured. The architecture of the proposed system is given in figure 2.1. It consists of a blood pressure sensor, a heartbeat sensor, and a pressure sensor.

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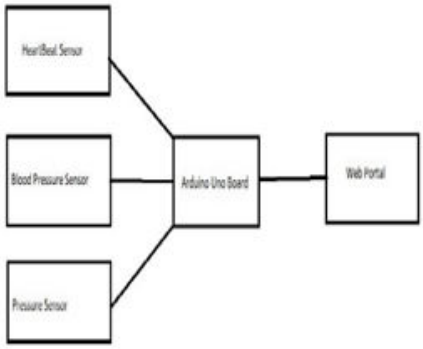

Fig: A Novel System for Monitoring Mother's and Baby's Health

The heartbeat sensor, we are using is a pulse oximeter sensor pcmed 0409 which is used to measure the heartbeat rate count of a pregnant woman. The MAX30102 Sensor uses a photodetector to detect the reflection as well as beam light through the skin. The sensor's operation can be broken into two parts: measuring heart rate and measuring blood oxygen levels. The oxygen in haemoglobin has the unique ability to absorb infrared light. The colour of the blood increases with haemoglobin content. So it can just absorb additional IR light.

The amount of light reflected fluctuates as the blood flows through the veins in the finger, producing an oscillating waveform. We can get the heartbeat reading by measuring this wave. The idea behind blood oxygen level measurement is that red and Infrared light change depending on the amount of oxygen in your blood. Blood with insufficient oxygen absorbs more RED light, and blood with adequate oxygen absorbs more IR light. We can determine the level of oxygen by measuring the ratio between the two. The data will then be transmitted to the website.

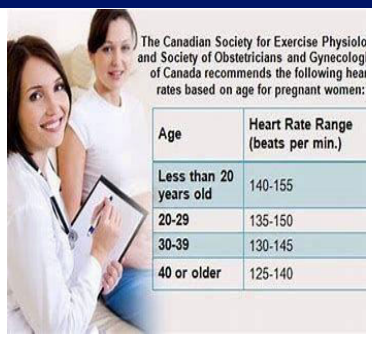

Fig: Heartbeat rate of women during pregnancy

We are using a Blood pressure sensor(MAX86140). A master node SPI interface for communication with the sensor is provided. SPI(Serial Peripheral Interface) provides full duplex communication. SPI sends data between two devices ie., from the sensor to the website.

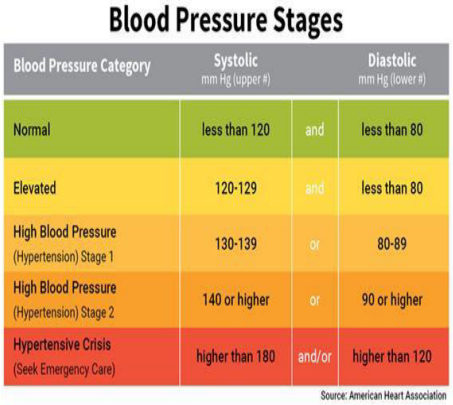

Fig: Blood pressure of women during pregnancy

And also pressure sensor(msp300) is used to measure the kick counts of a baby inside the mother's womb, whether that baby is alive or not. The Pressure sensor upon sensing the kick force of the baby per minute converts pressure into an analog electrical signal and sends the data to the website. We are maintaining a Real-time Database which is used to store the data collected from sensors. The ESP module continuously tries to establish a connection over the internet to transfer the data from the heart rate sensor, blood pressure sensor, and Pressure sensor which was processed by Arduino Uno board.

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Results:

The result of the various sensors that is the Heartbeat sensor, Blood Pressure sensor, and Pressure sensor is shown in the form of graphs are shown below. The below figure Heartbeat rate of Pregnant Women in the past 30 Days. Initially, it was at 68 and the heart rate is increasing and decreasing.

Fig: HeartBeat of Pregnant Woman

Now, the below figure shows the Blood pressure of a pregnant woman. It shows the Blood pressure of a pregnant woman in 4hrs that is from 6 am to 6 pm. The green line indicates Normal blood pressure and it is good. And also, there is another line red that shows the change in blood pressure which says the change in Systolic and Diastolic Pressure. When the Pregnant Woman is sleeping(at Rest) there is a minute change in normal blood pressure and similarly, we see in waking mode, there is a minute change that is in red and green in both cases indicating normal.

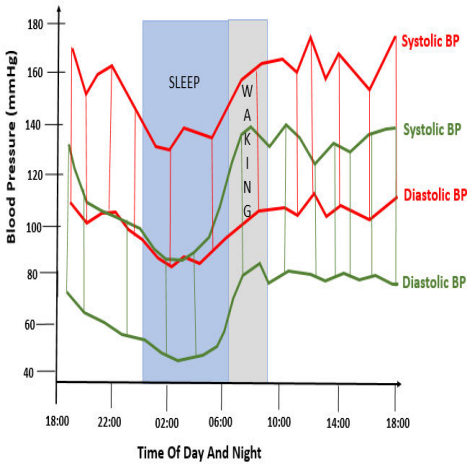

Fig: Blood Pressure of a pregnant woman

The Fig shows the baby's kick rate inside the mother's womb of a pregnant woman. The Baby kicking with pressure is low on the first day, as the day passes the force of the baby kicking is increasing and decreasing.

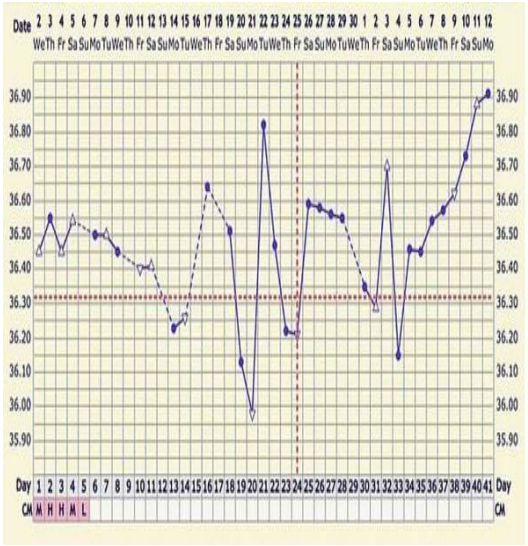

Fig: Baby's Kick rate inside Mother's Womb

Conclusion:

In the Existing Systems, they are all focussing either only on a pregnant woman or fetal movements. Our System focuses on everything about the pregnant woman and baby, for keeping her healthy and protecting her from maternal death. It also detects high-risk pregnancies and fetus deaths. And also monitors the health condition of the mother, this will help her to take care of herself and her baby. The Doctor can easily treat the

patient by using graphs which are given by pressure sensor and also by looking at the report of blood pressure and heart rate of pregnant women.

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