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SMART MATERNAL REAL TIME MONITORING USING IoT-TECHNIQUE

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Abstract - *Fetal monitoring during pregnancy is extremely important to prevent and diagnose life-threatening conditions for the foetus and the mother. In the process of fetal growth and development various abnormal conditions occur from time to time, which can lead to congenital diseases at birth. Thus pregnant women must undergo routine check-ups, these check-ups can avoid maternal mortality rate to a very large extent. To check whether the foetus is normal the basic information to be known is fetal heart rate, temperature and movement. In this device the parameters are measured including the indication of labor pain i.e. excessive sweat and fair contraction. These parameters are measured using sensors which are placed on an abdomen belt and the measured parameters are updated in the cloud. The cloud data are used for future analysis and in case of emergency an alert message will be sent through GSM.*

Keywords- Accelerometer sensor, Force sensor, GSM, IOT Microcontroller, Pulse rate sensor, Sweat sensor, Temperature sensor.

Abbreviations-GSM(Global System for Mobile communication), IoT(Internet of Things), LED(Light Emitting Diode),BPM(Beats Per Minute)FSR(Force Sensitive Resistors)

I. INTRODUCTION

Maternal mortality rate is high because of no proper routine check-ups. Pregnancy is the time duration where one or more offspring develops inside a women. A pregnancy may end in a live 2birth, abortion or miscarriage, though access to safe abortion cares varies globally. Childbirth typically occurs around 40 weeks from the start of the last menstrual period (LMP).This is just over nine months, where each month averages 31 days. When measured from fertilization it is about 38 weeks. An embryo is the developing offspring during the first eight weeks following fertilization after which the term foetus is used until birth. During the first trimester, the possibility of miscarriage is at its highest around the middle of the second trimester, movement of the foetus may be felt.Prenatal care improves pregnancy outcomes. Prenatal care may include taking extra folic acid, avoiding drugs and alcohol,

Regular exercise, blood tests and regular physical examinations, Complication of gestational diabetes, iron deficiency anaemia, and severe nausea and vomiting among others. In the ideal childbirth labor begins on its own when a woman is "at term". Prenatal care may also include the knowledge about the foetus growth and development. Poor prenatal care results in foetal death which lead to maternal mortality for women aged 15-49 years accountedfor 36.4%of total female mortality; 28.2% inurban areas and 38.4% in rural areas. About 50% of the maternal deaths for women aged 15-29 years in rural areas were due to pregnancy complications and childbirth. Prolonged and obstructed labor ranks high among the most common causes of maternal deaths. About 99% of these deaths occur in low and middle-income countries like India where 44,000 women die due to preventable pregnancy-related causes .In order to overcome these issues real time monitoring of the foetus is necessary, it can be obtained with the help of this device which consist of sensors like temperature sensor, pulse rate sensor, accelerometer sensor, sweat sensor and force sensor. These sensors are used to measure the vital parameters like temperature, heart rate and movement of the foetus along with the symptoms of labor pain. The measured parameters are stored in cloud using IoT(Internet of Things), the stored data is easily accessible by the patient as well as the doctor from any part of the world using the cloud address this will also be useful to check the previous data. GSM(Global System for Mobile communication) module is used to send alert indication in case of any emergency.

II. METHODOLOGY

This device is designed as an abdomen belt consist of sweat sensor, force sensor, temperature sensor, pulse rate sensor and accelerometer sensor which is connected to a microcontroller. The microcontroller is programmed with the threshold values for the parameters temperature, pulse rate, amount of force and sweat, if the threshold values of these parameters exceed then an alert message

will be sent through GSM and all the measured data will be stored in cloud using IoT.

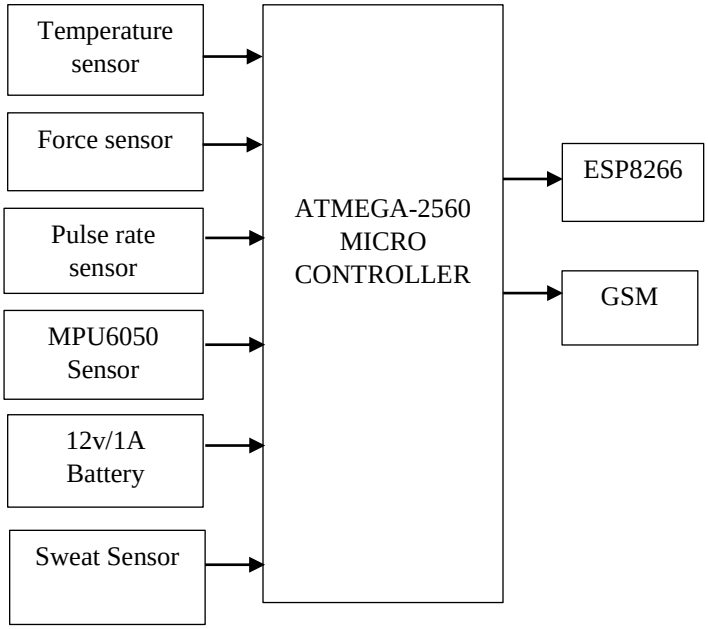

Fig 1. Block diagram of the hardware setup

III. HARDWARE SETUP

1. ACCELEROMETER SENSOR

Accelerometers are used to measure the movement of the foetus in all dimensions. From the fourth month of pregnancy the baby will start kicking but it will not be observed by the mother, the normal movement of the baby per day is upto 10 times, diminished movement results in abnormalities like oligo hydramnios and cord around the neck. Six degrees of freedom is measured using the accelerometer MPU-6050; Left-Right, Back-Forward,Up-Down.It is a tap detector ,user programmable sensor, Orientation detector and signalling.

Fig2.Accelerometersensor

2. FORCE SENSOR

Force Sensitive Resistors (FSR) 402 are a polymer thick film (PFT) device which exhibits a decrease in resistance with an increase in the force applied to the active surface. It allows to measure physical pressure, weight and squeezing. Its force sensitivity is optimized for use in human touch control of electronic device. FSRs are not a load cell or strain gauge, though they have similar properties. FSRs are not suitable for precision measurements. It is of 12.7 in diameter and 0.4mm thick.

Fig3. Force sensor

3. GSM

. We are using the most popular module based on Simcom SIM900A and Arduino Uno for this device. Interfacing a GSM module to Arduino is pretty simple [1]. There are many modules of GSM are available and this 900A is capable of sending SMS and making voice calls i.e 2G module. In case of emergency the alert message will be sent to the mobile.

4. IoT

IoT (Internet of Things) is used to sense the parameters using sensors and according to the software programmed it sends the measured values to the cloud from which anyone from anywhere can access the data with the help of the unique identification address [7]. In this device IoT technique is used to collect the measured parameters and store it in cloud, from which it can be accessed by the doctor and the patient for real time monitoring[4].

5. MICROCONTROLLER

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 14 can be used as PWM outputs),16 Analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a

USB cable or power it with an AC-to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila

Fig4. AT Mega 2560 microcontroller

6. PULSE RATE SENSOR

Pulse rate Sensor is a well-designed plug in modeheart-rate sensor for Arduino. It can be used to detect live heart-rate data the sensor can be clipped into the fingertip or earlobe and it will be plugged right into the Arduino. It also includes an open-source monitoring app that graphs your pulse in real time. It consist of 24-inch Color-Coded Cable, with (male) header connectors this makes it easy to embed the sensor and connect to an Arduino [8]. The Velcro Dots are 'hook' side and are also perfectly sized to the sensor these Velcro dots are very useful to make a Velcro (or fabric) strap to wrap around. Transparent Stickers are used on the front of the Pulse Sensor to protect it from oily fingers and sweaty earlobes. The Pulse Sensor contains 3 holes around the outside edge which make it easy to sew it into almost anything [2].

Fig5. Pulse rate sensor

7. SWEAT SENSOR

This sensor is easy to use, compact and lightweight, high cost of water, droplets identification and detection sensors. The principle used is to measure the size of the trace amount of water droplets through the line with a series of parallel wires exposed. And domestic and foreign Products compared not only small , powerful, and cleverly designed with the following features : First, the amount of water to simulate Conversion; Second, plasticity based on the sensor output Analog values; Third, low power consumption , high sensitivity

Fourth one, it can directly connected to a microprocessor or other logic circuitry, and the controller board for a variety for example: Arduino Controller STC microcontroller, AVR microcontroller and so on. The operating voltage of the sensor is DC5v. Less than 20mA is the working current. This sweat sensor is an Analog type with dimensions of 40mm x 16mm detection area. The working temperature is around 10^0C to 30^0C.

Fig6. Sweat sensor

8. TEMPERATURE SENSOR

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling.The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±1/4°C at room temperature and ±3/4°C Over a full −55°C to 150°C temperature range.

Fig7. Temperature sensor

IV. PROPOSED METHOD

There are several device which have been designed to monitor the heart rate and motion of the foetus. In this technique we have designed a device which is used to monitor the heartrate, temperature and motion of the foetus as well as labor pain symptoms like excessive sweat and fair contraction can be detected, this will be greatly helpful in frequently monitoring the foetus.

V. RESULTS AND DISCUSSION

As mentioned in the methodology the sensors detect the respective parameters and the values are stored in the cloud. Those values can be seen in the mobile through IoT. The normal fetal temperature is around $.3^0$ to $.4^0$ C. This will be changed according to the metabolic activity of the mother. The normal pulse rate of the fetus is around 120 to 160 bpm. The normal range will be varied during gestation. Increased rate occurs during 10^{th} week around 170 and it will be reduced to 130 during term. Motion of the fetus is measured and the kick counts are calculated. Normal kick count is around 10 per day. All the abnormalities in the normal range can be detected and will be intimated to the mother. The labor pain symptoms are detected during the term. The internal pressure i.e the fair contraction created by the fetus will be measured along with the excessive sweat secretion of the mother. At this time an alert message will be sent to the patient's guardian through GSM. This will be much more helpful in taking the mother to the hospital at the correct time.

V. CONCLUSION

As discussed, the maternal mortality rate is increased because of no proper routine check-ups, unawareness and less knowledge about the baby's health condition. This device helps to monitor the baby's condition frequently and to be treated immediately in case of emergency.

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