Fetal Health Monitoring System

Shruthi.T[1], Sripriyaa.V.N[2], Suganthi.V[3], Kalpana.R[4], Kapila Vani.R.K[5]

[1,2,3]*Department of Computer Science and Engineering, Prince Shri Venkateshwara Padmavathy Engineering College, Chennai, India.*

[4]*Assistant Professor, Department of Computer Science and Engineering, Prince Shri Venkateshwara Padmavathy Engineering College, Chennai, India.*

[5]*Assistant Professor, Department of Computer Science and Engineering, Prince DR.K Vasudevan College of Engineering and Technology, Chennai, India.*

ABSTRACT: *The technology has developed a lot but still many women die during their pregnancy due to various complications. Especially pregnant ladies from rural areas can't do their regular checkup during their pregnancy due to lack of hospital facilities for which they need to travel for hours leading to more complications. This may lead to death of baby or mother or even both. In order to avoid this some of the vital parameters like heart beat rate, body temperature, Respiration, SPO_2(stamina), ECG of mother must be monitored during their early stages of pregnancy. This project provides us a way to monitor all these parameters and send the data to doctor via internet such that the data collected can be viewed only by doctor and the screen on patients' side gets hide. At the same time doctor cannot make any changes to the data displayed, he can only view it. We have developed this project especially for primary healthcare centers in and around rural areas.*

KEYWORDS: **ECG, heart beat rate, SPO_2, Respiration and temperature sensor, pic16f877a microcontroller, IOT.**

I. INTRODUCTION

Now-a-days people's food habits have changed. People consume more junk foods, fast foods, aerated drink, etc. Apart from this people suffer from stress due to work pressure. And we all know that human body is alkaline in nature and acidic in behaviour. So some of the parameters like ECG, blood pressure, SPO_2(stamina), respiration rate, blood glucose level, body temperature, etc need to be monitored regularly because change in any one of the parameter will affect the normal range of other parameters adversely which in turn leads to critical situation of one's health. So it is essential for every human to maintain the health.

Especially for pregnant ladies it is more essential that all the parameters must be in a normal level. Because if the mother' health become critical then definitely it will affect the baby. Hence it is necessary for the pregnant ladies to do their check up regularly at their early stages of pregnancy. But in rural areas we don't have much hospital facilities for which they need to travel a long distance and also people don't have awareness about their health. Due to this many babies born are handicapped and affected by many diseases. At times even it may lead to death of mother or baby or even both. Travelling a long distance during pregnancy is also dangerous and uncomfortable for them. So it would be easier and helpful for them if there is a facility for regular checkup in nearby primary health care centers. This paper provides the idea to monitor these parameters at primary health care centre and then transmit these data to specialist staying at distance via internet. This presents a working model which use harmless sensors to measure heart beat rate, body temperature, Respiration, SPO_2(stamina), ECG which is transferred to the PC via microcontroller pic16f877a, then these data are transferred to the specialist at distant hospital. The specialist interprets the data he received and tells whether the patient's condition is normal or not. So patient can visit the higher hospital only if it is necessary else they can avoid the unnecessary travelling.

II. BACKGROUND AND RELATED WORK

There are many researches being conducted regarding this issue.

A. *Remote Patie*

B. ***nt Monitoring System:*** This proposes a method to capture, compare and generate alert regarding the patient's condition using the heart rate and make the captured image be available to the physician. The project provides an image base technique to acquire and analyze a constant streaming of ECG signal through web camera for image capturing, information extraction and analysis performed using MATLAB tools.
The obtained images are then used for image processing. The image captured will contain information regarding the patient's heart rate and other information such as ECG, blood oxygen, breathing rate etc. From this image the part containing the heart rate is cropped for analysis using preset pixel positions. The cropped samples are converted to black and white image.
Now, this is compared with stored image to check whether heart rate lie within the normal range or not. If heart rate is not within range then corresponding .txt file is generated and this file along with the image is uploaded into server. When server detects this it send alert to C2DM server along with the ID of phones registered into the services. C2DM will then send a notification to all the registered ANDROID phones alerting the doctor regarding the patient's condition.

B. ***Design and implementation of a wearable ECG system:*** This project implements a wearable ECG system with smartphones for real-time monitoring, self-diagnosis and remote-diagnosis for chronic heart disease patients before sudden outbreaks. This project makes use of ***smart shirts*** with ECG sensors which can be worn by inpatients or outpatients and monitored in real-time. Healthcare professionals can access patient's data wirelessly in real time with their smartphones. The ECG sensor monitors the patient and collects the data. Now, these data from the ECG sensing hardware can be shown in graphics with smartphone applications to the doctor. This system can be useful especially for senior citizens who live alone or have a disability. Therefore, this system can be utilized for remote medical systems to assist the elderly patients, for self-testing diagnostics, or for physicians to diagnose diseases of the circulatory system.

C. ***A Hospital Healthcare Monitoring System using Wireless Sensor Networks****:* Here pregnant woman parameters such as blood pressure (BP) and heart rate of the woman and heart rate and movements of fetal are monitored to control their health condition. For this a coordinator node has attached on patient body to collect all the signals from the wireless sensors and sends them to the base station. The attached sensors on patient's body form a wireless body sensor network (WBSN) and they are able to sense the heart rate, blood pressure and so on. This system can detect the abnormal conditions, issue an alarm to the patient and send a SMS/E-mail to the physician. Also, the system consists of several wireless relay nodes which are responsible for relaying the data sent by the coordinator node and forward them to the base station. The main advantage of this system in comparison to previous systems is to reduce the energy consumption to prolong the network lifetime, speed up and extend the communication coverage to increase the freedom for enhance patient quality of life.

D. Smart health monitoring system using GSM technology for pregnant lady: This provides an idea for monitoring all the parameters of a human and also incorporated saline monitoring system which gives an alarm when the saline bottle is about to empty. The experimental setup can be operated for monitoring by doctor from anywhere covered by the Cellular (GSM) service by exchanging SMS messages with the remote mobile device. At the consultation unit, a dedicated application software is required to manage the follow of SMS messages from the mobile and display the temperature and heart beat of the patient.

III. CURRENT METHODOLOGY

In existing system people need to go to the hospitals where specialists and equipments are available and people need to wait for long hours. Particularly, People in rural areas need to travel a long distance to consult a doctor in person about their health and for their regular check up, due to lack of well equipped hospitals near to their place. It is time consuming and added physical strain for the patients. To overcome these disadvantages, this project serves as a solution.
This can be used in nearby health centers' in and around rural areas which, lowers the difficulties faced by pregnant ladies.

IV. PROPOSED METHODOLOGY

The objective of this system is to monitor the health parameters of the pregnant ladies accurately. This also helps the pregnant ladies to avoid travelling to the long distance hospital during their pregnancy. It uses harmless sensors to measure the necessary human target parameters like heart beat rate, body temperature, Respiration, SPO_2(stamina), ECG which is transferred to the Personal Computer via embedded microcontroller pic16f877a, then these data are transferred to the specialist at distant hospital for consultation. The figure 1 shows the system architecture of our project.

HEARTRATE: The normal resting adult human heart rate is 60–100 bpm. We would like to develop and instrument which can acquire heart rate from fingers and can be interfaced with flash embedded microcontroller to reduce electronics complexity and to increase acquiring speed. For this we make use of the Heart rate sensor PCB.

Working of heart rate PCB:

The heart rate PCB works on the basic principle of optoelectronics. All it takes to measure you heart rate is a pair of LED and LDR and a microcontroller. IR led emits infrared radiation and surface reflects the infrared light. Depending on reflectivity of the surface amount of light reflected varies this reflected light is made incident on reverse biased IR sensor which results in reverse leakage current. Amount of electron-hole pairs generated depends on intensity of incident IR radiation. More intense radiation results in more reverse leakage current. This current can be passed through a resistor to get proportional voltage. Thus as intensity of incident rays varies, voltage across resistor will vary accordingly.

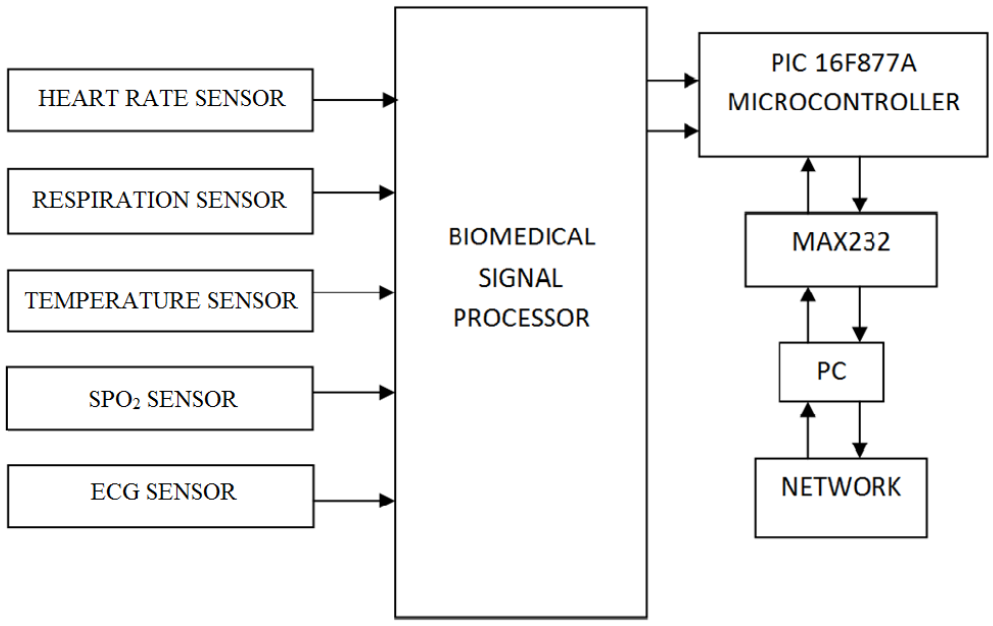

Figure 1: System Architecture

Steps to measure the heart rate:

1. The board is powered from a 3-5.5V power supply.
2. Place the tip of your forefinger gently over the sensor on its face. Your finger should be still and should not press too hard on the sensor.
3. Within a couple seconds the circuit stabilizes and you will see the LED flashing synchronously with your heart beat.
4. We can feed output to the input pin of the PIC embedded microcontroller.
5. We can view this output in PC by connecting with microcontroller via MAX232.
6. The data collected can be stored for future reference and is transmitted to the doctor.

RESPIRATION: The normal respiration of human is 12 to 17 per minute. For this we make use of Resistance Temperature Detector (RTD) with platinum sensor. Generally humans breathe in cold air and breathe out hot air which is measured using the platinum sensor. The sensor is kept near patient nose and the graph gets displayed on the screen of the PC accordingly with respect to breathe in and breathe out temperature.

Then this is fed into signal conditioner for processing the bio-medical signals. The main task of processing biomedical signals is to filter the signal of interest out of from the noisy background. Then we can feed this output to the input pin of the PIC embedded microcontroller. From here the output is fed to PC via the MAX232 and the corresponding graph is viewed. We can also store this data for future reference.

TEMPERATURE: Normal temperature of a human should be between 36.5–37.5 °C. Mainly for pregnant ladies the temperature must be normal else it may affect the baby adversely. This can be measured with the help of thermistor. The patient is asked to hold the thermistor. After few minutes the resistance value changes in accordance with body temperature. Then we can feed this output to the input pin of the PIC embedded microcontroller and can view the output in PC.

SPO_2: Saturated Peripheral Oxygen is the fraction of oxygen-saturated hemoglobin relative to total hemoglobin (unsaturated + saturated) in the blood. The human body requires and regulates a very precise and specific balance of oxygen in the blood. Normal **blood oxygen levels** in humans are considered 95-100 percent.

This is measured with the help of dual wavelength infrared. The hardware implementation consists of two LEDs (red and IR) placed on the patient's finger and a photo detector to get the corresponding PPG signal which is then used to estimate the parameters. Then we can feed this output to the input pin of the PIC embedded microcontroller and can view the output in PC in the form of graph. This gives us the stamina of the pregnant ladies.

ECG: Electrocardiography is the process of recording the electrical activity of the heart over a period of time using electrodes placed on the skin. These electrodes detect the tiny electrical changes on the skin that arise from the heart muscle's electro physiologic pattern of depolarizing and re-polarizing during each heartbeat.

For the measurement of ECG, silver-silver chloride electrode is used. For pregnant women we need to extract the fetus ECG from the mother's ECG. The obtained ECG is then fed to the signal conditioner for filtering the noise from the bio-medical signal obtained and this is given to the input pin of PIC. This output is fed into PC and the ECG graph of both mother and fetal can be viewed.

PIC 16F877A MICROCONTROLLER: In our project, we have preferred PIC microcontroller instead of other microcontroller because this is more efficient than other since it as many in-built features like temperature sensor, RAM, EPROM, Pulse Width Modulation, UART, USART, ADC, DAC, communication ports, Sleep mode processor etc. Also this as a very high speed synchronization like 9600 baud rate and 19200 baud rate. It is also low cost quality process, technology support. Hence it ia an best industrial solution.

MAX232: The MAX 232 is a dual RS-232 receiver / transmitter that meets all EIC RS232C specifications while using only a +5V power supply. It has 2 onboard charge pump voltage converts which generate +10 V and -10 V power supplies from a single from a single 5V power supply.

DATA TRANSFER: Now all data collected from each module is transmitted to the doctor via the internet for consultation. Doctor gain access to this data but it can be only viewed on his/her computer and cannot make any changes in data. At the same time when doctor is viewing the data, patient cannot see the data in his side i.e. screen gets hide and only doctor can view it. The doctor then interprets the data he received and tells whether the patient is in critical condition or not. If the patient is critical then the immediate action can be taken thus saving both the mother and baby.

V. CONCLUSION AND FUTURE WORK

With this project pregnant ladies in rural areas can avoid a long travel during their pregnancy to consult a doctor living in city. The necessary parameters are measured in the nearby primary health care centers and send to doctor. The doctor interprets the data received and tells the current status of the health. So the patient can visit the doctor if it is necessary else they can avoid the long travel to the hospitals.

Also, this project is more economic and also reduces the complexities faced during the pregnancy Thus this project provides us an efficient solution to the existing project.

The temperature sensor i.e. thermistor now included can be replaced by a good sensor without any disadvantages because the current one has got some disadvantages. Instead of using traditional temperature sensors, we can incorporate a CMOS- compatible integrated pressure and temperature sensor with a PWM output.

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BIOGRAPHY

Shruthi.T is a student doing B.E degree in computer science and engineering in Prince shri venkateshwara padmavathy Engineering college, Chennai. Her research interest includes Database management systems.

Sripriyaa.V.N is a student doing B.E degree in computer science and engineering in Prince shri venkateshwara padmavathy Engineering college, Chennai. Her research interest includes Theory of computation.

Suganthi.V is a student doing B.E degree in computer science and engineering in Prince shri venkateshwara padmavathy Engineering college, Chennai. Her research interest includes mobile computing.

Kalpana.R is an Assistant Professor in computer science department at Prince Shri Venkateshwara padmavathy Engineering College, Chennai. She is a M.E graduate. Her research interest includes Networks, OOPS and java programming.

Kapila Vani. R. K. as Assistant Professor in computer science department at Prince Dr.K vasudevan College of Engineering and Technology, Chennai. She is a M.E graduate. Her research interest includes compiler design, Theory of computation and Software project management.