IoT-Based Health Monitoring System Of Pregnant Women For Prenatal Care

Priyadharshini V[1], Shanmugapriya M[2], Dhachayani S[3], Mrs.D.Shanthi Chelliah[4]
[1, 2, 3, 4] Dept of ECE
[1, 2, 3, 4] Sri Muthukumaran Institute of Technology,Chennai-69

Abstract- *Women safety is vital important and it is need of the hour. In spite of several legal and moral steps are adopted worldwide, safety for women is not ensured at any methods .Many wearable devices and mobile applications are available to aid or help the women to safeguard themselves without the human intervention. In addition to above health monitoring of pregnant women during later stages is essential. Hence, a prototype is designed to ensure the protection of pregnant women. The proposed system shows a flexible and interoperable combination of a device and application that will accessorize and empower the citizens and serve as a multifunctional device. The purpose of this project is to present a novel method for monitoring the fetal body with maternal characteristics such as movement (kicks) and heart rate by employing an accelerometer sensor and a heart rate pulse sensor. In this project Arduino micro controller interfaced with various sensors, is used to sense the movements and other vital health parameters. Because of it's relationship with various fetal health issues, monitoring fetal movement (FM) is considered a significant aspect of fetal well-beingevaluation. When abnormality is been detected, the current location is been obtained using GPS Sensor and an alert mail is sent to the care taker and medical center. The designed prototype provides a cost effective solution and efficient in performance which can be used to monitor the health of pregnant women for safety issue. Therefore there is need of a simpler safety solution that can be activated as simply as by pressing a switch and can instantly send alerts to the near ones of the victim.*

Keywords- Pregnant women Health Monitoring, IOT based Health Monitoring, IoT (Internet of Things), Prenatal Care

I. INTRODUCTION

Maternal and new-born well-being is a concern for underdeveloped as well as developing countries. Pregnancy problems, such as miscarriage, stillbirth and premature birth, increase the risk of maternal and new- born death. Pregnancy problems can be reduced by making lifestyle changes and focused health monitoring under supervision of trained, well equipped health care professionals during and after pregnancy. Approximately more than 40% population reside in rural areas, where medical systems are not integrated to facilitate information exchange. In the first trimester of pregnancy, most pregnant women in these countries are unable to get their normal checks, which results in a greater death rate for both the new-born and mothers in these areas. Also, it is not possible to monitor health vitals of pregnant women in the absence of physicians all the time during pregnancy due to several reasons like global availability of physicians, labs etc. The women's health is at jeopardy as a result of this predicament. Although, practitioners recommend ultrasound scans to see the growth of fetus. In underdeveloped and developing countries, access to such scanning facilities is not very common as well as expensive. To address these issues, the authors propose a solution in the form of a device which consists of various sensors like Temperature sensor, Heartbeat rate sensor, Blood Pressure sensor, Sweat sensor to measure sugar levels, oximeter to measure oxygen level, weight machine to measure weight, Accelerometer sensor and other devices like Arduino, GSM module etc. which can be further converted into compact device for accessing vital statistics of pregnant women to integrate it and to transfer the captured readings to the Thing speak cloud so that the analytics can be monitored by physicians with the help of mobile or web application etc. There are also concerns about the long-term implications of prolong ultrasonic exposure on the fetus, its affordability and accessibility. Ultrasound scans can detect some issues, but they can also expose the baby to heat, which can cause birth defects. High mortality rates in rural areas due to lack of knowledge and awareness are a problem. People skipped their regular check-ups not only because of a lack of hospitalsin the vicinity and approaching hospitals and medical practitioners is tough due to distance, time and affordability as well as earning livelihood for survival is the priority. In order to ensure the birth of healthy children, timely qualitative medical attention is required. It is very important to monitor various vital statistics during pregnancy like blood pressure, blood sugar, weight, vaginal bleeding, body temperature, blood oxygen saturation levels, heartbeat of fetus, fetal kick count etc. and even behaviour to track stress and anxiety. We all know that if skilled and smart care is made affordable during the pregnancy then more and more lives during and after childbirth can be saved. The Internet of Things (IoT) has made it possible to implement real- time remote health monitoring systems. The cloud server enables data storage and a wide range of health data analytics.

II. LITERATURE REVIEW

In the title [1] Iod-Nets – An IoT based intelligent health care monitoring system foambulatory pregnant mothers and foetuses Internet of things (IoT) and Artificial Intelligence (AI) have become the most predominant tools in healthcare applications for pervasive and smart Systems for automated diagnosis. Based on the integration of IoT sensors and deep learning algorithms,this study proposes the development of intelligent monitoring systems for maternal and foetal signals in high-risk pregnancies. IoT sensors collect maternal clinical data, such as temperature,blood pressure, oxygen saturation level, heart rate, and fetal heart rate and store them on the cloud for monitoring and prediction purposes. Furthermore,a novel optimizedsingle-dimensional Convolutional Neural Network(1D-OCNN)is proposed for better classification and prediction of the different emergencies of both mother and fetus. The IoT systems have been designed based on the multiple sensors interfaced with the MICOT boards (Node MCU+MCP3008) and cloud mechanism. Nearly 9000 data were collected and used for the evaluation. The extensive experimentation is carried out using cloud- centric learning algorithms such as K Nearest neighborhood (KNN), Random forest(RF), Support vector Machines(SVM),Convolutional neural networks(CNN) and Extreme learning machines (ELM) and various parameters such as accuracy, precision, recall, sensitivity, and F1-score are calculated.Based on the above results, the suggested system is a practical and efficient alternative for maternal and fetal monitoring using IoT and artificial intelligence.. In this title [2] Women Safety Device with GPS Tracking Using Arduino In today's world women safety has become a major issue as they cannot step out of their house at any given time due to fear of physical abuse and violence.Now these can be brought to an end with the help of a Women safety device. This safety device consists of a micro controller,emergency button switch. On sensing the emergency situation this device provides the current location of women and sense it to emergency contact through GSM MODULE. This safety device also includes a LED and an electric shock inverter circuit which is used to hurt the attacking person due to which there is a chance for the women toescape. GPS receiver gets location INFORMATION from satellite in the form of latitude and longitude.The GSM modem sends an SMS to the pre-defined mobile number.When a woman is in danger she can press the switch which is with her. In this title [3] **WOMEN SECURITY SYSTEM USING ARDUINO WITH[4]GPS AND GSM** In every way, the world is getting more dangerous for women.Women's crime is on the rise. Due to an increase in crime, employed women are feeling unsafe.This study suggests a quick-response method to assist women in times of need. Whensomeone is going to harass a woman, she can press the button and her current location information is transmitted as an SMS alert to the pre-defined numbers based on latitude and longitude. The controller used is ARDUNIO UNO. It is interfaced with a push button,a GPS module, a GSM modem and an LCD Display (16×2). When the switch is hit, the controller uses a GSM modem to transfer the current location data from the GPS module to the predetermined phone number. The program is developed in 'C' Language. This project's goal is to provide women a sense of security.Safety has been a major concern for women for many years. In this title [4] Review on Telemonitoring of Maternal Health care Targeting Medical Cyber-Physical Systems We aim to review available literature related to the telemonitoring of maternal health care for a comprehensive understanding of the roles of Medical Cyber-Physical-Systems (MCPS) as cutting edge technology in maternal risk factor management, and for understanding the possible research gap in the domain.We extract 1340 articles relevant to maternal health care that addresses different risk factors as their managerial issues. Of a large number of relevant articles,we included 26 prospective studies relating to sensors or Medical Cyber-Physical-Systems (MCPS) based maternal telemonitoring. reover, we have identified a number of cyber-frameworks as the basis of information decision support system to cope with the different maternal complexities.We have found the Medical Cyber-Physical System(MCPS) as a promising technology to manage the vital risk factors quickly and efficiently by the care provider from a distant place to reduce the fatal risks. In this title [5] WOMEN SAFETY SYSTEM USING ARDUINO NANO AND GPS MODULE Ensuring the safety of women in society is a crucial issue, and leveraging technology can play a significant role in achieving that goal. An example of utilizing technology to enhance women's safety is the implementation of a GPS-based system. Specifically, a women's safety system equipped with a GPS module has been designed to provide assistance to women in need. This device incorporates a GPS module to track thewoman's location and, in case of emergencies, promptly notify a designated emergency contact. Activation of the system can be initiated through a smartphone app or a dedicated button on the device. By utilizing satellite signals, the device's GPS module accurately determines the woman's position while also offering communication capabilities.Women play a major role in society as equal to men.

III. METHODOLOGY

It consist of sensors, Arduino with sensors tool which keep user under observation at all the time Using IOT. proposed a portable device as a kit

which is automatically activated base on the pressure difference crosses over the threshold in unsafe situation. For our proposed system, we use Heartbeat and Temperature sensor to detect the abnormalities.This is possible by the sensors namely BP sensor, heart rate sensor and accelerometer in the hardware kit. In other way the person itself can make it manually.The continuous measured physiological parameters can be stored on the chip and which may further useful for the person.We use multiple sensor for the safety purpose like vibration sensor, tilt sensor, heartbeat sensor and GPS. The GPS is used to identify location .

BLOCK DIAGRAM:

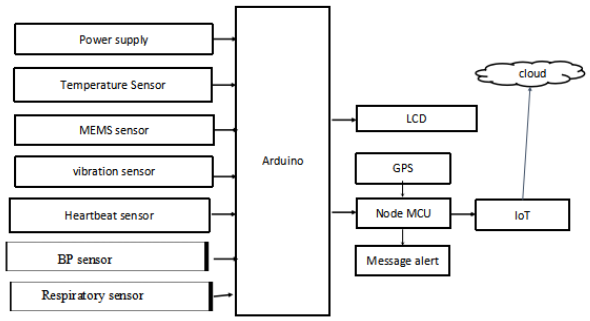

Fig.1 Block Diagram of Health Monitoring System

In this system, we use ARDUINO UNO microcontroller which acts as brain of the system, because the entire system program instruction stored in it. The details of the hardware and software required for this project are given below

IV. HARDWARE DESCRIPTION

Arduino UNO: The Arduino Uno is a low cost, flexible, and easy to use programmable open source microcontroller board. This board can be interfaced with other Arduino boards, Arduino shields, Rasperry Pi boards. They can control Relays, Leds, Servos, and Motors as an output.

Fig.2 Arduino Uno

POWER SUPPLY

The power supply section is the important one. It should deliver constant output regulated power supply for successful working of the project. The primary of this transformer is connected in to main supply through on and off switch& fuse for protecting from overload and short circuit protection.

Node MCU:

Node MCU is a low-cost open source IOT platform ESP32 (32-bit MCU). In this ESP module it has a build in Wi-Fi module. It is used for the purpose of Transmitter and Receiver communication**.**

Fig.3 Node MCU

Temperature Sensor:

This is a LM35 is a temperature sensor measuring having an analog output voltage proportional to the temperature. It provides output voltage in Centigrade (Celsius). It does not require any external calibration circuitry. The sensitivity of LM35 is 10 mV/degree Celsius.

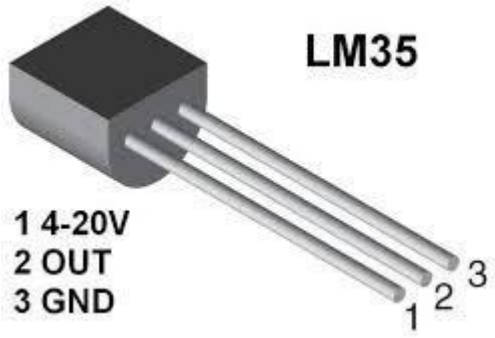

Fig.4 Temperature Sensor

MEMS Sensor:

Micro-electromechanical systems (MEMS) is a technology that combines computers with tiny mechanical devices such as sensors, valves, gears, mirrors, and actuators embedded in semiconductor chips. MEMS or what he calls analogy computing will be "the foundational technology of the next decade." MEMS is also sometimes called smart matter.

Fig.5 MEMS Sensor

Heart Beat Sensor

This component is ideally suited to adding heartbeat sensing to your project. This detection module combines a phototransistor and IR LED, which when a finger is placed between will provide a varying signal. Heart beat sensor is designed to give digital output of heat beat when a finger is placed on it. This digital output can be connected to microcontroller directly to measure the Beats Per Minute (BPM) rate.

Fig.6 HeartBeat Sensor

Respiratory Sensor:

A device that can measure chest expansion and contraction during respiration by detecting changes in capacitance; additionally, these sensors can be employed to detect air humidity from exhaledreaths as a means of monitoring respiration

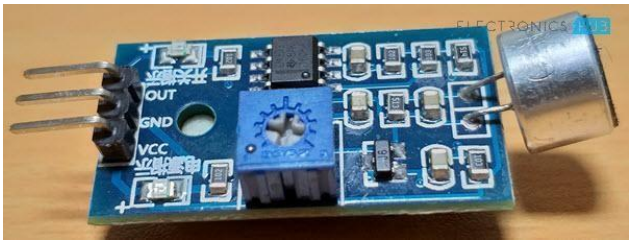

Fig.7 Respiratory sensor

Vibration Sensor:

Vibration sensors are devices that detect vibration, shock, and sound. They can be used in machinery to detect problems before they happen. Vibration sensors work by detecting the motion of a material or object by sensing its frequency. The faster the movement, the higher the frequency detected on a vibration sensor

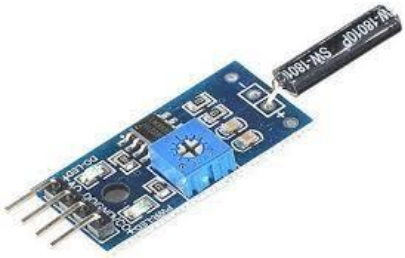

Fig.8 Vibration Sensor

Blood Pressure Sensor:

The Blood Pressure Sensor is a non-invasive sensor designed to measure human blood pressure. It measures systolic, diastolic and mean arterial pressure utilizing the oscillometric method. Pulse rate is also reported.

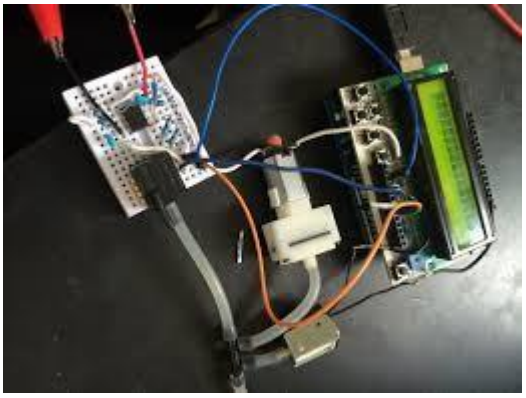

Fig.9 Blood Pressure Sensor

LCD

LCD screen is an electronic display module which uses liquid crystal to produce a visible image and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are two such lines.

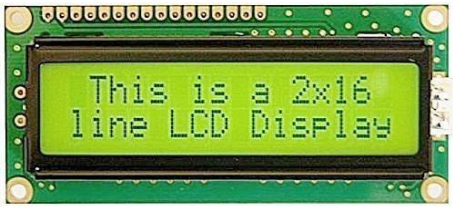

Fig. 10 16X LCD

IOT

The Internet of Things (IoT) is the network of physical devices, vehicles, buildings and other items embedded with electronics, software, sensors, actuators and network connectivity that enable these objects to collect and exchange data. Data is updated to a specific site or a social network by which the usercan able to access the data

Fig. 11 IOT board

IV. SOFTWARE DESCRIPTION

EMBEDDED C

Embedded C is most popular programming language in software field for developing electronic gadgets. Overall, Embedded C is a powerful language for developing software for embedded systems, offering the flexibility and control needed to meet the unique requirements of these systems.
In embedded system programming C code is preferred over other language. Due to the following reasons:

- Easy to understand
- High Reliability
- Portability
- Scalability

ARDUINO SOFTWARE IDE

The Arduino Software (IDE) is a development environment that facilitates writing, compiling, and uploading code to Arduino boards. It's designed to be user-friendly and accessible for both beginners and experienced developers working on projects involving Arduino microcontrollers.It connects to the Arduino and Genuine hardware to upload programs and communicate with them. Since version 1.0.1, the Arduino Software (IDE) has been translated into 30+ different languages. By default, the IDE loads in the language selected by your operating system

THINGSPEAK:

ThingSpeak is an open-source Internet of Things (IoT) platform that allows users to collect, analyze, and visualize data from sensors or devices in real- time. It provides a cloud-based infrastructure for storing and managing IoT data, as well as tools for data analysis, visualization, and integration with other applications

V. VERIFICATION AND RESULTS

Implementing an IoT-based pregnancy women health monitoring system for prenatal care offers significant benefits. Verification involves technical validation of hardware and software integration, ensuring accurate data transmission and user-friendly interfaces. Data integrity and security protocols are essential to protect sensitive health information. Resultantly, continuous monitoring of maternal and fetal vital parameters enables early detection of complications like preeclampsia or abnormal fetal development. Remote access for healthcare providers facilitates timely interventions. Personalized care plans based on data analytics optimize prenatal care, leading to improved maternal and fetal health outcomes. Patient engagement increases with access to real-time health data, enhancing adherence to care recommendations.

Fig.12 Simulation output

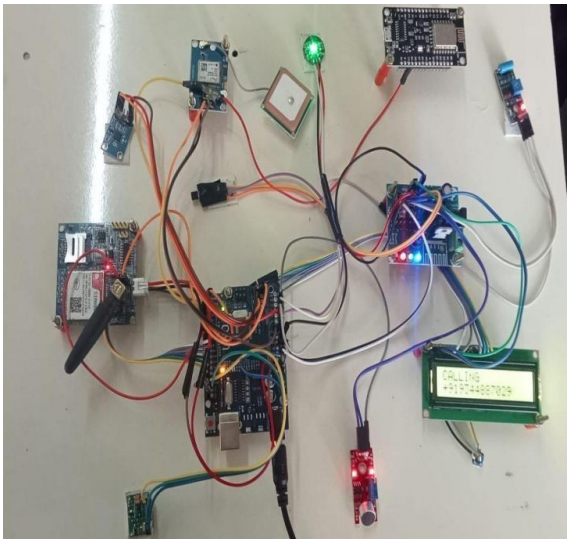

Fig.13 Hardware Prototype

Fig.14 LCD OUTPUT

REFERENCES

[1] S.Shiny Amala, Dr.S.Mythili, ―IoT Based HealthCare Monitoring System for Rural Pregnant Women‖, International Journal of Pure and Applied Mathematics, Volume 119, Issue 15, ISSN: 1314- 3395, 2018

[2] V.Santhi, K.Ramya, APJ.Tarana, G.Vinitha, ―IOT Based Wearable Health Monitoring System for Pregnant Ladies Using CC3200‖, International Journal of Advanced Research Methodology in Engineering & Technology, Volume 1, Issue 3, ISSN: 2456 6446, 2017

[3] .A.C.Sumathi, P.Shayestha, M.Umira, S.Vinothini, ―Health Monitoring System for Pregnant Women‖, International Journal of P2P Network Trends and Technology, Volume 7, Issue 4, ISSN: 2249-2615, 2017

[4] Santhi S, Gandhi AP, Geetha M, Nirmala K, et al. ―Smart Maternal Healthcare Monitoring System using Wireless Sensors Network‖, BioTechnology: An Indian Journal, Volume 12, Issue 12, 2016

[5] Devi .L M.Rekha, "Pregnant Women Healthcare Monitoring System Based On Iot",April 2018.

[6] S. Subalakshmi, G. Murugaboopathi, D. Senthilkumar,"Efficient EER-LEACH Protocol for Monitoring the Activities of Pregnant Women Using Wearable Body Sensor Network",Volume 7,2018.

[7] Vaishnavi Aswar, Pratiksha Takawane, Umakant Jadhav, Pratik Bondre, " A Model of an Automatic Blood Pressure Monitoring and Triggering System for Hospital", Vol. 6, Issue 9, September2017.

[8] M.Nivedha,J.P.Vinusha,Mrs.M.Saraswasthi,"Wearable Healthcare Device for Pregnant Women", Vol.9, No.1 April 2017

[9] T.Saraswathi,S.Amutha, "Iot Based Wireless Healthcare Monitoring",AIJR Publisher in Proceedings of the 3rd National Conference on Image Processing, Computing, Communication, Networking and DataAnalytics, April 2018.

[10] Shruthi.T, Sripriyaa.V.N, Suganthi.V,Kalpana.R, Kapila Vani.R.K, Fetal Health Monitoring System International Journal of Scientific Research and Review, ISSN NO: 2279-543X, Volume 7, Issue 3, 2018