An IOT Driven Healthcare System for Remote Monitoring

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Abstract- **HRV (Heart Rate Variability) acts to be a predictor for cardiovascular diseases. In this paper, the authors propose a low-cost and easy to Remote HRV Monitoring System based on the Internet of Things (IoT) technology for borderline Hypertensive patients in the proposed system, it continuously monitor the health parameters such as HRV (Heart Rate Variability), pulse oximetry and body temperature. These parameters are derived using sensors. Arduino transmits patient data to the server the caretaker and doctors are intimated through SMS and surrounding peoples with buzzer for providing adequate medical help in case of emergency situation and also doctor can provide remarks about the condition to the patient through this system. Now there are no HRV and Pulse oximetry monitoring the alert for patients. By doing so all the ideal traits of a 'IoT health care system for remote monitoring' in terms of low cost, easy to use, and secure that serves in saving lines.**

Index Terms- NodeMCU Wi-Fi, Hypertension, Heart Rate Variability (HRV), Cardiovascular disease, Emergency alert.

I. INTRODUCTION

Technology has advanced at a very fast pace in today's world. We want to work on is one that has not been done before but will be very useful and effective in helping and avoid deaths which are caused by the biggest concern of today's world is cardiac arrest. IoT for healthcare offers to be a vital solution in adjourning such a serious issue. IoT, the inter-networking of various real world objects has become a popular phenomenon. With the rise in advantages of sensors and actuators for use with various platforms, healthcare industry is being revolutionized by breaking the traditional methods. Hypertension has become common a serious disease that remains as the root causes for major Cardiac mortality and Stroke mortality. Hypertension is a condition where the blood pressure in the arteries of the body is higher than 120/80 mm Hg (more than 120 systolic and more than 80 diastolic). Risks health events like Stroke or Heart attack related to Hypertension does not happen all of a sudden; rather it is a continued risk factor that results in such life threatening events. Thus, the proposed system aims to remote monitor as well as alert in critical situation based on the HRV parameters and Heart rate for borderline Hypertensive patients. IoT shares the results of sensor data in terms of manipulated HRV data to a remote medical practitioner through a server application. This helps the patient's condition without a hospital visit. The system continuously monitors the patient's condition, if there is any emergency situation the system alert doctor/caretaker through SMS and buzzer sound for patients and nearby once. There are currently no remote HRV analysis systems for hypertensive patients available to help doctors track the progression of the patient's condition and serve as an alert system prior to critical medical events.

II. RELATED WORKS

IoT technology based remote patient monitoring using web service and cloud computing has be build. The system uses an IOIO microcontroller board that obtains ECG signals and sends it to the mobile device wirelessly using Bluetooth technology. An android application had been used to collect, store and transfer the ECG data. Here the pulse sensor is to be attached to the patient body that acquires patients heart beat data. This can be detected by using the method of a photoplethmograph (PPG). The sensor could be attached to the finger or ear lobe. The system combines the benefits of ZigBee and Wi-Fi technology. Arduino Uno module is responsible to establish a secure communicating channel for

transmission of pulse data from pulse sensor module to the server. Analog/digital conversion is performed on arduino board. The server end consists of three servers, MQTT server, application server and data base server. MQTT server acts as a message broker. The transfer of data from arduino board to MQTT server is through Wi-Fi technology [1]. Then the MQTT server is connected to application server host. MySQL 5.5 data base server is connected to the application server. The application queries the data base every 5 second for plotting the histogram of incoming data and the last 30 sec of the current pulse lobed into the system is displays as the pulse wave. The database makes viewing the historic data of the patient easily accessible. If there is any emergency situation the system give SMS alert to doctor.

III. BLOCKDIAGRAM OF PROPOSED SYSTEM
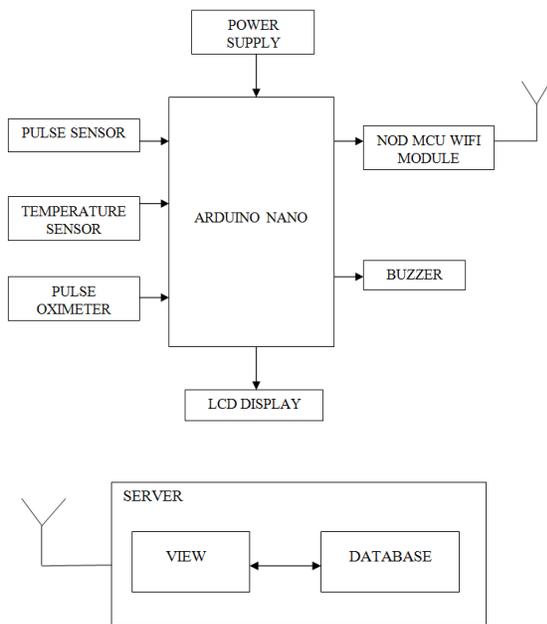
Fig -1: Block diagram of proposed system

The Fig. 1 gives an overview of the proposed system architecture. The working and background of each component in Fig. 1 is as detailed below.

A. Pulse sensor

Pulse sensor is used to provide digital out of heart beat when finger is placed on it. Pulse sensor that can be used for detecting the cardio-vascular pulse wave from a fingertip. It is a non-invasive optical technique of retrieving vital information about the cardiovascular system from the fingertip. It uses an infrared light source to transmit light through finger on one side, and a photo detector placed on the other side which receives and measures the small variations in the transmitted light intensity. The variations in the received signal are related to changes in blood volume inside the tissue. The signal is filtered and amplified to obtain a nice and clean PPG waveform, which can be thus used to derive the instantaneous heart rate. The Pulse sensor also provides a digital pulse output which is related with the heart beat.

B. Pulse oximeter

Pulse Oximeters are non-Invasive medical sensors used to measure the Oxygen saturation (SpO2) of hemoglobin in blood. This tool attaches painlessly to fingertip, sending two wavelength of light through the finger to measure how much oxygen in the blood.

C. Temperature sensor

Temperature sensor is used to measure the heat or energy generated by body. The DS18B20 is a 1-wire programmable Temperature sensor. It is widely used to measure temperature in hard environments like in chemical solutions, mines or soil etc. The constriction of the sensor is rugged and also can be purchased with a waterproof option making the mounting process easy. It can measure a wide range of temperature from -54°C to +125° with a decent accuracy of ±5°C. This requires only one pin of the MCU to transfer data so it a very good choice for measuring temperature at multiple points without compromising much of your digital pins on the microcontroller.

D. Buzzer

Buzzer is an electronic device used to produce sound. In this system buzzer is used to alert the caretaker during extreme condition. Buzzer makes noise to provide alert when an emergency situation occurs.

E. Arduino Nano

Arduino Nano is an open source microcontroller board. Atmega328 is the microcontroller used in the Arduino Nano. It has a wide range of applications and is a major microcontroller board because of its small size and flexibility. Digital pins 0 (RX) and 1 (TX) provide the UART TTL (5V) serial communication in ATmega328.

IV. WORKING

The sensor such as pulse sensor, pulse oximeter and temperature sensor collects information about body parameters like heart beat rate, blood oxygen saturation (SPO2) and body temperature respectively. These body parameters are transmitted to arduino nano. Arduino uploads this information to the server using NodeMCU Wi-Fi module. LCD screen is interfaced with arduino which shows instantaneous readings of body parameter. Arduino compares the sensor data with predetermined threshold and it provides alert using buzzer when there is any health risk. And also alert SMS will send to the doctor and caretaker. Any person having an effective internet connection can monitor these body parameters from anywhere in the world. Doctor can provide remarks to the patient through the webpage and it displays in LCD screen of the system.

V. RESULT

Circuit connections are made using copper PCB. The body parameter displayed on LCD screen of the system when sensors are connected to the body. Then the system is connected to hypertensive patient. Hardware design of the proposed system is given in the figure 2.
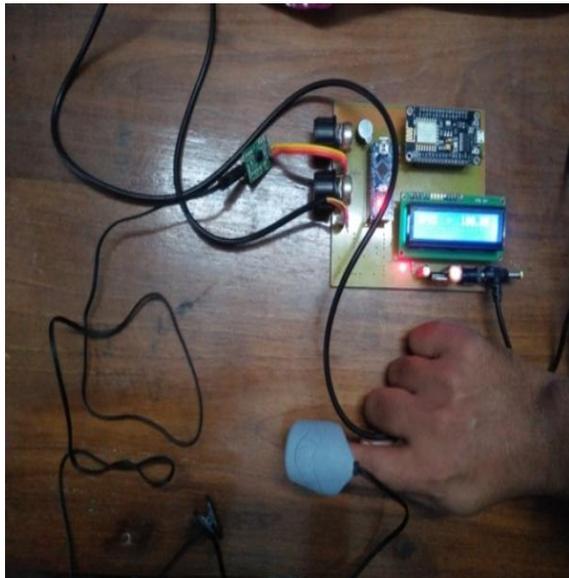
Fig -2: Designed hardware

An alert SMS is obtained in the specified mobile numbers. i.e., Doctor's and caretaker's number (in fig-3) and beep sound was arised from the buzzer.
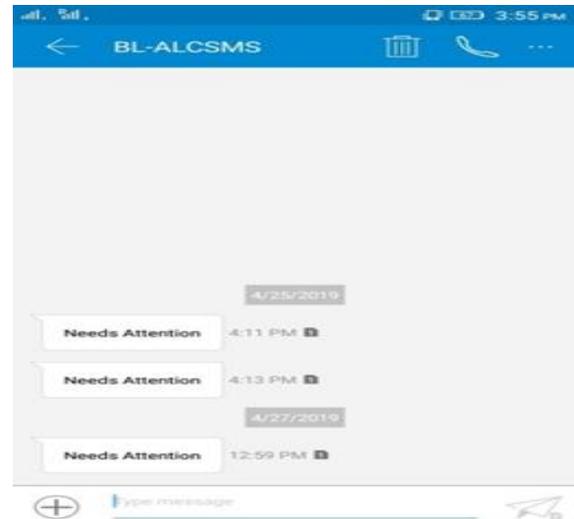

Fig -3: Received message on mobile

All these information's are continuously uploads into the server. It can be monitor from web view of the server. Doctor can send any messages to the patient through webpage (in fig -4).
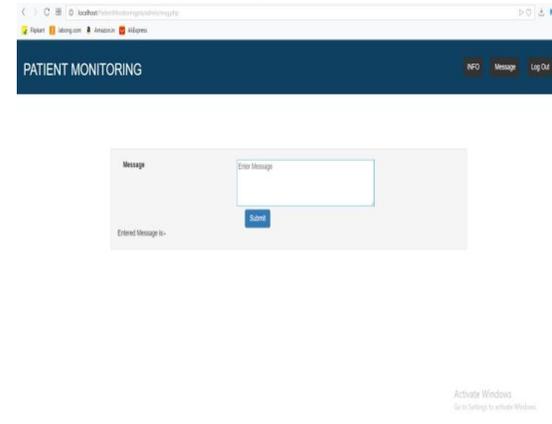

Fig -4: web view consist of tab for doctor's review

VI. CONCLUSIONS

Concept of remote monitoring the patient's condition is one among the various break-through in healthcare industry by IoT. This project provides a great facility for patients which usually suffer from Heart attacks. So there is no need to continuously go to the physicians for checkup. In emergency case, the system sends SMS to care taker and doctor to provide immediate medical help and also provide a buzzer sound for patients and nearby ones. The sensors will pass the pulse values and the temperature values to the arduino nano module through wired connection. Here Wi-Fi technology is used to transmit data from

arduino nano module to server. The proposed system here has to solve all limitations and is designed to be more reliable, low-cost, easy-to-use system for Hypertensive patient.

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