

Remote Health Care Monitoring System Through IoT

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Abstract : The main aim of the paper is to create a healthcare application based on IoT for monitoring the patient's health. IoT plays a significant role in healthcare domain. In this paper, the ATmega328 microcontroller is used, which acts as a gateway to communicate with the sensors such as heart rate, pulse oximeter, ECG and blood pressure sensor. It receives the data from the various sensors and sends these data values which are extracted from the sensors to the network through Wi-Fi and hence provides healthcare team as well as guardians to monitor the healthcare parameters from any remote location. The controller is also connected with LCD in order to alert the patient or the caretaker about any abnormal cases. Thus the system is very interactive with the user. The major issue with RHM is that data needs to be securely transmitted and only authorized user must be able to access the data. Such a security issue can be resolved by sending the data values to the cloud through the Wi-Fi module ESP8266 which is password protected and users can access the data by logging to the webpage. At the time of any emergency or in any abnormal cases, an alert message is sent to the doctor through Email service from the IFTTT protocol. This system is efficient with low power consumption capability, easy setup, high performance and time to time response.

Keywords - Health monitoring, IOT, Arduino, Sensors, If This Than That (IFTTT) Protocol.

I. INTRODUCTION

Remote HealthCare Monitoring is becoming a prominent solution for hospitals and health care organizations, which aim to offer a high quality care service pushing down costs and increasing their potentials market. Good health is every ones need. Good health care system is necessary for development of any country. The internet of things (IoT) is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, and connectivity which enables these objects to connect and exchange data which is the latest trending technology. It allows objects to be sensed or controlled remotely across existing network infrastructure. The main principle of IoT is that the objects/things i.e. sensor nodes identify, sense, process and communicate with each other [1].

In case of any patient who has to be continuously monitored by the doctor, this system allows the patient to be monitored continuously by the doctor and take care of the health regularly in home thus minimizing the hospital stays and costs. And the system also interacts with the user such as if the user has high blood pressure then the system itself suggests some home remedies or guidelines like have less salt. And in case of any critical situation a doctor is being informed by the notification to his E-mail.

IOT patient monitoring has 4 sensors:

1. Heart beat sensor
2. ECG sensor
3. Blood pressure sensor
4. SPO2 sensor

To operate IOT based health monitoring system system, Wi-Fi connection is needed. The microcontroller connects to the Wi-Fi network using a Wi-Fi module ESP8266 thus updating the data values to the cloud by extracting the data from the various sensors. The Arduino UNO [2] reads the input from various sensors and then sends the captured data to the cloud through the Wi-Fi connection so that the doctor can access the data anytime from any remote location. Thus the data is sent repeatedly to the cloud after a particular interval of time.

II. RELATED WORKS

In [Media Aminian and Hamid Reza Naji, 2013], It monitors the various physiological parameters from multiple patient bodies such as heart beat, blood pressure and so on. In this paper, a coordinator node which is attached on the patient body collects all the signals from the various sensors and then send it to the base station. This system also issues an alarm to the patient via SMS/E-mail in case of any abnormal conditions [4].

In [Prabhakaran R, Jili k p, 2015], authors described the monitoring of human health using IoT from a remote location. The main aim of this work is that, a doctor can monitor health condition of the patient from anywhere in the world. This paper includes two sensors for measuring patient body temperature and heart beat. These measured parameters are transmitted to the central node using Zigbee model. They used the microcontroller PIC16F877 which acts as the brain of this node [5].

In [Megha Koshti, Prof. Dr. Sanjay Ganorkar, 2016], A health care monitoring system is necessary to constantly monitor patient's physiological parameters. The tele-medical system focuses on the measurement and evaluation of vital parameters e.g. temperature, electrocardiogram (ECG), heart rate variability, fall detection etc. This paper presents a monitoring system that detects the specific abnormality of cardiac function. This paper records the electrical activity of the heart, analyses it and then detect the normal or abnormal conditions like arrhythmia with the help of Raspberry Pi [6].

In [V. Santhi. K. Ramya, APJ. Tarana, G. Vinitha, 2017], This paper provides a wearable device which will monitor the vital parameters of patient continuously. Many women are dying every day in the world from pregnancy complications. Thus this paper aims to minimize the death of both mothers and babies. It monitors the parameters such as temperature, heart rate and blood pressure of a pregnant woman. It rises an alarm in case of any abnormalities in the patient health parameters and communicates to the web app using Wi-Fi which is built in CC3200 [7].

In [Shreyaasha Chaudhury, Debasmita Paul, Ruptirtha Mukherjee, Siddhartha Haldar, 2017], This System monitors the various health parameters such as heartbeat, ECG and temperature of the patient. The data can be accessed anytime from remote location as it is based on IoT technology. In case of any abnormal behavior they are recognized and the doctors as well as caretakers are notified immediately through a message service or an audio signaling device [8].

Thus our system is developed using arduino. We measure four parameters such as heartbeat, blood pressure, ECG and oxygen level in blood (SPO2). Also we have an intelligent alert system on the basis of critical situation of the patient, if the patient is suffering minimum level then the system itself suggest the medicine on the basis of patient history, if the level of criticalness is more than the information is conveyed to the consent family members and doctors or hospitals immediately. Thus the system is very interactive with the user.

III. PROPOSED SYSTEM

In the proposed system, we are using Arduino as core controller and various sensors to monitor the patients health condition. We are connecting the different sensors to Arduino to monitor the health condition of patient. The Arduino will pick the data from different sensors which are attached to patient and then processes the data.

The sensor data can be viewed on the cloud using a special IP address by the doctors and also the guardians on work who might be worrying about the patient. Additionally the IoT module also provides a Wi-Fi for viewing the data on mobile through Android App in this paper, which provides the doctors to access the patient details very easily rather than browsing it. Thus it saves the time.

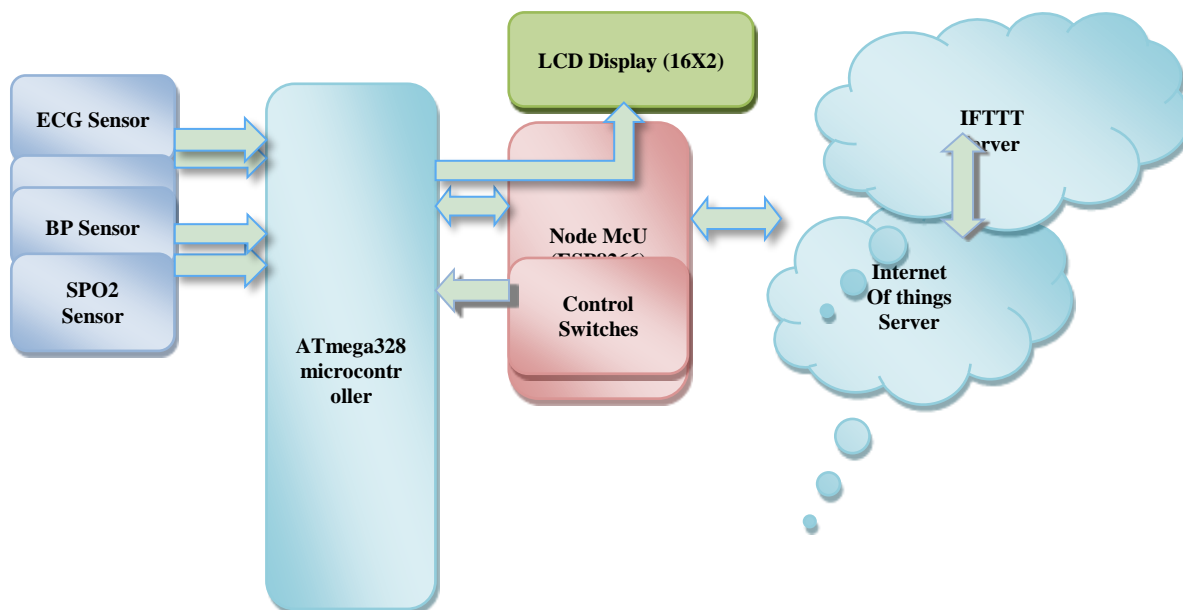


Figure 1. Block Diagram of Proposed System

Hardware Components

Arduino UNO: It is a microcontroller board based on the ATmega328p. It has 14 digital pins, 10 pins, 6 analog inputs, a 16MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It is an open-source electronics platform based on easy to use hardware and software. Arduino consists of both a physical programmable circuit board and piece of software, or IDE that runs on your computer, used to write and upload computer code to the physical board.



Figure 2. Arduino UNO

Heartbeat Sensor: This sensor is used to measure the heart rate of the patient. Pulse sensor is a well-designed plug-and-play heart-rate sensor for Arduino. Clip the pulse sensor to your earlobe or fingertip and plug it into the Arduino, you can ready to read the heart rate. It also includes an open-source monitoring app that graphs your pulse in real time.



Figure 3. Heartbeat 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 technique.



Figure 4. Blood Pressure Sensor

ECG Sensor: The ECG sensor allows you to assess the electrical activity of the heart. ECG electrode sticks to patient's chest to pick up ECG signals. It is connected to AD8232 Single Lead Heart Rate Monitor using wires. ECGs can be extremely noisy, the AD8232 Single Lead Heart Rate Monitor acts as an OP-AMP to help obtain a clear signal from the PR and QT Intervals easily.



Figure 5. ECG Sensor

SpO2 Sensor: SpO2 stands for peripheral capillary oxygen saturation, it is an estimate of the amount of oxygen in the blood. More specifically, it is the percentage of oxygenated haemoglobin compared to the total amount of haemoglobin in the blood. Thus spo2 sensor measures oxygen level in blood.



Figure 6. SpO2 Sensor

ESP8266: The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 module is an extremely cost effective board with a huge, and ever growing community. This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors.



Figure 7. ESP8266

16x2 LCD: LCD (Liquid Crystal Display) screen is an electronic display module 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. These modules are preferred over seven segments and other multi segment LEDs. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix.



Figure 8. LCD Display

Software Description

Arduino IDE: The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

IoT Server (Adafruit): IoT Server will be triggered by the IFTTT server that is it sends the ON/OFF commands packets to the Node MCU. Adafruit IO is a system that makes data useful. Our focus is on ease of use, and allowing simple data connections with little programming required.

IFTTT Server: IFTTT is an automation that will enable to connect 2 services so that, when something happens with one service, a trigger goes off and an action takes place automatically on the other.

Embedded C Language: Embedded C is a set of language extensions for the C programming language by the C Standards Committee to address commonality issues that exist between C extensions for different embedded systems.

IV. APPLICATIONS

- As IOT Healthcare is the most demanding field in the medical area. This work is for, elderly person in our home. Also for the senior citizen living alone or living with 1 or 2 members. This proposed work really proves helpful when family members need to go out for some emergency work.
- Disable patients can use this system. Disable patients who find it really very difficult to go to doctors on daily basis or for those patients who need continuous monitoring from the doctor.

V. ADVANTAGES

- IOT Monitoring proves really helpful when we need to monitor & record and keep track of changes in the health parameters of the patient over the period of time. So with the IOT health monitoring, we can have the database of these changes in the health parameters. Doctors can take the reference of these changes or the history of the patient while suggesting the treatment or the medicines to the patient.
- Hospital stays and hospital visits for routine check-ups are minimized due to Remote Patient Monitoring.
- Patient health parameter data is stored over the cloud. So it is more beneficial than maintaining the records on printed papers kept in the files. Even the digital records which are kept in a particular computer or laptop or memory device like pen- drive, it is likely that these data may get corrupted and data might be lost. Whereas, in case of IOT, the cloud storage is more reliable and does have minimal chances of data loss.

VI. RESULTS AND DISCUSSION

Different health parameters which are collected such as heart rate, ECG, blood pressure and spo2 will be displayed on the serial monitor of arduino ide as shown in the Figure 9.

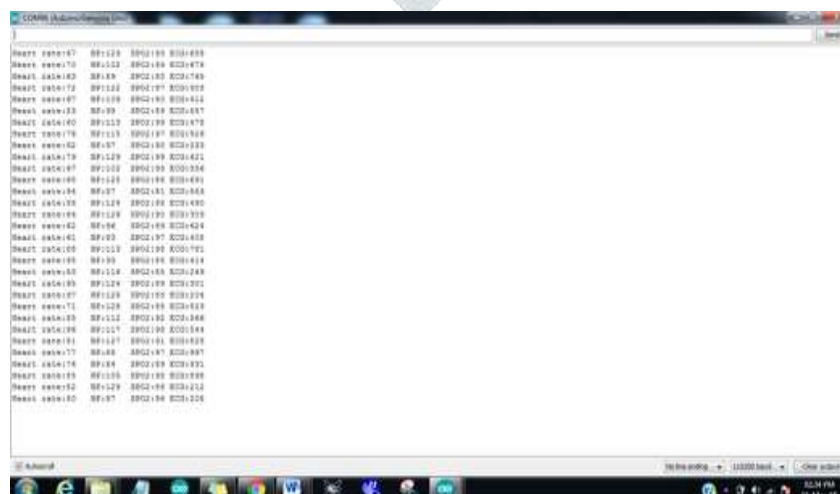


Figure 9. Results Displayed on Serial Monitor

The ECG signals which are extracted will be plotted on the serial plotter as shown in the Figure 10. An electrocardiogram (ECG) is widely used in medicine to monitor small electrical changes on the skin of a patient's body arising from the activities of the human heart. This simple and noninvasive measurement easily indicates a variety of heart diseases.

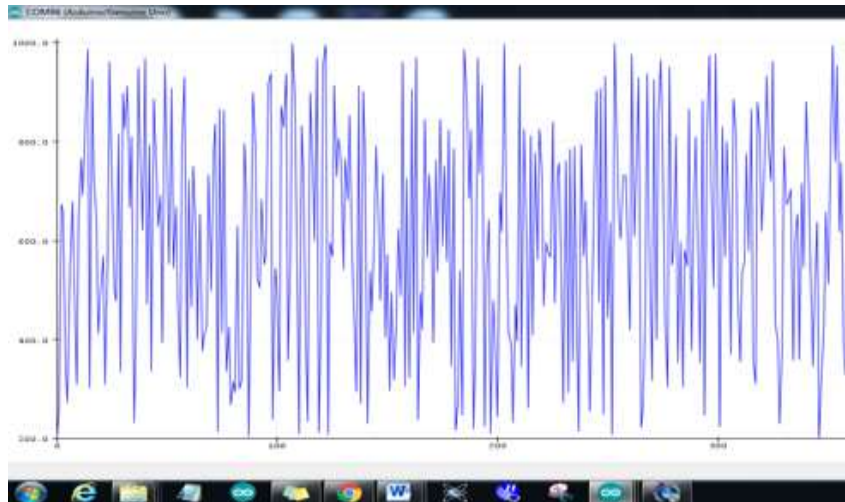


Figure 10. ECG Signals on Serial Plotter

The same data values or real time parameters will be updated in the cloud which can be viewed by the doctor anytime from any remote location. The Adafruit IO HTTP API provides access to your Adafruit IO data from any programming language or hardware environment that can speak HTTP. It is the easiest way to interact with the data.

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2018-05-11 15:29:09 Heart rate:
2018-05-11 15:29:09 98
2018-05-11 15:29:10 BP:
2018-05-11 15:29:10 96
2018-05-11 15:29:11 SP02:
2018-05-11 15:29:12 80
2018-05-11 15:29:12 ECG:
2018-05-11 15:29:12 320
  
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Figure 11. Real-time monitoring of Health parameters

Figure 11 shows values of the four parameters such as speed of the heartbeat measured by the number of contractions of the heart per minute. Measures the pressure of the blood in the arteries as it is pumped around the body by the heart. Normal blood pressure is 120 over 80 (120/80). This system is very interactive with the user. If the blood pressure readings are consistently 140 over 90, or higher, then it displays hypertension and in case of low blood pressure it displays hypotension. Spo2 shows the amount of oxygen which is saturated in the blood which is nothing but arterial hemoglobin saturation. Finally the ECG values are displayed which are continuously monitored by the healthcare teams, guardians in real time.

VII. CONCLUSION

Conventional monitoring and data collection methods, which required physical presence at the hospitals, could in many cases be replaced by remote monitoring over the internet. In this work IoT based remote healthcare monitoring system was proposed. This proposed system measures four parameters using sensors such as blood pressure sensor, heart beat sensor, ECG sensor and spo2 sensor. These sensors monitor health condition and send data wirelessly. This treasure trove of data, when analyzed and presented to physicians in easy-to-assimilate visualizations has the potential for radically improving healthcare and reducing costs.

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