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Portable and Remotely Data Accessible Cloud Based Patient Monitoring System

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Abstract: ***The healthcare industry has seen significant growth in years due to involvement of IoT in the industry. Proposed system is a combination of microcontroller, sensors and Wi - Fi module. The IoT platform employed in the system is ThingSpeak. ThingSpeak is an open - source Internet of Things (IoT) application and API to store and retrieve using HTTP protocol over the net or via a Local Area Network (LAN). The proposed IoT based device can read heartbeat rate and measure the temperature. It continuously monitors the heartbeat rate and temperature and updates them on the IoT platform.***

Keywords: Health monitoring, Cloud, API, sensors, Microcontroller

1. Introduction

In the recent years, IoT technology has been increasing for the need of upholding various sectors. In recent years IoT has grabbed the foremost of economic areas specially automation and control. Biomedical is one in all recent trends to supply better health care. So, having a wise system consisting of multiple parameters is cost effective, easy to use, comfortable and efficient. Additionally, doctors play a vital role, but the tactic of check - up is quite lengthy like first someone should register then he/she will get the appointment booked so exceedingly while the check - up reports are generated. In this lengthy process, working people tend to ignore the check - ups or postpone it. The proposed system is the trendy approach which reduces time consumption within the method. Medical scientists try within the sector of innovation and research since many decades to introduce better health services and happiness in human lives. This contribution towards the society is quiet worthy because people can detect abnormal practice of the body before entering into any serious diseases. The one that is worried more about the person can confirm and keep the track of his health by sitting in any corner of the earth with the help of IoT. The body temperature, heart rate, physical phenomenon, respiration rate are prime parameters to diagnose the disease. The proposed system collects the temperature values and pulse rate values and accumulate them on the cloud so that they can be monitored anytime and anywhere. [1]

1.1 Objective

To develop such a system which can measure the health parameters and can be monitored remotely without monitoring a person being physically present near the patient.

Adulthood patients and kids with heart problems should be periodically monitored and their loved ones or their consulted doctor must find out their status about health from time to time. Hence the proposed system uses sensors that allow it to detect the heart rate moreover as temperature and maintain the track of the patient's health. The patient database is viewed, that is stored on the cloud.

1.2 Literature Survey

Statistics from Becker's Hospital review suggests that: Nearly 60% of healthcare providers use IoT devices in their institutions.73% of the facilities are used to monitor the patients with the IoT devices.89% of the facilities have suffered from security breaches in their system.87% of organisations are planning on implementing IoT in their facilities by 2022. Organizations feel that IoT has saved up to 57% of their facilities. Also, the IoT healthcare market was valued at USD 28.42 billion in 2015 and is projected to reach USD 337.41 billion by 2025, growing at a CAGR of 28.2% over the forecast period. [2]

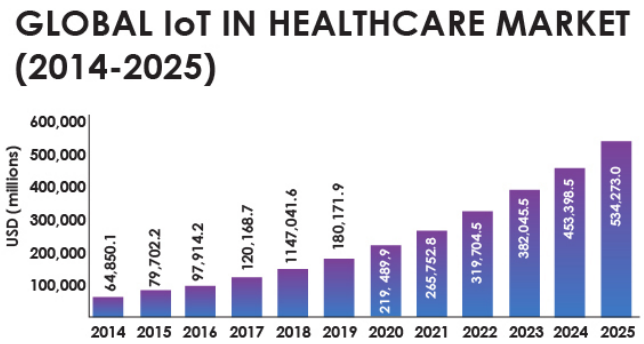

Figure 1

Report by Frost and Sullivan analysis, the world IoT market was worth $22.5 billion in 2016 and is anticipated to succeed in $72.02 billion by 2022 at a CAGR of 26.2%. Offering great help to the healthcare domain, the Internet of Medical Things (IoMT) market is crammed with smart devices like wearables, medical or vital monitors for healthcare used on body. Within the home, community, clinic or hospital settings while associating real time location, telehealth and other devices. [3]

2. Methodology

Internet of Things (IoT) and cloud computing plays an important role in today's telemonitoring health system. This technique keeps track of a patient's physiological parameters through collection of body sensors' data. The patient's health cards are created by the doctors and the patients can access and communicate with one another without any

physical presence. Using cloud computing, the information is stored, updated and accessed from anywhere within the world. It is very suitable for rural areas where medical facilities are not available. As a result, in recent years the costlier healthcare and long waiting time in hospitals have been replaced by the concept of in - home patient monitoring system. This technique collects the data of assorted body parameters through bio sensors, wearable devices and smart textiles which transmits the information to the central node server securely through Cipher - text Policy Attribute Based Encryption (CP - ABE) method. In turn, the server shares the collected data to the medical officials for further treatment. The server generates the mail to the patient's guardian and medical staff in emergency situations. It is very beneficial for elders and chronic patients who require continuous monitoring.

3. Existing System

In a hospital, either the nurse or the doctor should move physically from one patient to a different patient for medical examination because of which it is not possible to observe the patient's condition continuously. Thus, any critical situation cannot be easily found unless the doctor or nurse checks the patient's health at that moment. This could be a strain for the doctors and the medical staff who need to take care of plenty of patients within the hospital. When medical emergencies take place, the patients are often unconscious and unable to press an emergency alert button. The protocol that is being used to transfer the data is HyperText Transfer Protocol (HTTP) for general communications over the internet. However, when HTTP is applied to communication in IoT, protocol overhead and resulting performance degradation could be a significant issue. Moreover, IP addresses depend on physical location which causes the matter of complexity in network control. [4]

4. Proposed System

The system continuously monitors the patient's health parameters and updates the patient's health status on the cloud platform. The monitored data is delivered to medical staff as well as the patient's guardian through mail. Upon sensing unwanted changes in the health parameters, the system alerts the medical officials about the abnormal parameter. Thus, reduces the requirement for manual monitoring done by the medical staff. The proposed system uses a microcontroller with Wi - Fi module to send data from sensors to cloud platform ThingSpeak. Microcontroller has been interfaced with the Wi - Fi module which functions with the API key provided on the cloud platform. Medical officials can see the medical history recorded on the cloud platform using the ThingSpeak access ID and access key. The sensors used in the proposed system are the Heartbeat sensor and the temperature sensor.

4.1 Flowchart

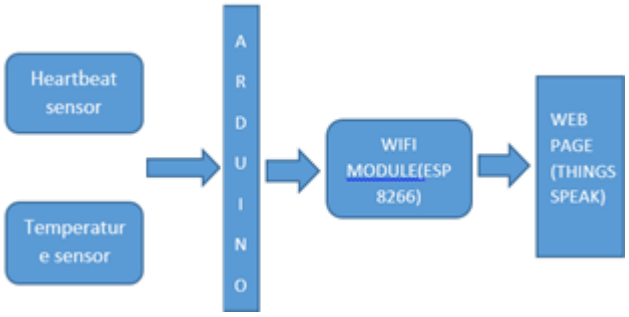

Figure 2

Fig.2 shows general flowchart of the proposed system.

4.2 Components

1) Arduino Uno - Reads the data from the sensors and sends data to the cloud through ESP8266.
2) ESP8266 Wi - Fi module - Connects to the internet using Wi - Fi and sends the data from Arduino to the cloud.
3) Pulse Sensor - The sensor generates digital output to the Arduino when a finger is placed on it.
4) LM35 Temperature Sensor - The sensor gives an analog output to the Arduino.
5) Push Buttons
6) 10k Resistor
7) Male - Female Wires
8) Breadboard

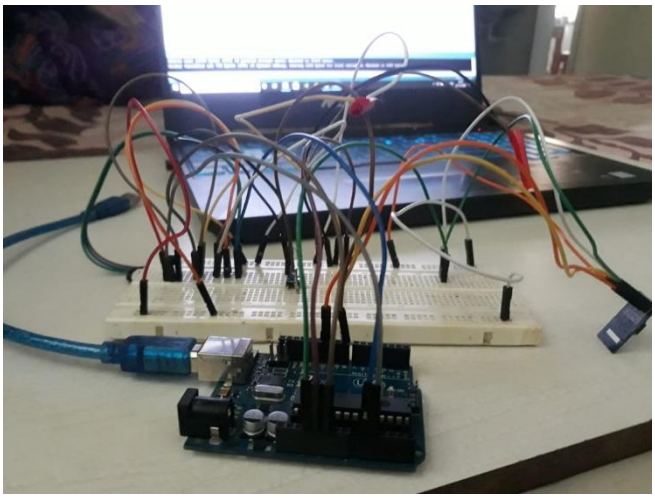

Figure 3

Fig.3 shows hardware circuitry of the system.

4.3 Connections

- Signal pin of pulse sensor - A0 of Arduino
- Vcc pin of pulse sensor - 5V of Arduino
- GND pin of pulse sensor - GND of Arduino
- Vout of LM35 - A1 of Arduino
- Tx of ESP8266 - Pin 10 of Arduino
- Rx of ESP8266 - Pin 11 of Arduino
- CH_PD and Vcc of ESP8266 - 3.3V of Arduino
- GND of ESP8266 - Gnnd of Arduino
- Push button - Digital Pin 8 of Arduino

4.4 Software

ThingSpeak is a super tool for IoT based projects. ThingSpeak provides a cloud computing platform which is used to accumulate the data. ThingSpeak 'Collects' the information from the sensors,' Analyse and Visualize' the information and 'Acts' by triggering a reaction.

In the proposed system, the ThingSpeak platform is used to observe the patient's heartbeat and temperature online using the internet. The IFTTT platform is used to send the alert message to the medical staff as well as the patient's guardian, whenever the patient is in the critical state.

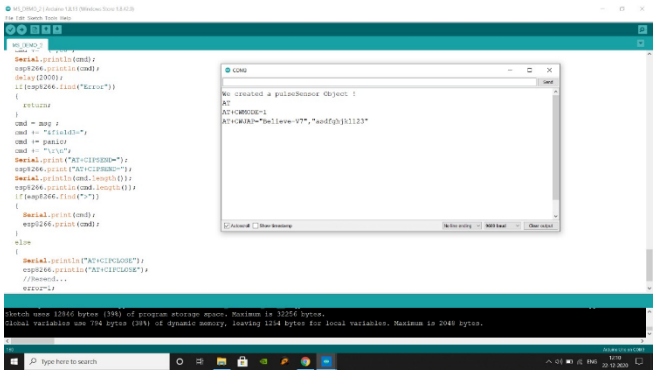

Figure 4

Fig.4 shows the image of Arduino IDE for hardware and cloud setup.

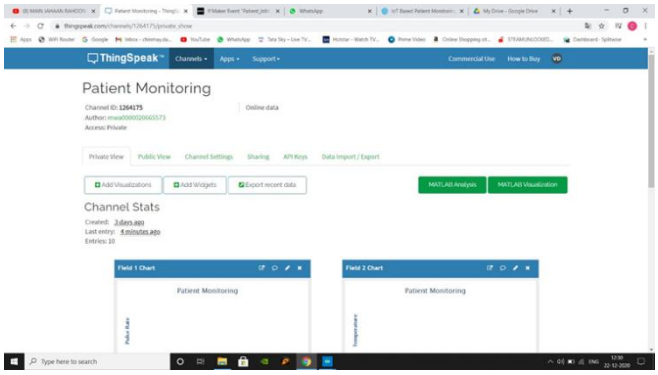

Figure 5

Fig.5 is the dashboard of the cloud computing platform.

5. Working

First, include all the libraries. Make an instance for timer, software serial and pulse sensor to use in the code.

Set - up low - level interrupts for many accurate BPM matches and enable DEBUG to point out ongoing commands on serial monitors.

Set the Wi - Fi name, password and IP of thingspeak. com.
Declare string to update information on ThingSpeak channel. API key is needed which might be found from ThingSpeak channel - > API key.

In the setup function, set the information measure for serial communication between Arduino serial monitor and ESP8266. Start the ESP communication by giving AT command thereto and connect it by calling connectWiFi (); function, then initialize Timers by calling t. every (time_interval, do this); which can take the readings of the sensors and update on the channel after every time_Interval which is defined in the code.

Functions like WiFi (), panic_button (), update_info () and get Readings () are used to set up the cloud as per our requirements.

Make the function for connectWiFi () which can return true or false depending uponWi - Fi connected or not. AT + CWMODE = 1 will make ESP8266 add station mode. AT + CWJAP=\, command, employed in the function, is to attach to the access point (Wi - Fi router).

Make get Readings (); function to require pulse sensor and LM35 readings and convert to the string using dtostrf (); function.

Define char array for BPM and temp and convert float value of the sensors to string using dtostrf ().

Create a function for collecting sensor information on the ThingSpeak channel and attach the readings.
Send this information using the "AT + CIPSEND = " command.

Similarly, make a function for the button, when the button goes to High, ESP8266 sends the data to the server using AT - CIPSTART and AT + CIPSEND commands.

Attach this information to "&field3="
In loop function call panic_button () and timers using t. update () function.

6. Observations

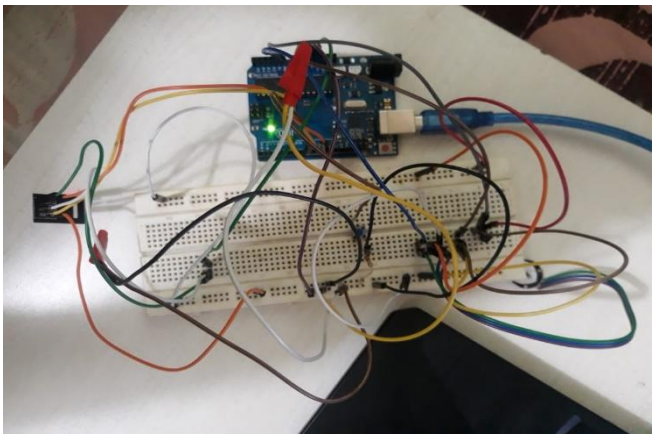

Figure 6

In Fig.6, the normal initialization of the hardware system is observed.

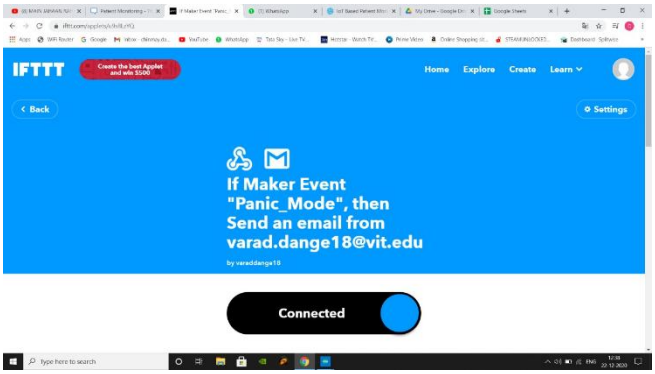

Figure 7

Fig.7 shows the dashboard of IFTTT which is used to trigger the email in emergency situations.

7. Result

The proposed IoT based system is the new approach for remote measurement and monitoring of the patient's health. The proposed design efficiently measures and monitors all the parameters collectively. It improves patient's engagement with the medical staff, doctors and hospitals on regular basis. Addition of more wearable sensors like ECG, EEG, Pressure, air flow within the system which improves the overall performance of the system. Looking on the application sides like sports, exercise, physiotherapy, selection of various sensors in a system is possible. It allows the system to be more advanced and easier to access.

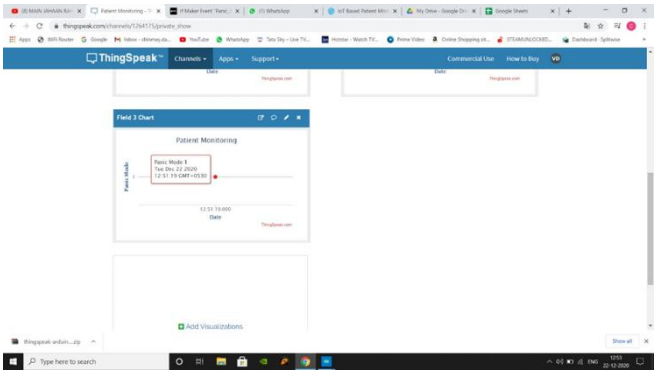

Figure 8

Fig.8 shows the final result on the cloud.

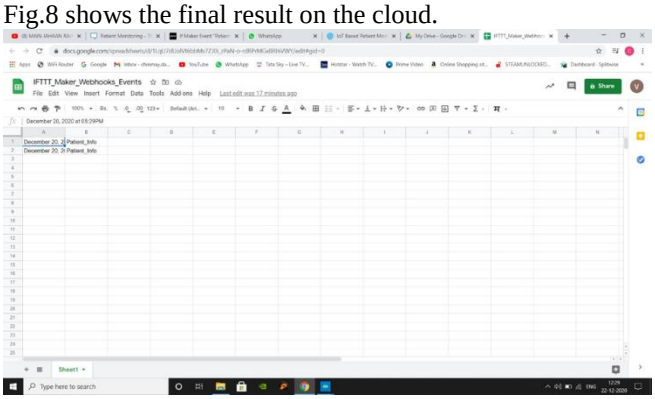

Figure 9

Fig. 9 is the spreadsheet which keeps the record of sent emergency mails through IFTTT.

8. Conclusion

The impact of technical revolution in medical field is simply tremendous. Furthermore, the system and communication tools have improved the practise implementation to the greater extent. The health monitoring system proposed during this paper is developed with the aim of providing the doctors the much - needed patient health history in real time. This could help the physician with the right analysis and remedy. Accuracy and price of the device are equally emphasised via the employment of suitable sensors. The concept of nested cloud utilized in the system enhances the protection of sensitive data saved on clouds compared to the present methodologies. It provides better handling of the key and data dynamically within the nested server.

9. Acknowledgement

We would like to thank our department of Instrumentation and Control for providing various test components. We would like to thank our professors for guiding about project. We have reviewed the concept very nicely and the above - described project have brought us good knowledge regarding IoT and interfacing part of the hardware components.

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