COURSE NAME: IOT FUNDAMENTALS

COURSE CODE: ECE3501

SLOT: F1

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FALL SEMESTER 2021-22

Final Project Report

Patient Health Monitoring using ESP8266 & Arduino

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Abstract

In this project, we made an IoT based Health Monitoring System which records the patient heart beat rate and body temperature, along with that send an E-mail alert whenever those readings goes beyond critical values. Pulse rate and body temperature readings are recorded over ThingSpeak so the authorized personnel can then access these data stored using any IoT platform. So in such a situation, where the number of patients are increasing everyday and the hospital beds are getting filled rapidly and areas where the epidemic is spreading, an IoT based health monitoring system seems like the best solution.

Literature Survey

IoT is making any objects internally connected in the recent decade and it has been considered as the next technological revolution. Smart health monitoring mechanism, smart parking, smart home, smart city, smart climate, industrial sites, and agricultural fields are some of the applications of IoT. The most tremendous use of IoT is in healthcare management which provides health and environment condition tracking facilities. IoT is nothing but linking computers to the internet utilizing sensors and networks [1].

Normal heart rate ranges between 60 and 100 beats per minute for healthy people. The typical restful heart for adult males is roughly 70 bpm and for adult females 75 bpm . Female with 12 years of age and above, typically have higher rates of heart in contrast with males. The temperature of human body is simply the heat of body and the sum of heat radiated by the body is scientifically determined. The average person's body temperature relies on different factors such as ambient temperature, the person's gender, and his eating habits. In healthy adults, it is likely to range between 97.8 °F (36.5 °C) and 99 °F (37.2 °C). [2]

Tamilselvi et al. [3] has developed a health monitoring system that can track a patient's main symptoms such as heart rate, percent oxygen saturation, body temperature, and eye movement on the IoT network. To do this, the system used heart rate, SpO2, temperature and eye blink sensors as capture elements and an Arduino-UNO as a processing device. The developed system has been implemented, but specific performance indicators for each patient are not described.

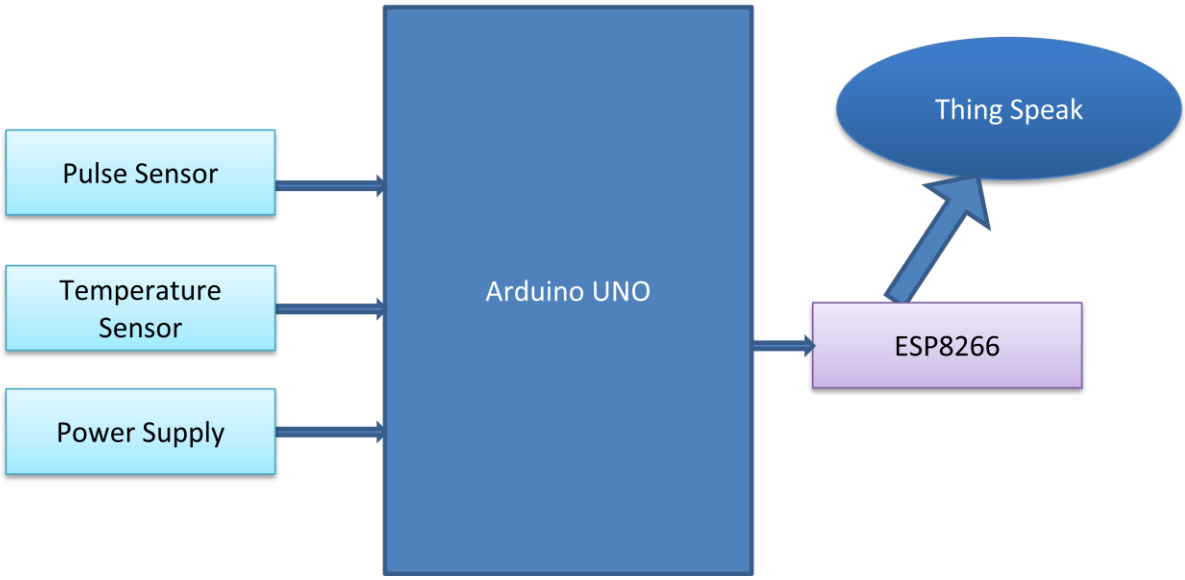
Problem Statement

Diagnosing and monitoring of health being a very important task in healthcare industry. Due to time constraint, people are not visiting hospitals, which might and possibly lead to a lot of health issues. With the increasing use of technology, there is an urgent need to have such a smart health monitoring, a model that automates the problem of patient's vital data collection and delivery. The main objective in this project is to build a IOT based continuous patient health monitoring system and analysis system based on an Arduino microcontroller and ESP8266 as Wi-Fi module , which a patient can use at home to measure his or her vitals which will be helpful for the early detection of any kind of abnormalities in the body.

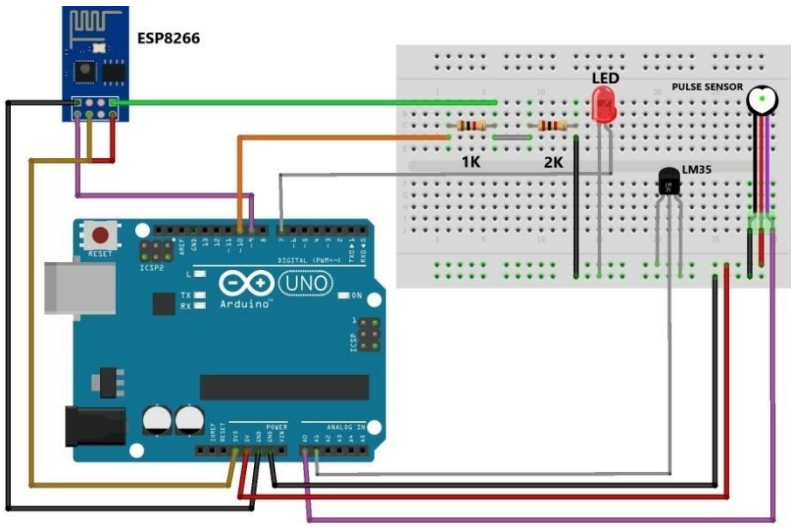
Design details

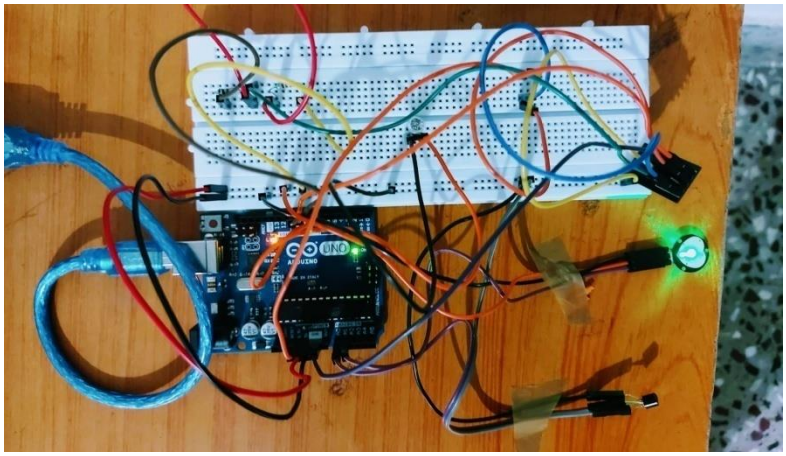
1. Firstly, gathering all the hardware components and forming the design structure of the project and linking it the arduino IDE by connecting the arduino.

Block Diagram



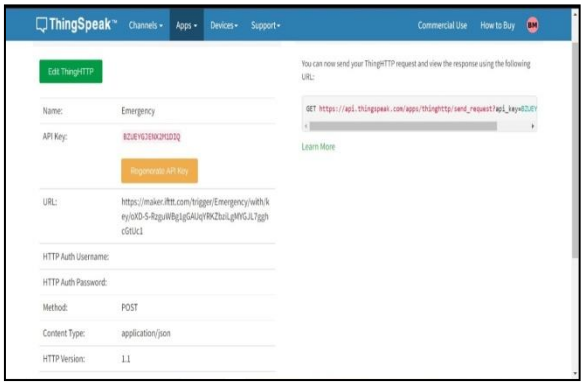
Circuit Diagram

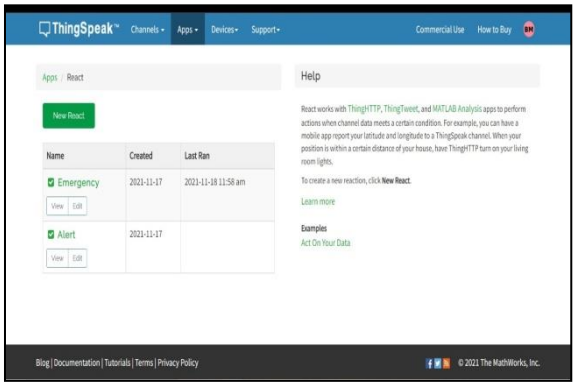




2. Configuring ThingSpeak to record Patient data online :

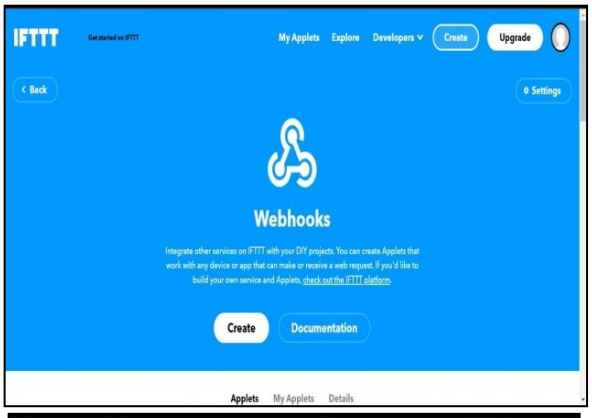
- Creating an account on ThingSpeak.com
- Now creating a new channel under the channel bar, filling all the required details and naming 2 fields as ‘Pulse Rate’ and ‘Temperature’ respectively by making the channel public. Also add Widgets (Gauge) for and name them Pulse and Body Temp respectively.
- Next using the ThingHTTP under Apps bar to trigger the IFTTT applet for data entry to Google sheets and send email/SMS. It helps in communicating among devices and web services without implementing the protocol on the device, URL for triggering will be generated from IFTTT.

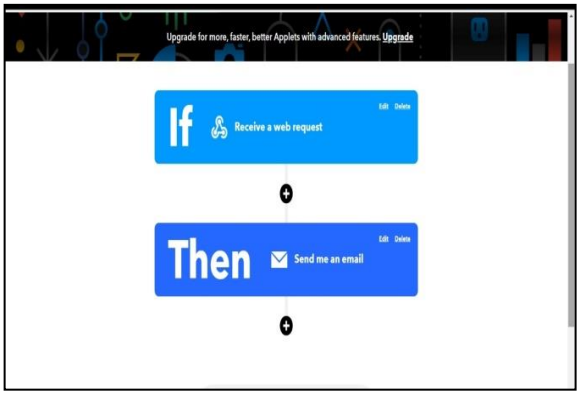


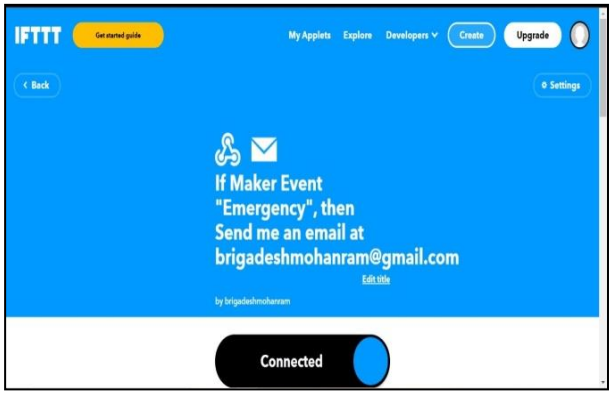


3. Configuring IFTTT for triggering Mail/SMS based on ThingSpeak values:

- After logging in to the IFTTT, under webhooks select documentation URL will be obtained which will be used for ThingHTTP.
- Now creating applets under the My Applet bar, after this click on ‘+this’ and choosing trigger as ‘Receive a web request’.
- Creating the trigger fields and enters the event names.
- Same steps will be followed for making applet for sending email when a emergency event occurs.

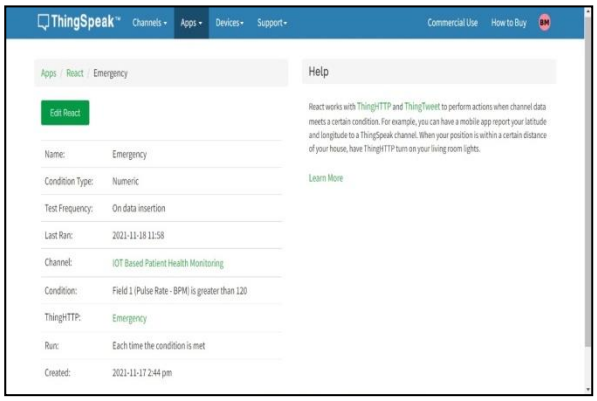


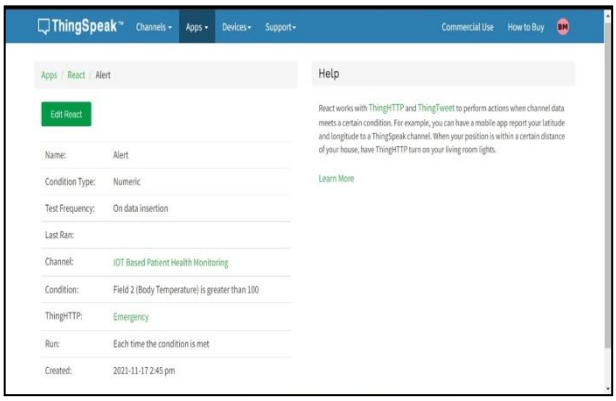




4. ThingHTTP for connecting ThingSpeak with IFTTT

    - Creating a new ThingHTTP and editing all the URLs generated in the previous step.
    - Filling all the necessary details and saving it.
    - Now creating the React under the App bar, we crate 2 channels in that one for temperature and one for bpm.
    - Each time the condition of abnormality was met React will run





Hardware components

i. **Arduino Board:** The Arduino UNO board continuously reads input from these 3 senses. Then it sends this data to the cloud by sending this data to a particular URL/IP address. Then this action of sending data to IP is repeated after a particular interval of time.

ii. **ESP8266:** ESP8266 is used as a WIFI module, but it is actually a microcontroller. This microcontroller has the ability to perform WIFI related activities hence it is widely used as a WIFI module. Used to connect wifi with the Arduino Uno and helps send data to cloud.

iii. **Pulse Sensor:** It is used to measure the pulse rate of the individual.

iv. **Temperature Sensor (LM35):** It is used to measure the temperature of individual's body. The operating temperature range is from -55°C to 150°C.

v. **LED:** In this project LED is used to see whether the sensor is reading the values or not.

vi. **Breadboard:** It is a construction base for prototyping, which is for used for designing and testing circuit. Since, the components are not soldered we can change the circuit design at any point.

Software components

i. **IFTTT (if, this, then, that):** It is a software platform that connects devices from different developers to trigger the automations involving the devices. In the project IFTTT platform is to connect ThingSpeak to email/SMS service so that alert message can be sent whenever the patient is in critical state.

ii. **ARDUINO IDE:** It is used for writing the code for the functioning of the device, here we are using library for Pulse Rate Sensor which has to be downloaded online, along with that we need Timer library for using timer to set interval to take readings.

iii. **THINGSPEAK:** It will collect the data, analyse it and acts on it by triggering a reaction using internet, channels and web pages. It will be used to monitor patient's heart beat and temperature online using internet. It will be connected to the IFTTT platform to send alert message when observed condition is abnormal.

Working mechanism

1. All the hardware connections are made and implemented with the help of the Arduino and the sensors involved.
   Code Link:
   https://docs.google.com/document/d/1bQ-YX2ogyNANu0dlxnLYKmdTUymWyBMBsGJn8pgHa0U/edit?usp=sharing

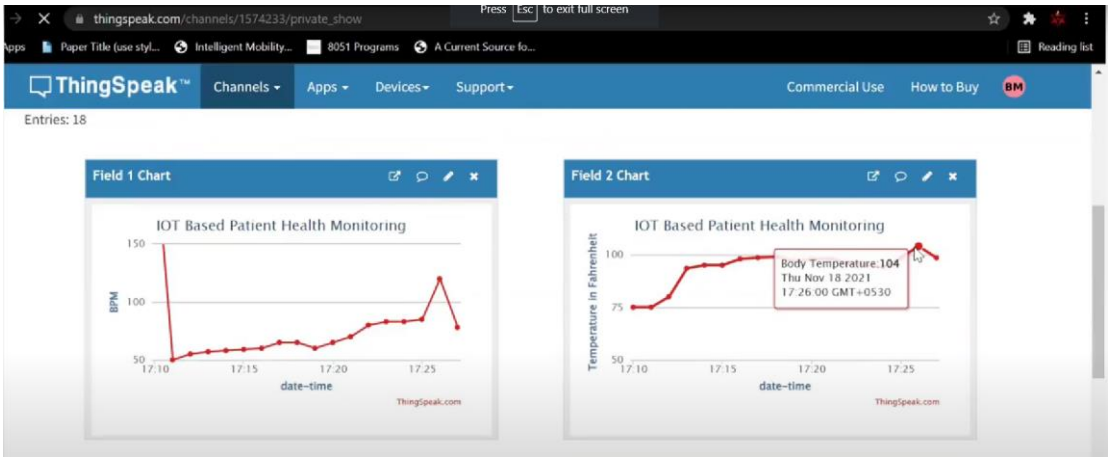
2. The Pulse Rate Sensor clips are kept onto a fingertip or earlobe which is used to measure the heart rate of the patient.

3. LM35 sensor measures the body temperature of the patient.

4. Data collected through the sensor are then sent to ThinkSpeak via internet.

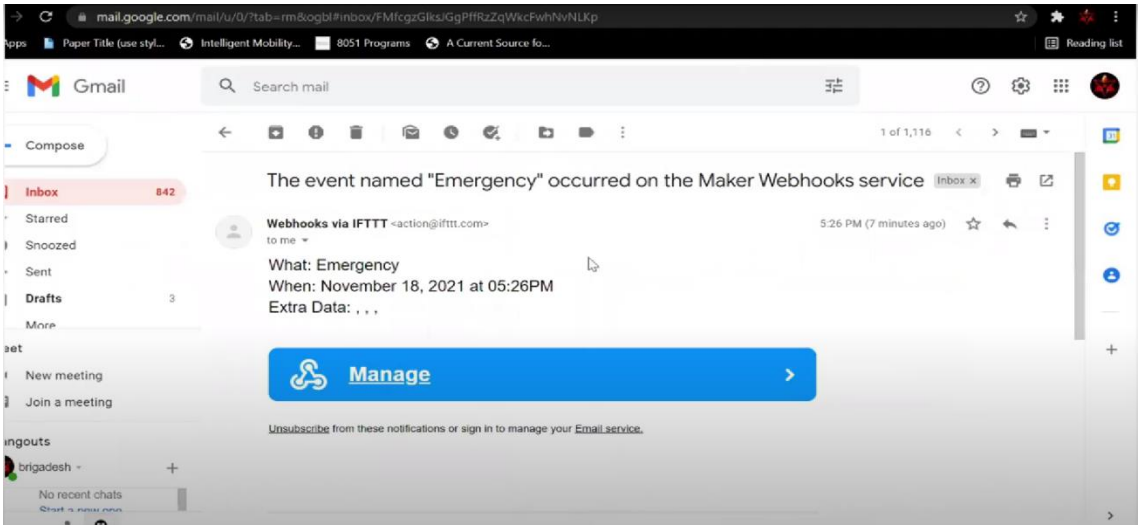
5. ThingSpeak account is setup and Write API Key is generated, Arduino code is written with APIs generated.

6. The data collected from these sensors is stored in the ThingSpeak channel and the output is displayed on the ThingSpeak platform.



7. IFTTT setup and linking it with ThingHTTP and React done during the designing of the project will be collecting all the information of the patient.

8. If the data value is above the threshold then alert email to the registered email-id stating an Emergency has raised.



Features Covered From IoT Point of View

i. **HTTP (Hypertext Transfer Protocol)**: It is a layer application layer protocol which is used for distributed, collaborative and hypermedia information system. It is used by Thingspeak in this project.

ii. **MQTT (Message Queuing Telemetry Transport):** It is an open OASIS and ISO Standard protocol. It is used to transport messages between devices. It usually runs primarily over TCP/IP. It is used by Thingspeak.

iii. **OAuth 2.0 (Open Authorization)**: it is an open standard used by internet users to grant permission to websites or applications to access their information on other websites but without providing the passwords. Used by IFTTT platform in this project.

iv. **ESP8266 Wi-Fi module**: It is a self contained SOC with integrated TCP/I{ protocol stack that can give microcontroller access to your Wifi network. It allows loss free transmission if data. The ESP8266 module enables microcontrollers to connect to 2.4 GHz WI-Fi, using **IEEE 802.11 bgn.**

Results obtained

Video link of the project:
https://drive.google.com/file/d/1M9mG5mgliLHT16ugoOd0uPNgoGvkPf8k/view

Future scope

- Future work might also include improving security by implementing advanced user authentication schemes. And deploying the platform in the real healthcare environment for assessing the framework with respect to user acceptability and performance.

- We can also add Twilio API we can also add a feature of making calls if emergency is there for a long period of time.

- If we are using this project in bigger scale then a better cloud support like AWS or GCP can be used which also helps us to analyse the data more efficiently.

- We can add a GPS module in IOT patient monitoring using Arduino MEGA .This GPS module will find out the position or the location of the patient using the longitude and latitude received. Then it will send this location to the cloud that is the IOT using the Wi-Fi module. Then doctors can find out the position of the patient in case they have to take some preventive action.

References

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