SMART HEALTH MONITORING SYSTEM USING IOT

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Abstract

Smart healthcare monitoring systems have received significant attention in recent research since they are recommended for patients. Monitoring the home patient and continuously supervising their health condition is particularly a difficult task during busy schedules. People, especially the elderly, should be checked and informed about their health state regularly to protect them in life-threatening situations. This paper provides an IoT-based system that keeps track of the health indices of the patients, such as heart rate and temperature along with the temperature and the humidity of the room in which the patient is accommodated, as a patient need to be placed at a certain temperature and humidity to avoid discomfort. If a system detects any unexpected changes or abnormalities in the parameters, it will alert the corresponding caretakers and neighbors via notifications about the patient's condition using open-source software, ThingSpeak.

Index Terms

Smart healthcare monitoring, IOT Devices, ThingSpeak.

I. Introduction

THE IOT-based Patient Healthcare system is a real-time patient monitoring system that has been hugely helpful to the healthcare industry. From a research standpoint, IoT-based smart healthcare devices attracted increased attention from Regular medical examinations become increasingly important as a person's age increases. Individuals may benefit from IoT-based arrangements for frequent health exams because scheduling regular health check-up visits is time-consuming and difficult for most people. As a result, about 15% of the world's population, specifically around 110–190 million elders, are suffering from different unexpected illnesses because of lack of care. Such patients require continuous attention, but nurses and caregivers may not be always available. Hence, the need for smart devices to monitor patient parameters is crucial. The primary goal of this research is to create and deploy Smart Health Monitoring System using IoT that measures a patient's body temperature, pulse, room temperature and humidity. These details can be accessed by the physicians or caretakers from anywhere at any time through an internet application. To treat a patient for any disease, a doctor will need to know their pulse rate. As a result of our recommended strategy, doctors may readily be informed about their patient's health difficulties. This project can quickly monitor patients with changes in numerous tiny circumstances, such as heart rate and body temperature. Although these changes are minor, they serve an important part in establishing a patient's state since they can detect any significant disorders. This project benefits bed-ridden patients the most since they cannot move and must be watched 24/7.

II. LITERATURE SURVEY

For healthcare monitoring devices, there have been several research attempts and real-time implementations. However, we focused only on wearable and wireless healthcare monitoring systems to give healthcare assistance to various community members who work on a regular basis. In general, a wireless healthcare monitoring system can be used to keep in check the health state of patients, the physically handicapped, the elderly, and chronically ill people at any time and from any place. Consequently, anyone may receive correct therapy and improve their health problems without having to contact a doctor on a regular basis. In 2010, Shivam Arora and Dr. Amita Goel developed a microcontroller to monitor heartbeats, respiration, and temperature readings, it also uploads the findings to the online application, displayed on the mobile screen, through the ThingSpeak platform. IoT can also be used to identify whether a person is experiencing symptoms of Covid-19, alerting the person as well as authorities to act[1]. But this doesn't keep track of the conditions the patient is kept in. Also, since all the sensors are wired to Arduino the module is not remote. The disadvantage of this article is that it requires several changes in order to improve device functionality and acquire desired characteristics such as improved costs, increased design complexity, device size, and weight.

Punit Gupta, et al. [2] conducts research on medical care to deliver medical data information by connecting a heartbeat and temperature sensor to the internet through Wi-Fi / Ethernet. A second-generation Intel Galileo board was used in the designed system to track patient data on real-time graphs through a Xampp-based database server to analyze health reports for further monitoring. But this system does not keep track of the main parameters on regular basis and the alert needs to be sent to the caretakers first.

Surya Deekshith, Gupta, et al. [3] explains how to build a healthcare system with a Raspberry Pi. A Raspberry Pi and GSM

module are implemented in this system to observe multiple ECG processes that are tracked to determine the type of disease using a Python-coded algorithm. The data from pulse rate is automatically updated in the website database using Module MySQLdv. Wi-Fi updates are also accessible via USB 2.0 port for network connectivity. But this needs an extra module to send the notifications which might become more complex and might not work for all the sims.
Omar S.Alwan et al. [4] have established a system that uses two transceivers to monitor the body temperature parameter cone. The system is based on wireless communication and consists of two devices: a Raspberry Pi 2 and a Zigbee module, and an Arduino with a Zigbee shield. The main drawback of this paper is the quality of electronic hardware components is low and the cost of those components is high.

III. Proposed System

The Proposed system makes use of various IoT sensors and Wi-Fi modules to keep track of various health parameters in real-time. This can be partitioned into three layers: collection of data, processing of data, and storing the data. The data collection is the data detecting layer that measures various parameters. To detect the heart rate and body temperature, the pulse sensor and the DS18B20 are used respectively. Similarly, the room's temperature and humidity can be measured using the DHT11 sensor. The data collected is then sent to the data logging layer after processing the data. In the proposed system, we made use of the Wi-Fi modules: ESP32 and ESP8266 for transferring the parameter values to the cloud. These values are then reflected in the ThingSpeak cloud by connecting to the Wi-fi modules using the auth code provided by the cloud. Using this, all the health parameters can be monitored in real-time and any emergencies can be immediately detected and notified to the caretakers of the patients.

IV. design and architetcure

A. Design

The basic idea of the project is to send the values obtained from the sensor to the ThingSpeak and sent alerts to guardians in case of abnormalities. Initially, DHT11, DS18B20 and pulse sensor are used to measure the room temperature along with humidity, body temperature and heart rate respectively. The data gathered is then sent to ThingSpeak by establishing the connection using ESP32 and ESP8266 which are the two different Wi-Fi modules. The parameters are now shown in the form of charts and notifications are sent in case of emergencies. Thus, we can say that the system requires minimalistic design. The boards and the sensors need to be covered to protect them from occurrence of any external damage. A proper internet connection is required to continuously monitor and send data to ThingSpeak. Block diagram of the connections and implementations is as shown in Fig 1. The sensors which we are planning to utilize are in the Hardware Requirements section.

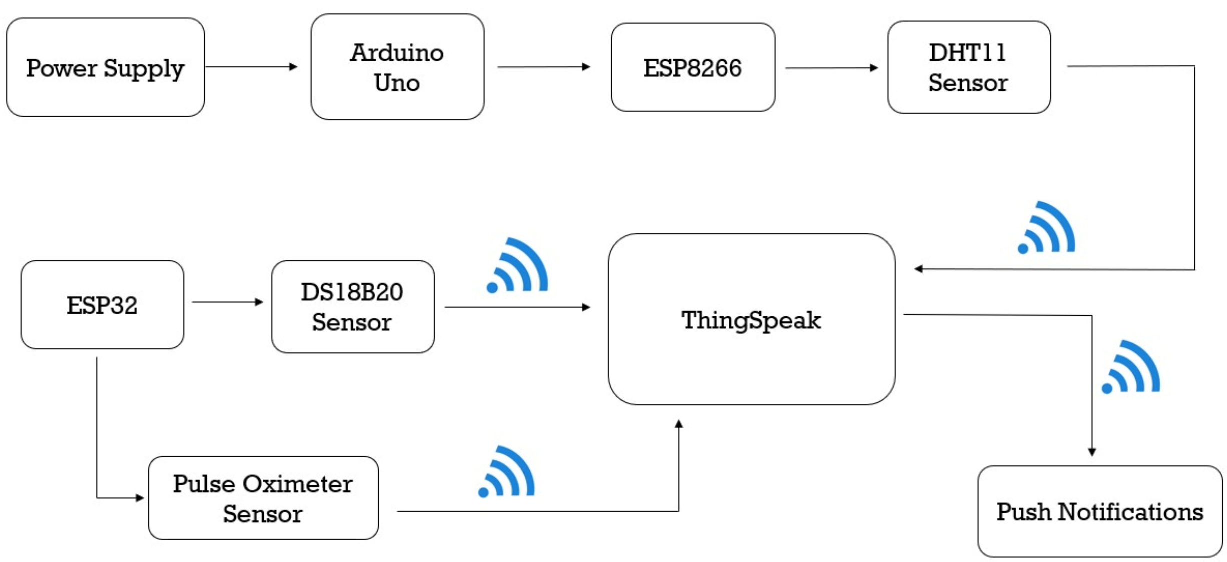

Fig 1

B. Hardware Requirements

(i) Arduino Uno Board - Arduino Uno is an open-source microcontroller board created by Arduino.cc based on the Microchip ATmega328P microcontroller. The board has digital and analog input/output (I/O) pins that can be used to connect to different expansion boards (shields) and other circuits. It contains 14 digital input/output pins, 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header, and a reset button.

(ii) ESP32 – It's a series of low-cost, low-power microcontrollers with built-in Wi-Fi and dual-mode Bluetooth. The ESP32 can function as a stand-alone system or as a slave device to a host MCU, minimizing communication stack overhead on the primary application CPU. Espressif Systems, a Shanghai-based Chinese firm, designed and developed the ESP32, which is manufactured by TSMC using their 40 nm technology. It is the ESP8266 microcontroller's replacement.

(iii) ESP8266 - The ESP8266 is a low-cost Wi-Fi microchip, with built-in TCP/IP networking software, and microcontroller capability, produced by Espressif Systems in Shanghai, China. ESP8266 WiFi Module is a self-contained SOC with an inbuilt TCP/IP protocol stack that can grant access to your WiFi network to any microcontroller. The ESP8266 may run applications or offload all Wi-Fi networking activities to another processor.

(iv) DS18B20 - The DS18B20 digital temperature sensor operates on a single bus and contains a 64-bit ROM for storing the component's serial number. The DS18B20 digital temperature sensor operates on a single bus and contains a 64-bit ROM for storing the component's serial number.

It can connect a large number of DS18B20 sensors to a single bus in parallel.

Introduction of the Pins VCC: 3.3V-5V working voltage DO: data input/ output pin GND: ground

(v) DHT11 - The DHT11 is a basic digital temperature and humidity sensor that is extremely inexpensive. It measures the ambient air with a capacitive humidity sensor and a thermistor and outputs a digital signal on the data pin (no analog input pins needed)

Specifications 3 to 5V power and I/O 2.5mA max current use during conversion (while requesting data) Good for 20-80Good for 0-50 °C temperature readings +-2 °C accuracy

(vi) Pulse Sensor: A pulse sensor is a plug-and-play sensor that is used to detect heart rate data. Athletes, students, mobile and game makers, and others use this sensor. This sensor attaches to an earlobe or a fingertip with jumper cables and links to an Arduino board. The pulse rate can be monitored in real-time using an open-source monitoring program.

C. Software Requirements

(i) ThingSpeak: ThingSpeak is a Ruby-based open-source program that allows users to speak with internet-connected gadgets. By providing an API to both devices and social network websites, it makes data access, retrieval, and logging easier. ThingSpeak was first introduced by ioBridge in 2010 as an IoT application support service. ThingSpeak features integrated support for MathWorks' numerical computing software MATLAB, allowing ThingSpeak users to analyze and visualize submitted data using MATLAB without purchasing a MathWorks MATLAB license..

(ii) IFTTT : IFTTT derives its name from the programming conditional statement "if this, then that." The company sells a software platform that connects multiple developers' apps, devices, and services in order to trigger one or more automations involving those apps, devices, and services.

V. IMPLEMENTATION

The workflow is made up of three main parts: collecting the data, processing the data, storing the data, and finally displaying the data. Data collection is the most important stage because it determines the measuring system's precision and accuracy. The sensors to be utilized in data collection are connected via Wi-Fi modules such as esp32 and esp8266. The Arduino Uno is used only for the power supply. Both Wi-Fi modules are connected to the Wi-Fi network using the SSID and password, and the connection between the modules and the network is verified. The sensors must then be tested to ensure that they function properly. The three sensors used here are DHT11 (for monitoring room temperature and humidity), a pulse sensor (for detecting a person's pulse), and DS18B20 (for checking the body temperature of a person). The Wi-Fi modules are connected to the sensor outputs. After completing the hardware connections, the Wi-Fi modules and sensors are provided with a +5 V power supply.

(i) Capturing Data :-

After completing accurate hardware connections, the patient must hold the temperature sensor to obtain the patient's temperature. The pulse sensor is wrapped around the fingers to provide the module with pulse values, and the DHT11 sensor continuously records the temperature and humidity of the room.

(ii) Processing Data :-

As we are using two different Wi-Fi modules ESP32 and ESP8266, the interfacing of sensors is done separately. DS18B20 and Pulse sensor are connected to the ESP32 module, these sensors are used for calculating the body temperature and pulse of a person, while the DHT11 sensor is connected to the ESP8266 which is used to calculate the room temperature and humidity. The steps of interfacing the sensors are shown below:

ESP32:

1. Downloading and installing the required packages or libraries of DS18B20 and Pulse sensor.
2. After installing, connections are to be made of DS18B20 and Pulse sensor with ESP32 circuit.
3. After connecting, verify the values of sensors, so that they are connected properly.
4. If the connection is successful, values will be shown on the Serial Monitor.
5. Variations in values can be tested by moving our hands.

ESP8266:

1. Downloading and installing the required packages or libraries of DHT11.
2. After installing, connections are to be made from ESP8266 to DHT11.
3. After connections are done properly, the values are verified from sensors so that they are connected properly.
4. If the connection is successful, values will be shown on the Serial Monitor.

5. Variations in values can be tested by placing the sensor in different locations.

(iii)Recording Data :-

Recording the data is the final step of this system. In this step, the communication channel is created on ThingSpeak for saving and recording the data.

1. A ThingSpeak account is to be created.
2. Open a new channel and create your own channel.
3. Getting API Key for that channel from ThingSpeak.
4. Establishing a connection from the sensors data to the ThingSpeak using the API key and Channel number.
5. Once the connection is established, the data is sent to the ThingSpeak continuously.
6. Charts on the ThingSpeak channel shows different values according to the values obtained from different sensors.
7. Later the values are read to the ThingSpeak, and a connection is established from ThingSpeak to the Email using IFTTT(If this then that).
8. In IFTTT, each module is considered an Applet and since there are four parameters, four applets were created.
9. The applets are created for both the "in case" and "that case". So when the "if case" is true then "that case" happens.
10. Here the "if case" takes place when the sensors read a value below the Threshold level and the "that case" is sending the email alerts to the Guardian.

The sensor values from the Wi-Fi modules are now transferred to the ThingSpeak which shows the measurements. The essential information is provided on the screen while also being stored in the cloud for future reference when a channel is opened on ThingSpeak. The data is shown on screen and is also saved in the cloud, where it may be retrieved by doctors for further study.

Source Code: https://git-classes.mst.edu/mkvdx/smart-health-monitoring-system-using-iot.git

VI. Results

To determine the capabilities of the healthcare monitoring system, the prototype was evaluated with different patients. We are considering four parameters for performance analysis, namely heart rate, body temperature using esp32 and room temperature and humidity using esp8266. The success is assessed by sending the data to Thinspeak and alerting the Guardians by using available sensors. The obtained values are graphed in ThingSpeak, and if any irregularities are detected, notifications are sent. The below figures 2-7 depicts the results obtained from the implementation of the project.

Fig 2

Fig 3

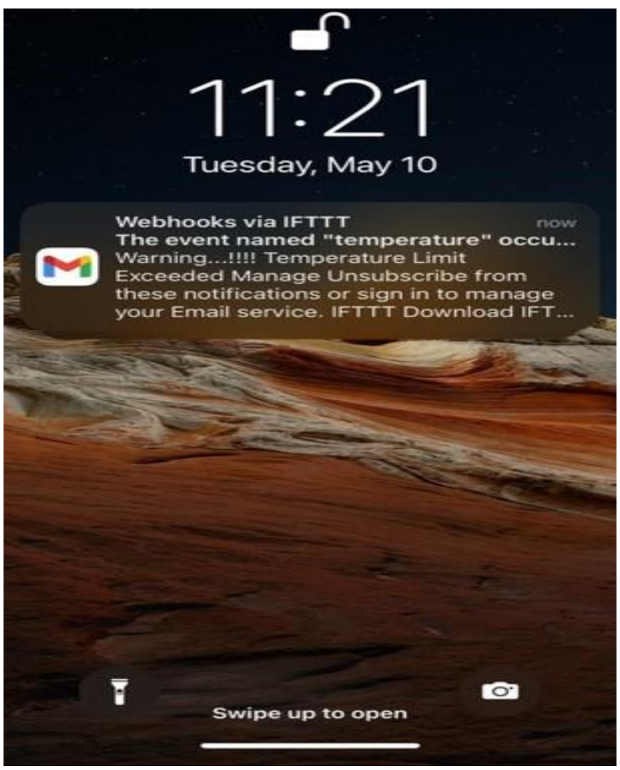

Fig 4

Fig 5

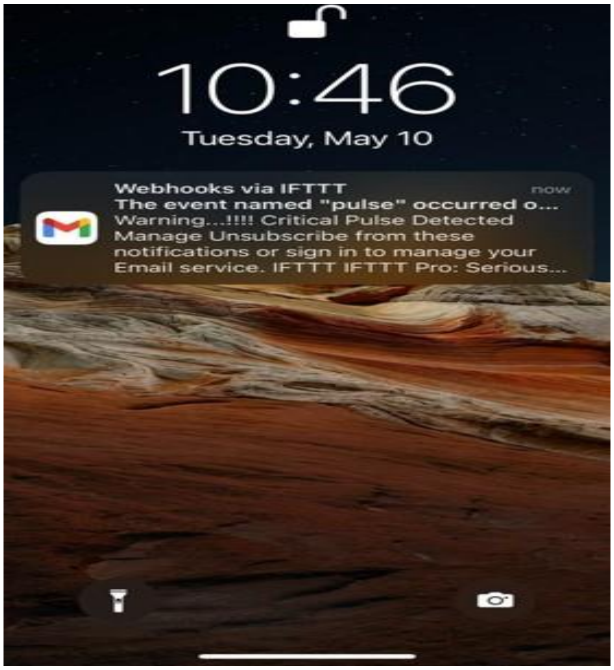

Fig 6

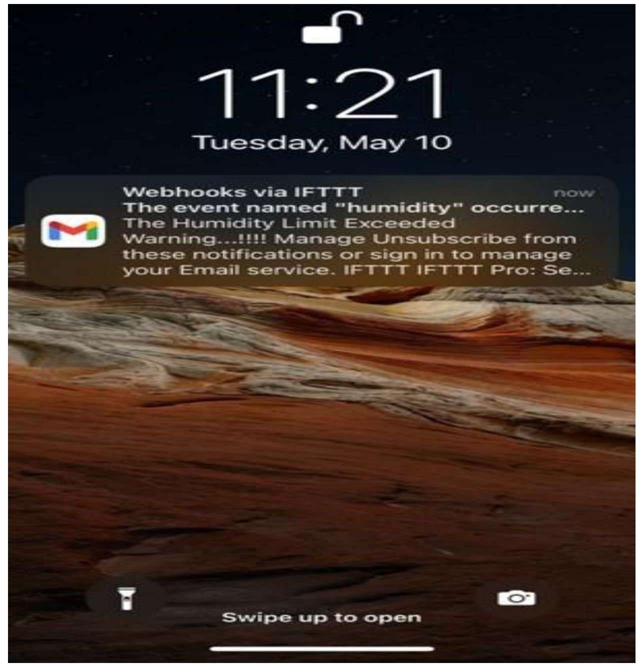

Fig 7

VII. Observation

In this project, we have used technology to make a patient's life simpler for diagnosis and treatment by monitoring his heart rate and temperature, along with the temperature and humidity of the room he is placed in. The data acquired by the sensors is wirelessly transmitted to the ThingSpeak cloud, allowing the caretaker to monitor the patient's status 24/7 and be notified of any abrupt changes in his condition via a toast notification. Apart from this, as the information is stored on the ThingSpeak server, authorized individuals can check on the patient's status remotely. Thus, contactless patient tracking and treatment are fairly feasible using our proposed work since it allows the caretaker to keep track of patient health metrics just by receivingthe alert notifications.

VIII. FUTURE ENHANCEMENTS

At present, we are using only three sensors. In most real-world scenarios, other accurate sensors can also be included to track the patient's vitals and a high-power source can be employed to keep them stable. Also, we are now using two different Wi-Fi modules but, in the future, all the functionalities can be implemented wirelessly using a single Wi-Fi module. A complete and full-fledged app can also be created to display the values and to sending the alert notifications. In the case of an emergency for a patient traveling alone, GPS tracking may be integrated with the app. With this GPS Monitoring, the notifications can be delivered even if the patient is traveling. Furthermore, we can establish communication with the nearest hospital so that in case of any emergency, an ambulance can be sent.

IX. References

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