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A Novel Smart Health Monitoring System

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***ABSTRACT*-- Internet of Things provides better medical facilities in healthcare systems. It is a fast-growing, user-friendly technology that allows everything to be connected and allows effective communication between the connected "things". IOT helps connect the people by smartly empowering their health and wealth through wearable gadgets. The proposed system communicates via network-connected devices and looks at the patient's health and records their medical information. This system will be active 24 hours and provides medical aid to the patients even within the areas with no hospitals in their regions by connecting over the web. The system acquires information about their health status via wearable devices that record their pulse and temperature. The obtained values are transferred to the cloud for easy access. The patient history will be stored in the webserver, and the doctor can access the information whenever needed from any corner of the world.**

***Keywords*—Internet of things, thingspeak, smart health, Arduino Uno, pulse sensor, heart rate**

I INTRODUCTION

The use of smart devices and mobile technologies` in health has caused a significant impact on the world. Health experts continuously take advantage of these technologies, thus generating a considerable improvement in health care . Likewise, Most of the ordinary users are being served from the benefits of the E-Health (health care supported by ICT) to improve for help and assist their health. According to the World Health Organization,the highest attainable standard of health is a fundamental right for each and every individual. As this genuinely inspires us, we decide to propose a novel system that puts forward in smart patient health monitoring system which uses sensors to track vital patient parameters and uses the Internet to update the doctors to help in case of any issues at the earliest preventing death rates.

Patient Health monitoring using IoT is a growing technology to enable the monitor of patients (e.g. in the home), which may increase the access in health care and decrease healthcare delivery costs. This significantly improves the individual's quality of life. It allows patients to take care of their independence, prevent complications, and minimize personal costs.

This system facilitates these goals by delivering care right to the house. Also, patients and their family members feel comfort knowing that they are being monitored and supported if a problem arises. Pulse and sign are the two most significant indicators for human health. Rate is that the per-minute amount of heartbeats commonly called the heartbeat rate. To measure the heartbeat rate, an increase within the blood flow volume will be utilized by calculating the pulses. IoT based smart health monitoring systems aim to target the standard design and implementation patterns of intelligent IoT based intelligent health monitoring devices for patients. In this system, a device is designed to measure vital values such as heart rate and body temperature, directly affecting patient health. The temperature sensor and the pulse sensor on the device monitor related data from the patient's fingertip analyzed with the Arduino UNO. These analysis results are transferred to the "Smart Health" interface, created with the Thing speak cloud network, which provides a platform to quickly collect and analyze data from the sensors connected through the Internet. The data is displayed on the webserver. When the patient's vital parameters reach critical levels, an audible-visual alert is sent to the patient and family members via Thing speak. The device's primary purpose is to increase the chances of survival by providing medical assistance to the patient within the first few hours in case of a possible heart attack.

II EXISTING SYSTEM

In the existing system, the people in the rural areas or the underdeveloped countries face the lack of treatment and health care services in time. Essentially the elderly patients face the barriers of regularly attending the clinic or to have the extended stay in the hospitals some of the chronically ill or bedridden patients undergoes the harsh life of wearing the wired sensor every time and not able to move and easy walk with the wires on their body all time. In addition to that travelling is one of the burdens. Hence our project is cost-effective and reduces all the barriers which the patients are facing it saves time and flexibility..

III METHODOLOGY

A. Problem Description

Now a day's patients are facing problematic situation due to specific reason for heart problems and attacks, which is because of the nonexistence of good medical maintenance to patients at the needed time. Thus, the system uses Temperature and Heartbeat sensor for tracking the patient's health. The sensor is connected to the Arduino to follow the patient health and WiFi connection to transfer the data to the webserver. Doctors and patient relatives can see their patient health condition whenever needed from the corner of the world.

B. Objective

In this project, a wireless patient monitoring system is developed that allows patients to be mobile in their social areas. The developed system continuously measures the patient's heart rate and body temperature and provides monitoring and tracking through a web server. The device's primary purpose is to make provision that they get medical aid as soon as possible.

C. System Architecture

The proposed system of IoT based heath monitoring system consists of Arduino microcontroller which is the brain of the project. Arduino collects real time data of patient's health from pulse sensor which measures heartbeat in minutes or BPM (beats per minute). A digital temperature sensor connected to Arduino measures temperature of the patient's body. A generic ESP8266 IoT module is connect to Arduino UNO, it is responsible for connecting the machine to internet and also for sending health data to a IoT server (Thingspeak) for storing and monitoring. This is useful for a healthcare professional for active monitoring of a patient on site.

Fig.1 shows the basic architectural design of the smart health monitoring system.

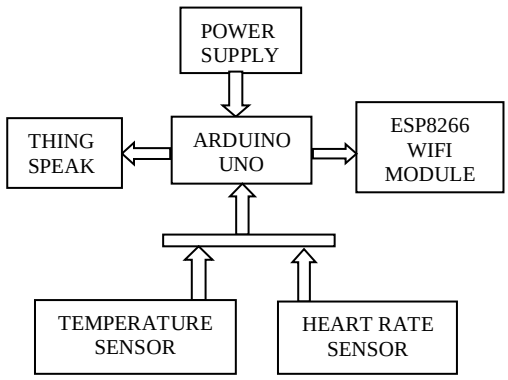

Fig.1 System Architecture

Arduino UNO

Arduino Uno is a microcontroller board which is based on the ATmega328P (datasheet). It contains everything that needs to support the microcontroller. Connect the Arduino UNO to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Fig.2 Arduino UNO

Heartbeat Sensor

The heart rate is detected by the reflection of the light which is emitted by the green LED on the APDS-9008 light sensor. Fig.3 shows the front and back sides of the pulse sensor.

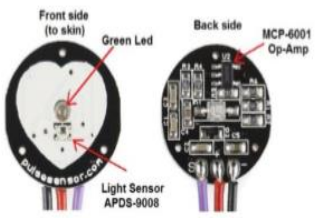

Fig.3 Pulse Sensor front and back sides

LM35 Temperature Sensor

In LM35 Temperature sensor, the output voltage varies, supported by the temperature around it. Fig 4 shows the Pin Configuration of LM35 Temperature Sensor respectively.

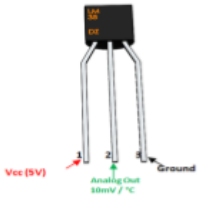

Fig.4 LM35 Temperature Sensor

ESP8266 Module

Fig.5 shows the ESP8266 Module which is a very user friendly and low-cost device to provide internet connectivity to your projects. The module can work both as an Access point (can create hotspot) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it to the internet making Internet of Things as easy as possible.

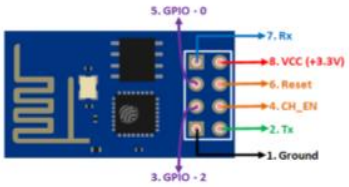

Fig.5 ESP8266 WiFi Module

Thingspeak

As in Fig.6, ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize and analyse live data streams in the cloud. ThingSpeak provides instant visualizations of data posted by your devices to ThingSpeak. With the ability to execute MATLAB® code in ThingSpeak you can perform online analysis and processing of the data as it comes in. ThingSpeak is often used for prototyping and proof of concept IoT systems that require analytics.

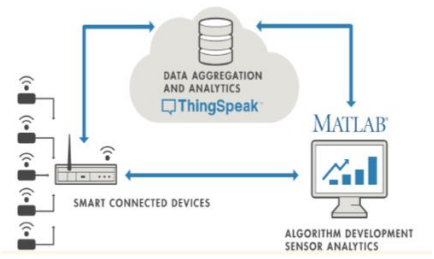

Fig.6 Thingspeak Network

ThingSpeak provides an excellent tool for IoT based projects. Using the ThingSpeak site, we can monitor the sensed values and control the system over the Internet, using the Thingspeak Channels and webpages provided by ThingSpeak. ThingSpeak Collects the data from the sensors, Analyses and Visualizes the data, and acts by triggering a reaction. The following are the steps for channel creation in Thingspeak.

Step 1: First of all, We Create an Account on ThingSpeak.com, then Sign In and click on Get Started.

Step 2: Now go to the 'Channels' menu and click on New Channel option on the same page for further process.

Step 3: Now, we saw a form for creating the channel, fill in the Name and Description as per our choice. Then fill 'Pulse Rate', 'Temperature' in Field 1, Field 2 labels, and tick the Fields' checkboxes. Finally, Save the Channel. Now our new channel has been created. Fig.7 shows the channel creation.

Step 4:- We will see two charts and two gauges, as shown below. Note that the Write API key will use this key in our code.

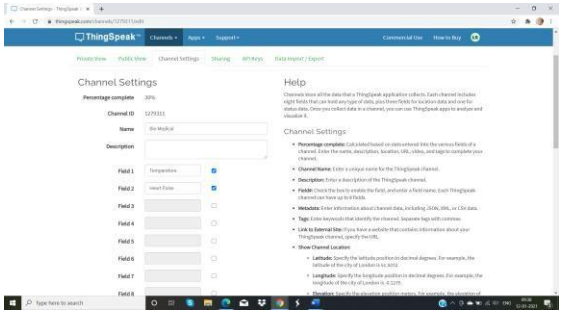

Fig.7 Channel creation

IV IMPLEMENTATION

A. Circuit Diagram

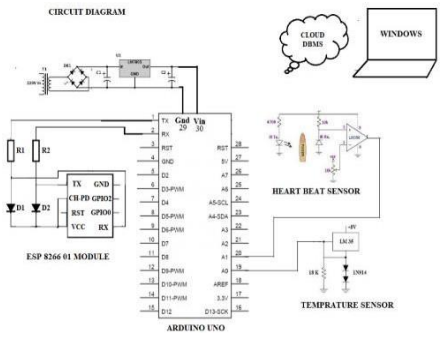

Fig.8 Circuit Diagram

The Arduino is responsible for collecting, displaying and sending the data to ESP8266. The

whole circuit can be powered using USB or via "Vin" pin (9V-12V). The ESP8266 module is a microcontroller board with RAM, ROM, clock, communication protocols, and I/O pins just like any other microcontrollers and needs to be programmed to make it functional. Arduino collects and sends patient's data to the ESP8266 Module. It will connect to its designated server that is programmed to it and passes it. Measuring body temperature can reveal a lot about the patient's health, and a healthcare professional can identify abnormalities in a patient's health.

1. Connect Pulse Sensor output pin to A1 of Arduino and other two pins to VCC & GND.

2. Connect LM35 Temperature Sensor output pin to A0 of Arduino and other two pins to VCC & GND.

3. The RX pin of ESP8266 works in 3.3V and will not communicate with the Arduino when we connect it directly with the Arduino.

The 5V into 3.3V. This can be done by connecting 2.2K & 1K resistor

4. The RX pin in the ESP8266 is connected with the pin 10 of Arduino through the resistors.

5. Connect the TX pin with the ESP8266 to the pin 1 of the Arduino.

B. Experimental Setup

The system is implemented by using the combination of hardware components and web server. All the hardware requirements are assembled in the working phase. The proposed system is demonstrated in Fig.9.

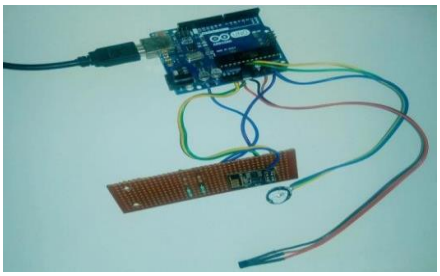

Fig.9 Smart heath monitoring system

IOT patient monitoring has two sensors. The temperature sensor and the Heartbeat sensor. This project is useful since the doctor can monitor patient health parameters by visiting a Thing Speak website. Now the doctor or family members will monitor or track the patient's health through the Android apps. To operate an IOT based health monitoring system project, we need a WiFi connection.

The microcontroller or the Arduino board connects with the WiFi network using a WiFi module.This project will work with a working WiFi network. So we create a WiFi zone using a WiFi module, or you can even create a WiFi zone using Hotspot on our mobile phone. The Microcontroller continuously reads input from these two senses. Then this values sends to the cloud by sending this data to a particular URL/IP address. Then, sending data to IP is repeated after a specific interval of time. For example, we have sent data every 30 seconds in this project.

In this project, we will send the LM35 temperature sensor data and heart rate sensor data to ThingSpeak using the ESP8266. ThingSpeak is an IOT platform that lets us store the data in the cloud and develop the Internet of things (IOT) applications.

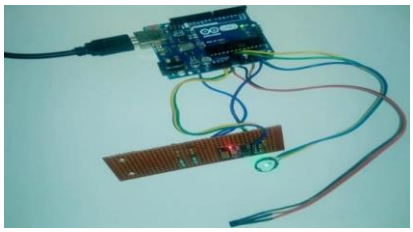

Fig.10 Connected Components in ON Status

C. *Thingspeak Setup*

To create a channel on thingspeak First, go to ThingSpeak.com and click on "Get Started for Free". Then the sign-up form will come up enter the information required and sign up for thingspeak. After that, click on "New Channel" to create a channel to store the information. Fig.11 shows the information about the new channel. After that, go to the API keys section in thingspeak and copy that write API key and include this API key in our code.

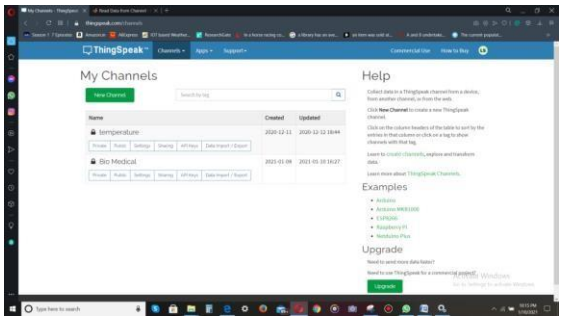

Fig.11 Smart Health Monitoring Channel

V RESULT

The user prototype is depicted in Fig.12, where the system is tested with one user. It shows that one user's hand is attached with body temperature sensor (LM35), Heart rate sensor and the data displayed in the webserver.

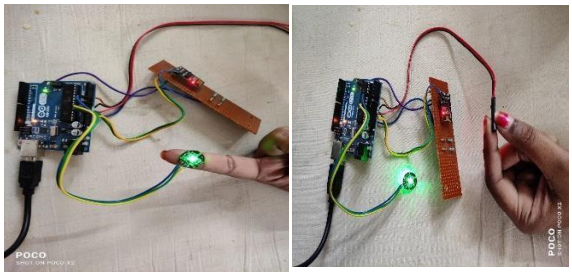

Fig.12 Prototype

After connecting the circuit and uploading the code in Arduino IDE software, the following graph shown in Fig.13 is generated in Thingspeak dashboard.

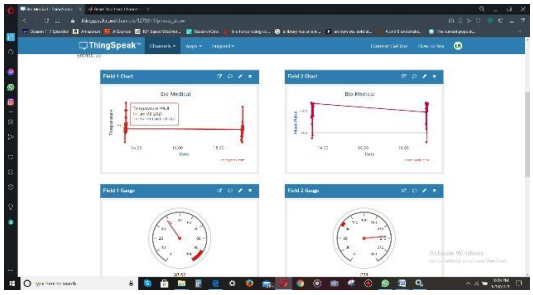

Fig.13 Temperature and heart rate sensor chart

After uploading and running the Arduino code, It should be connected with our WiFi and begin sending data to thingspeak about every 30 seconds. If any sudden changes happen in temperature values, the temperature widget which is shown in Fig.14, should be alert by turning on a red colour.

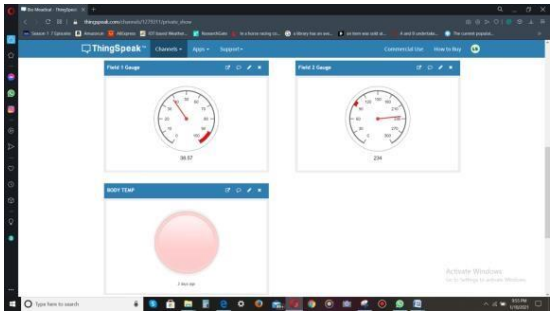

Fig.14 Temperature Widget

VI CONCLUSION AND FUTURE DEVELOPMENT

A. Conclusion

The health monitoring can be positively used in emergencies as it can be daily monitored, recorded and stored as a database. Patient health parameter data is held over the cloud. It is more advantage than maintaining the records on printed papers kept in the files. This device is used monitored and keep track of changes in the patient's health parameters over the period. So doctors can reference these changes or the history of the patient while suggesting the treatment or the medicines to the patient. Hospital stays and visit for daily routine are minimized due to remote monitoring system.

B. Future Development

We shall add GPS module in IOT patient monitoring using the Arduino Uno and WiFi module project. This GPS module will determine the position or the location of the patient using the longitude and latitude values will received. Then it will be send this location to the cloud webserver that is the IOT using the WiFi module. Then doctors can find out the patient's position in case they have to take some preventive action.

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