

Smart Wearable Real Time Health Monitoring System using IOT and Cloud

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Abstract—Technology is changing our world rapidly. Over the years technology has transformed various sectors ranging from telecommunication to entertainment to health-care. With advancement in technology and production of compact and portable sensors, there have been attempts to use new technologies in multiple domains to improve human quality life. The health-care industry is one of the key areas of research where the technology has been adopted. IoT principles have been widely employed to connect existing medical resources and provide patients with smart, dependable, and effective healthcare services. In this paper have made an attempt to present an IoT architecture customized for healthcare applications. The prevalent healthcare model is mostly in-hospital based and includes periodic visits that might prove to be strenuous to patients. The aim of this work is to present a remote healthcare monitoring system especially for older and Chronic Heart Failure(CHF) patients to daily collect vital signs at home and send them using Internet of Things (IoT) and is later stored in the cloud using ThingSpeak. This allows the doctor to keep an eye on the patient from afar and take timely action if necessary. In the process we have identified a set of four parameters, i.e. Oxygen Saturation (SpO2), Pulse rate, Temperature and Position detection by using wearable sensors. These sensors are connected to a Raspberry Pi. The microcontroller acts as a server once it gets connected to internet and sends data to ThingSpeak cloud. All of the variables can be detected and tracked on any mobile device connected to the same network, including laptops and smartphones.

Index Terms— Max30100 sensor module, Raspberry pi, Accelerometer, LCD, Temperature sensor, GPS module, GSM module, and ThingSpeak.

I. INTRODUCTION

All are necessary for the life. In all these six major elements, oxygen contains 65% in a human body. Human breath oxygen because it is needs to burn the fuel [sugar, fatty acids] in our cells to produce energy. “Oxygen is also a particular important part of immune system. It kills bacteria and feeds the cells that make up the human body's defence against viruses and other intruders.

Oxygen is introduced into the lungs by breathing. Where it is transport by red blood cells to entire body to be used to produce energy. For Healthy person needs oxygen in the range 95% to 100%” [1]. When blood oxygen levels are low, it can be a sign of hypoxemia. This means there is a difficulty in delivering the oxygen to all of its cells, tissues, and organs in the body. Asthma, heart illness, anaemia, chronic obstructive pulmonary disease, pneumonia, euphoria, and high blood pressure can all be caused by low blood oxygen levels. Hence people require to monitoring the oxygen saturation in the blood regularly. “Heart rate for adult males on an average is

70 bpm and for adult females on an average is 78 bpm” [2]. The Internet of things is the inter-connected of devices, apps, sensor and exchange data. This project demonstrates the Remote Health Monitoring Program run by Raspberry pi. A system is meant to monitor vital factors such as heart rate, oxygen saturation, and body temperature on a continuous basis. SMS based on patient-oriented views and IOT-based patient evaluation framework. In an Io-based framework, hidden parts of a growing patient can be seen in a variety of clients. By using GPS can helps to find the location of the patient. GPS are used to detect the Latitude and Longitude of any location on the Earth. This device receives links from satellites each second, and time and date which helps to locate the exact location of the patient.

II. LITERATURE SURVEY

[1] “IoT Based Health Monitoring System” by V Tamilselvi , S Srihalaji, P Vigneshwaran, P Vinu, J. GeethaRamani

The device designed monitoring for real time health parameters. It is more acceptable to use GSM and IoT to determine a patient's condition or condition. Temperature, heartbeat, eye blink, and SPO2 (Peripheral Capillary Oxygen Saturation) sensors are used in the devised device method to obtain the patient's body temperature, coronary heart rate, oxygen saturation percentage, and eye movement. The system use ARDUINO-UNO board as a microcontroller as well as the Cloud computing technology. The accelerometer sensor used to get body movement of the patient. The collected vital parameters from the patient's body are sent to the legal individual's smart phones and laptops via a cloud server. These records can be stored and evaluated for further assessment and monitoring of a patient's health.

[2] “Development of IoT Heartbeat and Body Temperature Monitoring System for Community Health Volunteer” by Saowakhon Nookhao, Vipha Thananant, Thanakorn Khunkhao

The heartbeat and body temperature monitoring system is designed for the patient's who suffers from the cardiac disease and frequently they need to visit hospital regularly for a regular health checkup. The system is made up of two parts portable measuring equipment and an Android app. People's heart rates and body temperatures can be measured with the portable measuring gadget. The device uses Arduino board that connects the heartbeat and temperature sensor. Microcontroller displays the heartbeat and a temperature value on LCD and at the same time using Wi-Fi module sends data to ThingSpeak IoT platform. Using the Firebase database, the Android application can maintain track of all measurement devices and community member records. It also displays a graph of heart rate and temperature measurements in real time as well as at predetermined intervals, such as a day or week.

[3] “IoT based Real Time Health Monitoring” by Vani Yeri, D.C. Shubhangi

The device designed to check vital parameters by inserting on the patient's body. By using sensor like, Heartbeat, GSM sensor, ECG sensor, and Temperature sensor helps to collect all the parameters and then processed by Arduino- UNO microcontroller. The processed data are stored in the cloud via WIFI module. If sensor data is not within acceptable range then a warning message is sent to the mobile application. Then the doctor can take action immediately. But the drawback is they can also use GPS tracker to tracker the location of the patient.

III. METHODOLOGY

Using SPO2, temperature and accelerometer sensor helps to collect the real time data and stored in the server. Since data are in analog first need to convert all the collected data into digital using convertor IC. Max30100 helps to collect heartbeat and also the oxygen saturation in the blood (spo2). The Raspberry Pi 3 serves as a central server to which all sensors are wired through GPIO pins or the MCP3008 analog-to-digital converter if the sensors' output

is analogue, as the Raspberry Pi only deals with digital signals. The pi reads the real values and with the help of wireless LAN and Bluetooth facility by which can setup WiFi Hotspot for internet connectivity stores the data in the ThingSpeak. Whereas ThingSpeak is an open source Internet of Things (IoT) platform, it has the ability to collect data in real time and visualize it in the form of charts. This module also supports with the measures to be done after an irregularity in a patient's health is discovered, such as contacting his or her family members as well as the hospital via GSM and GPS. When patient get falls will trigger an alert in the form of SMS and also the location of the patient to the patient's family/doctor using GSM and GPS module respectively. So that the doctor can instantly take the action immediately.

IV. SYSTEM ARCHITECTURE

In block diagram max30100 sensor consist of IR and RED LED with photodetector.

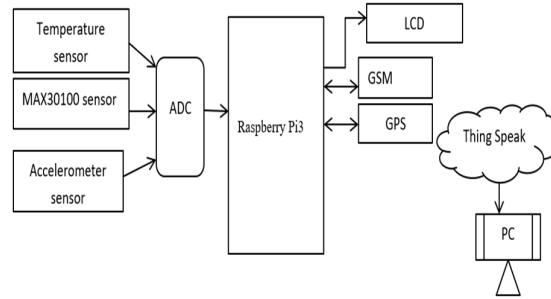


Figure1: Block diagram of a proposed system

When a user place a fingertip on the IR and RED LED the photodetector detects and light gets penetrate into the fingertip and provides the oxygen saturation and also heartbeat value to the microcontroller. Then convert those values into digital using ADC. The microcontroller processes all the sensor values and using in build WiFi module in the raspberry pi 3 sends all the values to ThingSpeak. Where ThingSpeak is an IoT and cloud platform which is used to store and retrieve the data. Then user can visualize their sensor data using MATLAB's several build-in plots or display data in charts, or custom plots. The stored data can be send to doctor to take medication.

Hardware Description

A. RASPBERRY PI 3

It's a single-board computer that runs the LINUX operating system. The microcontroller has 1.2 GHz clock frequency and has 1GB internal Ram features. It works on 3.3v to 5v of operating voltage. "The feature enables to send data to the cloud is inbuilt wireless LAN and Bluetooth facility, which can help to connect WIFI HOTSPOT. For Internet of Things this feature is best suited"[6].

B. Max30100 sensor

The MAX30100 is a multi-purpose sensor used by many applications. The sensor can be used to monitor the heart rate and oxygen saturation in the blood. "It contains a pair of Light Emitting Diodes like, RED and IR LED. Along with that it comprises of Photo Detector and a series of low noise signal processing devices to detect heart rate and pulse oximetry. The operating voltage is in between 1.8V to 3.3V" [7].

C. Accelerometer sensor ADXL345

The ADXL335 works with low power, small, 3-axis sensing accelerometer. In tilt-sensing applications, it can detect gravity's static acceleration as well as dynamic acceleration produced by motion, shock, or vibration. With a full-scale range of ± 3 g, used to measure the acceleration. The voltage used for operation is 3V to 6V DC and current is 350 μ A [8].

D. LM35 Temperature sensor

The output voltage of the LM35 series of integrated-circuit temperature sensors is proportional to the temperature in Celsius (Centigrade). The sensor has a features of low output impedance. It draws only 60 amps from its supply and has a very low self-heating of less than 0.1°C in still air. The LM35D has been tested to work in temperatures ranging from 0° to +100°C [9].

E. GSM/GPRS Module

GSM is a technology that allows a computer and a GSM system to connect. Global Packet Radio Service (GPRS) is a GSM extension that makes data transfer rates high. The GSM module integrated with power supply and communication facilities for a computer. GSM is a sort of wireless MODEM device used to communicate with a computer over a GSM or GPRS network. It requires a SIM card (Subscriber Identity Module) as a mobile device to activate a network To initiate a network connection, a mobile device must have a SIM card (Subscriber Identity Module). They also have IMEI (International Mobile Equipment Identity) numbers to identify them, similar to mobile phones [9].

F. GPS Module

“The Global Positioning System (GPS) used for navigation. Module checks its location on the earth and provides latitude and longitude of its position. The supply voltage required is 3.6v” [10].

V. RESULT

The hardware implementation of the proposed system is shown in Figure2. For testing, the sensors are connected to a patient. The readings of the sensors are displayed on the LCD and the real time data is stored in the ThingSpeak.

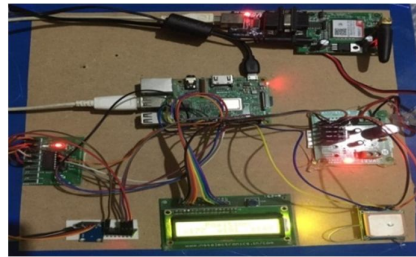


Figure2: Hardware connection of the system



Figure3: Temperature value on LCD



Figure4: Pulse and SPO2 real time value on LCD

The Figure 3 and Figure 4 show the output of the Temperature, Heartbeat and SPO2 value on LCD respectively.

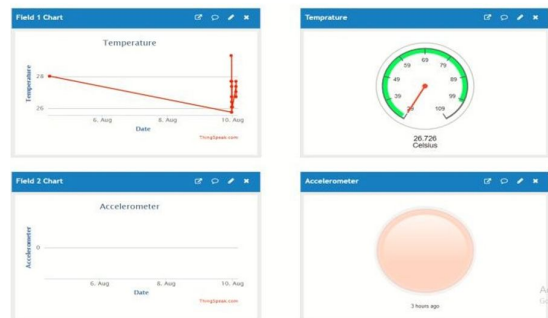


Figure5: Temperature and accelerometer data in ThingSpeak

All the values are stored on the server and the most recent value is displayed on the ThingSpeak. Figure 5 and Figure6 shows the real time data of temperature, accelerometer, pulse rate and SpO2% value in the ThingSpeak.

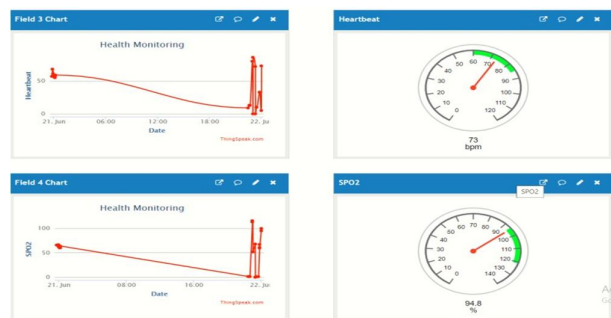


Figure6: Pulse and SPO2% data in ThingSpeak

Figure5 show the SMS result of the patient. when Patient's fall down it will trigger the sms alert with all the parameters to a family and also to concerned doctor. So, the doctor can immediety can take action and also with the help to lattitude and longitude can track the patient location.

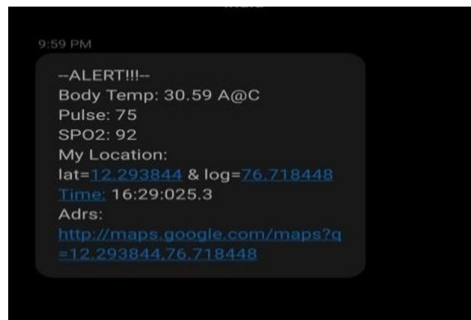


Figure7: SMS Alert

VI. CONCLUSION

The proposed system is implemented for wireless health monitoring of the patients. Raspberry pi can be used as a gateway for the IoT and sensor node. The given system is helpful for the people suffering from the chronic diseases like cardiac arrest, asthmatic, COVID-19, osteoporosis problems. The system supports to view real time data, remote monitoring of the people and gives the location of the patient. The health parameters depend upon the climate, age of the person and stamina. When a patient suddenly falls down emergency alert message will trigger to the caretaker and also to a concern doctor with all the parameters including the location of the patient.

FUTURE WORK

In future work, the system could be expanded into one complete model that the patient could easily handle everywhere. Instead of ThingSpeak can use other technologies also, like Google IoT platform, Thinger etc. There is a possibility to improve the system by adding a few more sensors with different microcontrollers.

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