

IoT Based Remote Health Monitoring System for Patients and Elderly People

YOUSUF NASSER AL HUSAINI, MOHAMMED AL NUAIMI, SHERIMON P.C
Department of Computer Studies, Arab Open University, Muscat
OMAN

Abstract— Since the aging global population is increasing day by day, the need for proper and better elder care has become necessary to promote active and healthy aging. Assistance is very helpful for them during this period. For that, constant monitoring is a must. Most of them are suffering from aging-associated diseases like dementia, Parkinson's disease, Alzheimer's disease, etc. IoT has proved its crucial role in supporting the elderly using the latest technological advancements which make eldercare hassle-free. The main objective of the project is to design a health-based monitoring system for the elderly which makes it easy for their caretakers to monitor their health conditions from time to time. This health-based monitoring system monitors the values of their Spo2, heart rate using MAX30100 module and temperature levels using LM35 module. Any variation from the normal value would alert the caregivers about them. The fall detection sensor detects a fall during their movement and alerts the concerned authorities if detected any. Alerts are sent through GSM Module and IFTT web application. In this paper we will be discussing the working, implementation of the sensors and the application used in the system. The results of this system showed good accuracy with high performance for every sensor we used.

Keywords— Health-based Monitoring System, Spo2, Heart rate, Temperature, Fall detection, Alert

Received: June 18, 2021. Revised: April 27, 2022. Accepted: May 29, 2022. Published: June 27, 2022.

1. Introduction

IoT is a leading, innovative and exceptional technology that offers substantial development, influence and possibilities [1]. The Internet of Things (IoT), which allows ordinary objects to achieve understanding and to interconnect, is regarded as the upcoming development of the Internet [2]. The awareness about the IoT technology provides flawless combination of cyber world with our physical world and will basically qualify and boost human interconnection around the planet [3]. In this paper, we are illustrating the working and implementation of an in-home health-based monitoring system for the elderly people by using different sensors. In this scenario, it would be really helpful for them and their caretakers to monitor their health conditions whenever necessary.

2. Literature Review

2.1 IoT Based Remote Health Monitoring System

Internet of Things is enhancing a new experience in the field of health by implementing it in a reachable and cost-effective manner. Utilizing the true advancement in IoT technology, challenges faced by the aged people for consulting a doctor can be overcome. This has paved the way to the prototype of an IoT-oriented remote health monitoring system for these people. It comprises of heart rate sensor, body temperature sensor, and galvanic skin response sensor. All of these sensors were integrated into one system

with Arduino UNO and Raspberry Pi. Every result from the data is being sent to the cloud storage through raspberry Pi and the cloud storage is being updated in a real-time database. This data is accessed using an android application along with a graphical representation of the health results. Making such IoT devices as wearable and portable reduces the need for hospital visits to an extend and doctors can prescribe medicines monitoring the persons results through the application [4].

2.2 Intelligent assistance for elderly with dementia

Even though dementia is a normal disease among aged people, it has an indefinite number of symptoms like memory loss, lack of concentration, change in behavior and character. This paper has focused on promoting the life of these people self-dependent by developing an integrated system that allows collecting, recording, and transferring of data from the sensors placed at the house through the cloud application. Evaluation and transmission of data are performed here entirely using IoT over the internet [5].

2.3 A Fall Detection System

In this context, we can see an IoT-based project that senses the fall of elder people. The most interesting components used in this project are Low-power wireless sensor networks, smart devices, big data, and cloud computing. a 3D-axis accelerometer

placed into a 6LowPAN wearable device is used to receive data from movements of the elderly people in real-time. Big data comes into the place where high efficiency in fall detection is considered. It runs on a smart IoT gateway. The moment a fall is detected an alert is initiated and the caretakers are notified automatically. This system also comprises cloud-based services that allow health authorities to acquire data for further analysis and also utilizes this data to develop a new machine learning model based on each fall being detected [6].

3. Configuration and Setup

Setting up of ESP8266 and ARDUINO UNO:

1. Download Arduino IDE software and install it.

2. After setting up, for ESP8266 select NodeMCU 1.0 (ESP-12E Module) and for ARDUINO UNO select Arduino Uno from the board manager and corresponding ports from toolbox.

3.1 MAX30100 SENSOR

This sensor operates at a voltage of 1.8V-5.5V and has two LED's, one emitting a red light and other infrared light. Infrared light is used for the pulse rate and both these lights are used for measuring the oxygen levels in the bloods. The sensor reads the absorption levels for both light sources and stores them in a buffer which is read by I2C. It is processed by doing test trials. SpO2 and heartbeat values are done using the index finger, forehead and temporal bone [7]. The following is its wiring setup:

MAX30100	ARDUINO UNO
VIN	5V
GND	GND
SCL	A5
SDA	A4
INT	D2

Wiring diagram is shown in Fig 2

3.2 LM35 SENSOR

LM35 is a temperature sensor that gives temperature within a range of -55C to 150 C. It is a three terminal device that gives an analog voltage proportional to the temperature in Celsius. This analog value is converted using NodeMCU ADC. LM35 Temperature Sensors operates in a way which converts a temperature value into a voltage value [8].

The following is its wiring setup:

LM35	ESP8266
+Vcc	3V
Vout	A0
GND	GND

Wiring diagram is shown in Fig 3.

3.3 MPU6050 SENSOR

MPU6050 is a Micro Electro-Mechanical System (MEMS) is a complete 6-axis Motion Tracking Device that operates at a working voltage of 3-5V. It comprises of a 3-axis Accelerometer, 3-axis Gyroscope and Digital Motion Processor [9]. It has I2C interface to communicate with the microcontrollers and comes with a Built-in 16-Bit ADC that provides high accuracy [10].

The following is its wiring setup:

MPU6050	ESP8266
VCC	3.3V
GND	GND
SCL	D1
SDA	D2

Wiring diagram is shown in Fig 3

3.4 GSM MODULE (SIM 800A)

SIM800 combines TCP/IP protocol and extended TCP/IP AT commands that are very helpful in data transmission applications [11]. SIM800A follows transferring of voice, SMS and data with efficient power consumption [12].

The following is its wiring setup:

SIM800A	ARDUINO UNO
GND	GND
RX	D10
TX	D9

Wiring diagram is shown in Fig 2

3.5 IFTT SETUP

IFTT is an application that connects devices to send/receive several web services using conditional statements triggered by changes that occur within the microcontroller [13]. IFTTT is a well-known responsive programming application where applets can deliver over 400 services of IoT products and web applications [14]. In IFTT a service called webhook is

provided that works on the ESP8266 programmed in Arduino IDE. At first, ESP8266Wifi library has to be downloaded. During setup, “this” trigger and “that” event (sending an SMS) can be configured in the IFTT website itself. After setup, a unique API key is provided by the IFTT application which has to be included in the programmed code.

The following steps shows the setup instructions on IFTT

- 1) Login or create an account.
- 2) In the service section, search for webhooks.
- 3) Select “Documentation” to generate the private key (has to be included in the programmed code).
- 4) After that, select “create” to create an applet.
- 5) Then select “this” and now search for webhooks. From that choose “Receive a Web Request”
- And followingly type the event name and then click on “create a trigger”.
- 6) After creating “this” condition click on “that” to create a reaction for the defined event.
- 7) Search and choose “Android SMS” (action to be done).
- 8) To define the action, phone number and message content is required. After that click on “create action” to complete the process.

More events can be created in the similar manner. Fig 1 shows the two applets created after setup.



Fig 1 setup of IFTT

4. Working

The following shows the working of both of our systems.

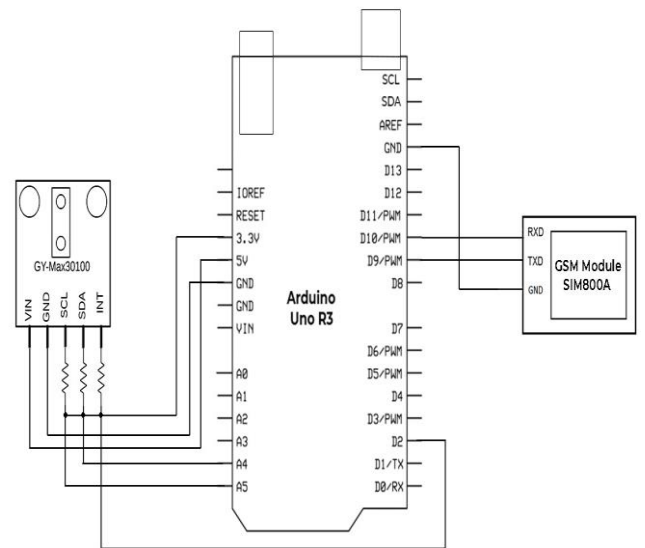


Fig.2 Connection Diagram of MAX30100 and GSM Module with Arduino UNO

As shown in Fig.2, the user is asked to place his finger on sensors like MAX30100 to acquire their heart rate, spo2. In MAX30100, there are two led’s-one red and one IR light. These help in measuring pulse rate and oxygen levels in blood and alerts the user in case of any deviation from the set value through SMS alerts using GSM module.

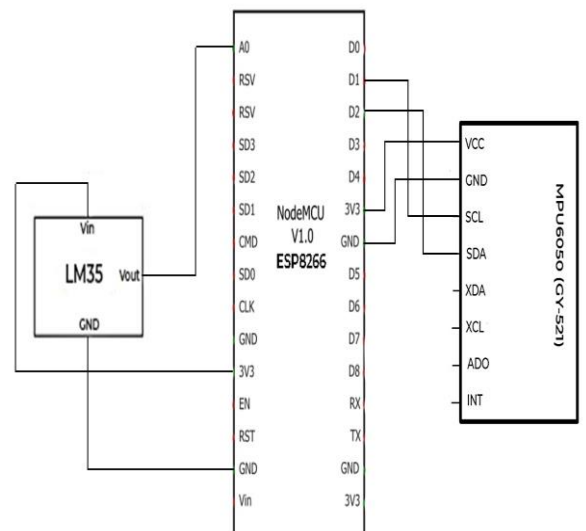


Fig.3 Connection Diagram of LM35 and MPU6050 with NODEMCU

In case of fall detecting system as shown in Fig.3, MPU6050 sensor sends alerts about sudden and unexpected falls. As mentioned earlier This sensor has 3-axis accelerometer, 3-axis gyroscope and

along with that X, Y, Z axes are also available in 2's complement form. In, LM35, body temperature is being measured as analog value and is converted to digital value using NodeMCU ADC [15]. Alerts to the responsible personnel for the fall detection and LM35 sensor is sent through the IFTT web application.

5. Performance Analysis

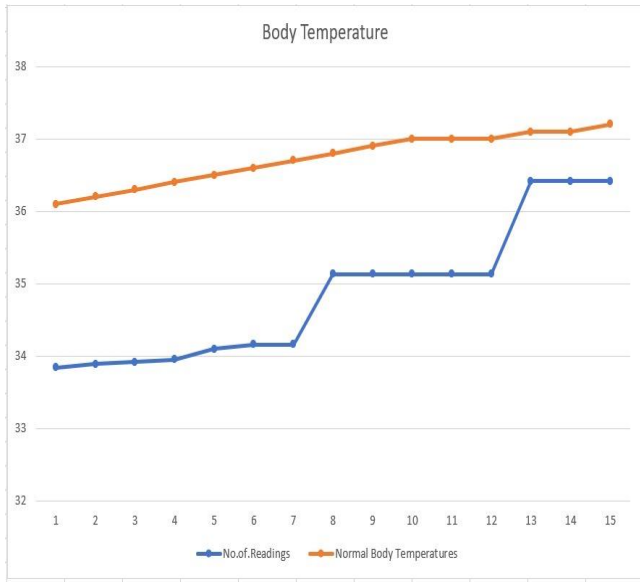


Fig 4 Shows the Real-time Accuracy of LM35

The above figure portrays the normal body temperature with the recorded values. This analysis shows the continuous range of values for number of readings and shows a minimum of 93% accuracy.

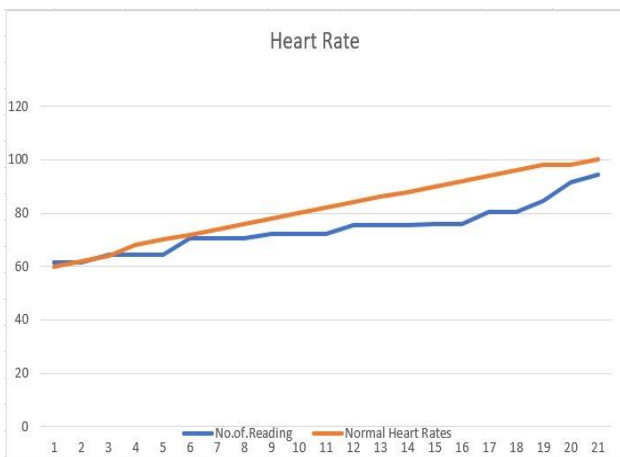


Fig 5 Plots the accuracy of MAX30100(heart rate)



Fig 6 Plots the accuracy of MAX30100(SpO2 level)

Fig.5 shows the comparison of normal heart rate with the recorded values. It shown an accuracy of 90%. Fig.6 shows the comparison between normal SPO2 with the recorded value and has an accuracy of 95%.

6. Result Analysis

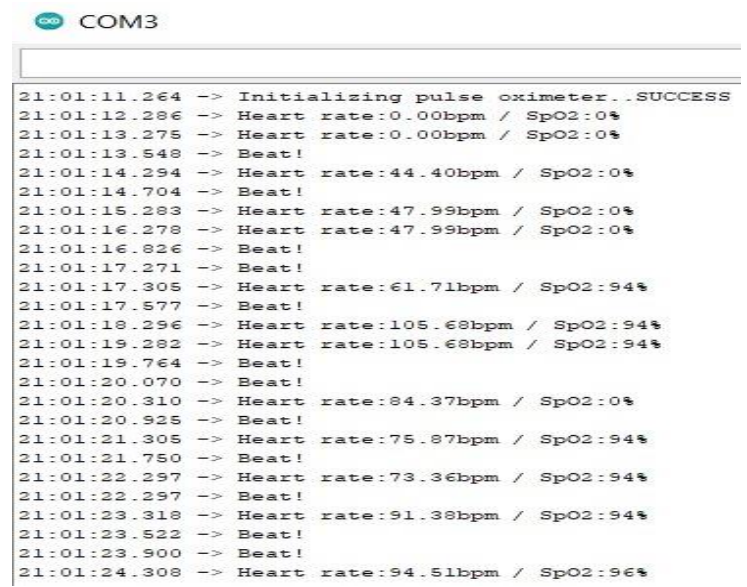


Fig.7 Values from MAX30100.

Here the serial monitor shows the readings of heart rate and SpO2 level when finger is placed by an individual.

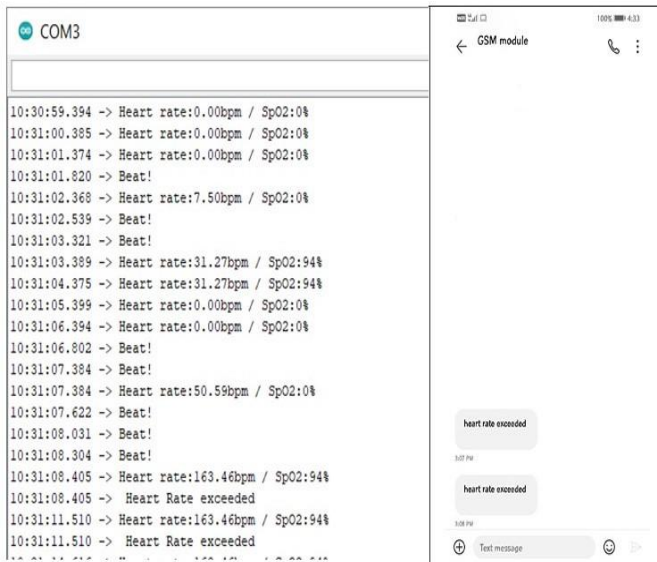


Fig.8 SMS alerts as output when heart rate exceeds the limit.

In case of any deviation of heart rate from the normal value is being detected, a corresponding SMS alert is sent to the care taker of the individual.

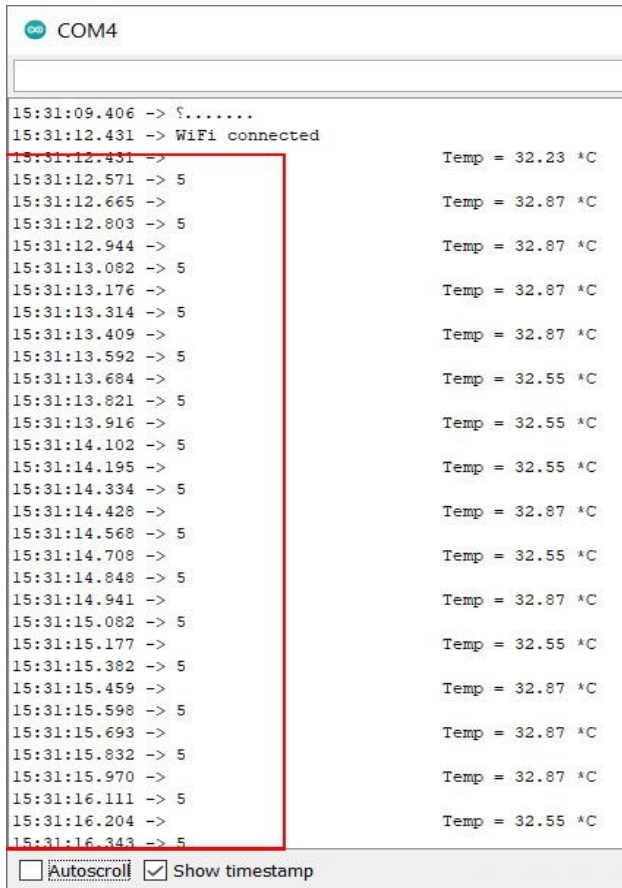


Fig.9 Values for fall detection (highlighted) and temperature sensor

The outputs of the second system are being displayed which shows temperature sensor values and continuous taking of values for fall detection..

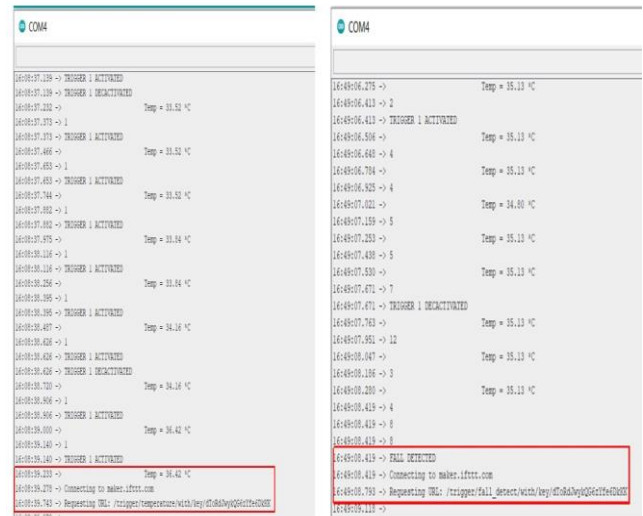


Fig.10 Fall detection and value of exceeded temperature.

This figure shows the deviation of temperature and detection of fall which correspondingly makes the connection to the IFTT app.

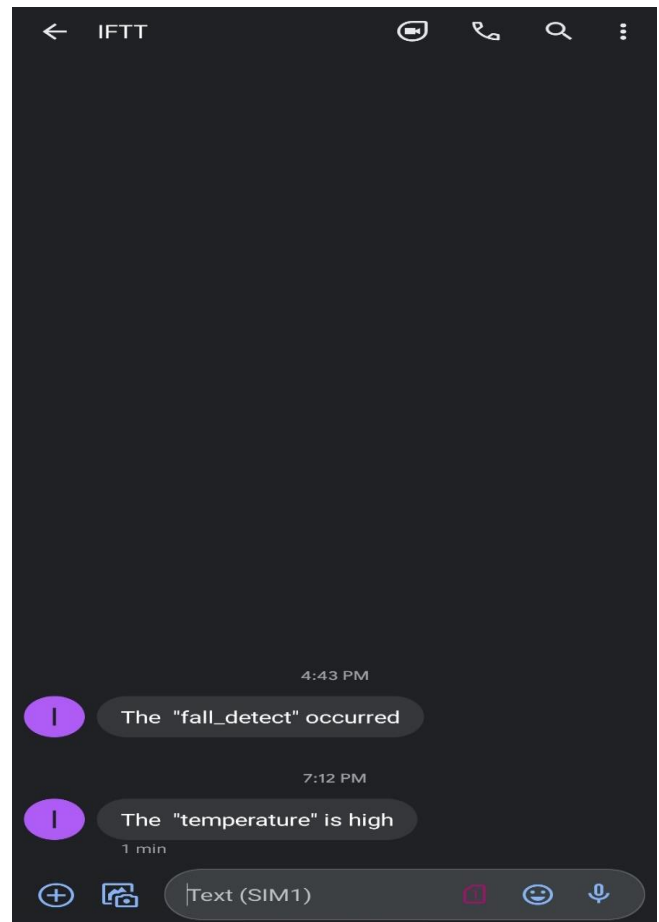


Fig.11 Output after fall detection and exceeded temperature value.

This shows the output received by the user through the IFTT app about the fall detection and temperature variation.

7. Conclusion

Living in a world where aged people are increasing day by day is challenging and needs to be considered as technical assistance is a must to make them feel independent to do their own needs. IoT is making their dreams true. Our system is designed with such a motive, and it can become of great use. Above all, our system shows good accuracy and performance as portrayed in the analysis. To conclude, this is a useful and easy to use a monitoring system that helps the aged to know about their primary health stats and also to sense their movements in real-time.

Acknowledgment

First and foremost, we would like to express our gratitude to The Research Council - TRC for providing us with the opportunity to further develop this area of the internet of things; it is a true honor. Second, we would like to express our gratitude to our supervisor, Dr. Sherimon, for his guidance, advice, ideas, and assistance in completing this paper. Last but not least, we appreciate the support of our university administration.

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