IOT BASED SMART MEDICINE BOX

A Project Report

Submitted by

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to

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in partial fulfillment of the requirements for the award of the Degree of

Bachelor of Technology (B.Tech)

in

MECHATRONICS ENGINEERING

Under the guidance of

Mr. N JEYAKKANNAN

CREATING TECHNOLOGY
LEADERS OF TOMORROW
ESTD 2002

DEPARTMENT OF MECHATRONICS ENGINEERING

Jyothi Engineering College
NAAC Accredited College with NBA Accredited Programmes*
Approved by AICTE & affiliated to APJ Abdul Kalam Technological University
A CENTRE OF EXCELLENCE IN SCIENCE & TECHNOLOGY BY THE CATHOLIC ARCHDIOCESE OF TRICHUR
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June 2022

DECLARATION

I the undersigned hereby declare that the project report "IOT BASED SMART MEDICINE BOX", submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of Mr. N Jeyakkannan. This submission represents my ideas in my words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in this submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously used by anybody as a basis for the award of any degree, diploma, or similar title of any other University.

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DEPARTMENT OF MECHATRONICS ENGINEERING

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ESTD 2002

CERTIFICATE

This is to certify that the report entitled "IOT BASED SMART MEDICINE BOX" submitted by GEO V O (JEC18MC018), HAGGIN C SAJEEV (JEC18MC019), SREENATH K BALAN(JEC18MC037), YADHUKRISHNAN C A (JEC18MC040) to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree in Bachelor of Technology in **Mechatronics Engineering** is a bonafide record of the seminar work carried out by himunder my/our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

Mr. N Jeyakkannan	**Dr. Vivek Lukose**
Assistant Professor	**Associate Professor**
Internal Supervisor	**Head of the Department**

ACKNOWLEDGEMENT

I take this opportunity to thank everyone who helped me profusely, for the successful completion of my project work. With prayers, I thank **God Almighty** for his grace and blessings, for without his unseen guidance, this project would have remained only in my dreams.

I thank the **Management** of Jyothi Engineering College and my Principal, **Dr. Sunny Joseph Kalayathankal** for providing all the facilities to carry out this project work. I am grateful to the Head of the Department **Dr. Vivek Lukose** for his valuable suggestions and encouragement to carry out this project work.

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Finally, I take this opportunity to express my gratitude to my parents for their love, care, and support and to our friends who have been constant sources of support and inspiration for completing this project work.

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VISION OF THE INSTITUTE

Creating eminent and ethical leaders through quality professional education with emphasis on holistic excellence.

MISSION OF THE INSTITUTE

- To emerge as an institution par excellence of global standards by imparting quality Engineering and other professional programmes with state-of-the-art facilities.
- To equip the students with appropriate skills for a meaningful career in the global scenario.
- To inculcate ethical values among students and ignite their passion for holistic excellence through social initiatives.
- To participate in the development of society through technology incubation, entrepreneurship, and industry interaction.

VISION OF THE DEPARTMENT

Create eminent and ethical leaders committed to profession and society in the field of Mechatronics through quality professional education to excel in industrial automation and innovation.

MISSION OF THE DEPARTMENT

To impart orientation to meet the challenges of the modern industry and provide motivation for research.

To provide quality education to create graduates with professional and social commitment.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1: Graduates shall possess fundamental and advanced knowledge in electronics, electrical and mechanical along with fundamental knowledge in mathematics, basic sciences and computer programming to analyze and solve the challenges related to automation.

PEO 2: Graduates shall have ability to design and create novel solutions with modern tool usage which lead to a lifelong learning or higher qualification, making them experts in their profession.

PEO 3: Graduates shall have the ability to work in a multidisciplinary environment with good professional and ethical commitment

PROGRAMME SPECIFIC OUTCOMES

Graduate possess -

PSO 1: Associate the concepts related to electrical, electronics, Mechanical, Robotics, Control, and Instrumentation to solve the challenges of modern industries.

PSO 2: Analyze and design systems with modern tools for the benefit of the society.

PROGRAMME OUTCOMES

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
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7. **Environment and sustainability:** Understand the impact of the professional engineering

   solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
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9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

COURSE OUTCOMES

COs	Description
C413.1	Students will have the ability to effectively gather and interpret information from literature survey and use this knowledge to identify, formulate, analyze and solve complex problems and to evaluate and interpret various solutions.
C413.2	Students will gain the ability to communicate effectively with written, oral, and visual means in a technical setting.
C413.3	Students will have the ability to use modern design and analysis tools to analyse and evaluate complex problems.
C413.4	Students will be able to carry out calculations involved in design, consider and evaluate alternate assumptions, approaches, and procedures. Ability to fabricate system components related to engineering problems giving consideration to environment and society.
C413.5	Students will have the ability to serve as effective team member to plan and complete the project/task within a specified budget and time.

CO MAPPING TO POs

	POs											
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C413.1	3	3	3	3	1	-	-	-	-	-	-	3
C413.2	2	-	-	-	-	-	-	2	2	3	-	-
C413.3	-	2	2	2	3	-	-	-	-	2	-	1
C413.4	-	2	3	3	-	3	3	-	-	-	-	-
C413.5	-	-	-	-	-	-	-	-	3	-	3	-
Average	2.5	2.33	2.67	2.67	2	3	3	2	2.5	2.5	3	2

CO MAPPING TO PSOs

	PSOs		
COs	PSO1	PSO2	PSO3
C413.1	3	3	3
C413.2	3	3	3
C413.3	3	3	3
C413.4	3	3	3
C413.5	3	3	3
Average	3	3	3

ABSTRACT

Though the health care society is slow in adopting IoT (Internet of Things) than other fields, IoT in the field of medicine is destined to keep the people safe and healthy where the main purpose is to decrease the cost of health care in the coming years. In today's world, major problems related to healthcare and medicine are due to the lack of proper medication and proper monitoring in the required time.This includes not consuming medicines on time and not receiving proper medical checkups on time.The proposed solution is a device which alerts the patient to consume prescribed medicines on time and also monitors basic physiological parameters.where a medical professional or authorized individual may continually check the patient's status on the cloud server. The sensors used are pulse rate sensor, body temperature sensor (LM35), and the last one is a heartbeat sensor. The signals from these sensors are sent to the micro-controller. The data are stored and published online. Hence, the professional and family member can monitor their patient from a remote location at any time.

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LIST OF ABBREVIATIONS

IoT	Internet Of Things
NodeMCU	Node Micro Controller Unit
Soc	System On Chip
LM	Linear Monolithic
LED	Light Emitting Diode
RTC	Real Time Clock
IDE	Integrated Development Environment

CHAPTER 1

INTRODUCTION

1.1 Overview

A pill organizer, pill container, dosette box, pill-case or pillbox is a multi compartment compliance aid for storing scheduled doses of medications. Pill organizers usually have square-shaped compartments for each day of the week, although other more compact and discreet versions have come to market, including cylindrical and pen-shaped cases. Some organizers have sections corresponding to times of the day. Pill organizers are viewed as a way to prevent or reduce medication errors on the part of the patient, though evidence of effectiveness is not strong and they have been linked to medication errors. In this decade, IoT-based systems have played a critical role in medical equipment. As a result, several academics are attempting to build a variety of IoT-based medical devices. Now-a-days health problems like cardiac failure, lung failures & heart related diseases are arising day by day at a very high rate. Due to these problems time to time health monitoring is very essential. Medicine boxes are useful for all types of patients, including the elderly, those who have memory deficiencies, and those taking multiple medications as an aid in remembering to take proper doses of their medications in compliance with their doctor's recommended dose.

The project proposes an IoT based medicine box with basic health monitoring, that alerts the patient to consume the prescribed medication on time, it also monitors basic physiological parameters such as pulse, body temperature on regular intervals and alerts the necessary in case of emergencies.

1.2 Application

The proposed solution is a device which alerts the patient to consume prescribed medicines on time and also monitors basic physiological parameters. Data regarding the prescribed medicines and their corresponding timings are stored in a server, based on it the patient is notified.The system also contains sensors including Temperature sensor, Pulse rate sensor which are used to collect physiological data.The data is analyzed to monitor the health conditions and generate timely reports, which can be reviewed by the doctor. In the case of emergencies, the necessary are alerted

1.3 Benefits

In today's world, major problems related to healthcare and medicine are due to the lack of proper medication and proper monitoring in the required time. This includes not consuming medicines on time and not receiving proper medical checkups on time. The proposed device, which alerts the patient to consume prescribed medicines on time and also monitors basic physiological parameters. Which vastly reduces errors that could happen due to untimely medication, Further the monitoring system allows the doctor to review the patient and alter his/her prescription remotely via IoT gateways.

CHAPTER 2

LITERATURE SURVEY

2.1 IoT Based Emergency Health Monitoring System

In this decade, IoT-based systems have played a critical role in medical equipment. As a result, several academics are attempting to build a variety of IoT-based medical devices. The following is a summary of the researcher's work: A researcher created a patient monitoring system with the goal of collecting data for clinical research and academic studies. PHS will allow for quicker and safer preventative care, reduced total costs, more patient-centered treatment, and increased sustainability. Researchers built a system that monitors bodily parameters such as pulse rate and ECG in this study. The primary interface is an ARM7LPC 2138 CPU, and the data is presented via a graphical user interface. If any of the parameters falls inside the usual range, an SMS notice is sent to the mobile device. This paper describes an electronic gadget that uses wireless sensor technologies to monitor the health of elderly persons in their own homes. Implement a remote healthcare system that uses a medical care provider gadget to monitor the patient's health state. This paper depicts an IoT-enabled system for monitoring the patient's body 24 hours a day, seven days a week. Patient monitoring systems are becoming more popular among researchers and patient guardians. This technology can measure physiological data from the patient's body every 15 seconds. This system is in charge of collecting the patient's pulse, body temperature, and heart rate and sending the data to the IoT Cloud platform through WIFI-Module, with the patient's health status saved in the cloud. It allows the medical professional or allowed person to monitor the patient's health on the cloud server, where the medical expert or authorized person may continually monitor the patient's status. The planned goal of this study is to provide patients with appropriate and effective health care.

2.2 Internet of Things (IoT) Based Smart Health Care Medical Box for Elderly People

Though the health care society is slow in adopting IoT (Internet of Things) than other fields, IoT in the field of medicine is destined to keep the people safe and healthy where the main purpose is to decrease the cost of health care in the coming years. A smart IoT based healthcare system has been proposed here, which contains an intelligence medicine box associated with sensors and server for regular health monitoring. This smart medicine box with wireless internet connectivity helps the patients to get regular health care and create easy communication between doctor and patient without meeting physically. The proposed medicine box helps the patient to take the right medicine at the right time along with an email which will help the patient to take the medicine. A laptop is used as a server where detailed information about doctor and patient are stored along with prescription and appointment date. Both doctor and patient have IDs' and password for accessing the server. Also, the data of medication and temperature of patient are stored on the server for doctor's ease. The Doctor can change the patient's prescription if necessary, which will also be notified via email. Moreover, the doctor can take immediate steps in case of an emergency. In recent days healthcare system is changing all over the world. IOT based application of smart healthcare system has created a new dimension of medication and healthcare in hospitals. The objective of his project is focusing on proper medication of a patient. Older people who need regular monitoring of their medication will be benefited through this project. Server for storing medication time and other information, mail transferring protocol, temperature sensor for proper monitoring of patient body temperature has been integrated in this project.

2.3 IOT Based Patient Health Monitoring Portable Kit

Proposed a system, which measured the Heartbeat and temperature of the patient using micro controller and the data can be transferred to the medical professionals using WFI module, ESP8266 on their mobiles. The system could be extended by adding other feature like location access, adding the ambulance services, adding doctor's list and some specialists list in the selected fields. Survey on Health Monitoring Management using Internet of Things They proposed a system which can measure Patient's heart beat, patient's temperature, Respiration rate using the technology of Raspberry Pi which means their system relayed on Raspberry Pi in which patient's result can be monitored on the monitor screen of a computer and all the updated data or information will display on the webpage using IOT module. It was mainly designed for measuring and have a look over patient privately at home. In this system, they had proposed that it will cover the parameters like Electrocardiography (ECG), heart rate variability, pulse oximetry, plethysmography and fall detection. A Developed a personal health diagnosis based on the symptoms of the patients and emphasized on the various technologies like wireless technologies . This paper proposed a system which is efficient and low cost and Raspberry Pi which covered parameters like oximetry, blood pressure, temperature. This system was designed based on wireless sensor network they basically made networks strong so that people can easily contact each other without any hurdle. They made the network that strong so that people can easily upload the medicine's prescription and medical reports without meeting each other the problem can be resolved. This system proposed that people can contact the doctor using WSN i.e. wireless sensor network in which they had covered heartbeat and temperature using different sensors .

CHAPTER 3

METHODOLOGY

The NodeMCU micro-controller unit was used to process the data and upload the processed data to the cloud. MAX30100(Pulse Oximeter sensor) and LM35(Temperature Sensor) were the sensors used to record the physiological parameters such as blood oxygen level, heart rate, temperature. The sensors are interfaced to the NodeMCU, which uploads the sensor data to the Blynk IoT cloud. The data can be visualized graphically using the Blynk web dashboard or the Blynk mobile application.

The medicine timing system used the DS3231(Real Time Clock) for receiving current data and time data for the micro-controller. DS3231 is interfaced with the Arduino UNO micro-controller, the timings of the medicines to be consumed are prefed into the code, the timings are compared with the real time provided by the DS3231 RTC, and alerts are provided at the specified time.

The programming of both the micro-controllers were done using the Arduino IDE and the Blynk IoT cloud is used for the visually interpreting the sensor data on a web dashboard as well as on a mobile application.

3.1 Components

Most important component of this project is the NodeMCU micro-controller which reads the sensor data and upload it to the cloud via Wi-Fi. The sensors MAX30100 and LM35 also plays a key a key role in reading the physiological parameters. DS3231 RTC is used for current time and LEDs and buzzer is used for indications.

3.1.1 NodeMCU

The NodeMCU is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip called the ESP8266. That makes it an excellent choice for IoT projects of all kinds. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems and hardware which is based on the ESP-12 module, and like this, it can also be programmed using Arduino IDE and can act as both WiFi hotspot or can connect to one. The NodeMCU is available in various package styles. Common to all the designs is the base ESP8266 core.

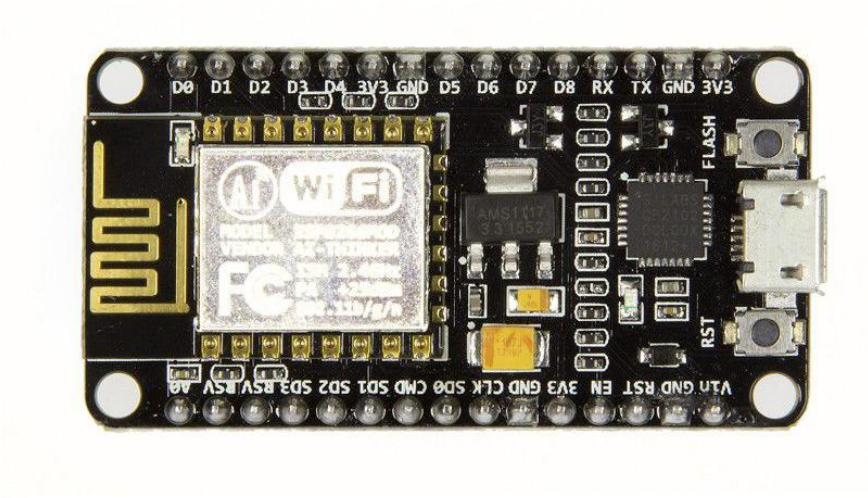

Figure 3.1: NodeMCU Micro-controller board

Designs based on the architecture have maintained the standard 30-pin layout. It has one Analog Input Pin, 16 Digital I/O pins along with the capability to connect with serial communication protocols like SPI, UART, and I2C. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects. Its applications include prototyping for IoT devices, low powered battery-operated applications, and projects requiring I/O interface with Bluetooth and WiFi capabilities.

- Operating Voltage: 3.3V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz
- PCB Antenna
- Small Sized module to fit smartly inside your IoT projects

3.1.2 MAX30100

Figure 3.2: MAX30100 Pulse Oximeter sensor

The sensor is integrated pulse oximetry and heart-rate monitor sensor solution. It combines two LED's, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse and heart-rate signals. It operates from 1.8V and 3.3V power supplies and can be powered down through software with negligible standby current, permitting the power supply to remain connected at all times. The device has two LEDs, one emitting red light, another emitting infrared light. For pulse rate, only infrared light is needed. Both red light and infrared light are used to measure oxygen levels in the blood.When the heart pumps blood, there is an increase in oxygenated blood as a result of having more blood. As the heart relaxes, the volume of oxygenated blood also decreases. By knowing the time between the increase and decrease of oxygenated blood, the pulse rate is determined.It turns out, oxygenated blood absorbs more infrared light and passes more red light while deoxygenated blood absorbs red light and passes more infrared light. This is the main function of the MAX30100

- Consumes very low power (operates from 1.8V and 3.3V)
- Fast Data Output Capability
- Interface Type: I2C

3.1.3 LM35 Temperature sensor

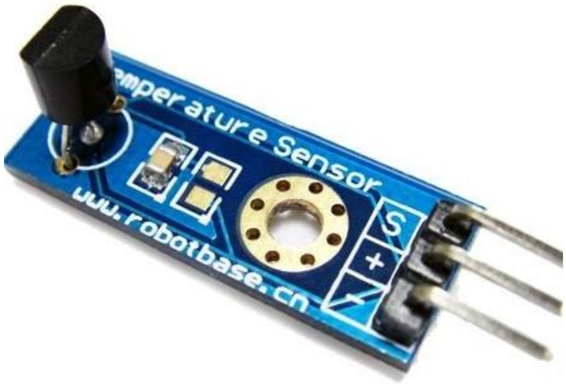

Figure 3.3: LM35 Temperature sensor

LM35 is a temperature sensor that outputs an analog signal which is proportional to the instantaneous temperature. The output voltage can easily be interpreted to obtain a temperature reading in Celsius. The advantage of lm35 over thermistor is it does not require any external calibration. The coating also protects it from self-heating. LM35 can measure from -55 degrees centigrade to 150-degree centigrade. The accuracy level is very high if operated at optimal temperature and humidity levels. The conversion of the output voltage to centigrade is also easy and straight forward. The input voltage to LM35 can be from +4 volts to 30 volts. It consumes about 60 microamperes of current.

- Calibrated Directly in Celsius (Centigrade)
- Rated for Full −55°C to 150°C Range
- Suitable for Remote Applications
- Operates from 4 V to 30 V
- Low Self-Heating, 0.08°C in Still Air

3.1.4 DS3231 RTC

Real Time Clock or RTC is a timekeeping device in the form of an Integrated Circuit. RTC is an integral component of many time critical applications and devices like Servers, GPS.

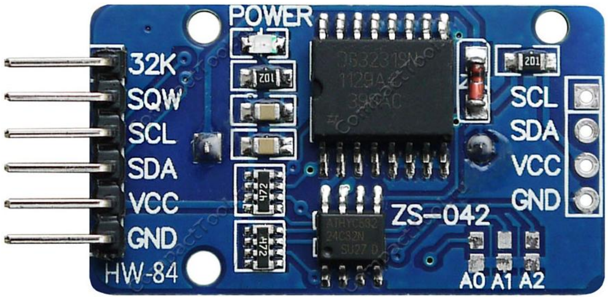

Figure 3.4: DS3231 RTC

DS3231 RTC module is a famous real-time clock in the market for its accurate results. Here, RTC stands for real-time clock. It is an affordable system that manages Time and Date with high precision. This small-sized module has six pins, an inter-integrated (I2C) interface for data transmission, and a battery cell for power-backup. DS3231 Real-time Module comes with a TWI interface, two alarm clocks, and an inbuilt temperature-compensated crystal Oscillator. DS3231 real time clock module features high accuracy and low power consumption. This RTC module maintains seconds, minutes, hours, day, date, month, and year information. In this module, the date is set based on whether the month is 29, 30 or 31 days, and also whether it is leap year or not. This module can be used in 12-hour and 24-hour formats.Can function with low voltages.

3.1.5 Arduino UNO

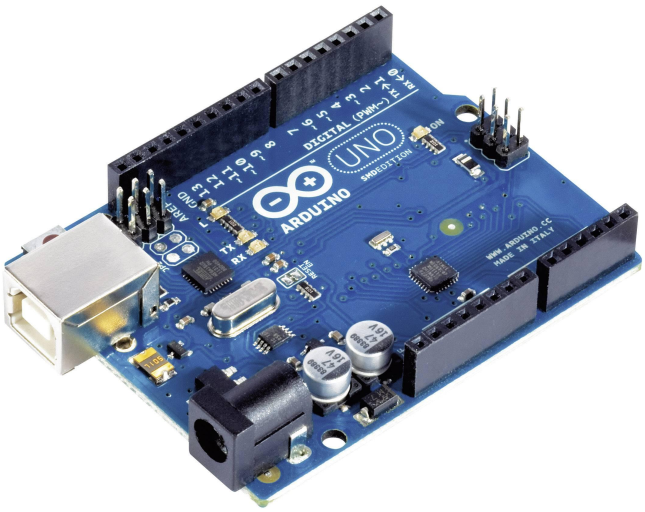

Figure 3.5: Arduino UNO

The Arduino UNO is a micro controller board based on the ATmega328. It has 20 digital input/output pins (of which 6 can be used as PWM outputs and 6 can be used as analog inputs), a 16 MHz resonator, a USB connection, a power jack, an in-circuit system programming (ICSP) header, and a reset button. It contains everything needed to support the micro-controller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started, It features an ATmega16U2 programmed as a USB-to-serial converter. This auxiliary micro-controller has its own USB bootloader, which allows advanced users to reprogram it.

3.2 Setup

The setup of this project can be classified into two subsections, one is the monitoring section which is intended to measure the required physiological parameters and upload it to the cloud so that, it facilitates monitoring of those essential parameters remotely from any device with internet accessibility. The other section is tasked at alerting the patient to consume the required medication on time as per the prescription.

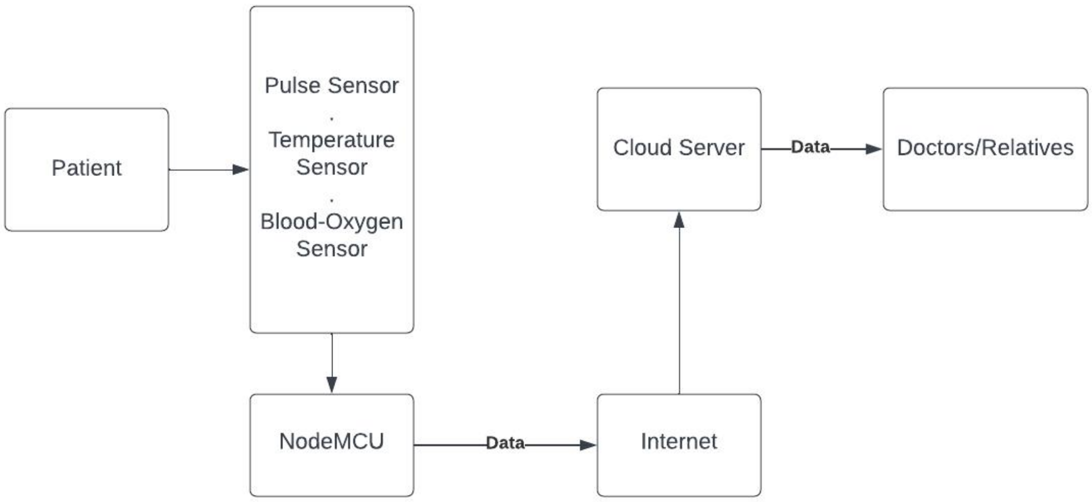

Figure 3.6: Block Diagram of the Monitoring section

The monitoring section comprises of the various sensors required to measure the physiological parameters such as blood oxygen level, pulse rate, body temperature. The sensors MAX30100 and LM35 are used. The NodeMCU receives the data from these sensors. The NodeMCU is connected to the internet via WiFi, the NodeMCU uploads the data to the cloud, which is later visualized.

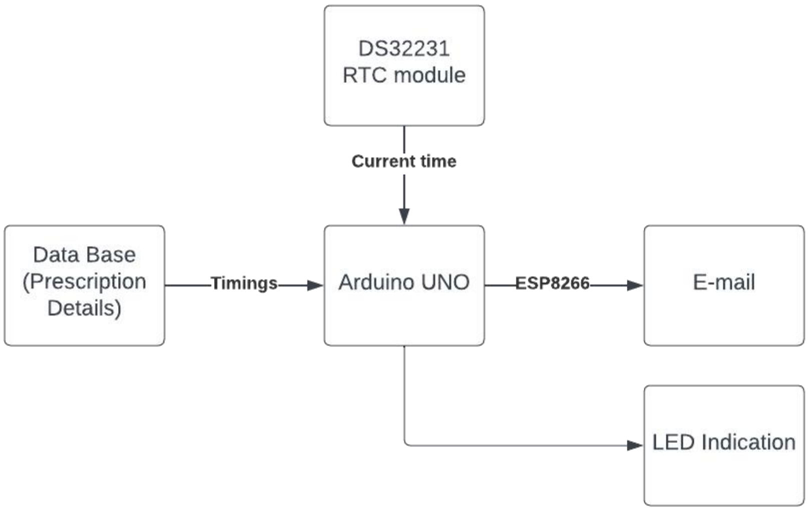

Figure 3.7: Block Diagram of the Timing section

The timing section contains the DS3231 RTC module which is used to keep the track of time and date, The RTC module constantly feeds the current date and time to the Arduino UNO, the Arduino's memory holds a database which contains details of the time at which the prescribed medicines are to be consumed. The Arduino compares the both and alerts the patient on time for medicine. A buzzer is used to get the patients attention and LED bulbs are placed to indicate which medicine is to be consumed.

3.2.1 Hardware

The NodeMCU is the main micro-controller used in the patient monitoring section along with the MAX0100 pulse oximeter sensor and LM35 temperature sensor. The NodeMCU houses the Esp8266 WiFi chip which facilitates internet connectivity.

The MAX30100 pulse oximeter sensor is interfaced with the NodeMCU the communication is done using the I2C protocol. The SDA and SCL pins of the sensor are interfaced with the digital pins D1 and D2 of the NodeMCU, The LM35 temperature sensor is an analog sensor, it is interfaced to the analog pin A0 of the NodeMCU, the entire assembly is powered using a USB cable.

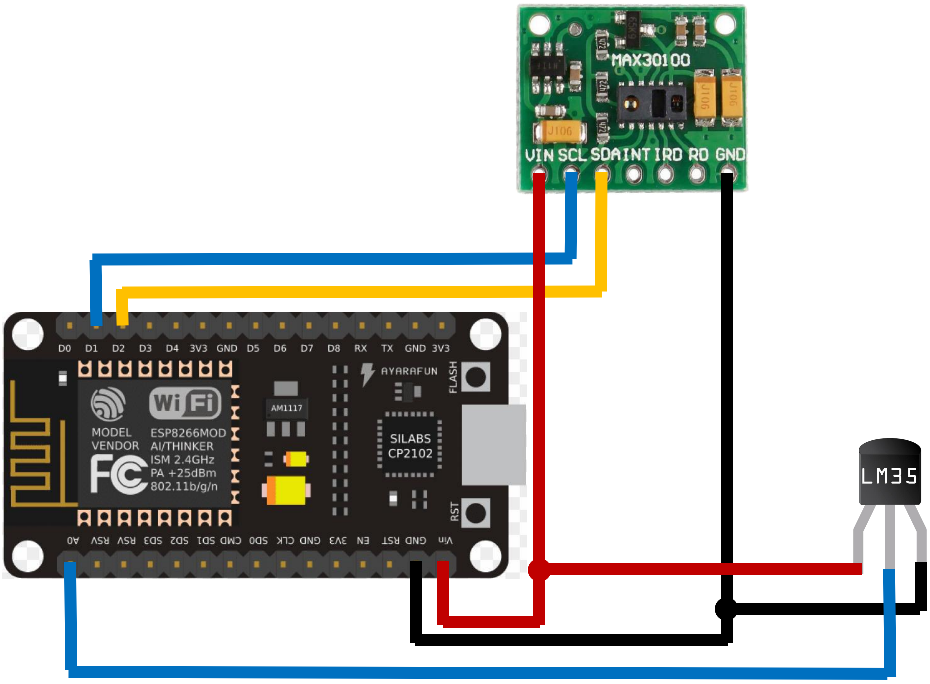

Figure 3.8: Circuit Layout of the Monitoring section

The Arduino UNO is the micro-controller used in the timing section, along with the DS3231 RTC module and the LEDs used for the indication and the buzzer for alerting the patient for medicine consumption.

The DS3231 RTC module is interfaced to the arduino UNO, the communication is done using the I2C protocol. The SCL and SDA pins of the RTC module is interfaced to the analog pins A5 and A4 of the arduino UNO respectively. The Arduino's memory holds a database of the timings of the prescribed medicines. The arduino compares the timings from the database to the values returned by the RTC module, when the timings match the buzzer and the indication lights are turned on for alerting the patient.

The indication LEDs are power using the digital pins D8, D9 and D10 of the Arduino UNO micro-controller, which are activated by the program when the time from the database matches the current time returned by the RTC module. The buzzer is also triggered by the Arduino when the timings match, the buzzer is interfaced to the digital pin D13 of the Arduino UNO.

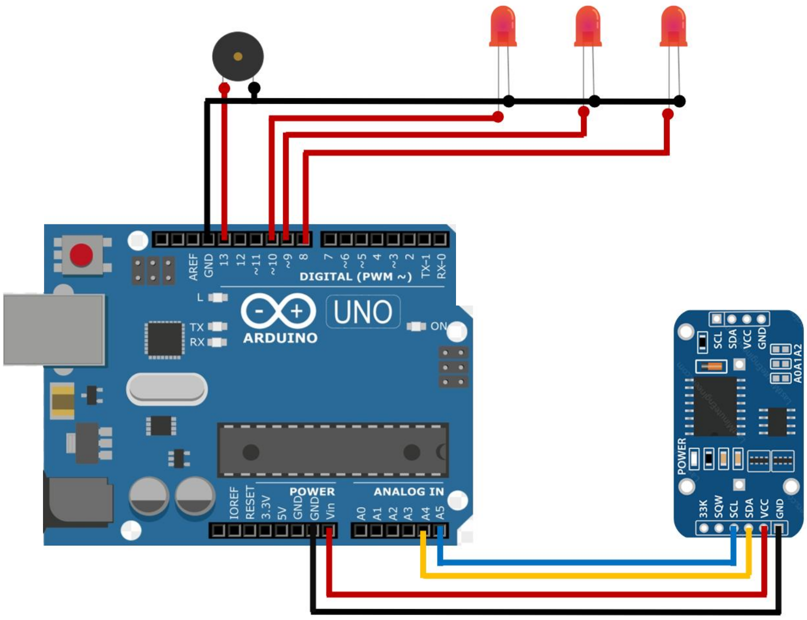

Figure 3.9: Circuit Layout of the Timing section

3.2.2 Software

Both the Arduino UNO and the NodeMCU are programmed using the Arduino IDE, The NodeMCU receives the data from the MAX30100 and LM35 interfaced to it, The NodeMCU is connected to the internet via WiFi. The NodeMCU uploads the data to the cloud for remote accessibility and visualization.

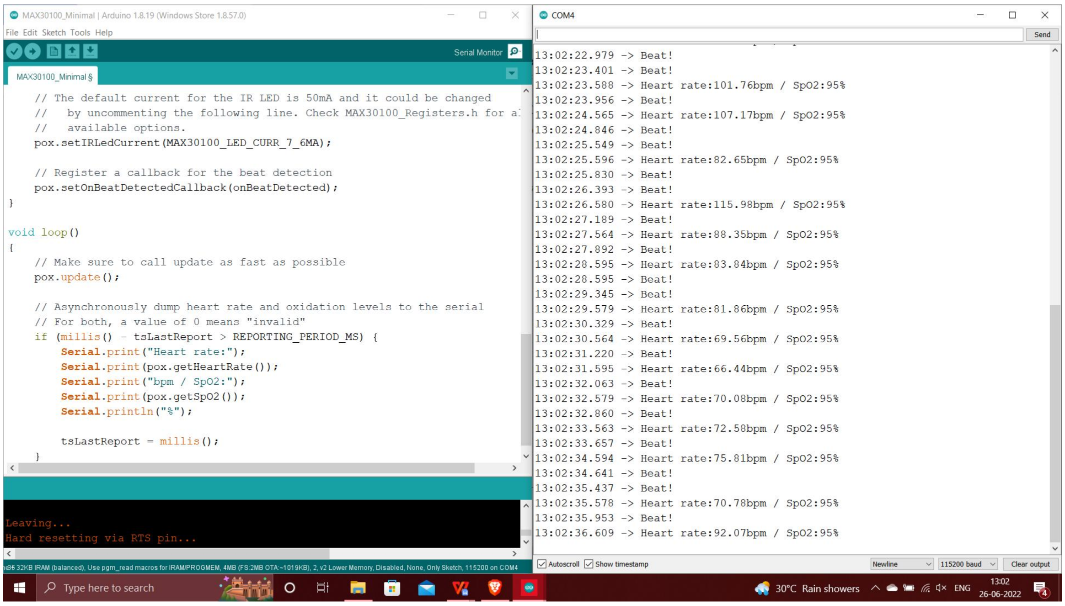

Figure 3.10: Arduino IDE (Program for reading the sensor values)

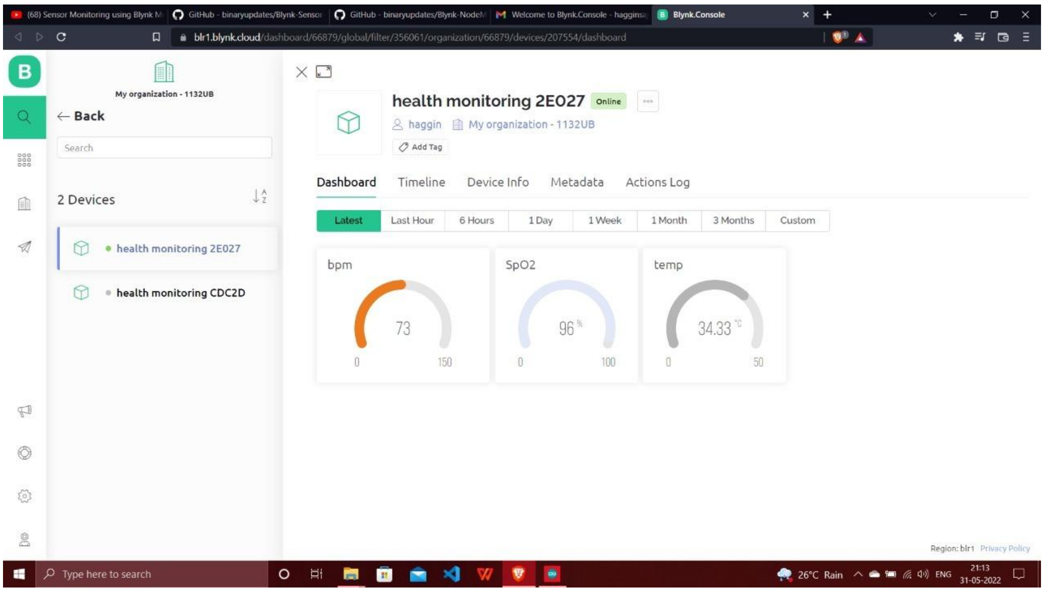

Figure 3.11: Blynk IoT Cloud (Online dashboard)

This project utilizes the free services provided by the Blynk IoT cloud for data storage and remote accessibility and visualization. Blynk is a new platform that allows you to quickly build interfaces for controlling and monitoring your hardware projects from your iOS and Android device.

CHAPTER 4

RESULTS

A system that alerts the patient to consume the prescribed medication on time,and also monitors basic physiological parameters of a person such as pulse, body temperature on regular intervals and alerts the necessary in case of emergencies was successfully developed. A NodeMCU interfaced with pulse oximeter sensor and temperature sensor measured the physiological parameters on regular intervals and uploads it to the cloud to facilitate remote monitoring. An Arduino UNO equipped with a RTC module alerts the user to consume the required medication on time.

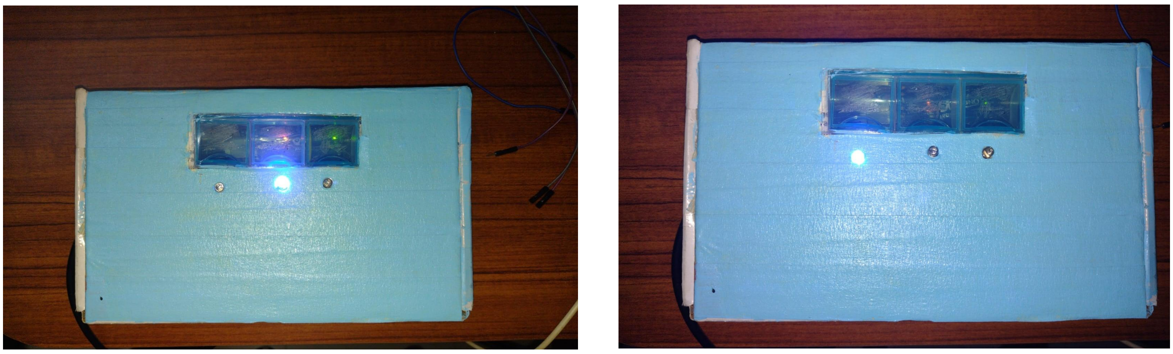

Figure 4.1: Finished model (Indicator LEDs indicates which medicine is to be consumed at a particular time)

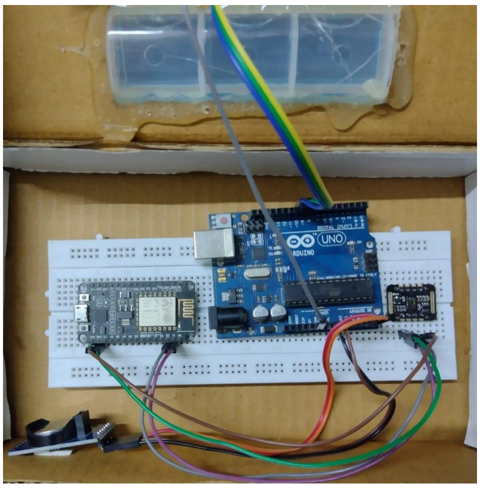

Figure 4.2: Internal Circuitry

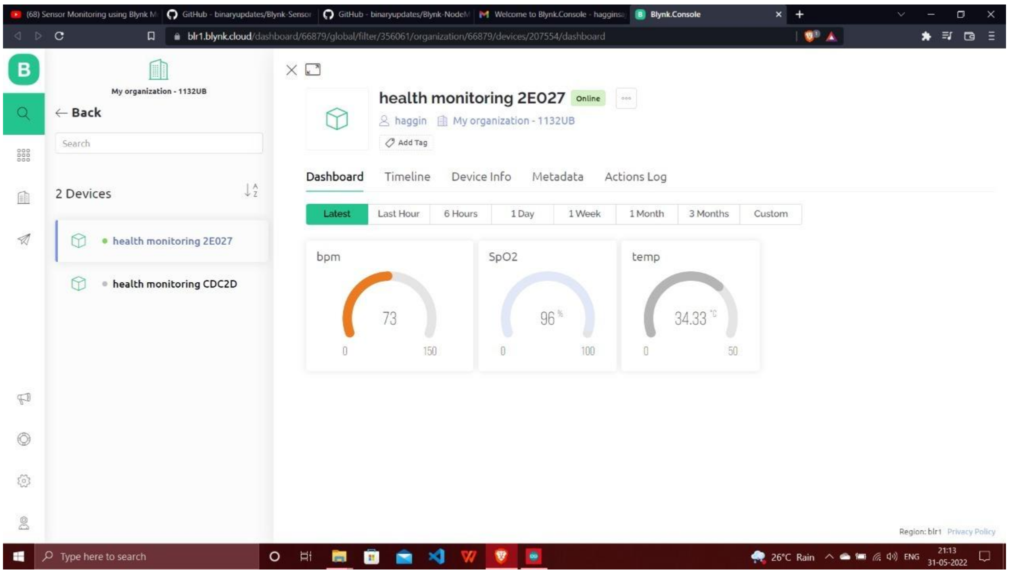

Figure 4.3: Blynk Online Dashboard

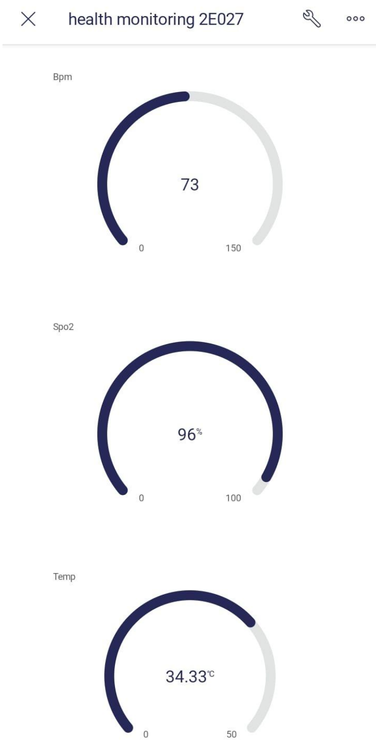

Figure 4.4: Blynk Mobile application

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 Conclusion

In recent days healthcare system is changing all over the world. IOT based application of smart healthcare system has created a new dimension of medication and healthcare in hospitals. The objective of this project is focusing on proper medication and continuous monitoring of a patient. Older people who need regular monitoring of their medication will be benefited through this project. Regular monitoring of blood oxygen level and pulse rate using pulse oximeter sensor and temperature using temperature sensor are also integrated in this project.

5.2 Future Scope

Developing a smaller and modular embedded system suitably in the form of a wrist band or any other wearable, which integrates all the sensors required in much compact space would enable real-time monitoring of the patient, which would be immensely helpful in the case of bedridden patients. In the business point of view, Designing of a custom mobile or web-application which facilitates individual user profile functionality, could be utilized for monitoring multiple patients simultaneously.

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APPENDIX A

NodeMCU Code

```
#include <Wire.h>
#include "MAX30100_PulseOximeter.h"
#define BLYNK_PRINT Serial
#include <Blynk.h>
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include "Adafruit_GFX.h"

#define REPORTING_PERIOD_MS 1000

char auth[] = "xxxxx-xxxx-xxx";        // Authentication Token Sent by Blynk
char ssid[] = "xxxxx-xxxx-xxx";        //WiFi SSID
char pass[] = "xxxxx-xxxx-xxx";        //WiFi Password

PulseOximeter pox;

float BPM, SpO2;
uint32_t tsLastReport = 0;

void setup()
{
 Serial.begin(115200);
 Blynk.begin(auth, ssid, pass);        //Initializing the Blynk IoT Service

 Serial.print("Initializing Pulse Oximeter..");

 if (!pox.begin())                     //Checking if the connection is established
 {
  Serial.println("FAILED");

}

else
 {
  Serial.println("SUCCESS");
  pox.setOnBeatDetectedCallback(onBeatDetected);
 }



void loop()
{
```

```
  pox.update();
  Blynk.run();

  BPM = pox.getHeartRate();                  //Reading the Pulse rate value
  SpO2 = pox.getSpO2();                      //Reading the Blood oxygen level
  if (millis() - tsLastReport > REPORTING_PERIOD_MS)
  {
    Serial.print("Heart rate:");              //Printing Pulse rate on Serial Monitor
    Serial.print(BPM);
    Serial.print(" SpO2:");                   //Printing Blood oxygen level on Serial Monitor
    Serial.print(SpO2);
    Serial.println(" %");

    Blynk.virtualWrite(V1, BPM);             //Uploading the Pulse rate value to the Blynk cloud
    Blynk.virtualWrite(V2, SpO2);            //Uploading Blood oxygen level to the Blynk cloud

    tsLastReport = millis();
  }
}
```

Arduino UNO Code

```
#include <Wire.h>
#include <DS3231.h>

DS3231 clock;
RTCDateTime dt;

void setup()
{
  Serial.begin(9600);

  Serial.println("Initialize DS3231");              // Initialize DS3231
  clock.begin();

  clock.setDateTime(__DATE__, __TIME__);   // Set sketch compiling time
  pinMode(8,OUTPUT);                              //Declaring the output pins
  pinMode(9,OUTPUT);
  pinMode(10,OUTPUT);
  pinMode(13,OUTPUT);
}

void loop()
{
  dt = clock.getDateTime();                         //Reading Current Date and Time

  Serial.print(dt.hour);   Serial.print(":");        //Printing Current Date and Time
  Serial.print(dt.minute); Serial.print(":");
  Serial.print(dt.second); Serial.println("");
```

```
 if(dt.hour == 13 && dt.minute == 25)            //Comparing Current time with prescribed time(1)
 {
  digitalWrite(8,HIGH);                          //Turing on LED 1 and buzzer
  digitalWrite(13,HIGH);
 }
 else
 {
  digitalWrite(8,LOW);
  digitalWrite(13,LOW);
 }

 if(dt.hour == 13 && dt.minute == 26)            //Comparing Current time with prescribed time(2)
 {
  digitalWrite(9,HIGH);                          //Turing on LED 2 and buzzer
  digitalWrite(13,HIGH);
 }
 else
 {
  digitalWrite(9,LOW);
  digitalWrite(13,LOW);
 }

 if(dt.hour == 13 && dt.minute == 27)            //Comparing Current time with prescribed time(3)
 {
  digitalWrite(10,HIGH);                         //Turing on LED 3 and buzzer
  digitalWrite(13,HIGH);
 }
 else
 {
  digitalWrite(10,LOW);
  digitalWrite(13,LOW);
 }

 delay(1000);
}
```