# *Home Automation using IoT*

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## IoT Fundamentals

Project Component

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# Table of Contents

# 1. Abstract

This project revolves around creating a home automation system prototype focussing on the ability to control the lights and fans, maintain the temperature and humidity of the room and the measurement of volume and flow rate of the water in overhead tank through the internet. All this will be monitored and controlled using various electronic equipment like IR sensor, Temperature and Humidity sensors, Flow Rate sensor and Relay Switches. A mobile application will be developed specifically to handle all these operations remotely using the internet. The system consists of a central device, a server and an Android application. The central device is a microprocessor, in this case, a NodeMCU that connects to the Internet and receives an order to control the switches. The server manages users and devices, and handles the communication between the application and the central device. The application is a frontend which presents the user with a list of devices to interact with.

In this Project, we have focussed on the control and monitoring of following things:

i. We control the lights, fans, and the A.C. of the room. Using IR sensor we can know if someone is in the room and accordingly we can turn on or off the appliances using Relay Switches.
ii. We maintain the temperature & temperature of the home using Temperature and humidity sensor module and relay switch.
iii. We measure the water volume and water flow rate using Water Flow Sensor and will be able to control the pump using Relay Switch. If the tank water gets filled then the pump will automatically get turned off using relay switch.

We also made a mobile application for more specific controlling like setting the volume limit, turning power on or off of Water Pump. We will also monitor and control the temperature and humidity, and the control the fans, lights and the A.C.

HARDWARE: DHT Sensor, IR Sensor, Level Sensor, Flow Rate Sensor, Relay Switch, NodeMCU, Pump.

SOFTWARE: MIT App Inventor, Firebase.

# 2. Introduction

Today, technology has become an integrated part of people's lives. It has, and continues to influence many aspects of daily life and has allowed better social interaction, ease of transportation, the ability to indulge in entertainment and media and has helped in the development in medicine. The creation of many devices such as mobile phones and computers have caused many people to rely on technology to communicate with their friends, store information such as pictures, movies, documents, and music. The internet has become a common interface that many devices use in order to simplify the daily life of many people. The Internet has given people the ability to search for information, store their own information in the cloud while also giving them better ways of managing information. From the time of its introduction, the amount of people that use mobile phones and the internet to communicate with other people has increased dramatically to become one of the major means of communication. Smartphones have allowed people to connect to the internet without the need for a computer, while still offering the same functionality but through different means. With the introduction of better hardware and better software, smartphones have become powerful devices and have become an important part of people’s daily lives. A major aspect is how the smartphone is able to connect and communicate with other devices. For example, smartphones can be used as a mouse for a computer, or it can connect to the speakers of cars allowing consumers to play their own music. There are many applications of this sort. A field that is recently gaining popularity is home automation which can also use smartphones as information or functionality hubs.

# 3. Motivation

The motivation for developing smart home systems comes from many reasons, but most prominent are convenience, security, energy management, connectivity and luxury. The cost of installing a smart home is also a large hindrance to the emergence of smart home systems into the market. The extra cost of the install is from the fact that even though a majority of homes were built in the near past, technology has been growing exponentially. This means that most homes were built before this technology was available, and

this creates a barrier for the development and sales of smart home systems. However, the technology is becoming better and cheaper, and this will help to make smart home systems an expense worth having when new homes are being built.

The biggest motivation behind smart home systems is the convenience. Convenience is really another way of saying “time saver”, and into day’s world where everything is moving faster, every second has value. Most of the technology we use today is based of convenience. Smaller conveniences in the home will be desirable because they allow the home to save the user time as well.

Energy management has become a huge factor in deciding anything, due to the trend of increasing cost of energy. As civilization grows, it constantly needs more energy to power itself. This leads to heavy pressure on efficient use of energy. Smart Home systems help the user do this and save them money at the same time.

Another reason for motivation on selecting this product is connectivity. The idea of connectivity is that having things connected results in communication or the transfer of information. By connecting everything in the home, so that everything can talk to each other, information about the home is easily attained.

# 4. Objectives

This project revolves around creating a home automation system prototype focussing on the ability to control the lights and fans, maintain the temperature and humidity of the room and the measurement of volume and flow rate of the water in overhead tank through the internet. All this will be monitored and controlled using various electronic equipment like IR sensor, Temperature and Humidity sensors, Flow Rate sensor and Relay Switches.

A mobile application is developed specifically to handle all these operations remotely using the internet. The system consists of a central device, a server and an Android application. The central device is a

microprocessor, in this case, a NodeMCU that connects to the Internet and receives an order to control the switches. The server manages users and devices, and handles the communication between the application and the central device. The application is frontend which presents the user with a list of devices to interact with.

# 5. Literature Survey

- Home Automation Using Internet of Things – This paper presents a Home Automation system (HAS) using Intel Galileo that employs the integration of cloud networking, wireless communication, to provide the user with remote control of various lights, fans, and appliances within their home and storing the data in the cloud. [1]

- Wireless Controlled Home Automation using IOT – This paper presents a Wireless Controlled Home Automation system (WHAS) using IoT. It uses computers or mobile devices to control basic home functions and features automatically through internet from anywhere around the world, an automated home is called a smart home. It is meant to save electric power and human energy. [2]

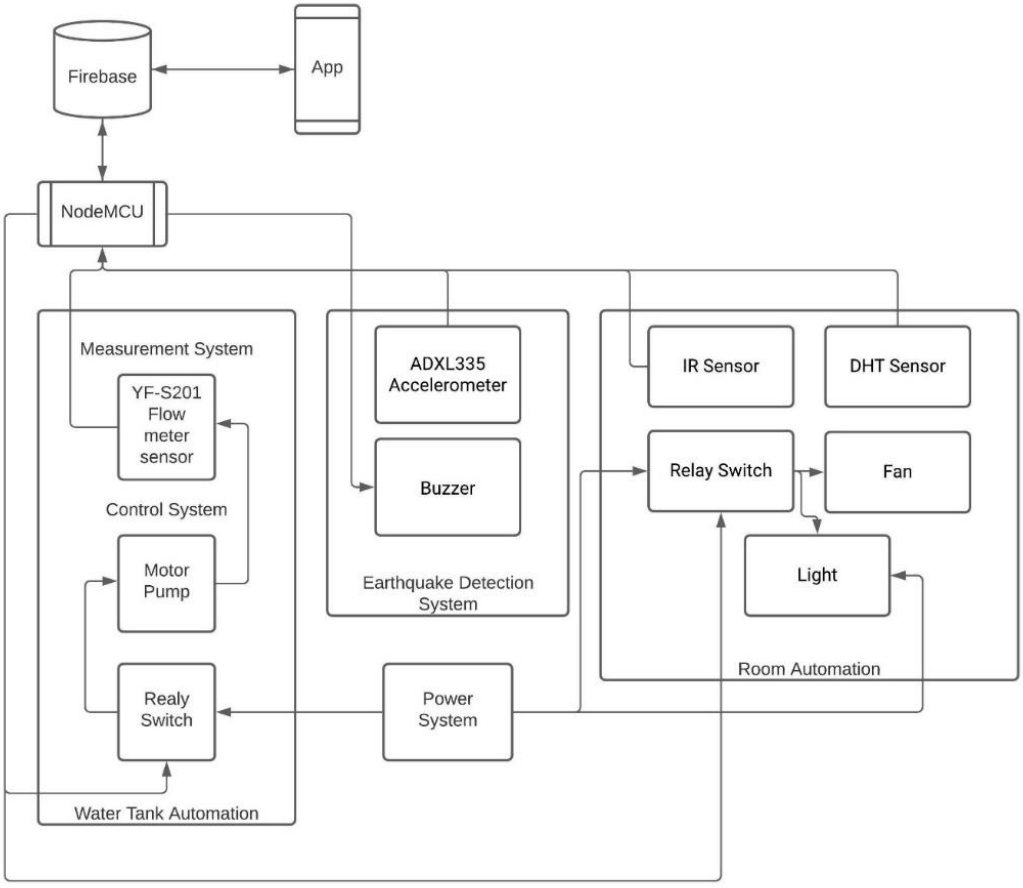
- A Review on Internet of Thing for Home Automation – This paper provides a review on IOT based home appliances which can make human life easier. This review paper gives an idea about IOT, IOT architecture, its benefits and working process of IOT based devices for home automation. [3]

  IoT technology is an information-carrying network comprising the internet and the traditional telecommunication network and enables all normal objects that can perform independent functions to communicate with each other. An IoT usually is a wireless network. Since there could be 1000 to 5000 devices around a person, an IoT may include 500 million to 1000 million objects. Each person on an IoT can connect a real object to the internet via an electronic label and

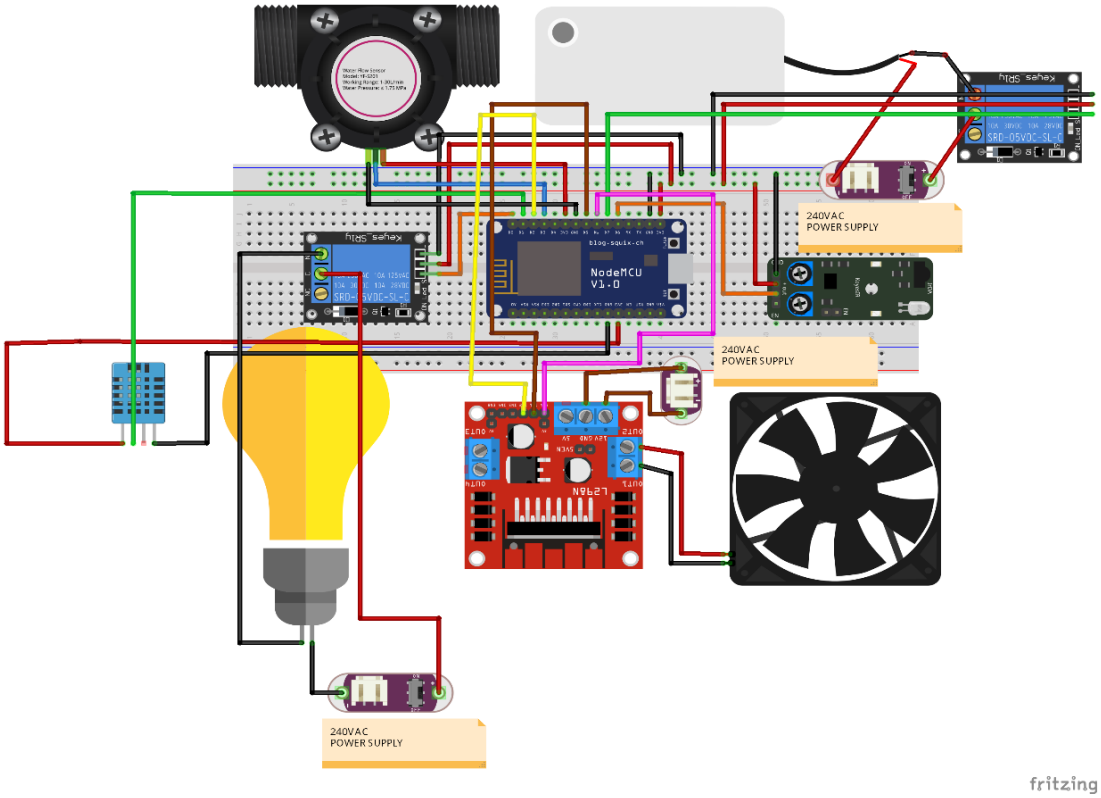
look for its specific position on the IoT. A central computer can be used for centralized management and control of the IoT. The IoT can also be used to remotely control household devices and automobiles, look for their locations, and prevent theft. The IoT integrates scattered information and transmits digital information between objects. It has broad market and application prospects and it is mainly applied in transportation and logistics, industrial manufacturing, the health and medical field, smart environments (households, offices, factories), and individual and social fields. As communication and hardware technologies have rapidly developed in recent years, many services and applications integrating these technologies into daily life have come to form the IoT.

# 6. Diagrams

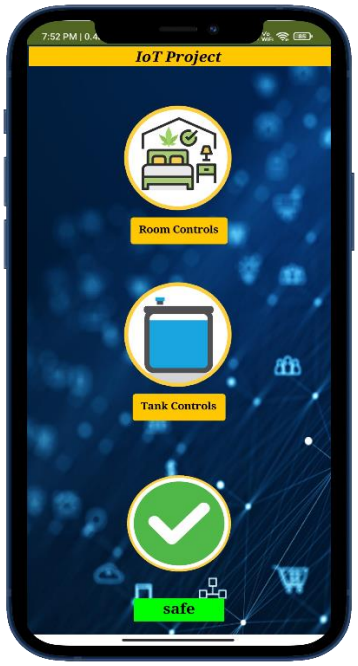
## 6.1 Block Diagram



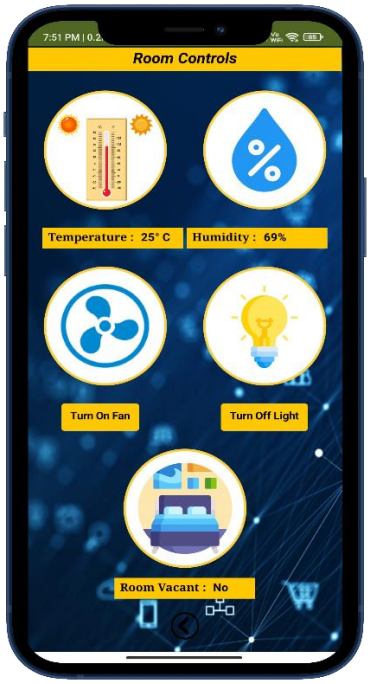
## 6.2 Circuit Diagram



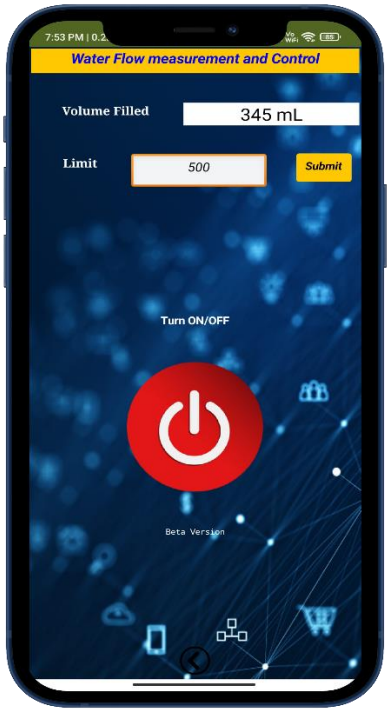

## 6.3 Homepage



## 6.4 Room Controls




## 6.5 Water Flow Measurement and Control



# 7. Algorithm

The project is a combination hardware and software (IDE, cloud and application).

It is made of three independent systems i.e., the room automation system, the earthquake detection system, and the tank overflow and measurement system.

## 7.1 Room Automation System

The IR (infrared) sensor placed near a door detects if a person entering or leaving the room, this data is then used to switch on/off the lights and fans of the room. The DHT (humidity and temperature measurement) sensor is used to measure the temperature and according to it increase/decrease the fan speed according to a pre-set range. The fan is attached to a motor driver module (L298) which can control the speed of the fan.

## 7.2 Earthquake Detection System

An accelerometer (ADXL335) measures the angles of the three axes (X,Y,Z) with respect to the earth's plane. By measuring the amount of acceleration due to gravity exerted on different angles, it can detect tilting, trembling and shaking of the device on which the sensor is attached. By setting a lower limit we can say if there's enough shaking that can be described as an earthquake and the user can alerted.

## 7.3 Water Flow Measurement and Control system

A flow rate sensor is used to measure the volume and level of the tank and according to this the motor driver module attached will work to fill/empty the tank. Also, the user can set the volume to be filled using the mobile application.

All the data from the sensors are fetched by NodeMCU (microcontroller) and sent to a cloud, the cloud then sends the data to the mobile application for the user to see. From the mobile application, the user can control the devices used. Once the user sets the value for the a particular device, the application sends the data to the cloud service which then sends the data to the microcontroller which is then forwarded to the sensor such that an action can take place.

# 8. Conclusion

We have learned so much information in our project thus far. We are very excited to see what the future can hold for it. Whether it is something that can help us receive employment, allow us to utilize it for our own home, or for the shear fact that it has allowed us the opportunity to learn and apply the education we've received at VIT, designing this has been a great experience. Not only has this project been helpful from an educational stand point, but also from a real world stand point.

# References


[1] Vinay Sagar K N and Kusuma S M, "Home Automation Using Internet of Things" in International Research Journal of Engineering and Technology (IRJET), January 2015.
Available: https://www.irjet.net/archives/V2/i3/Irjet-v2i3317.pdf

[2] Naga Venkateshwara Rao Kollipara and T. Sudheer Kumar2, "Wireless controlled home automation using IoT" in International Research Journal of Engineering and Technology (IRJET), June 2020.
Available: https://www.irjet.net/archives/V7/i6/IRJET-V7I6470.pdf

[3] Radhika Garg and Swati Gupta, "A Review on Internet of Thing for Home Automation " in International Journal of Engineering Research & Technology (IJERT), July 2020.
Available: https://www.ijert.org/research/a-review-on-internet-of-thing-for-home-automation-IJERTCONV8IS10022.pdf

[4] Sudha Kousalya, R Vasanthi, G Reddy Priya and B Venkatesh, "IOT Based Smart Security and Smart Home Automation" in International Journal of Engineering Research & Technology (IJERT), April 2018.
Available: https://www.ijert.org/research/iot-based-smart-security-and-smart-home-automation-IJERTV7IS040026.pdf


# Appendix

## i. Code

```
#include <ESP8266WiFi.h>
#include<FirebaseArduino.h>

// credentials
```

```
#define FIREBASE_HOST "water-flow-4ace3-default-
rtdb.firebaseio.com"
#define FIREBASE_AUTH
"W645aD6xOQZDWuqqSXwnR1DBlh92oB8xmfWWEN26"
#define WIFI_SSID "iBall-Baton" // input your home or public wifi
name
#define WIFI_PASSWORD "January2022" //password of wifi

// room sensors pin initialization
#define RelayFan 14 //D5
int relFan;
int buttonState1 = 0;
int relLight;
int ledPin = 12; // choose pin for the LED
int inputPin = 13; // choose input pin (for Infrared sensor)
int val = 0; // variable for reading the pin status

// ADXL335 Accelerometer
#define buzzer 12 // buzzer pin
#define x A0 // x_out pin of Accelerometer
#define y A1 // y_out pin of Accelerometer
#define z A2 // z_out pin of Accelerometer
/*variables*/
int xsample=0;
int ysample=0;
int zsample=0;
long start;
int buz=0;
/*Macros*/
#define samples 50
#define maxVal 20 // max change limit
#define minVal -20 // min change limit
#define buzTime 5000 // buzzer on time

// relay pin initialization
#define Relay 14 //D5
int rel;
int buttonState = 0;

// Flow meter pin initialization
#define SENSOR  2 //D4
```

```
long currentMillis = 0;
long previousMillis = 0;
int interval = 1000;
boolean ledState = LOW;
float calibrationFactor = 65   ;
volatile byte pulseCount;
byte pulse1Sec = 0;
float flowRate;
unsigned long flowMilliLitres;
unsigned int totalMilliLitres;
float flowLitres;
float totalLitres;
String Resivedata ;

void IRAM_ATTR pulseCounter()
{
  pulseCount++;
}
void setup()
{
  Serial.begin(115200);
  //relay Pin input
  pinMode(Relay,OUTPUT);
  digitalWrite(Relay,HIGH);

  //room sensors input and output
  pinMode(ledPin, OUTPUT);
  pinMode(inputPin, INPUT);
  pinMode(RelayFan,OUTPUT);
  digitalWrite(RelayFan,HIGH);

  // Flow meter input
  pinMode(SENSOR, INPUT_PULLUP);

  pulseCount = 0;
  flowRate = 0.0;
  flowMilliLitres = 0;
  totalMilliLitres = 0;
  previousMillis = 0;
```

```
  attachInterrupt(digitalPinToInterrupt(SENSOR), pulseCounter,
FALLING);

  WiFi.begin(WIFI_SSID,WIFI_PASSWORD);
  Serial.print("connecting");
  while (WiFi.status()!=WL_CONNECTED){
  Serial.print(".");
  delay(500);
  }
  Serial.println();
  Serial.print("connected:");
  Serial.println(WiFi.localIP());
  //Firebase initialisation
  Firebase.begin(FIREBASE_HOST,FIREBASE_AUTH);
  //Firebase Variable Setup
  Firebase.setInt("Switch",0);
  Firebase.setInt("SwitchLight",0);
  Firebase.setInt("SwitchFan",0);

  delay(1000);
  pinMode(buzzer, OUTPUT);
  buz=0;
  digitalWrite(buzzer, buz);
  for(int i=0;i<samples;i++) // taking samples for calibration
  {
  xsample+=analogRead(x);
  ysample+=analogRead(y);
  zsample+=analogRead(z);
  }

  xsample/=samples; // taking avg for x
  ysample/=samples; // taking avg for y
  zsample/=samples; // taking avg for z
}
//firebase reconnect function
void firebasereconnect()
{
Serial.println("Trying to reconnect");
Firebase.begin(FIREBASE_HOST, FIREBASE_AUTH);
}
void loop(){
```

```
if (Firebase.failed()){
  Serial.print("setting number failed:");
  Serial.println(Firebase.error());
  return;
}

//room controls code
relLight=Firebase.getString("SwitchLight").toInt();
if(relLight==1){
  digitalWrite(ledPin,HIGH);
}
else{
  digitalWrite(ledPin,LOW);
}
// RelayFan code
  relFan=Firebase.getString("SwitchFan").toInt();
  if(relFan==1)
  // If, the Status is 1, turn on the RelayFan
  {
  digitalWrite(RelayFan,LOW);
  Serial.println("RelayFan ON");
  }
  if(relFan==0)
  // If, the Status is 0, turn Off the RelayFan
  {
  digitalWrite(RelayFan,HIGH);
  Serial.println("RelayFan OFF");
  }

val = digitalRead(inputPin); // read input value
 if (val == HIGH)
 { // check if the input is HIGH
    digitalWrite(ledPin, HIGH); // turn LED OFF
    Firebase.setString("RoomVacancy","NO");
 }
 else
 {
    digitalWrite(ledPin, LOW); // turn LED ON
    Firebase.setString("RoomVacancy","YES");
 }
```

```
 // Relay code
  rel=Firebase.getString("Switch").toInt();
  if(rel==1)
  // If, the Status is 1, turn on the Relay
  {
  digitalWrite(Relay,LOW);
  Serial.println("Relay ON");
  }
  if(rel==0)
  // If, the Status is 0, turn Off the Relay
  {
  digitalWrite(Relay,HIGH);
  Serial.println("Relay OFF");
  }

  // FlowMeter Code
  currentMillis = millis();
  if (currentMillis - previousMillis > interval)
  {

  pulse1Sec = pulseCount;
  pulseCount = 0;

  // Because this loop may not complete in exactly 1 second intervals
we calculate
  // the number of milliseconds that have passed since the last
execution and use
  // that to scale the output. We also apply the calibrationFactor to
scale the output
  // based on the number of pulses per second per units of measure
(litres/minute in
  // this case) coming from the sensor.
  flowRate = ((1000.0 / (millis() - previousMillis)) * pulse1Sec) /
calibrationFactor;
  previousMillis = millis();

  // Divide the flow rate in litres/minute by 60 to determine how many
litres have
  // passed through the sensor in this 1 second interval, then multiply
by 1000 to
  // convert to millilitres.
```

```
flowMilliLitres = (flowRate / 60) * 1000;
flowLitres = (flowRate / 60);

// Add the millilitres passed in this second to the cumulative total
totalMilliLitres += flowMilliLitres;
totalLitres += flowLitres;

// Print the flow rate for this second in litres / minute
Serial.print("Flow rate: ");
Serial.print(float(flowRate));  // Print the integer part of the variable
Serial.print("L/min");
Serial.print("\t");       // Print tab space
Serial.println();

Firebase.setFloat("Volume",totalLitres);
Firebase.setInt("Volume in mL",totalMilliLitres);

//Limit initialization
Resivedata = Firebase.getString("Limit");
Serial.println(totalMilliLitres);
String data=Resivedata.substring(1,sizeof(Resivedata)-1);
Serial.println(data.toInt());
if (totalMilliLitres==data.toInt()){
   Firebase.setInt("Switch",0);
}

// Earthquake Code
int value1=analogRead(x); // reading x out
int value2=analogRead(y); //reading y out
int value3=analogRead(z); //reading z out

int xValue=xsample-value1; // finding change in x
int yValue=ysample-value2; // finding change in y
int zValue=zsample-value3; // finding change in z

/*displying change in x,y and z axis values over firebase*/
Firebase.setInt("buzXvalue",xValue);
Firebase.setInt("buzYvalue",yValue);
Firebase.setInt("buzZvalue",zValue);
delay(100);
```

```
    /* comparing change with predefined limits*/
    if(xValue < minVal || xValue > maxVal || yValue < minVal || yValue
> maxVal || zValue < minVal || zValue > maxVal)
    {
    if(buz == 0)
    Firebase.setInt("buz",buz);
    start=millis(); // timer start
    buz=1; // buzzer / led flag activated
    }

    else if(buz == 1) // buzzer flag activated then alerting earthquake
    {
    Firebase.setInt("buz",buz);
    if(millis()>= start+buzTime)
    buz=0;
    }

    else
    {
    Firebase.setInt("buz",buz);
    }

    digitalWrite(buzzer, buz); // buzzer on and off command

    // handle error
    if (Firebase.failed()) {
    Serial.println(Firebase.error());
    return;
   }
  }
}
```

# ii. Link to Simulation Video

Drive Link