

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY MANIPUR

Project Title: Smart Home Automation using Internet of Things(IoT)

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Group No: 1
Name: Chirag Goyal
Roll No : 16010201
Name: Sachin Kumar Sinha
Roll No : 16010205
Name: Mousam Kumar Baruah
Roll No : 16010213
Subject : Embedded system lab

1 ABSTRACT:

Nowadays everything becomes connected to Internet that make our life easy. The world is moving ahead very fast after the Internet came. First peoples were connected with internet and now devices. When people were connecting with Internet it was called Internet of Peoples and now devices and objects are connected with Internet, this is called Internet of Things(IoT). In 2018, 20 billion devices were connected with Internet and it is estimated that more than 75 billion will be connected to Internet means world is going transforming for automation and Internet of Things.

Internet of Things (IoT) is one of the promising technologies which can be used for connecting, controlling and managing intelligent objects which are connected to Internet through an IP address. Applications ranging from smart governance, smart education, smart agriculture, smart health care, smart homes etc can use IoT for effective delivery of services without manual intervention in a more effective manner. We are designing a product for safety and home automation. This system will be controlling lighting and other home appliances, water level, fire notification via smartphone.

2 INTRODUCTION:

The concept of “automated smart home” was first introduced over 80 years ago, and has been facing different technical limitations since then. Recently, home appliance manufacturers have launched a new initiative to bring the concept of smart homes to reality . This Smart Home initiative allows subscribers to remotely manage and monitor different home devices from anywhere via smart phones no physical distance limitations. Internet of Things(IoT) deals with billions of intelligent objects which would be connected to sense & collect the data and also communicate with surrounding people using mobile, wireless and sensor technologies. Main objective of IoT is to manage and control physical objects around us in a more intelligent and meaningful manner and also improve quality of life by providing cost effective living including safety, security and entertainment. Smart homes can be used for remotely monitoring and controlling electrical appliances of Smart Home fitted inside the home using smart & intelligent physical infrastructure.

3 LITERATURE SURVEY:

3.1 Bluetooth based home automation system using cell phones:

In Bluetooth based home automation system the home appliances are connected to the Arduino BT board at input output ports using relay. The program of Arduino BT board is based on high level interactive C language of micro-controllers; the connection is made via Bluetooth. The password protection

is provided so only authorized user is allowed to access the appliances. The Bluetooth connection is established between Arduino BT board and phone for wireless communication.

3.2 Zigbee based home automation system using cell phones:

To monitor and control the home appliances the system is designed and implemented using Zigbee. The device performance is record and store by network coordinators. For this the Wi-Fi network is used, which uses the four switch port standard wireless ADSL modern router. The network SSID and security Wi-Fi parameter are preconfigured. The message for security purpose first process by the virtual home algorithm and when it is declared safe it is re-encrypted and forward to the real network device of the home.

3.3 GSM based home automation system using cell phones:

Because of the mobile phone and GSM technology, the GSM based home automation is lure to research. The SMS based home automation, GPRS based home automation and dual tone multi frequency (DTMF) based home automation, these options we considered mainly for communication in GSM.

4 PROBLEM FORMULATON:

How to deal with controlled automation of home appliances and safety of home when we are not at home in a smart way with low cost. It makes very convenient for all to have all the devices adjusted just through your phone.

5 DESIGN METHODOLOGY:

In home automation system that we are designing the home appliances are connected to the Arduino BT board at input output ports using relay. We are interfacing fire sensor for detecting fire, water level indicators for measuring water level, LPG gas sensor for detecting gas leakages, motion sensor, with Arduino ATMega 2560 & NodeMcu . The program is implemented to work on data collected from sensors. The program of Arduino BT board is based on high level interactive C language of microcontrollers; that is interfaced with Node MCU board that has an inbuilt ESP8266 Wifi connection module that helps in connecting the system with internet. That data is send to Firebase database on server, from there the data can be accessed on smartphone and actions can be taken accordingly. The performed operation is send to the Firebase through Application & From Firebase the Operation is Send to the NodeMcu & ATMega2560. The password protection is provided so only authorized user is allowed to access the appliances through application. The connection is established between NodeMcu board and smartphone by wifi.

5.1 Component Details :

5.1.1 Arduino ATMega 2560 board:

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 microcontroller. It has 54 digital IO pins (of which 15 can be used as PWM outputs), 16 analog inputs, 3 sets of TX-RX that is transmitter and receiver pins, a 16 MHz crystal oscillator, a USB connection for program upload, a power jack, inbuilt voltage regulator of 5V, an ICSP header, a builtin LED and a reset button. It contains everything needed to support the microcontroller; we can connect it to a computer with a USB cable or power it with a DC adapter or battery to get started.

5.1.2 Node MCU board:

NodeMCU is an open source LUA based firmware developed for ESP8266 wifi chip. Earlier and nowadays ESP8266 module is used for Internet connectivity purposes via Wi-Fi. By exploring functionality with ESP8266 chip, NodeMCU firmware comes with ESP8266 Development board/kit i.e. NodeMCU Development board. NodeMCU comes with LUA based firmware but it can be used with Arduino IDE also for all purposes as when we run C/C++ program the LUA firmware is flashed with newly generated binary firmware code.

5.1.3 Ultrasonic sensor HC-SR04:

The ultrasonic sensor measures the distance of the object placed in front of it, sending the result to the serial port. It can work in the range of 3cm to 300cm. It measures the time spent by the signal sent by TRIG(trigger) and received pin by ECHO and is multiplied by speed of signal and divided by 2 to read the distance between object and sensor.

5.1.4 Gas sensor MQ5:

A gas sensor is a device which detects the presence of gas in an area. This sensor interacts with a gas to measure its concentration. Each gas has a unique breakdown voltage i.e. the electric field at which it is ionized. Sensor identifies gases by measuring these voltages. The concentration of the gas can be determined by measuring the current discharge in the device. The MQ5 gas sensor detects the presence of various gases such as hydrogen, carbon monoxide, methane and LPG ranging from 100ppm to 3,000ppm.

5.1.5 PIR based motion sensor:

A PIR-based motion detector is used to sense movement of people, animals, or other objects. They are commonly used in burglar alarms and automatically-activated lighting systems. They are commonly called simply PIR sensor (Passive Infrared sensor).

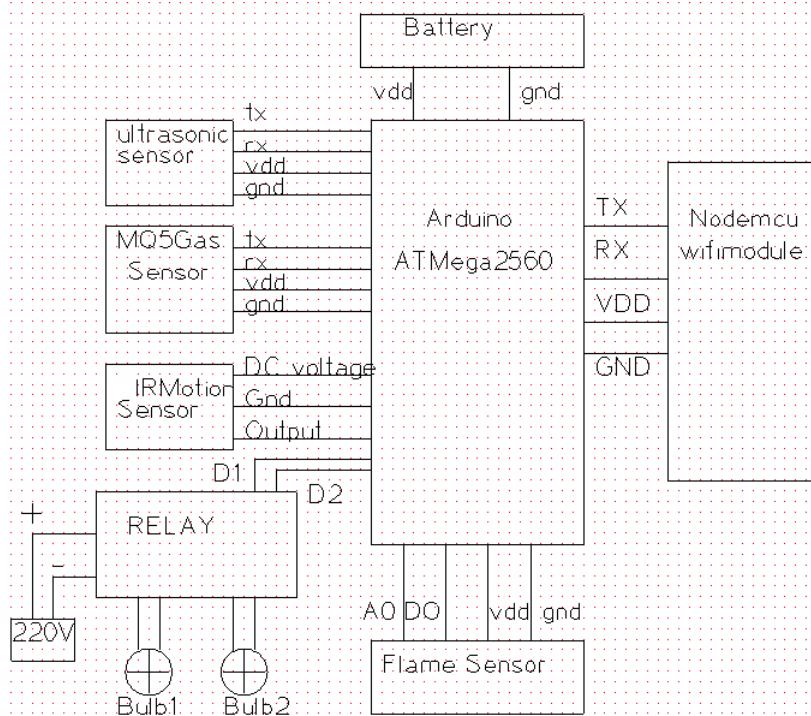
5.1.6 Infrared sensor:

The basic concept of an Infrared Sensor which is used as Obstacle detector is to transmit an infrared signal, this infrared signal bounces from the surface of an object and the signal is received at the infrared receiver.

5.1.7 Four channel 5V Relay module:

A relay is an electromagnetic switch. The input side is a coil while the output side is a switch magnetically connected to the coil. When current flows through the coil, the switch toggles. The module's three pins are VCC, IN and GND. All we need is apply power via the VCC and GND and give it a pulse at IN to turn on the relay.

5.2 Circuit Diagram :



6 IMPLEMENTATION & WORKING OF HOME AUTOMATION :

To Implement This Project we used Bottom to Top Approach. Here We analyse the working of each component as per the project uses & interconnect each other

6.1 Hardware Implementation:

In Hardware Implementation First of all we learn how the NodeMcu works ,the pin configuration ,its interfacing with different sensor.After that we connected the Nodemcu with Internet by using Wifi with smartphone .The connection of NodeMcu is done with Arduino platform by simple embedded Programming.This is First Step to start with this project .

In Next Step We connect flame Sensor for Fire detection With ATMega2560 & test its working .It takes Analog data from atmosphere ,next we set the threshold value of this flame sensor & compare the analog value with threshold value after that take the decision of Having Fire or Not Fire at home.

Similary We connect IR Sensor for intruder detetion & Gas Sensor LPG or Smoke detection With ATMega2560 & test individual working & take the decision according to the threshold value & Analog Input comparision.

For Water Level Detection We used ultrasonic sensor it is mainly used for distance mesurment.We are using Four channel Relay Switch to control the Home Appliances using smart phone via Internet. Relay Switch takes Input as Digital High & Low .

Finally We Integrate all the sensor & Relay with Arduino ATMega2560 & ATMega2560 is embedded with NodeMcu to Send the data to Firebase server via Internet.

6.2 Software Implementation :

In Software Implemantation the Required three platform :

- Arduino platform
- Android Studio
- Firebase Console

Arduino is used for embedded programming of microcontroller ATMega2560 & Nodemcu. Android studio is used to develope android application for smart home automation & Firebase console is used to store & fetch the data from server in Real time via connectivity .

In Software Development First of all We added the Firebase arduino & ESP8266 Wifi Library in arduino software . These library we download from github repository . After that we create a new project name “SMARTO” on google firebase with real time database .

To connect the Nodemcu with firebase Autentication & Host key is used which is copied from firebase & paste it on arduino program. To connect the NodeMcu with Wifi put Wifi ssid of network & password of smart phone network in arduino program.

These Sensing data we get from differnet different sensor which is embedded on ATMega2560 . The ATMega2560 send data to NodeMcu & NodeMcu is connected to internet which sends the data to server .In last We send the Sensor data to the server via autentication key of server .

We make one application named “Smarto” which is used to communicate with server & Send operation to server as well as showing the current state of sensor in application.The application shows the water level of Tank , Flame detected or not , Gas detected or not, Intruder detected or not and controlled the home appliances using toggle button.This application is also connected to firebase.The Main advantage of this application is if any Flame detected , Gas detected , Intruder detected or Water Tank is full, It shows the alert Notification on smart phone by Vibrate or ringing alert tone .

6.3 Code For NodeMcu:

```
#include <ESP8266WiFi.h>
#include <FirebaseArduino.h>
float f=100.0;
int trigpin = D5;
int echopin = D6;
int flamedetect=D7;
int gasdetect=D8;
int irdetect=D0;
long duration;
int distance;
#define WIFI_SSID "NO" //replace SSID with your wifi username
#define WIFI_PASSWORD "12345678" //replace PWD with your wifi password
#define FIREBASE_HOST "smarto-7050b.firebaseio.com" //link of api
#define FIREBASE_AUTH "xkKsh9QugSpT64ZrFSCj1m3droxVy0hcehipPV2H"
void setup() {
pinMode(trigpin, OUTPUT);
pinMode(echopin, INPUT);
Serial.begin(9600);
pinMode(D1,OUTPUT);
pinMode(D2,OUTPUT);
pinMode(D3,OUTPUT);
pinMode(D4,OUTPUT);
pinMode(flamedetect,INPUT);
pinMode(gasdetect,INPUT);
pinMode(irdetect,INPUT);
WiFi.begin(WIFI_SSID, WIFI_PASSWORD); //connect to wifi
while (WiFi.status() != WL_CONNECTED)
{
delay(100);
Serial.println("");
Serial.println("WiFi connected");
Serial.println("IP address: ");
Serial.println(WiFi.localIP());
Firebase.begin(FIREBASE_HOST, FIREBASE_AUTH);
```

```

}

void loop()
{
digitalWrite(trigpin, LOW);
delayMicroseconds(2);
//String sense=Firebase.getString("sensor");
digitalWrite(trigpin, HIGH);
delayMicroseconds(10);
digitalWrite(trigpin, LOW);
duration = pulseIn(echopin, HIGH);
distance = duration * 0.034/2;
Serial.print("Distance : "); Serial.print(distance);
Firebase.setFloat("waterlevel",distance);
String relay1=Firebase.getString("relay1");
delay(50);
String relay2=Firebase.getString("relay2");
delay(50);
String relay3=Firebase.getString("relay3");
delay(50);
String relay4=Firebase.getString("relay4");
delay(50);
Serial.print("Distance : ");
Serial.println(distance);
int flame=digitalRead(flamedetect);
int gas=digitalRead(gasdetect);
int ir=digitalRead(irdetect);
if(ir==HIGH)
Firebase.setString("ir","Intruder Detected");
else
Firebase.setString("ir","Safe");
if(flame==HIGH)
Firebase.setString("flame","Flame Detected");
else
Firebase.setString("flame","Flame Not Detected");
if(gas==HIGH)
Firebase.setString("gas","Gas Detected");
else
Firebase.setString("gas","Gas Not Detected");
if(relay1=="ON")
{
digitalWrite(D1,HIGH);
}
else
{
digitalWrite(D1,LOW);
}

```

```

if(relay2=="ON")
{
digitalWrite(D2,HIGH);
}
else
{
digitalWrite(D2,LOW);
}
if(relay3=="ON")
{
digitalWrite(D3,HIGH); }
else
{
digitalWrite(D3,LOW);
}
if(relay4=="ON")
{
digitalWrite(D4,HIGH);
}
else
{
digitalWrite(D4,LOW);
}
}

```

6.4 Code For Sensor with ATMega2560:

```

int flameA0 = A0;
int sensorThresflame = 900;
int flameoutput=2;
int smokeA0 = A1;
int sensorThresgas = 250;
int gasout=3;
int IRA4 = A4;
int iroutput=4;
int sensorThresir = 100; // 15-20 range of threshold
void setup()
{
Serial.begin(9600);
pinMode(smokeA0, INPUT);
pinMode(gasout,OUTPUT);
pinMode(flameA0, INPUT);
pinMode(flameoutput,OUTPUT);
pinMode(IRA4, INPUT);
pinMode(iroutput,OUTPUT);
pinMode(13,OUTPUT);

```

```

pinMode(12,OUTPUT);
pinMode(11,OUTPUT);
pinMode(10,OUTPUT);
pinMode(9,OUTPUT);
pinMode(8,OUTPUT);
pinMode(7,OUTPUT);
pinMode(6,OUTPUT);
digitalWrite(13,HIGH);
digitalWrite(12,HIGH);
digitalWrite(11,HIGH);
digitalWrite(10,HIGH);
digitalWrite(9,LOW);
digitalWrite(8,LOW);
digitalWrite(7,LOW);
digitalWrite(6,LOW);
Serial.begin(9600);
}
void loop()
{
int analogSensorflame = analogRead(flameA0);
Serial.print("Pin A0: ");
Serial.println(analogSensorflame); // Checks if it has reached the threshold
value
if (analogSensorflame < sensorThresflame)
{
Serial.println("FLAME DETECTED");
digitalWrite(flameoutput,HIGH);
}
else
{
digitalWrite(flameoutput,LOW);
Serial.println("NO FLAME"); }
int analogSensorgas = analogRead(smokeA0);
Serial.print("Pin A1: ");
Serial.println(analogSensorgas); // Checks if it has reached the threshold
value
if (analogSensorgas > sensorThresgas)
{
digitalWrite(gasout, HIGH);
Serial.println("SMOKE DETECTED");
}
else
{
digitalWrite(gasout, LOW);
Serial.println("NO SMOKE");
}

```

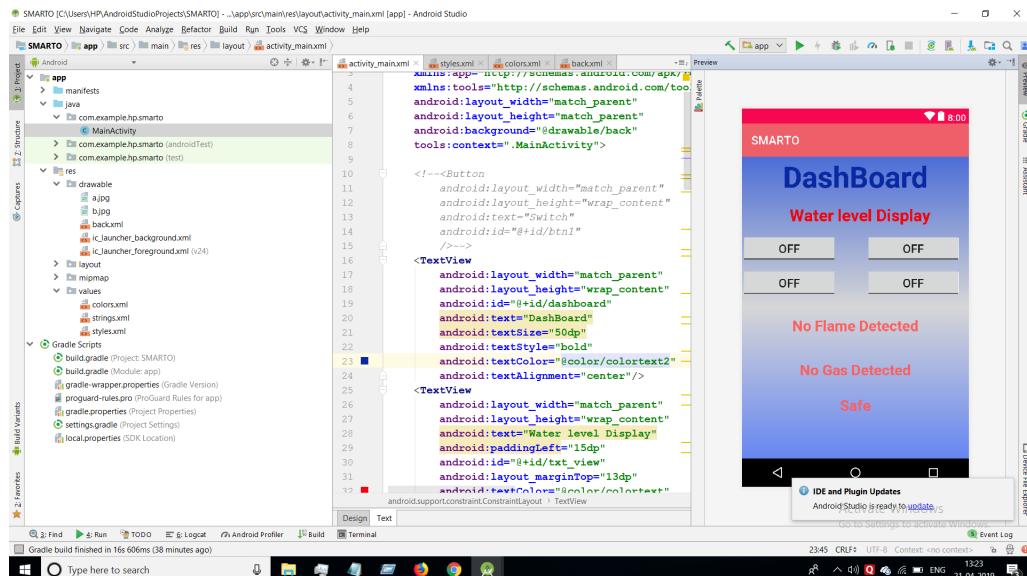
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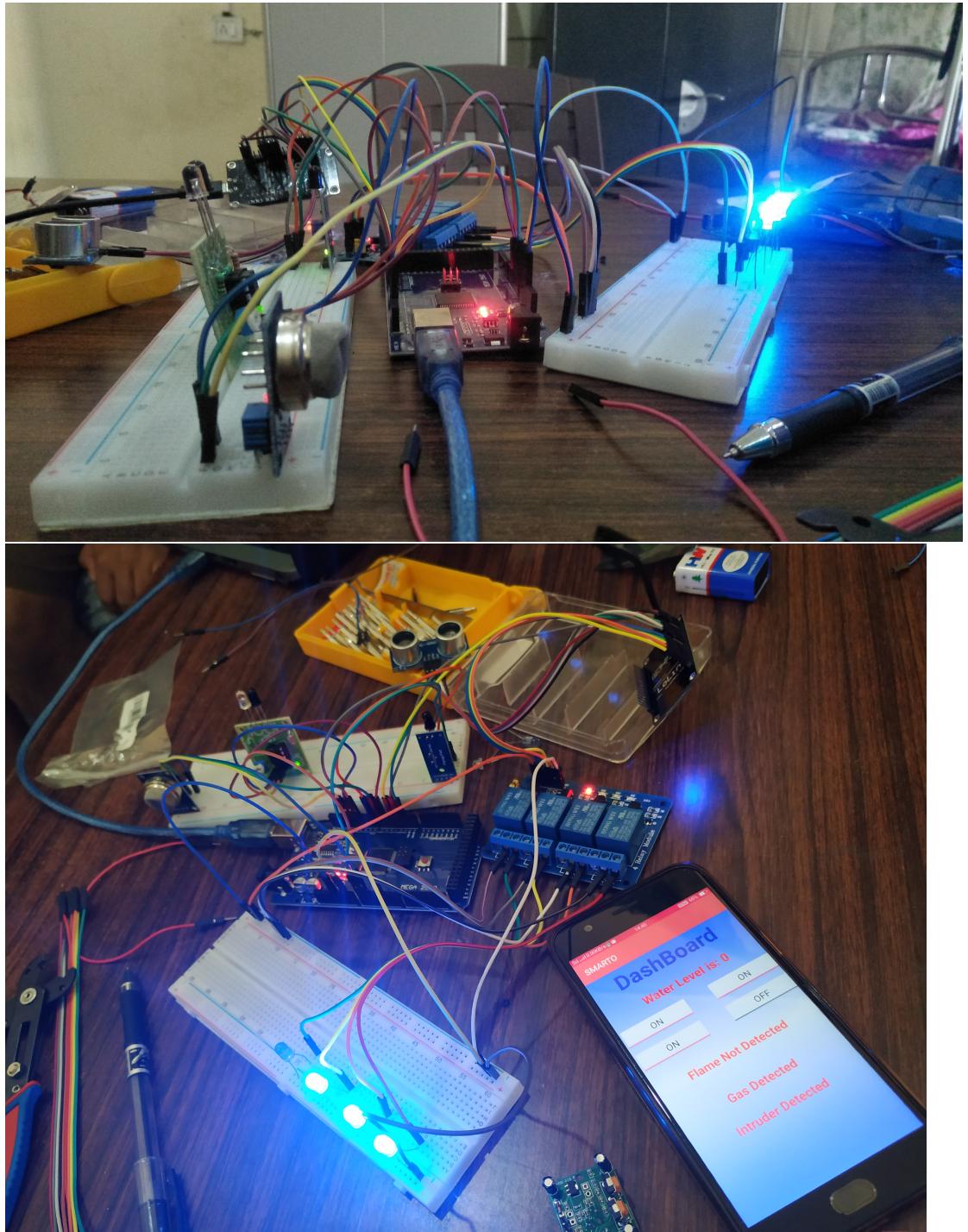
int analogSensorir = analogRead(IRA4);
Serial.print("Pin A4: ");
Serial.println(analogSensorir); // Checks if it has reached the threshold value
if (analogSensorir > sensorThresir)
{ Serial.println("INTRUDER DETECTED");
digitalWrite(iroutput,HIGH);
}
else
{
Serial.println("FINE====");
digitalWrite(iroutput,LOW);
}
delay(1600);
}

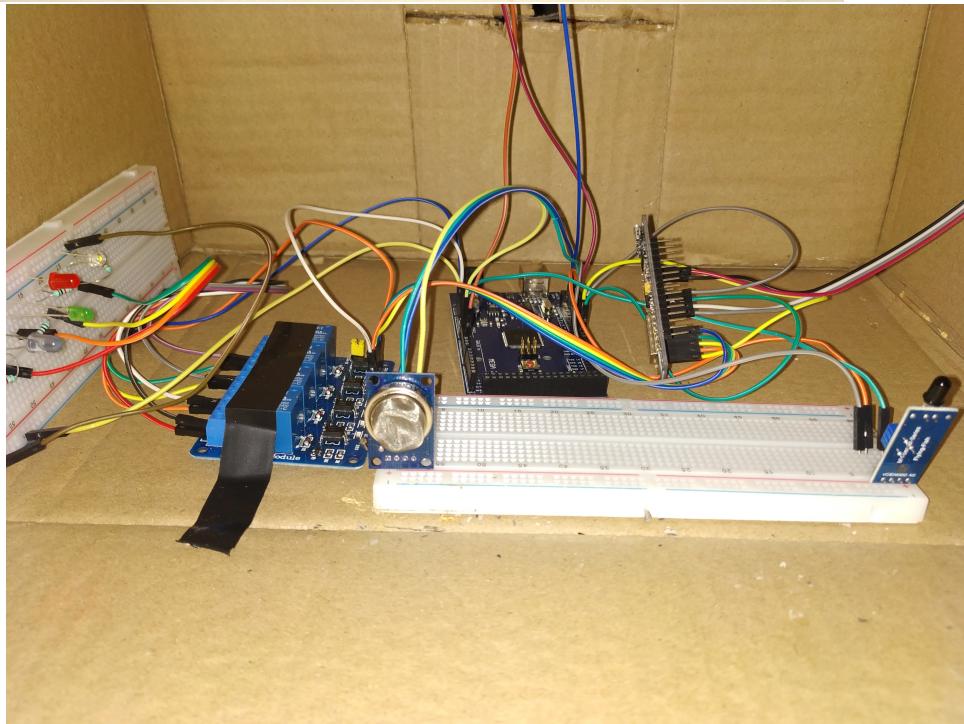
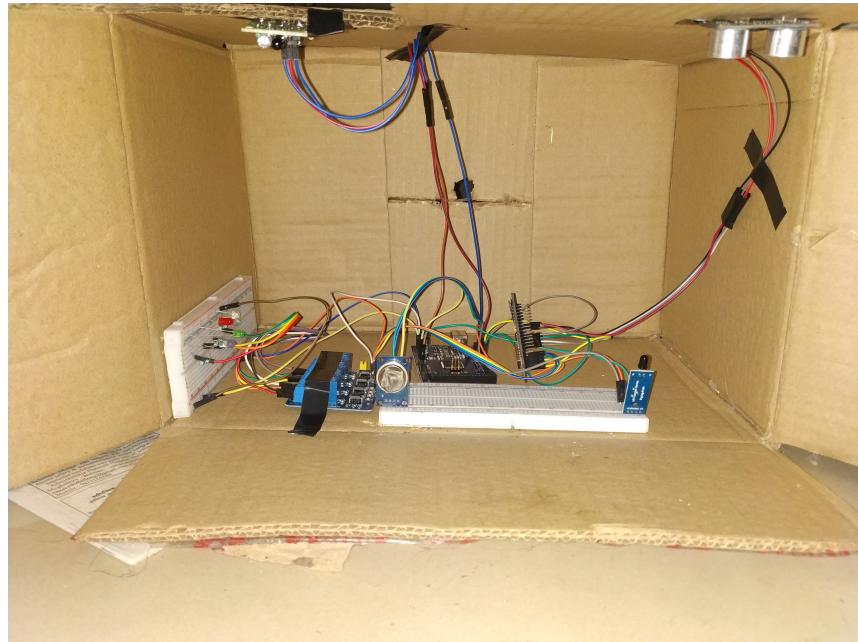
```

So this is it how we implement the smart home & discussed the brief working of the device.

6.5 Images of Home automation devices:







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7 CHALLENGES DURING PROJECT:

The Main challenges in this project is Library problem of firebase arduino library & The sensors are not so much accurate or good ,we have to check the sensor many times.The code is taking huge time to compile & upload on microcontroller.

The Main challege of this is Delay in Operations .It takes 5-6 second to switch on the appliances/Light & showing or updating the sensor value in firebase as well as application smarto.

8 CONCLUSION & FUTURE SCOPE:

The proposed Home Automation System enhances mobility and supports monitoring and control of devices from any location by a singe click in application. Being a simple and user friendly application ,It serves as an application of great help to the people. We can Monitor & control our home & appliances Thus, the Internet of Things based Home Automation System with android app will solve many problems of the people.

Future Scope is From the Smart Homes we can make Smart Industries, Smart Football Ground, Smart Hospital & Smart Cities. There are some more add ones & Functionality but the basic building block is same.We can Make the Smart home using Voice or Speech detection & monitor the Home live via vedio processing but it require a very good internet connectivity which is not possible in present.

9 REFERENCES:

- [1] Neha Malik , Yogita Bodwade “Literature Review on Home Automation System” IJARCCE
- [2] Pooja N.Pawar , Shruti Ramachandran , Nisha P.Singh , Varsha V.Wagh “A Survey on Internet of Things Based Home Automation System” IJARCCE
- [3] www.Arduino.cc - The official website of arduino.
- [4] Kumar Mandula, Ramu Parupalli, CH.A.S.Murty, E.Magesh, Rutul Lunagariya Centre for Development of Advanced Computing(C-DAC)
- [5] <https://firebase.google.com/>
- [6] <https://github.com/FirebaseExtended/firebase-arduino>