Automation of Home lighting system Project report

Course name: Measurements and Instrumentation

Supervisor: Thamilamaran a.

Slot: C1

No. of pages: 2

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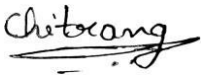
CERTIFICATE

This is to certify that the project work entitled "**Automation of Room lighting system**" that is being submitted by **Chitrang Agarwal ,M. Sai Srikar ,Moiz K. and Shant Rakshit** for Measurement and Instrumentation is a record of bonafide work done under my supervision. The of this Project work, in full or in parts, have neither been taken from any other source nor have been submitted for any other CAL course.

Name of the students	Reg. No	Signature
Chitrang Agarwal	19BEE0169	
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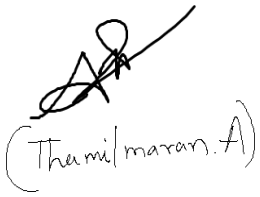

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Date: 04/06/2021

PROF. THAMILMARAN A

INDEX:

ABSTRACT:-

The world of engineering is about reducing power consumption of your abode to the minimum ,and thus increasing life span of your appliances and reducing energy consumed. Such a project is undertaken which helps solve the problem of consumption of electricity in an empty room. Since there need not be any lights or fan ON when nobody is in the room; this project ensures it and switches OFF power when not required.

This is done by the use of IR sensors which is most popular for the use as a motion detector. We detect the person entering and exiting the room using this IR sensor and thus switching ON/OFF the power in the room.

Not only detecting motion but also determining the number of people in a room will help in controlling the amount of power that should be used. All is detected by PIR sensors and then according to code in Arduino UNO, controls the electricity in the room.

Introduction:-

Since the overgrowing demand of power and electricity in day to day to life, we cant help but waste majority of it simply by keeping the appliances at home running even without a human present. The problem might be small on day to day basis but over long term can cost much money and also causes environmental damages. Since there is no need for appliances such as Fans and Light bulbs be ON even with nobody present in the room, it makes all sense that there be a mechanism to keep in check that no power is wasted. This is where a system which keeps track of number of people in a room at a given time comes in big help to reduce power consumption. By cutting the power when nobody is present in a room, we can save ton of resources overall.

Software Used:

- The software used to simulate the project is 'Tinkercad'.
- The coding and execution is done in Arduino ide.
- App to connect to and control nodemcu was made in "MIT App inventor"

Hardware Used:

Components:

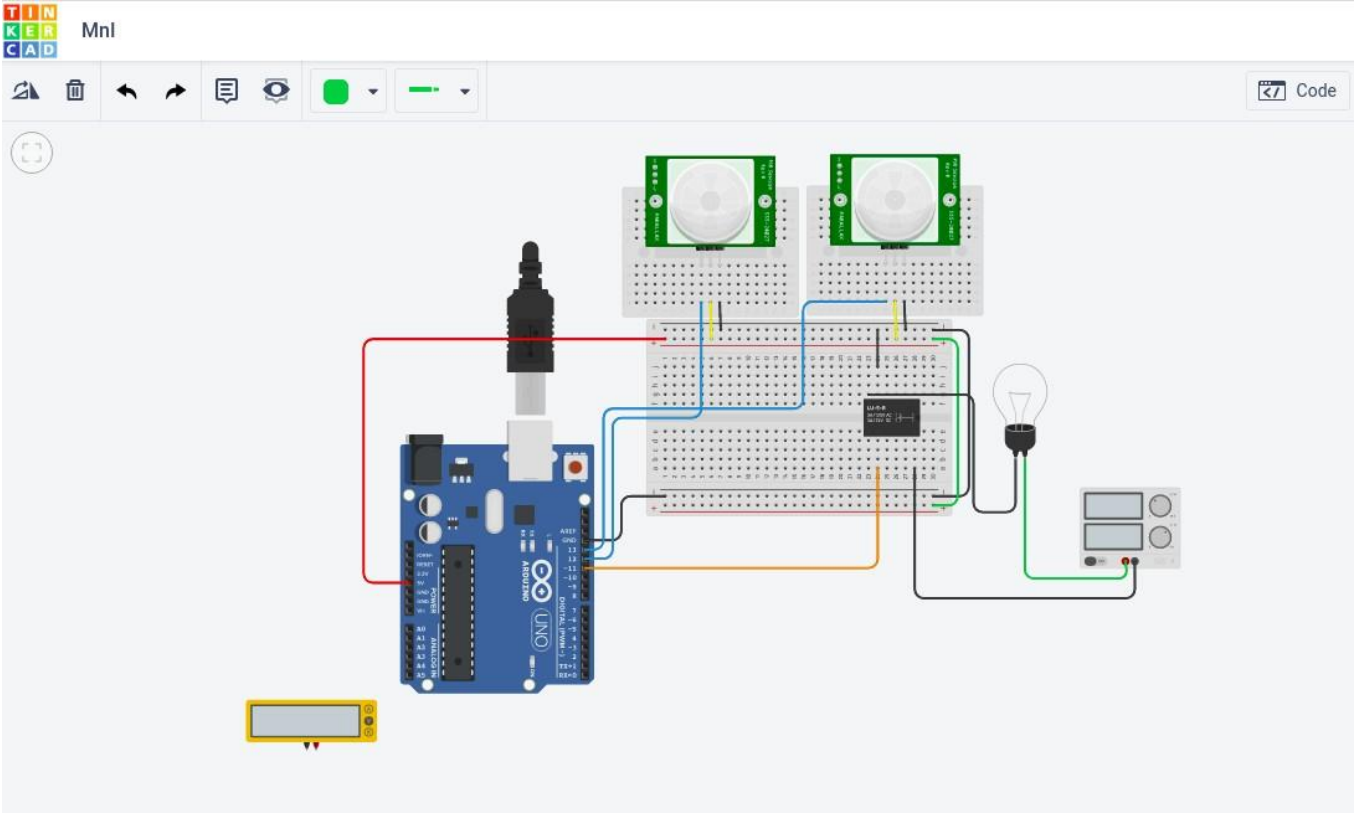
- IR sensors
- Arduino(As voltage source)
- Relay module
- Power supply
- Nodemcu(ESP8266)

Tinker-cad original designs:

Tinkercad is an online simulator provided by Autodesk to provide personnel to play around with the sensors and Arduino functionalities. The original project was also tinkered in the simulation and run through simulations to reach the next point in the project. Once the functions and codes performed as per satisfaction, the prototype was build in person and worked flawlessly.

Tinkercad was founded as a company in 2011 in the European Union by former Google engineer Kai Backman and his co-founder Mikko Mononen, with a goal to make 3D modeling, especially the design of physical items, accessible to the general public, and allow users to publish their designs under a Creative Commons license. In 2011, the tinkercad.com website was launched as a web-based 3D modeling tool for WebGL-enabled browsers, and in 2012 the company moved its headquarters to San Francisco. By 2012 over 100,000 3D designs had been published by users. In May 2013, Auto-desk announced at a Maker Faire that they would acquire Tinkercad.

In March 2017, Autodesk recommended users of the soon to be retired 123D Sculpt migrate to Tinkercad (or Maya LT). In May, Autodesk discontinued its 123D Circuits (Circuits.io) "Electronics Lab". The program's features were merged into Tinkercad.



Our take on the project started with this circuit and we further build upon this because of few limitations of Tinker-cad, the nodemcu couldn't be implemented.

Arduino ide:

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.[4]

The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program *avrdude* to convert

the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware. By default, avrdude is used as the uploading tool to flash the user code onto official Arduino boards.

Arduino IDE is a derivative of the Processing IDE, however as of version 2.0, the Processing IDE will be replaced with the Visual Studio Code-based Eclipse Theia IDE framework.

Arduino Pro IDE

Developer(s)	Arduino Software
Preview release	V0.1.2 / 14 September 2020; 8 months ago
Repository	git hub
Written in	C, C++
Operating system	Windows, macOS, Linux
Platform	IA-32, x86-64, ARM
Type	Integrated development environment
License	LGPL or GPL license
Website	blog

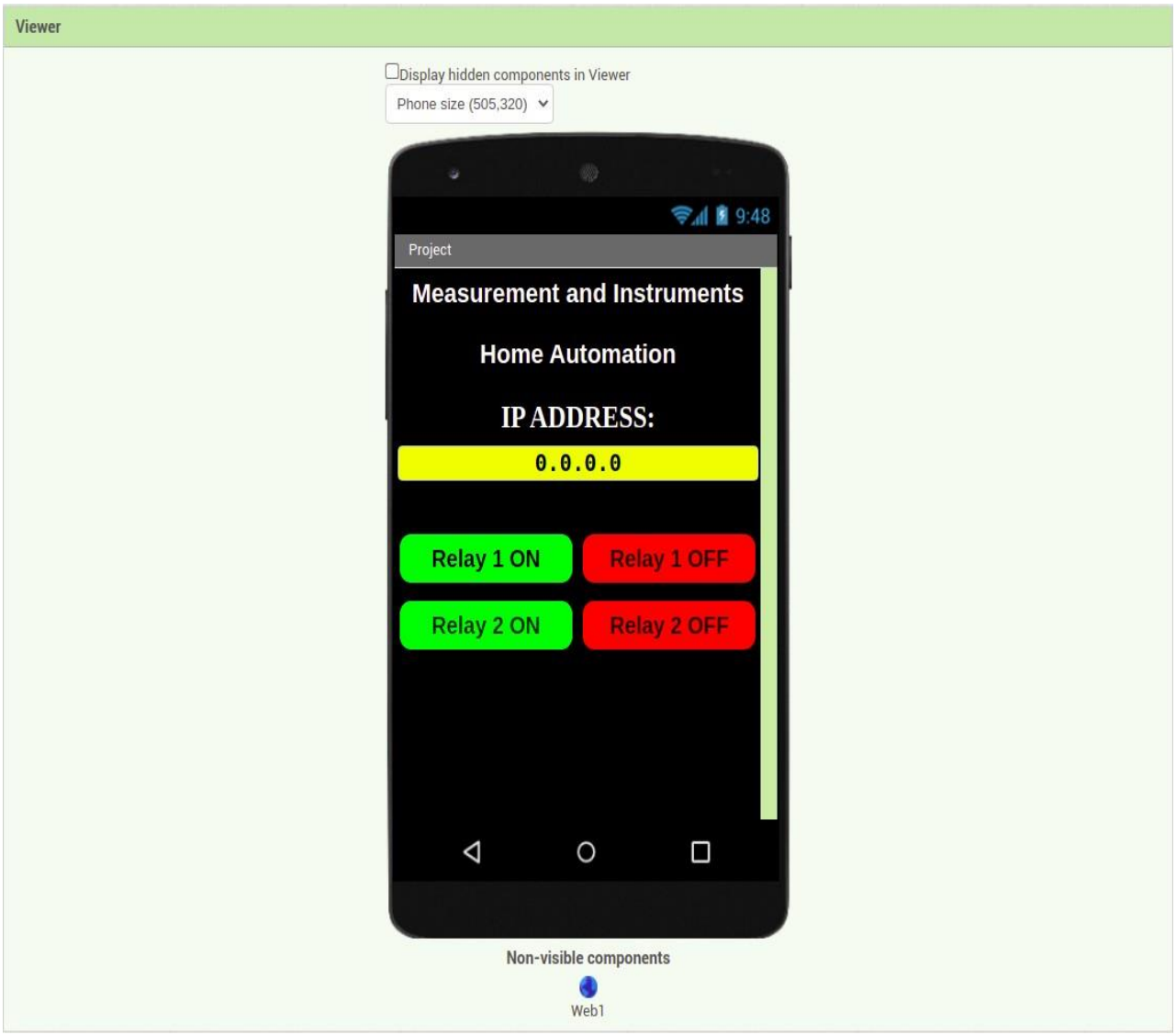
With the rising popularity of Arduino as a software platform, other vendors started to implement custom open source compilers and tools (cores) that can build and upload sketches to other micro controllers that are not supported by Arduino's official line of micro controllers.

MIT app Inventor:

It is an intuitive, visual programming environment that allows everyone – even children – to build fully functional apps for smartphones and tablets. Those new to MIT App Inventor can have a simple first app up and running in less than 30 minutes. And what's more, our blocks-based tool facilitates the creation of complex, high-impact apps in significantly less time than traditional programming environments. The MIT App Inventor project seeks to democratize software development by empowering all people, especially young people, to move from technology

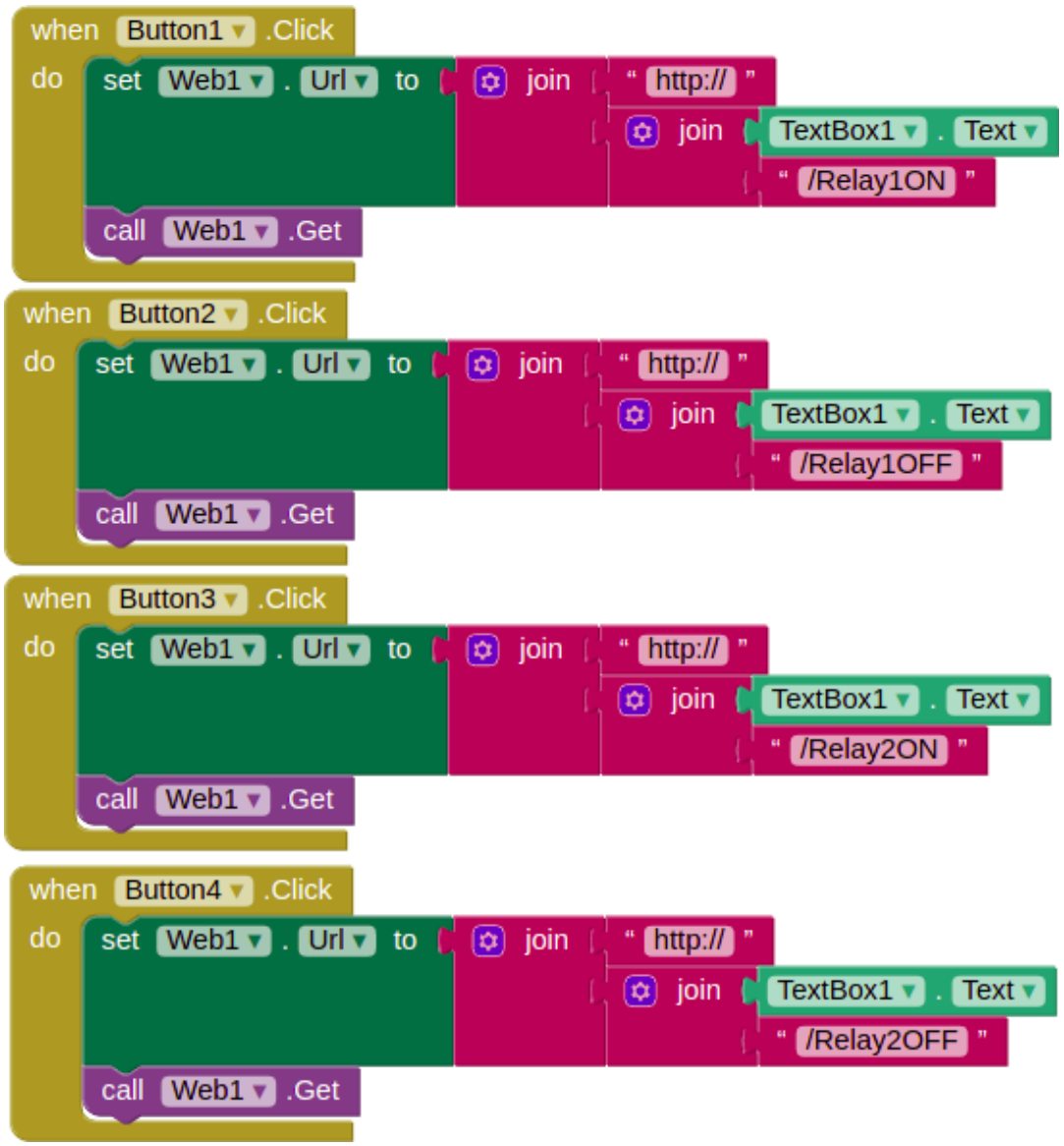
consumption to technology creation.
A small team of CSAIL staff and students, led by Professor Hal Abelson, forms the nucleus of an international movement of inventors. In addition to leading educational outreach around MIT App Inventor and conducting research on its impacts, this core team maintains the free online app development environment that serves more than 6 million registered users.
Blocks-based coding programs inspire intellectual and creative empowerment. MIT App Inventor goes beyond this to provide real empowerment for kids to make a difference -- a way to achieve social impact of immeasurable value to their communities. In fact, App Inventors in school and outside of traditional educational settings have come together and done just that.

Our application made in the app Inventor:



The application built has 2 main features:

- The app has to learn of the connection from the phone to the nodemcu that is used to control the relays. This hurdle is overcome by the use of a text box which takes in the ip address of the WiFi, the nodemcu is connected to and thus by manually giving the address in the text box in the phone app can help send the data through WiFi. This is done by following commands:



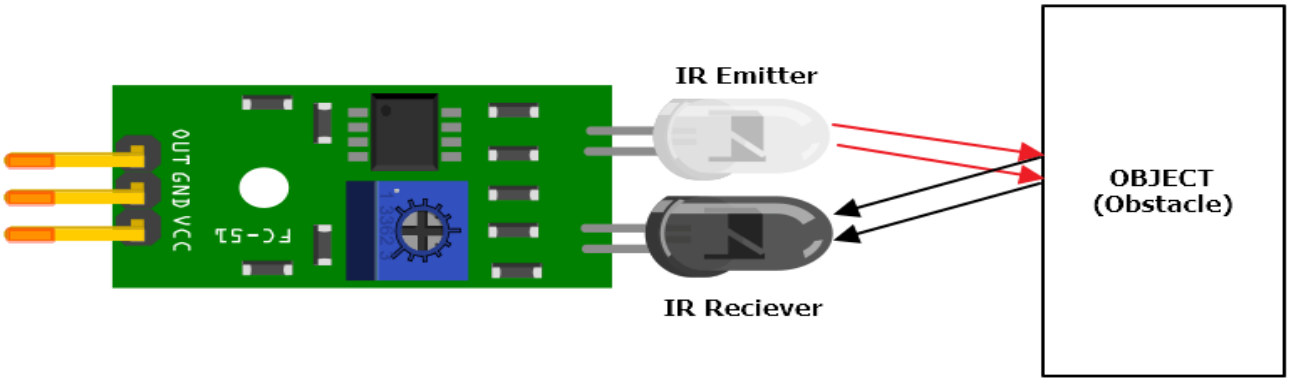
The commands works as following:
When a button(Suppose Relay 1 ON) is clicked the app will send a string of data "/Rela1ON" on a web page page with URL containing the ip address of the WiFi the nodemcu is connected with. Thus a

communication is set up between the node and the phone through that URL. Similar is the process for other 3 buttons.

- The other feature are the buttons itself. With the use of the buttons we get to provide the data to the node to be done when the user desires to be.

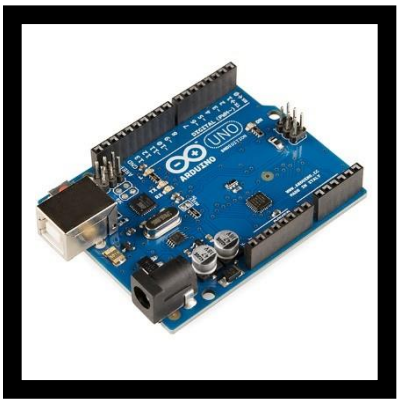
IR SENSOR:

An infrared (IR) sensor is an electronic device that measures and detects infrared radiation in its surrounding environment.
There are two types of infrared sensors: active and passive. Active infrared sensors both emit and detect infrared radiation. Active IR sensors have two parts: a light emitting diode (LED) and a receiver. When an object comes close to the sensor, the infrared light from the LED reflects off of the object and is detected by the receiver. Active IR sensors act as proximity sensors, and they are commonly used in obstacle detection systems (such as in robots).

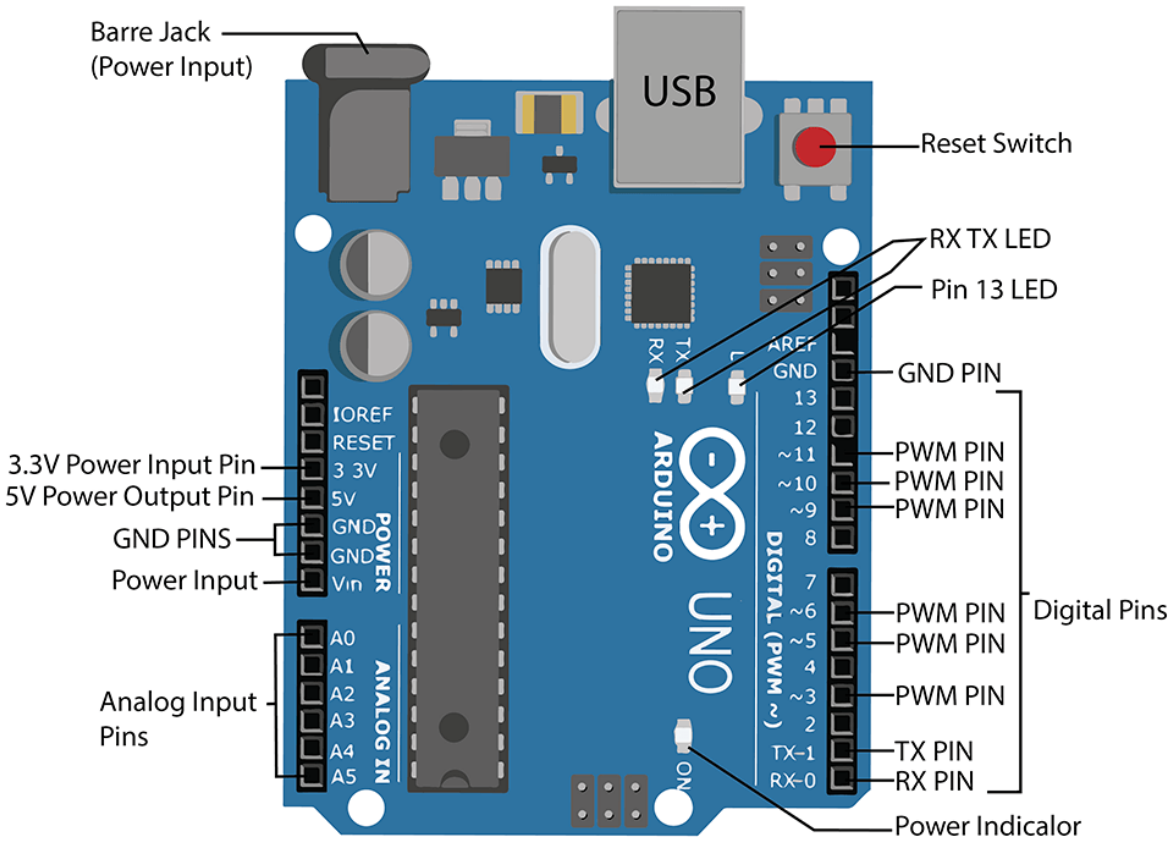


Note: Black surfaces absorbs light naturally. So it will not reflects much light on IR Reciever. This concept is used in Line follower robot.

ARDUINO BOARD:



The Arduino Uno is programmed using the Arduino Software (IDE), our Integrated Development Environment common to all our boards and running both online and offline. The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits.



Why Arduino?

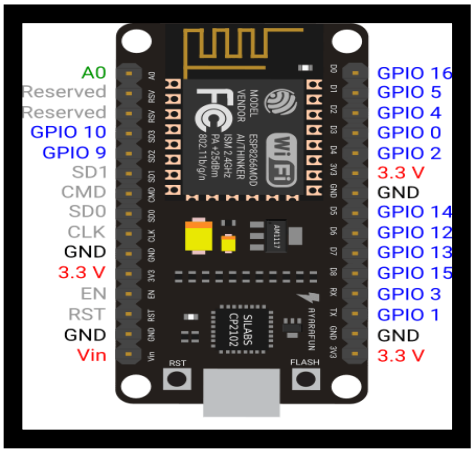
Thanks to its simple and accessible user experience, Arduino has been used in thousands of different projects and applications. The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows, and Linux. Teachers and students use it to build low cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics. Designers and architects build interactive prototypes, musicians and artists use it for installations and to experiment with new musical instruments. Makers, of course, use it to build many of the projects exhibited at the Maker Faire, for example. Arduino is a key tool to learn new things. Anyone - children, hobbyists, artists, programmers - can start tinkering just following the step by step instructions of a kit, or sharing ideas online with other members of the Arduino community.
There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many others offer similar functionality. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

- Inexpensive - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than $50
- Cross-platform - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.
- Simple, clear programming environment - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming

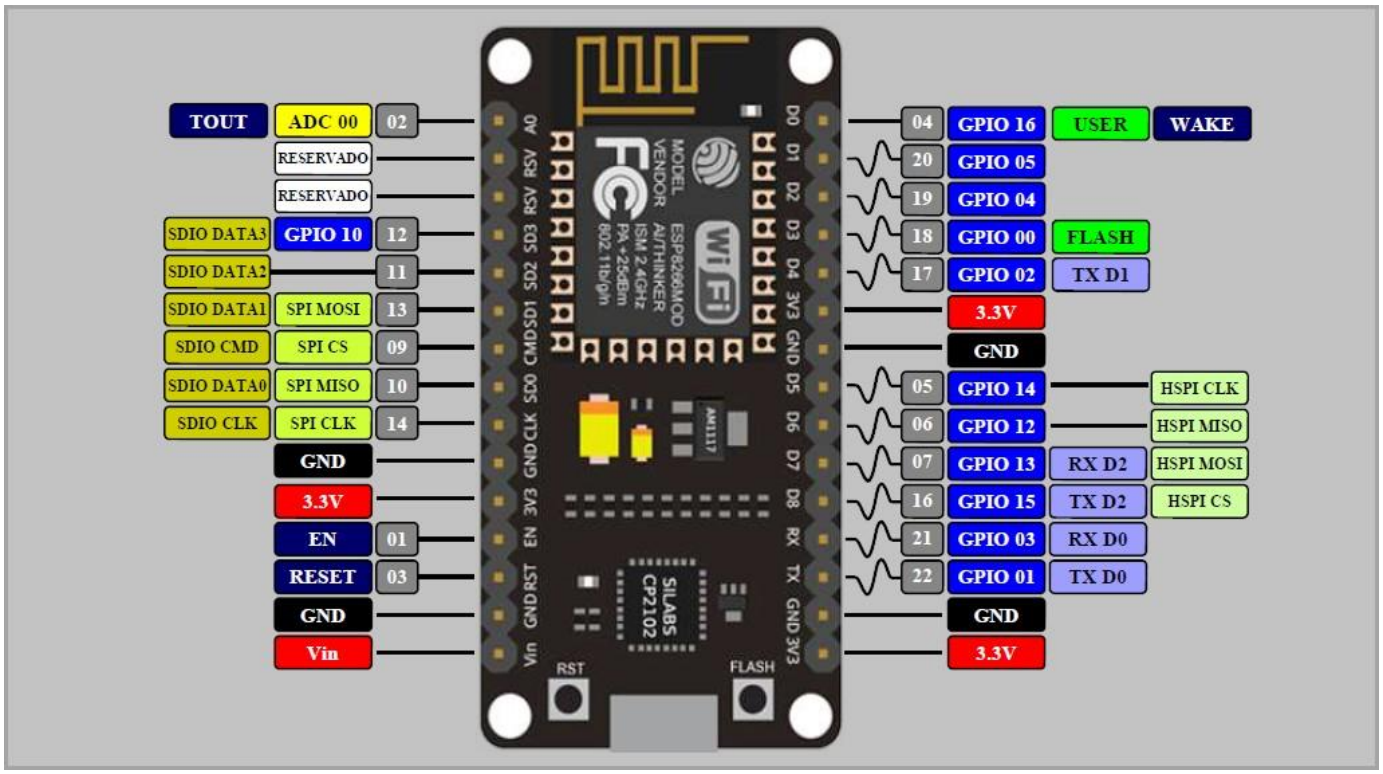
environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.

- Open source and extensible software - The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR-C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.
- Open source and extensible hardware - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

NODE MCU:



NodeMCU is a low-cost open source IoT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module. Later, support for the ESP32 32-bit MCU was added.



NodeMCU Development Board Pinout Configuration

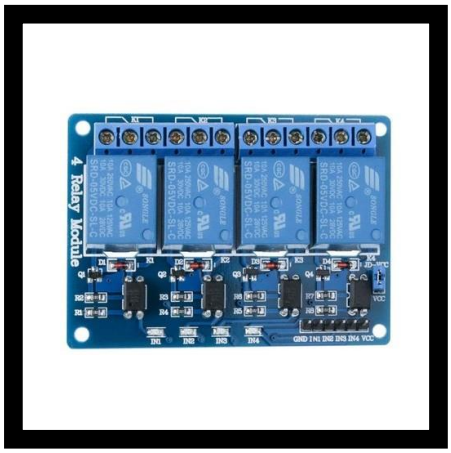
Pin Category	Name	Description
Power	Micro-USB, 3.3V, GND, Vin	Micro-USB: NodeMCU can be powered through the USB port 3.3V: Regulated 3.3V can be supplied to this pin to power the board GND: Ground pins Vin: External Power Supply
Control Pins	EN, RST	The pin and the button resets the microcontroller
Analog Pin	A0	Used to measure analog voltage in the range of 0-3.3V
GPIO Pins	GPIO1 to GPIO16	NodeMCU has 16 general purpose input-output pins on its board
SPI Pins	SD1, CMD, SD0, CLK	NodeMCU has four pins available for SPI communication.
UART Pins	TXD0, RXD0,	NodeMCU has two UART interfaces, UART0 (RXD0 &

	TXD2, RXD2	TXD0) and UART1 (RXD1 & TXD1). UART1 is used to upload the firmware/program.
I2C Pins		NodeMCU has I2C functionality support but due to the internal functionality of these pins, you have to find which pin is I2C.

NodeMCU ESP8266 Specifications & Features

·Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
·Operating Voltage: 3.3V
·Input Voltage: 7-12V
·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
·USB-TTL based on CP2102 is included onboard, Enabling Plug n Play
·PCB Antenna
·Small Sized module to fit smartly inside your IoT projects

RELAY MODULE:



A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a micro controller. When activated, the electromagnet pulls to either open or close an electrical circuit.

A simple relay consists of wire coil wrapped around a soft iron core, or solenoid, an iron yoke that delivers a low reluctance path for magnetic flux, a movable iron armature and one or more sets of contacts. The movable armature is hinged to the yoke and linked to one or more set of the moving contacts. Held in place by a spring, the armature leaves a gap in the magnetic circuit when the relay is de-energized. While in this position, one of the two sets of contacts is closed while the other set remains open.

When electrical current is passed through a coil, it generates a magnetic field that in turn activates the armature. This movement of the movable contacts makes or breaks a connection with the fixed contact. When the relay is de-energized, the sets of contacts that were closed, open and breaks the connection and vice versa if the contacts were open. When switching off the current to the coil, the armature is returned, by force, to its relaxed position. This force is usually provided by a spring, but gravity can also be used in certain applications. Most power relays are manufactured to operate in a quick manner.

For distribution of power in high current applications, GEP Power Products is the industry leader in high power relay module design and manufacturing.

Rated up to 70 amps, GEP's power relay modules are designed for seamless integration in high power distribution applications. The convenient integral mounting brackets provide easy installation and accessibility. With endless options such as terminal position assurance available for wire retention, GEP Power Products' power distribution solutions and off-road industry knowledge are second to none.

METHODOLOGY -

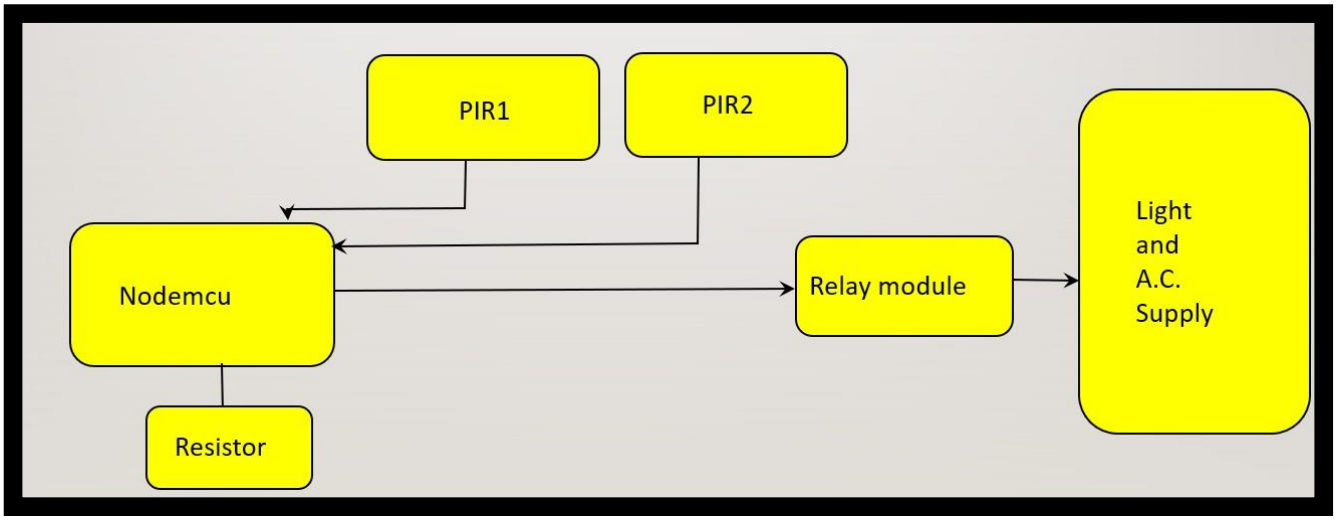
The workflow is as follows:

- When IR2 detects a motion just after detecting motion in IR1, the code calculates there is a plus amount of people in the room. The code increments total no. of people in room by 1 each time this takes place.
- This in turn makes Arduino send a signal to switch on the relay and thus turn on the lights in the room.

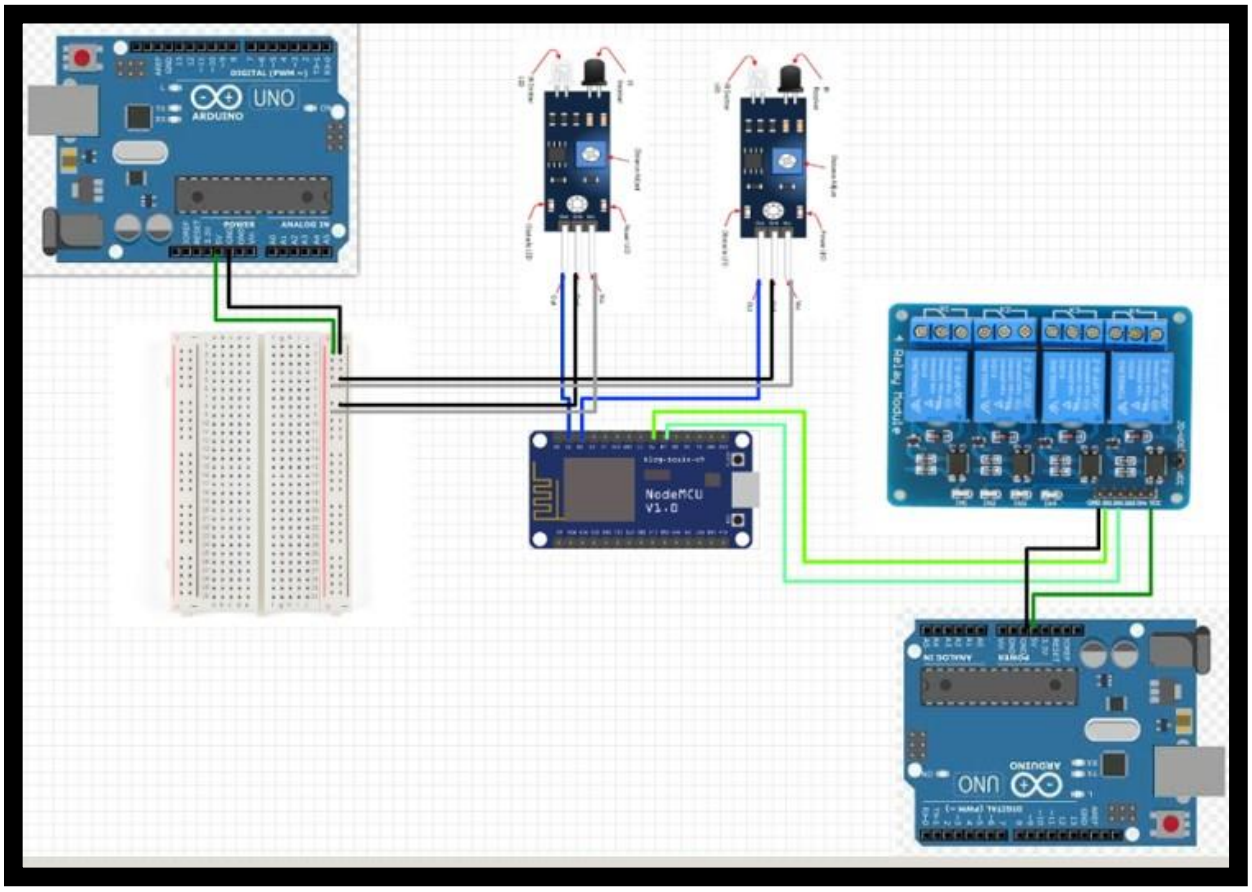
- Also subsequently when IR1 detects motion after detecting motion in IR2, it suggests a person leaving the room. The code hence decrements the total in room by 1 each time someone leaves.
- When the total is more than 0 the light is ON. When the total is 0 the light switches off.

- The total number in room can not only be used to control switching but also controlling the power output in the room.

BLOCK DIAGRAM:



CIRCUIT DIAGRAM:



PIN CONFIGURATION:

IR1:

- Power: 5v from Arduino
- OUT: pin D1 of Nodemcu
- Ground

IR2

- Power: 5v from Arduino
- OUT: pin D2 of Nodemcu
- Ground

Relay

- IN: pin D6 of Nodemcu
- IN: pin D7 of Nodemcu
- Ground

CODING:-

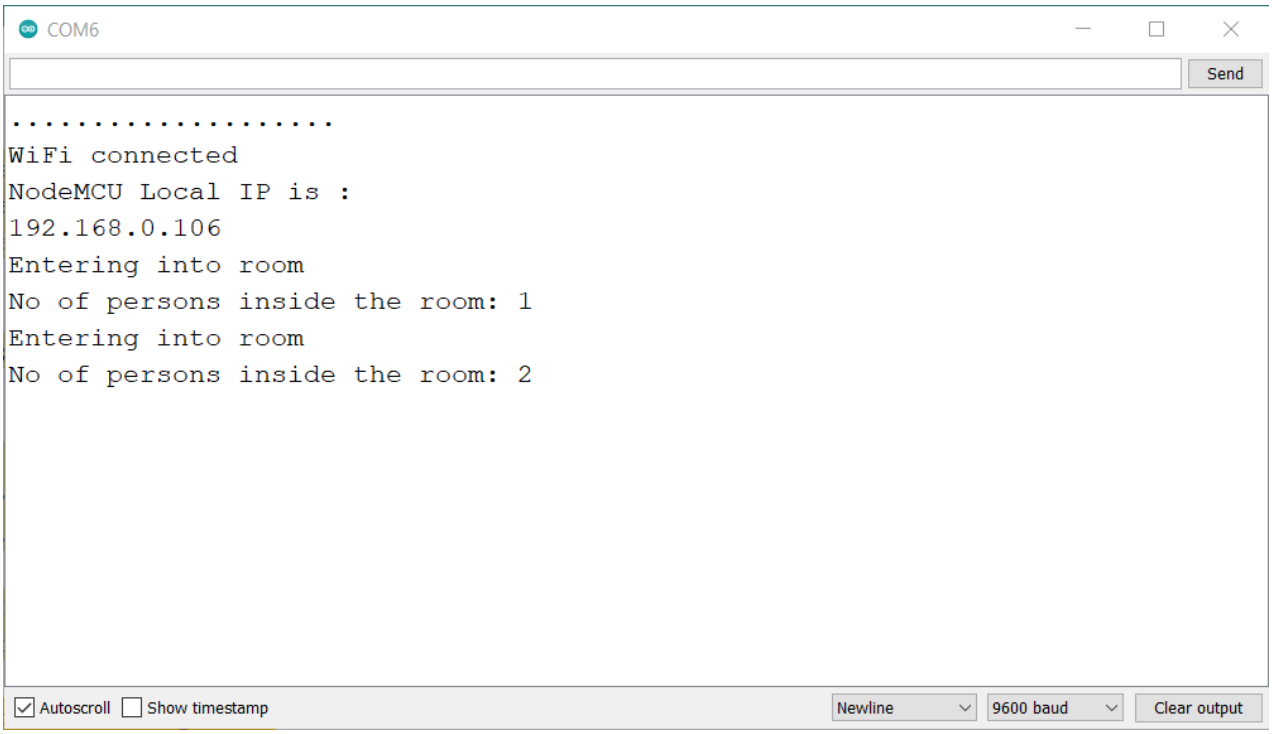
```
#include <ESP8266WiFi.h>
#include <ESP8266WiFiMulti.h>
#include <WiFiClient.h>
#include <WiFiClientSecure.h>
#include <WiFiServer.h>
#include <WiFiServerSecure.h>
#include <WiFiUdp.h>


WiFiClient client;
WiFiServer server(80);

/* WIFI settings */
char* ssid = "Muffadal villa";  //WIFI SSID
const char* password = "7d08c10c17974bc";    //WIFI PASSWORD

/* data received from application */
String data ="";

/* define L298N or L293D motor control pins and ir pins */
int Relay1 = 12;    //D6
int Relay2 = 13;    //D7
int irPin1=4;   //D2
int irPin2=5;   //D1

/* variables will help in counting */
int count=0;
boolean state1 = true;
boolean state2 = true;
boolean insideState = false;
boolean outsideIr=false;
boolean isPeopleExiting=false;
int i=1;

void setup()
{
  /* initialize motor control pins as output */
  pinMode(Relay1, OUTPUT);
  pinMode(Relay2, OUTPUT);
  pinMode(irPin1, INPUT);
  pinMode(irPin2, INPUT);

  /* start server communication */
  Serial.begin(9600);
  connectWiFi();
  server.begin();
```

```
  digitalWrite(Relay1,HIGH);
  digitalWrite(Relay2,HIGH);
}
void loop()
{

/*Counting of people in room*/

  if (!digitalRead(irPin1) && i==1 && state1){
     outsideIr=true;
     delay(100);
     i++;
     state1 = false;
  }

   if (!digitalRead(irPin2) && i==2 && state2){
     Serial.println("Entering into room");
     outsideIr=true;
     delay(100);
     i = 1 ;
     count++;
      Serial.print("No of persons inside the room: ");
      Serial.println(count);
     state2 = false;
  }

   if (!digitalRead(irPin2) && i==1 && state2 ){
     outsideIr=true;
     delay(100);
     i = 2 ;
     state2 = false;
  }

  if (!digitalRead(irPin1) && i==2 && state1 ){
     Serial.println("Exiting from room");
     outsideIr=true;
     delay(100);
     count--;
     if(count<=0){
     count=0;
       }
      Serial.print("No of persons inside the room: ");
      Serial.println(count);
     i = 1;
     state1 = false;
  }

    if (digitalRead(irPin1)){
```

```
 state1 = true;
}

 if (digitalRead(irPin2)){
 state2 = true;
}
if(count<=0){
  count=0;
  digitalWrite(Relay1,HIGH);
  digitalWrite(Relay2,HIGH);
   }

else if(count<=5 && count>0){
  digitalWrite(Relay1,LOW);
  digitalWrite(Relay2,HIGH);
  }

else if(count>5 && count<=10){
  digitalWrite(Relay2,LOW);
  digitalWrite(Relay1,HIGH);
}

/* If the server available, run the "checkClient" function */
client = server.available();
if (!client) return;
data = checkClient ();
Serial.println(data);

/* Conditions switching on and off */

if (data == "Relay1ON")
{
  digitalWrite(Relay1,LOW);
  }

else if(data == "Relay1OFF")
{
  digitalWrite(Relay1,HIGH);
  }

if (data == "Relay2ON")
{
  digitalWrite(Relay2,LOW);
  digitalWrite(Relay1,HIGH);
}
else if(data == "Relay2OFF")
{
  digitalWrite(Relay2,HIGH);
```

```
    }
}

void connectWiFi()
{
  Serial.println("Connecting to WIFI");
  WiFi.begin(ssid, password);
  while ((!(WiFi.status() == WL_CONNECTED)))
  {
    delay(300);
    Serial.print("..");
  }
  Serial.println("");
  Serial.println("WiFi connected");
  Serial.println("NodeMCU Local IP is : ");
  Serial.println((WiFi.localIP()));
}
/************ RECEIVE DATA FROM the APP **************/
String checkClient (void)
{
  while(!client.available()) delay(1);
  String request = client.readStringUntil('\r');
  request.remove(0, 5);
  request.remove(request.length()-9,9);
  return request;
}
```

OUTPUT: -



Comparison:

The implementations of home automation has always been automated either by remote controlled IR switches or through smartphones. The automation provided in markets are manual switches rather than automated by checking of presence of a person inside the room at a given time. We were able to overcome this by implementing a counting algorithm using IR sensors, which helped in checking the number of people and thus act according to that said number of people. Which makes this project much more efficient in power consumption.

Conclusion/Future scope:-

- The circuit is the basic switching device for now and will not be helpful if same amount of energy is used for 1 person in the room or 10 persons in the room.
- To overcome this we need a built-in regulator based on the number of people in the room.
- We have the total count of the people in the room but need to add a potentiometer to adjust for the power output.
- The automation can not only help reduce the energy consumption but addition of other sensors such as flame/smoke detectors, the vicinity can be efficiently evacuated.
- Addition of different modes of operation will help more control over our electricity consumption. Modes such as Manual switching, Triggered switching by IR sensors and other such sensors according to the customers needs.

References:-

- https://www.tinkercad.com/things/lYCV9s8Qoro-mni
- http://ai2.appinventor.mit.edu/
- https://www.arduino.cc/
- https://components101.com/development-boards/nodemcu-esp8266-pinout-features-and-datasheet
- https://www.simform.com/home-automation-using-internet-of-things/
- https://www.youtube.com/watch?v=ImaRBCWxUrs
- https://www.youtube.com/watch?v=QynTEeFF5-k