



ISLAMIC UNIVERSITY OF TECHNOLOGY  
(Organization of Islamic cooperation)  
Gazipur, Dhaka

PROJECT NAME:

**INTERNET OF THINGS (IoT) BASED HOME SECURITY SYSTEM**

SUBMITTED

In partial fulfilment of the requirement for the degree of B.Sc. Engineering in Electrical and  
Electronic Engineering

by

Oun Ali Samo -160020020  
Abbas Muntari -160020018  
Abdulahakim -160020008

Under the Supervision of

Mr. Golam Sarowar  
Assistant Professor  
Department of Electrical and Electronic Engineering

## **DECLARATION**

This project is a presentation of our research work. Wherever contribution of others are involved, every effort is made to indicate this point clearly, with due reference to literature and acknowledgement of collaborative research and discussions. The work was done under the guidance of Mr. Golam Sarowar, at Islamic University of Technology, Gazipur, Dhaka.

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**Oun Ali Samo**

---

**Abbas Muntari**

---

**Abdulkhakim**

**Approved by**

---

**Prof. Dr. Md. Rhul Amin**

**Head of Department**

**Department of Electrical and Electronic Engineering (EEE)  
Islamic University of Technology (IUT)  
Gazipur-1704, Bangladesh.**

In my capacity as supervisor of the project, I certify that the above statements are true to the best of my knowledge.

---

**Mr. Golam Sarowar**

**Assistant Professor  
Department of Electrical and Electronic Engineering  
Islamic University of Technology (IUT)**

**Date: 19<sup>th</sup> November, 2019**

## **AKNOWLEDEMENT**

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We express our warm thanks to Mr. Golam Sarowar for his support and guidance.

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## **Abstract**

Internet of Things (IoT) conceptualizes the idea of remotely connecting and monitoring real world objects (things) through the Internet. When it comes to our house, this concept can be aptly incorporated to make it smarter, safer and automated.

Home security is a very useful application of IoT and we are using it to create an inexpensive security system for homes as well as industrial use. The system will inform the owner about any unauthorized entry or whenever the door is opened by sending a notification to the user. After the user gets the notification, he can take the necessary actions. The security system will use a microcontroller known as ESP-8266 32-bit to interface between the components, a PIR Sensor and IR Sensor to monitor the status, a buzzer for sounding the alarm, and a Nodemcu ESP8266 Wi-Fi module to connect and communicate using the Internet.

This IoT project focuses on building a smart wireless home security system which sends alerts to the owner by using Internet in case of any trespass and raises an alarm optionally. Besides, the same can also be utilized for home automation by making use of the same set of sensors.

## **Overview of the Project**

- Designing the smart device circuit diagram.
- Applying the circuit accurately.
- Installing the Arduino Uno board which acts as the brain of the system.
- Connecting the microcontroller with the WiFi module to establish an internet connection.
- Setting up the PIR & IR sensors to detects the human activities over a particular range.
- Configuring the Blynk Application.
- Programming the microcontroller to detect the human activity using PIR and IR sensors in such a way that the alarm systems will switch on automatically and alert the owner.

## **Introduction**

IoT or Internet Things refers to the network of connected physical objects that can communicate and exchange data among themselves without the need of any human intervention. It has been formally defined as an “Infrastructure of Information Society”, because IoT allows us to collect information from all kind of mediums such as humans, animals, vehicles, kitchen appliances. Thus any object in the physical world which can be provided with an IP address to enable data transmission over a network can be made part of IoT system by embedding them with electronic hardware such as sensors, software and networking gear. IoT is different than Internet as in a way it transcends Internet connectivity by enabling everyday objects that uses embedded circuits to interact and communicate with each other utilizing the current Internet infrastructure.

An important factor to consider when we talk about home automation is Security. Home security is a very important feature of home automation and maybe the most crucial one. Home security made a drastic changes in the past few decades and continue to advance much more in the coming years. Previously home security systems meant having an alarm that would go off when somebody would break in but a smart secure home can do much more than that. Therefore the main objective of our work is to design a system which can alert the owner and others of an intruder break-in by sending a notification to their smart phones. The owner will also have the ability to stop or start the alarm remotely using just his smart phone. This system will help the users to safeguard their homes by placing the system on the doors or windows and monitoring the activity through their smart phones.

The IoT network consists of embedded electronics, sensors and software from their home, they want to be assured that their home is protected by intruders and thieves while they are gone. This is why the proposed system keeps the owner informed in the real time about the security status of their home. The designed system informs the user as there is a break-in so that the user can take necessary actions.



## Project description

### NodeMCU ESP8266 design Specifications

<b>Microcontroller</b>	<b>ESP-8266 32-bit</b>
<b>NodeMCU Model</b>	<b>Amica</b>
<b>NodeMCU Size</b>	<b>49mm x 26mm</b>
<b>Carrier Board Size</b>	<b>n/a</b>
<b>Pin Spacing</b>	<b>0.9" (22.86mm)</b>
<b>Clock Speed</b>	<b>80 MHz</b>
<b>USB to Serial</b>	<b>CP2102</b>
<b>USB Connector</b>	<b>Micro USB</b>
<b>Operating Voltage</b>	<b>3.3V</b>
<b>Input Voltage</b>	<b>4.5V-10V</b>
<b>Flash Memory/SRAM</b>	<b>4 MB / 64 KB</b>
<b>Digital I/O Pins</b>	<b>11</b>
<b>Analog In Pins</b>	<b>1</b>
<b>UART/SPI/I2C</b>	<b>1 / 1 / 1</b>
<b>WiFi Built-In</b>	<b>802.11 b/g/n</b>
<b>Temperature Range</b>	<b>-40C - 125C</b>

## Circuit Diagram:

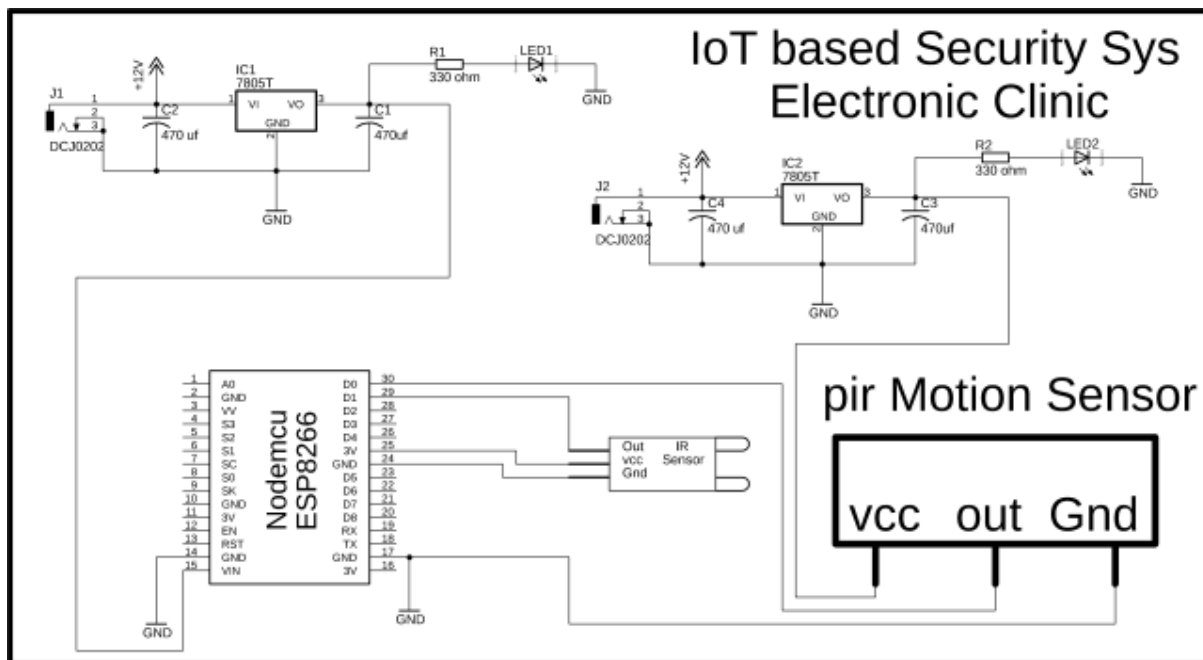


Figure 1 This Schematic is designed in CadeSoft Eagle 9.1.0 version.

As you can see in figure 1 two power supplies are used in this project. The power supply on the left side is used to power up the Nodemcu ESP8266 Wi-Fi Module while the power supply on the right side is used to power up the PIR Sensor. The voltage required to power up the PIR Sensor is from 5 to 20 volts as the PIR sensor module has a 3.3v voltage regulator. So the PIR Sensor module cannot be powered up using 3.3 volts from the Nodemcu Module. So that's why I am using a separate 5v regulated power supply for the PIR Sensor. Both the Power Supplies are exactly the same and can be powered up using a single 12v adaptor.

J1 is the Female Power Jack and this is where we connect a 12v adaptor, battery, or a Solar panel. Two 470uf capacitors are connected at the input and output sides of the 7805 voltage regulator. A 330-ohm resistor is connected in series with a 2.5v LED. This is a current limiting resistor. The output of the voltage regulator is connected with the Vin pin of the Nodemcu ESP8266 Wi-Fi module and the GND of the power supply is also connected with the ground of the Nodemcu Module.

The Out pin of the IR sensor is connected with the digital pin D1, VCC pin of the infrared sensor is connected with the 3v pin of the Nodemcu module while the GND is connected with the GND. The VCC pin of the PIR Sensor is connected with the output of the regulated power supply. The out pin is connected with the digital pin D0 and the ground pin is connected with the ground.

## Main components:

## Hardware:

### NodeMCU ESP8266

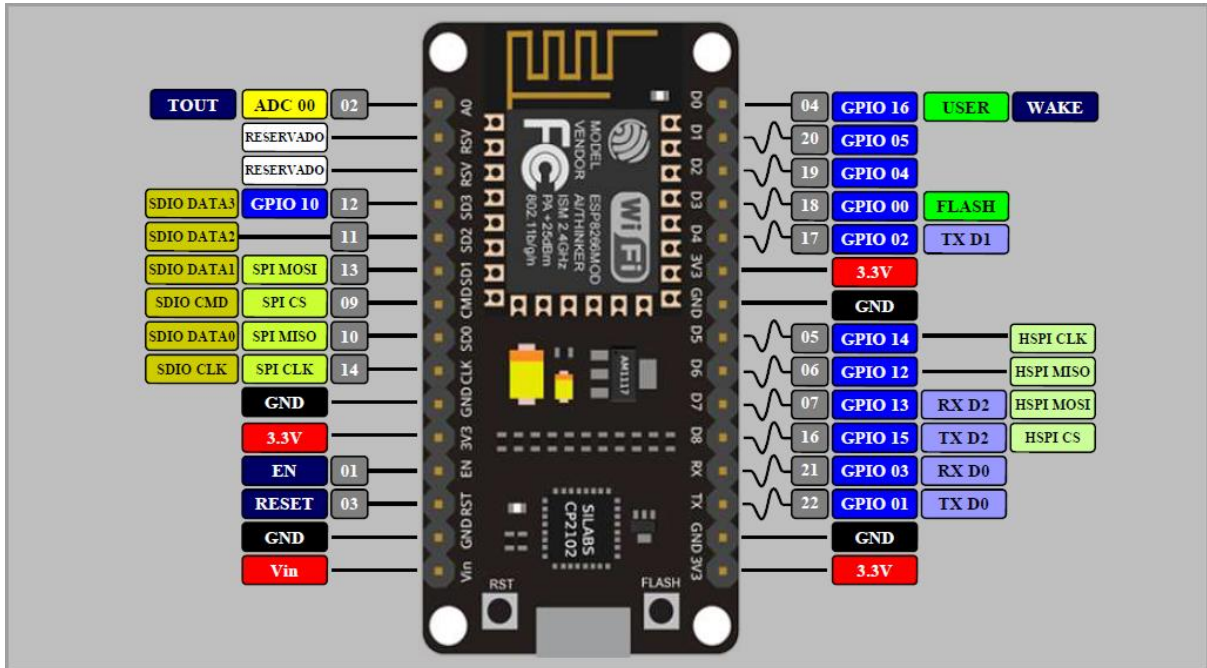


Figure 2 NodeMCU ESP8266 Wi-Fi development module IoT

NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266.

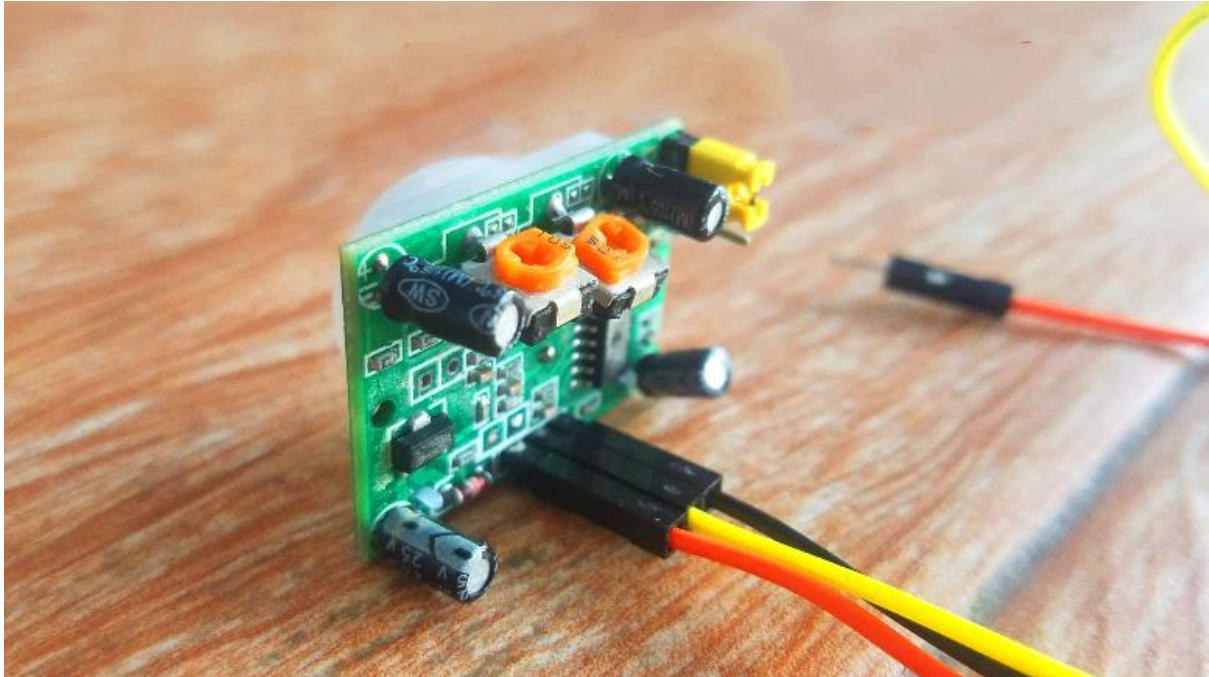
### Infrared Sensor (IR sensor)



*Figure 3 Infrared Sensor (IR sensor)*

This is an ideal IR Sensor that is used in this project. As you can see all the pins are clearly labelled with OUT, GND, and VCC. The white wire is connected with the OUT pin of the IR sensor and this will be connected with the digital pin D1 of the Nodemcu module, the brown wire is connected with the ground pin of the IR sensor and this will be connected with the ground of the Nodemcu module. The Red wire which is the VCC wire will be connected with the 3.3v pin of the Nodemcu module. It measures the heat of an object as well as detects the motion.

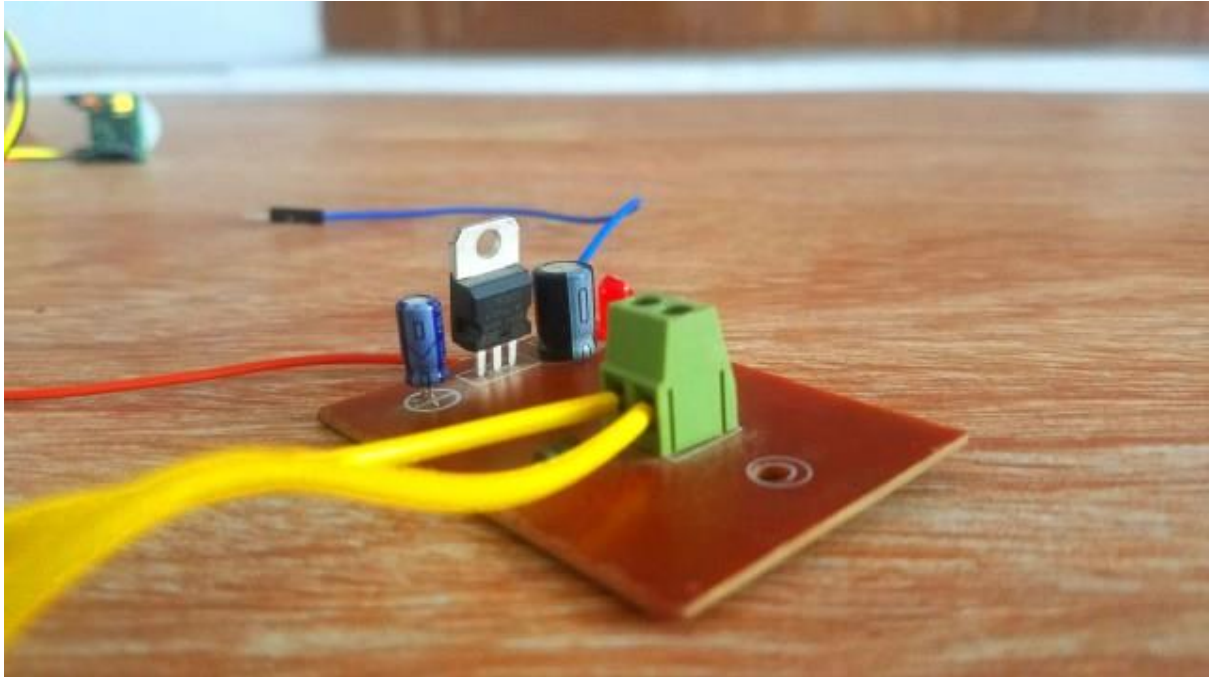
## Passive Infrared Sensor (PIR Sensor)



*Figure 4 Passive Infrared Sensor (PIR Sensor)*

In This PIR Sensor from The leftmost pin is the VCC “Red Wire”. The middle one is the OUT “Yellow Wire” while the rightmost pin is the ground “Black Wire”. I have a very detailed getting started tutorial on the PIR sensor. So for the basic understanding, you should watch that tutorial which explains everything. You can find a link to the tutorial in the related projects section. It is capable of sensing motion of the human and therefore it is also called as a motion sensor. Whenever a human pass through this sensor it will automatically sense the motion through IR radiation and send the data to the microcontroller.

## Regulated 5 volts power supply



*Figure 5 regulated 5 volts power supply based on the LM7805 voltage regulator*

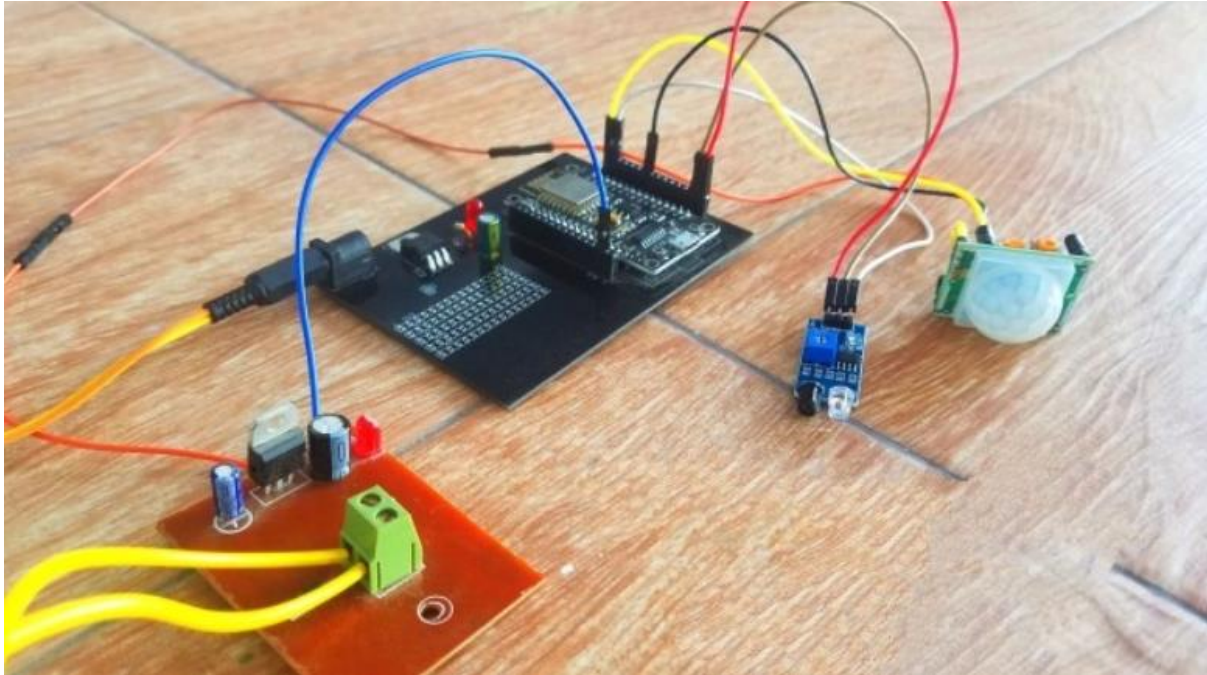
The figure 5 is a regulated 5 volts power supply based on the LM7805 voltage regulator. This power supply will be used to power up the PIR Sensor. The Orange wire is the 5v wire while the Blue wire is the ground wire. Serial communication interface is a feature in this board, including USB which will be used to load the programs from computer.

### **Furthermore Components and tools used in this project**

- DC Power Socket
- LM7805
- 470 uF/50 V
- 330 Ohm
- Led RED
- NodeMCU ESP8266
- PIR Motion Sensor
- IR TxRx Module
- 12 V DC Adapter
- Jumper Wire (Male to Female)



## Interfacing:



*Figure 6 IoT based home security system interface*

All the components are interfaced as per the circuit diagram. As you can see the output of this power supply is connected with the VCC pin of the PIR Sensor, while the out pin is connected with the D0 and Ground is connected with the ground.

The red wire from the IR Sensor is connected with the 3.3v pin of the Nodemcu module, the brown wire is connected with the ground while the out pin of the IR sensor is connected with the D1 pin of the Nodemcu module. One more thing make sure you connect the ground of the 5v power supply with the ground of the Nodemcu Module. So that's all about the interfacing.

## Software:

### Configuring Blynk Application

After the user installs the Blynk app on the smartphone, an account has to be created in the app to access its services. The first time the app is opened, it will ask to either sign in or create an account. Create an account and add a new project to get started as given in figure 7. Each project has its own authentication code which is used by the code to communicate with that particular model as provided in figure 8. To interface with our components, we need to add widgets to our model. To add widgets press „+” to add to the model. The app provides a neat interface to add all the required widgets and setting them up according to the code as shown in figure 9. The Blynk needs to be running in the background for the user to get real time notifications.

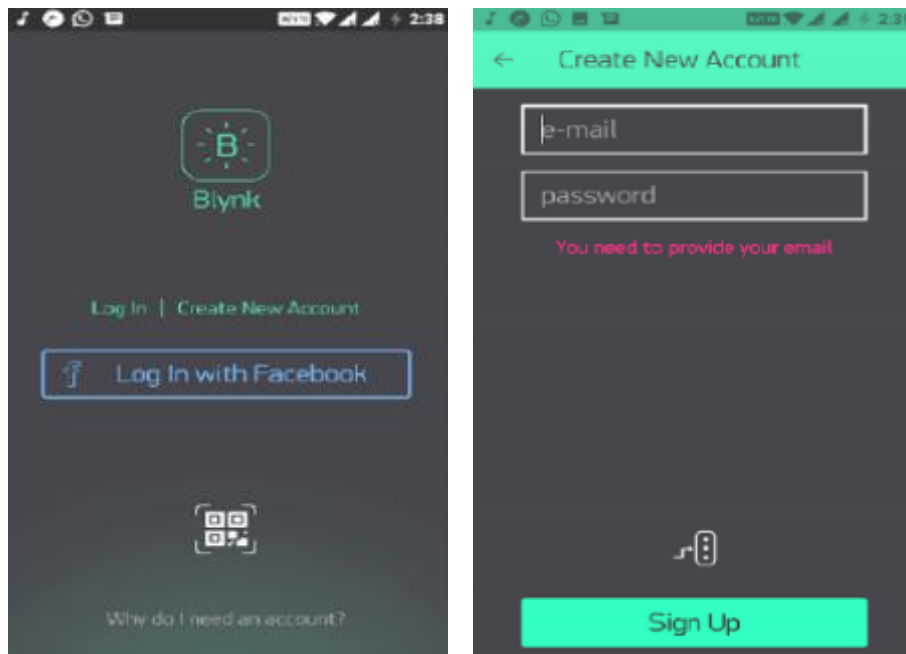


Figure 7 creating a new account



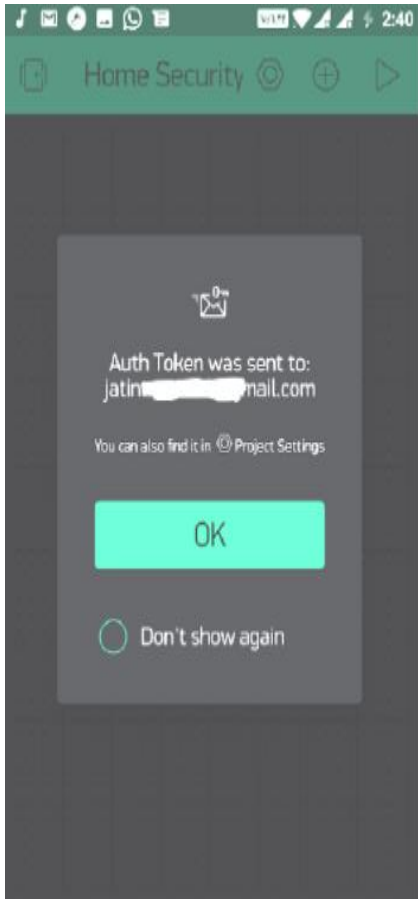


Figure 8 Authentication token

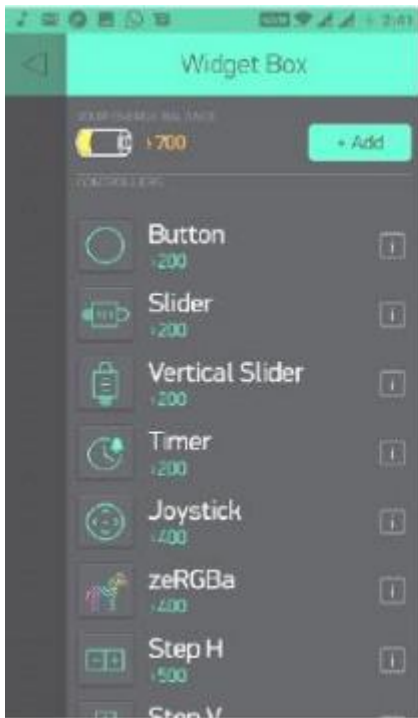


Figure 9 Adding widgets

## IoT Security System Programming “Nodemcu”

```
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include <SoftwareSerial.h>
#include <SimpleTimer.h>

char auth[] =
"DyWieVh9EKgPbrDQAapbwWVFBjXN_BqV";
char ssid[] = "ZONG MBB-E8231-6E63";
char pass[] = "electronicclinic";
SimpleTimer timer;

void myTimerEvent()
{
Blynk.virtualWrite(V1, millis() / 1000);
}

int pir_s = D0; // pir sensor
int ir_s = D1; // infrared sensor

void setup()
{
Serial.begin(9600);
Blynk.begin(auth, ssid, pass);
pinMode(pir_s, INPUT_PULLUP);
pinMode(ir_s, INPUT);
timer.setInterval(1000L,sensorvalue1);
}

void loop()
{
Blynk.run();
timer.run(); // Initiates BlynkTimer
}

void sensorvalue1()
{
if(digitalRead(pir_s) == HIGH)
{
Blynk.virtualWrite(V2,255 ); // turns on the led
Blynk.virtualWrite(V4,"Intruder detected on PIR
Sensor!!!" );
Blynk.notify("Intruder detected on PIR
Sensor!!!"); }
if(digitalRead(pir_s) == LOW)
{}
if( digitalRead(ir_s) == LOW)
{ Blynk.virtualWrite(V3,255 ); // turns on the led
Blynk.virtualWrite(V4,"Intruder detected on IR
Sensor!!!" );
Blynk.notify("Intruder detected on IR Sensor!!!");
}
if( digitalRead(ir_s) == HIGH)
{Blynk.virtualWrite(V3,0 ); // turns off the led}
}
```

## IOT Security System Program Explanation:

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

```
#include <BlynkSimpleEsp8266.h>
```

```
#include <SoftwareSerial.h>
```

```
#include <SimpleTimer.h>
```

```
char auth[] = “DyWieVh9EKgPbrDQAapbwWVFBjXN_Bqv”;
```

*This is the authentication number which was sent via email.*

```
char ssid[] = “ZONG MBB-E8231-6E63”;
```

*This is the name of the wifi router*

```
char pass[] = “electronicclinic”;
```

*This is the password.*

```
void myTimerEvent()
```

```
{ // you can send any value at any time.
```

```
  // please don't send more than 10 values per second.
```

```
  Blynk.virtualWrite(V1, millis() / 1000);
```

```
}
```

```
int pir_s = D0; // PIR sensor
```

```
int ir_s = D1; // infrared sensor
```

*The PIR sensor is connected with the digital Pin D0 of the Nodemcu Module and the Infrared Sensor is connected with the digital pin D1.*

*Unlike the Arduino and Mega, the Nodemcu ESP8266 WIFI module also has at least two functions which are the void setup and void loop functions. The programming of the Nodemcu module is just like the Arduino and Mega.*

```
void setup()
```

```
{
```

```
  // Debug console
```

```
  Serial.begin(9600);
```

```
  Blynk.begin(auth, ssid, pass);
```

```
  pinMode(pir_s, INPUT_PULLUP);
```

```
  pinMode(ir_s, INPUT);
```

```
  timer.setInterval(1000L,sensorvalue1);
```

```
}
```

*Sensorvalue1 is a user defined function and this function is called every 1 second.*

```
void loop()
```

```
{
```

```
  Blynk.run();
```

```
  timer.run(); // Initiates BlynkTimer
```

```
}
```

*Then starts the void loop function. Inside this function, we have only Blynk.run and timer.run functions.*

## Proposed Working Mode

Before we begin connecting the hardware, we have to get the ESP8266 set up by flashing the latest version of the firmware available for the module. This is because the chip comes with an older version of the AT command firmware pre-installed out of the box which cannot communicate with the Blynk libraries efficiently and will give an error with our code.

Internet which would be in the bin format and set up the ESP8266 to the Arduino Uno as described below in figure 10.

ESP8266	ARDUINO UNO
GND	GND
GP2	Not Connected
GP0	GND
RX	RX
TX	TX
CHPD	3.3 V
RST	Not Connected
VCC	3.3 V

*Figure 10 Setup to enable ESP8266 Flash mode.*

Once the ESP8266 has been flashed with the latest firmware, other components can be added to the configuration. For this we will need a breadboard to connect the microcontroller, reed sensor, buzzer and the ESP8266 using the jumper wires. The breadboard is used to interface between the various components available. It also makes it easy to connect multiple inputs to a single pin on the arduino board.

Following sketch shown in figure 11, which has been constructed using the Fritzing software shows how the components are supposed to be connected together using the breadboard and the jumper wires. The final configuration need not be identical to the given sketch, although the pins on each device needs to be connected to the same corresponding pins on the Arduino Uno board. The architecture diagram is shown in figure 12.

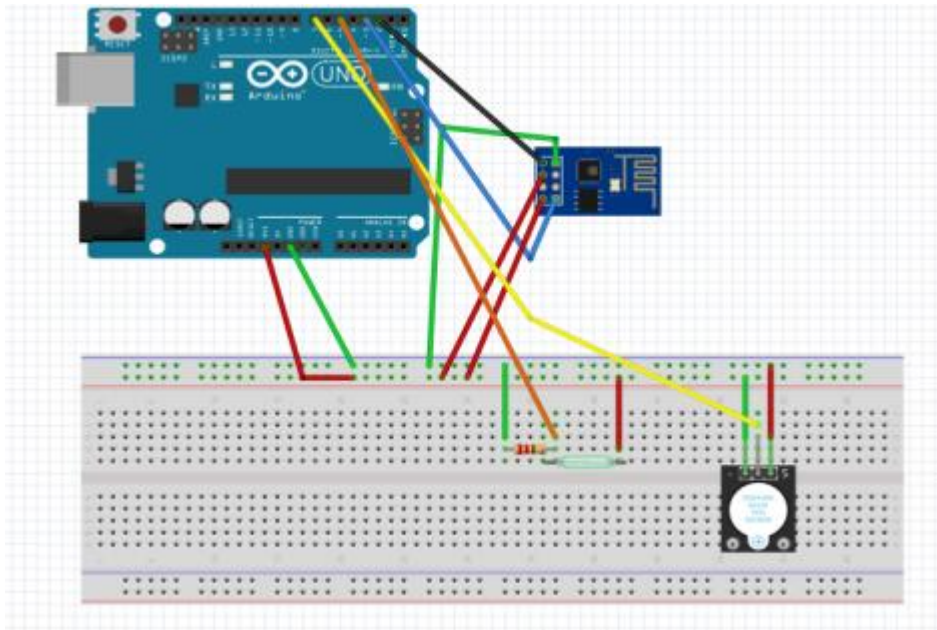


Figure 11 Sketch Diagram.

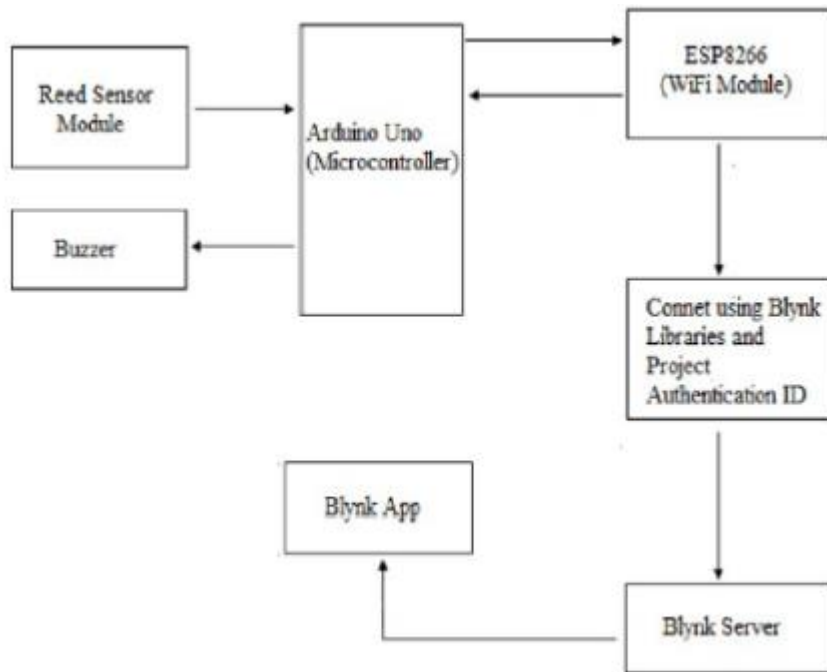


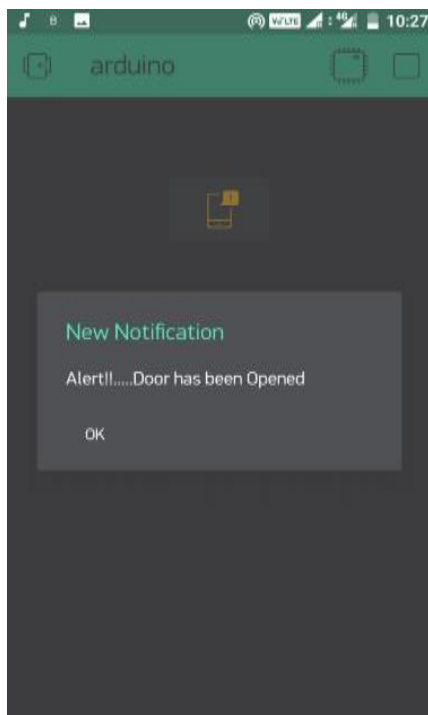
Figure 12 Architecture diagram of the proposed model

## Experimental results

The experiment was carried out in Pentium IV 2.60GHz Intel dual core processor, with 4 GB RAM, 15" LCD monitor with hard disk as 40 GB. The software required are Blynk App,

Arduino IDE, in windows operating system using C++ programming language. The resultant system was checked thoroughly by repeating the motion of opening the door multiple times to see if each time a notification is sent or not and by remotely switching the buzzer on or off from the Blynk app which showed that the system works in the intended way and flawlessly.

To test the endurance of the hardware, the setup was left turned on for a couple of hours and tested afterwards. The components got heated which is acceptable but still worked and the notification was shown in figure 13.



*Figure 13 Screenshot of Notification*

## **Application & Socio-Economic Impact**

- Low cost system with minimum requirements takes care of both home security as well as home automation.
- It eliminates most of the human interaction by providing intelligent system.
- Smart home and smart locks and alarms security.
- By using this system we can actually manage to make low cost, flexible smart homes to adjust its environmental conditions.
- This system not only just monitors environmental conditions but it acts according to inhabitant requirement.
- Since the same set of motion sensors can be deployed for home automation as well as security system the system is simple and inexpensive.
- This system does not require the user to manually trigger an alarm but still it provides the user with the advantage of analysing the situation and then triggering the security alarm remotely from his phone. This idea overcomes the common fault in many existing home security systems which causes unnecessary embarrassment by triggering security alarm due to the systems inability to judge a special situation in which it should not have triggered the alarm.

## **Conclusion and future scope**

The sensors placed on the door informs the home owner as soon as the door is opened by sending a Push notification. The user will get this notification irrespective of whether the phone is locked or unlocked or even if any other app is opened at the moment. This was the main objective of the project, which is the user feels safe and not worry about any intrusion or break-ins when he is away from home. This setup can also be used in commercial offices where some areas are restricted for certain personnel, such a system will immediately inform the administrator of any unauthorized personnel trying to access such an area. Therefore the extensibility and applicability of such a system is only limited only by the imagination.

Another important component of the project is the connectivity between the ESP8266 (WiFi module) and the Blynk server. The system successfully connected to the Blynk server using the authentication token and the Blynk libraries. As a result, we were able to get the notification on our smart phones as soon as there was any change in the status of the reed module sensor. Also the additional ability to control the alarm remotely is very beneficial and can be very useful in some unforeseen circumstances. It was also observed that the Blynk app worked smoothly and carried out all communication between the hardware and the app very accurately.

The developed system can also be used to in industrial and commercial applications such as offices, warehouses and other areas where some areas are reserved for authorized personnel only or other places where safety and precautions are of primary concerns such as internet server room of a big MNC from where corporate data can be stolen. The system can also be easily upgraded to add extra safety features such as cameras, motion detection sensors, etc. for increased safety. The system can also further be developed by adding an RFID scanner so that the authorized users need only carry a RFID or NFC tag with them on their person. The RFID scanner will work by scanning the tag wirelessly and if the user is authorized to enter, the alarm system will be disabled for some time so that the user can enter.



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