

# Smart Security & Home Automation Using Internet of Things (IoT)

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**Abstract:** IoT enabled home or a Smart home is basically a wireless smart control and operation of all home appliances like lights, fans, heaters, air conditioners, refrigerators, washing machines etc. When these devices are connected to the internet they are a part of Internet of Things. The backbone of this automation system is a basic microcontroller Arduino UNO connected to the internet via USB serial or ESP8266 (ESP-01) Wifi Module. Models can be integrated as and when required and also to ease human efforts.

**Keywords:** Internet of things, Arduino-UNO, Arduino-IDE, LDR, PIR

## 1. Introduction

In recent days it is very essential to utilize our resources so as to optimize between the availability and use. Therefore, one of the most concerns is the proper utilization of energy required in the household utilities. This is the main characteristic of smart home. Including above it also facilitate other factors to comfort our daily lives. Early concept of the first smart homes was an idea. For decades, the technology has explored the idea of home automation and control. First In 1898, Nikola Tesla created the first remote control to operate a toy boat. Tesla worked out a way to use radio waves to send instructions to his boat from a handheld device. After decades of progress in computing and developing electronics, the first ever a smart device was built - the ECHO IV. This machine is able to monitor the home's temperature and control other electrical appliances. In 1971, the microprocessor was invented, and technology steps into a new era of automation. Home automation had began to increase in popularity in the late 1990s and early 2000s as internet technology was developing fast and suddenly smart home became a much more affordable option for everyone.

Today's concerns of homes are to make it smart and secure. Our smart homes are well maintained which also ensures avoidance of the waste unnecessary energy. It also helps us to alert intruders. Current trends in home automation include remote control using smart phones, automated lights, automated temperature control, mobile/email/text notifications etc.

## 2. Internet of Things

Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects that are provided with unique identifiers.

Unique identifiers are logical addresses that usually follow IPv6.

It's a network of devices without requiring human-to-human/human-to-computer interaction.

Storage/Transmission/Analytics of huge amount of sensor data. Communication takes place via Network/Gateway.

### 2.1 ESP8266

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol which facilitates any microcontroller to access WiFi network. Each ESP8266 module (fig.1) is essentially programmed with an AT command set firmware so that it can simply hook this up to Arduino device and get about as much WiFi-ability as a WiFi Shield offers.

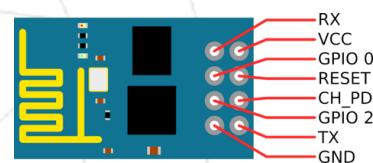
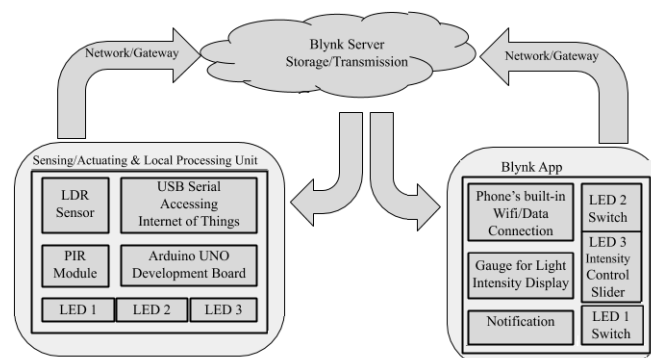


Figure 1: ESP8266 module

The ESP8266 supports APSD for VoIP applications and Bluetooth coexistence interface, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

### 2.2 Arduino-UNO microcontroller

This microcontroller platform based on ATmega328p IC is of open source type. The board has 14 digital pins, 6 analog pins and 6 PWM pins. This is programmable using Arduino IDE. The controller can be powered by (7-12)V using DC power jack or 5V using USB connector. Also it can supply to 3.3V or 5V to external sensors Max output current per pin: 40mA.



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Figure 2: Block diagram of the prototype

### 3. Hardware Components

Table 1: List of hardware components

Component Name	Quantity	Specification
Arduino Uno Microcontroller	1	ATmega328p
ESP8266-01 Wifi Module	1	Flash memory 1MB, power consumption <0.1mW, 802.11b output
PIR Module	1	Delay of sensing varies from 5min to 3sec and sensitivity varies from 3 meters to 7 meters
LDR Sensor	1	Maximum Operating Temperature: +80°C (Approx.) Dark resistance: 1-20MΩ
Light Emitting Diodes	3	
Resistors	1	100kΩ

#### 3.1 Interfacing of USB serial with arduino UNO

- Open Arduino Serial USB example and change auth Taken
- Run the blynk-ser script, located in scripts folder:

Windows: MyDocuments\Arduino\libraries\Blynk\scripts

Mac: ~/Documents/Arduino/libraries/Blynk/scripts

Linux: ~/Arduino/libraries/Blynk/scripts

The script is simply redirecting traffic to Blynk Cloud.

You can specify port, baud rate, and server endpoint like this

```
./blynk-ser.sh -c <serial port> -b <baud rate> -s <server address> -p <server port>
```

For instance:

```
./blynk-ser.sh -c /dev/ttyACM0 -b 9600 -s blynk-cloud.com -p 8442
```

Run blynk-ser.sh -h for more information. Be sure to select the right serial port (there may be multiple). Arduino IDE may complain with "programmer is not responding". You need to terminate script before uploading new sketch.

#### On Windows

Open cmd.exe (you may need to "Run as Administrator")

Navigate to scripts folder:

```
cd C:\...\libraries\Blynk\scripts
```

Run blynk-ser.bat file. For example : blynk-ser.bat -c COM3 (where COM4 is port with your Arduino) And press "Enter",

#### On Linux and Mac

Navigate to scripts folder:

```
cd User$/Documents/Arduino/libraries/Blynk/scripts
```

When inside this folder, run: user:scripts User\$ ./blynk-ser.sh

You may need to run it with sudo:

```
user:scripts User$ sudo ./blynk-ser.sh
```

This is what you'll see in Terminal app on Mac (usbmodem address can be different):

```
[ Press Ctrl+C to exit ] /dev/tty.usbmodem not found.
```

```
Select serial port [ /dev/tty.usbmodem 1451 ]:
```

```
Copy the serial port address: /dev/tty.usbmodem 1451 and paste it back: Select serial port [ /dev/tty.usbmodem 1451 ]: /dev/tty.usbmodem 1451
```

#### 3.2 Hardware design

##### Interfacing of esp8266 with Arduino UNO:

In order to make the ESP8266-01 Wifi Module connect to the blynk server and enable the Arduino Uno to transmit and receive data the wifi module must be flashed.

##### Step 1: Do connection with your Arduino Uno board

ESP8266:----->Arduino:

GND ----- GND

GP2 ----- Not connected (open)

GP0 ----- GND

RXD ----- RX

TXD ----- TX

CHPD ----- 3.3V

RST ----- Not connected (open)

VCC ----- 3.3V

**Step 2:** Download the firmware and ESP8266 flasher. Connect your Arduino board with your PC/laptop then go to control panel and check for COM port. Choose your COM port carefully.

**Step 3:** Browse for your firmware.bin file which you downloaded from the link. Click on the download button (fig.3). It will stop at 99% then remove the cable from the PC/laptop and you are done.

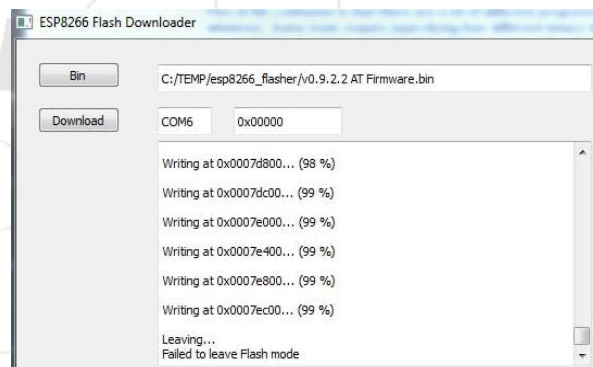


Figure 3: ESP8266 flash downloader

##### Interfacing of LDR and PIR with arduino-uno:

The LDR sensor is connected to the Arduino UNO with the help of jumper cables. One terminal of the LDR is connected to the 5V source of the Arduino using jumper cables and the other is connected to a resistance of 100kΩ. The other terminal of the resistance is connected to the GND port of the Arduino board.

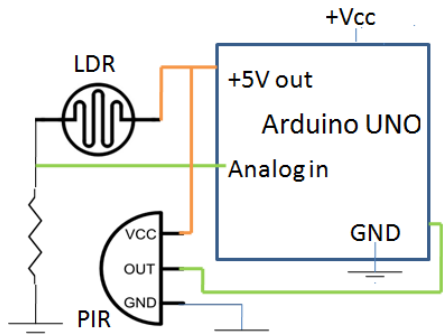


Figure 4: connection of LDR and PIR with Arduino

4. Software

Arduino IDE (Integrated Development Environment) is an application available for Windows, mac-OS and Linux platforms. It is originally written in Java. It is used to write programs for various arduino compatible boards. The source code for the IDE is released under the GNU General Public License, version 2. It supports C and C++ with the help of special provision of code structuring. The Arduino IDE has a range of libraries available in it. The Arduino IDE supplies a software library from the Wiring project, which provides various of input and output options. User-written code only requires two basic functions, for starting the sketch and the main program loop those are compiled and linked with a program stub main() into an executable cyclic executive program. The Arduino IDE converts 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.



Figure 5: Arduino-IDE and BLYNK app

BLYNK: Blynk is a Platform with iOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet via Blynk Server. It's a digital dashboard where building of a graphic user interface is possible by just dragging and dropping widgets. Using this app we can control development boards like Arduino, Raspberry Pi via internet over Wi-Fi, Ethernet, USB or using the ESP8266 chip. Since Blynk also works with USB we can use the app by

connecting the board that we are using to your laptop or desktop.

4.1 Program flowchart

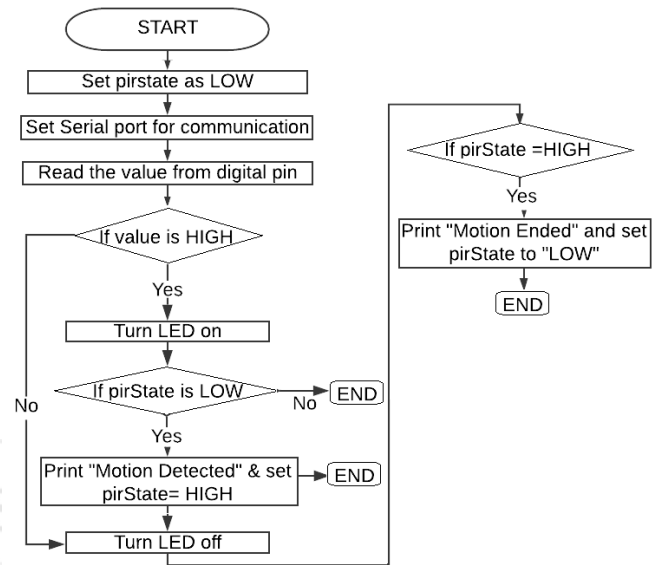


Figure 6: Flowchart of PIR sensor

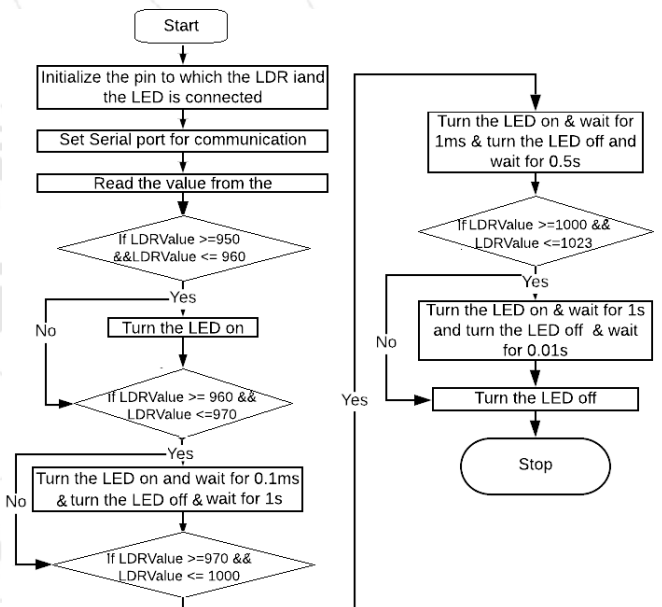
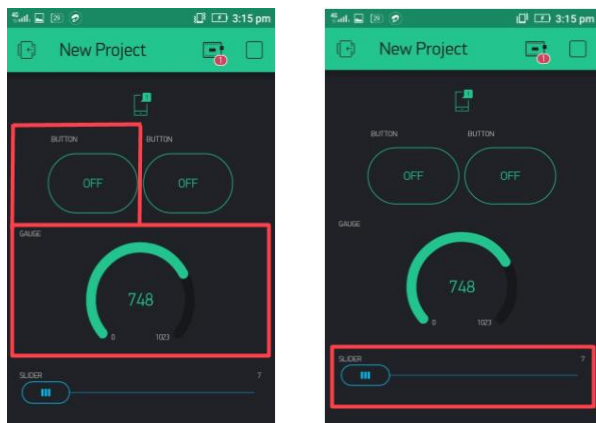


Figure 7: Flowchart of LDR sensor

5. Results

The control/display unit is for a prototype of a home automation system which is supposed to automate ,control certain household devices and also measure certain parameters. Listed below are the results we have achieved.



**Figure 8:** Blynk UI showing Gauge Widget & Button Widget

### 5.1 Automatic light control using LDR

Whenever the ambient brightness is low i.e. LDR value is less than 750 lux(lumens/sq.meters), it signals the microcontroller to turn on the led. This could be used for automatically switching on or switching off lights, depending on the ambient brightness. Instead of a led, the light must be connected to a bulb via a relay (SRD-05VDC-SL-C relay).

In the Blynk UI (Fig.8) the marked area is showing Gauge & Button Widget.

*Light intensity control using pwm:* Connect the led/light to the PWM (pulse width modulation) pin of microcontroller and using the slider application from the app, change the intensity of the light to a desired setting.

In PWM technique pulses of different on times are fed in from the microcontroller to the light/led. Different pulse width results in different intensities. Higher the on-time, more the intensity and vice versa. In the Blynk UI(Fig.8): Blynk UI Showing Slider Widget) the user simply increases the intensity by moving the slider from left to right and moves it from right to left to decrease it.

### 5.2 Intruder alert using PIR sensor

Everyone cannot afford to keep a security guard to protect their homes from intruders. In fact, in the age of IOT, they don't need to. All they need is a PIR sensor which track movement (by tracking heat) connected to a microcontroller which can send data over the internet. Whenever any intruder tries to break in or for that matter any movement is detected in the home, in absence of its owner, a notification pops up/alarm rings in the owner's phone, alerting him/her that there is unwanted presence in the home.

### 5.3 Over the air (OTA) switch

Sometimes it is really inconvenient to enter a room without any light and look for the switch in the darkness. IoT has a simple solution for this. The user can simply switch on and off the light from anywhere as per as his/her need. This OTA switch could even be helpful even if someone forgets to switch off the light before leaving the room/home

### 5.4 Measurement of light intensity

The gauge widget displays the brightness in lux (lumens/sq.meters). This information can be helpful if someone wants to change the brightness of the room to a desired value. In the Blynk UI, we can use the **Blynk UI Slider** to change the brightness level in lux.

## 6. Conclusion

The home automation system has worked satisfactorily by connecting electrical appliances to it and those were successfully controlled from a wireless mobile device by using ARDUINO-UNO (microcontroller). The Wi-Fi has been successfully tested on different mobile phones from different manufacturers, thus proving its portability and wide compatibility. We also examined about the security concerns like intruder alert/burglar alarm system including the online notification based on IOT technology. Thus a low-cost home automation & security system is successfully designed, implemented and tested.

## References

- [1] Ahmed El Shafee and Karim Alaa Hamed (2012), "Design and Implementation of a WiFi Based Home Automation System", World Academy of Science, Engineering and Technology, Vol. 6.
- [2] Home Automation using IoT,author-Dr. A. Amudha,International Journal of Electronics Engineering Research.ISSN 0975-6450 Volume 9, Number 6(2017) pp. 939-944© Research India Publications, <http://www.ripublication.com>
- [3] "Arduino FAQ-With David Cuartielles (April 5, 2013)".Malmö University. Retrieved 2014-03-24.
- [4] Rajeev Piyare (2013), "Internet of Things: Ubiquitous Home Control and Monitoring System Using Android Based Smart Phone", International Journal of Internet of Things.
- [5] [http://en.wikipedia.org/wiki/Electronic\\_component](http://en.wikipedia.org/wiki/Electronic_component).
- [6] <https://www.arduino.cc/en/guide/introduction>

## Author Profile



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