

NEXT GEN SMART EMULATOR

Kevin Curran.S¹, Monali.G², Monisha Shekar³, Shasaang.R⁴,
Dr.J.Geetha Ramani⁵

^{1, 2, 3, 4} UG Student, ⁵ Associate Professor

Department of Electronics and Communication Engineering
SNS College of Technology, Coimbatore, Tamil Nadu, India.

¹Kvncrn54@gmail.com, ²monaligraut@gmail.com, ³monishashekar0296@gmail.com, ⁴shassang29@gmail.com,
⁵geetharamanisns@gmail.com

Abstract: The “Next Gen Smart Emulator” presents a low cost prototype wireless embedded gateway for remote home control through internet. In general home automation means to connect all electrical devices in the home to a central control system that control those devices according to user inputs. A smart home can be easily controlled through internet using a smart-phone, tablet or computer. In the proposed prototype the data is transferred between the user and home appliances through internet. The system uses Wi-Fi transceiver to send data to the cloud. The proposed prototype automates the existing home appliances at low cost. The system does not require external memory storage as it uses low cost embedded devices and cloud as its main storage. Through integration of information technologies and the home environment various system and appliances are able to communicate in an efficient manner which results in convenience energy efficiency and safety benefits.

Key Words: Automation, ESP8266 Wi-Fi transceiver, relay module, Arduino UNO.

1. INTRODUCTION:

Home automation means to connect all electrical devices in the home to a central control system that control those devices according to user inputs. The connected electrical devices are intelligent in a sense that a programmable microcontroller with various sensors can be attached with them to improve the automatic functioning. The concept of Internet of Things (IoT) can turn the automated home into a smart home. IoT connects everyday objects to the internet, enabling those objects to communicate with each other and complete tasks with the help of sensors with less user intervention.

Internet of Things (IoT) term represents a general concept for the ability of network devices to sense and collect data from around the world, and then share that data across the Internet where it can be processed and utilized for various interesting purposes. The IoT is comprised of smart machines interacting and communicating with other machines, objects, environments and infrastructures. Now a days every persons are connected with each other using lots of communication way. Where most popular communication way is internet so in another word we can say internet which connect peoples.

Cloud computing is a complete new technology. It is the development of parallel computing, distributed computing grid computing, and is the combination and evolution of Virtualization, Utility computing, Software-as-a-Service (SaaS), Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS).

The concept of smart home can be viewed as an improvement in the home automation concept by incorporating the concepts like Internet of Things (IoT), cloud computing and big data. The global connectivity of home environment is an important feature of smart home. The proposed system consists of a prototype low cost wireless embedded gateway for remote home control and monitoring system that allows interaction between mobile client and legacy things through internet. In the proposed prototype model, it is focused on the wireless embedded home gateway which provides internet connectivity to the home automation.

2. MATERIALS:

The concept of home automation was done using Bluetooth, GSM, DTMF GPRS, where the prototype uses a host controller implemented on PC, which is connected to a microcontroller based sensor and device controllers. The device controllers are connected to the electronic devices through the I2C bus. The system allows more than one device controller to be connected to the host controller.

ZigBee based home automation system provides remote access to the user for the monitoring and controlling purpose. ZigBee wireless devices are most preferable because of its low power consumption. ZigBee take advantage of short-range wireless protocol and provide complete interoperability. This makes the complete home automation wireless[1].

(GUI) based application designed in MATLAB-14. Purpose of this designed application is to transfer the control signal to the MCU unit, so that MCU unit can compare the received data and transfer the control signal to relay section to turn on and off the device. To perform this task Instrument Control Toolbox of MATLAB is used to interface GUI environment and MCU 89S52 in serial mode with specified baud rate through communication port of PC or Laptop. On pressing of ON button in GUI it will transmit an ASCII code of ‘Q’ and on pressing of OFF button it will transmit an ASCII code of ‘q’ and the same is repeated for all AC devices[2].

Cloud storage service is used by many web applications, such as online social networks and web portals to provide services to clients all over the world. . The two enhancement methods to reduce the payment cost and service latency: (1) Coefficient based data reallocation, which aims to balance the workloads among all billing periods in order to minimize the payment cost by maximizing the reservation benefit. (2) Multicast based data transferring, which builds a minimum spanning tree to create new data replicas in order to minimize the Transfer cost for replica creation in a new data allocation deployment[3].

3. METHOD:

3.1 BLOCK DIAGRAM

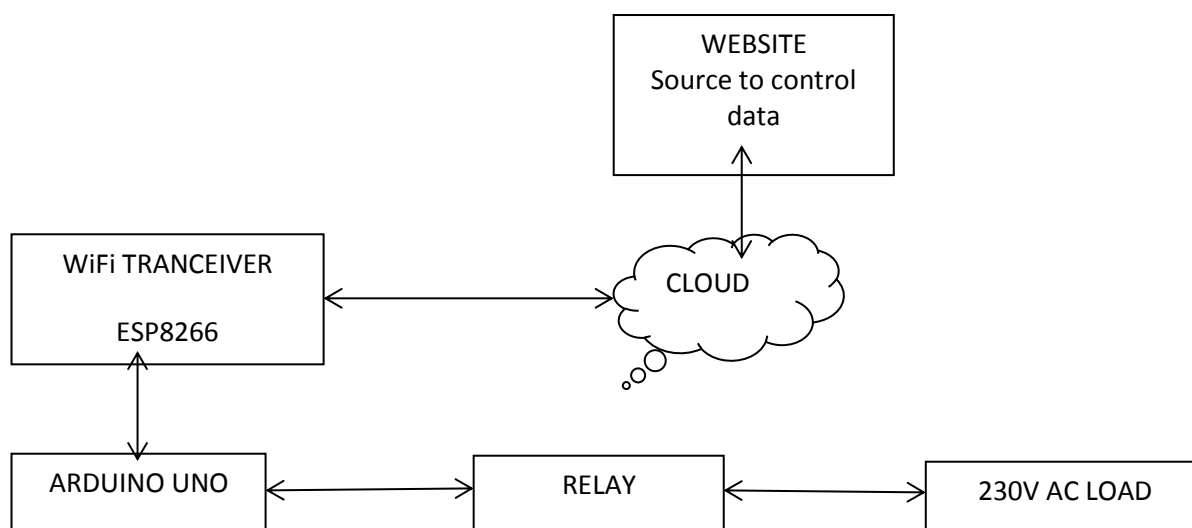


Figure 1.1 Block diagram of the module

Figure 1.1 shows the block diagram indicating the main parts of next gen smart emulator. Here the data from the 230v AC devices is controlled with the help of relay and arduino UNO. The data is sent to the cloud with the help of a Wi-Fi transceiver ESP8266. The data is processed in the cloud and the devices are controlled through IoT.

3.2HARDWARE DESCRIPTION:

Fig 1.2 shows the hardware circuit of the micro-controller connected with relay and interfaced with 230v AC devices. The relay is powered-up through the 5v pin of the arduino which is connected to the Vcc of the relay. The ground of arduino and relay module are interlocked. The output pins of the arduino are given as input to the relay. The positive supply of the AC load is given as an input to the normally open pin and the output is taken from the common pin and is given to the AC socket. The negative supply from the AC load is directly connected to the socket.

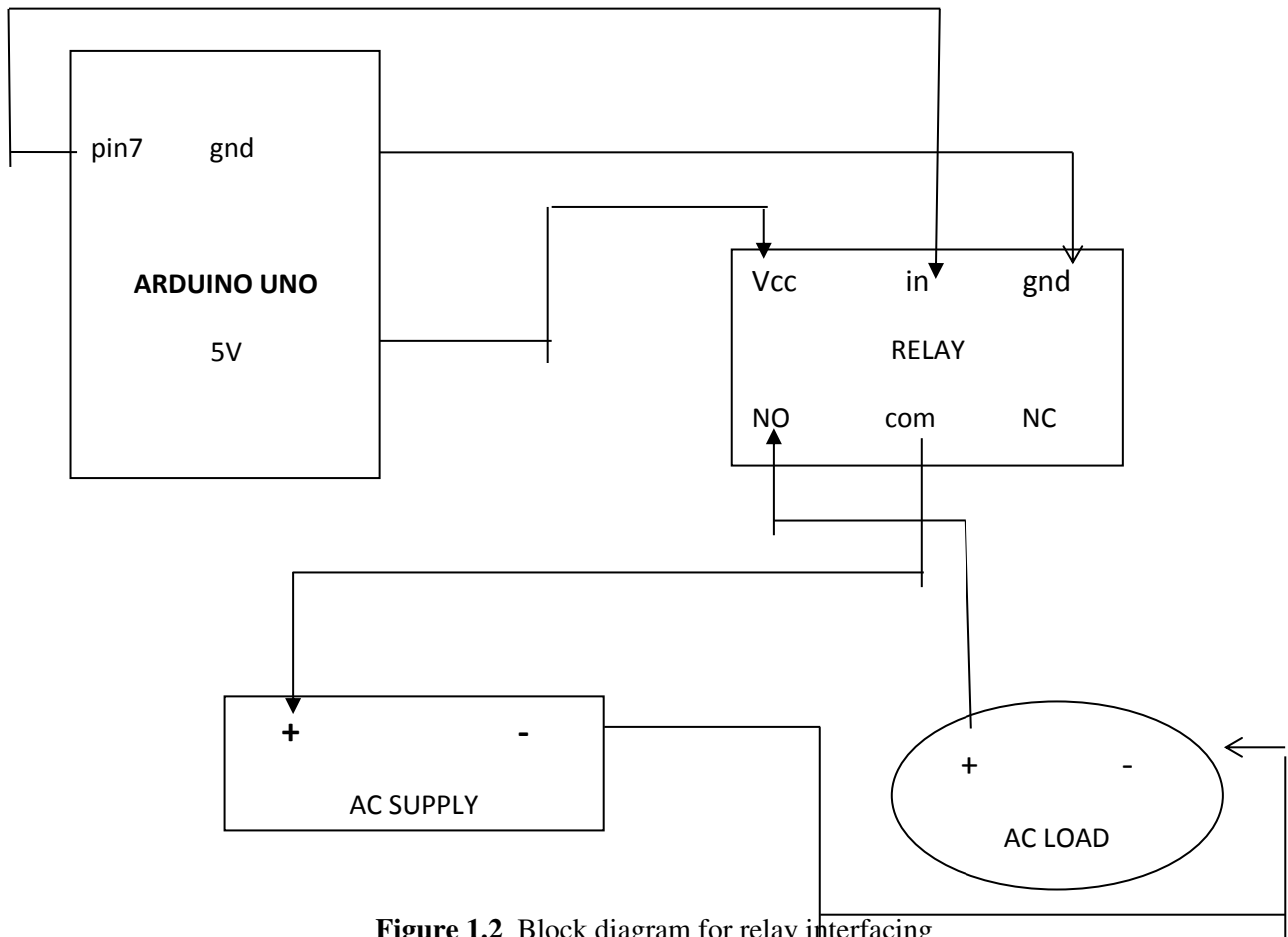


Figure 1.2 Block diagram for relay interfacing

3.3 SOFTWARE DESCRIPTION:

A minimal arduino c/c++ consists of only two functions. The two functions are `setup()` and `loop()`.

setup(): This function is called once when a sketch starts after the power-up or reset. It is used to initialize variables, input and output pin modes and other libraries needed in the sketch.

loop(): After `setup()` has been called, function `loop()` is executed repeatedly in the main program. It controls the board until the board is powered-off or reset

4. DISCUSSION:

4.1 WEBSITE

A website is a collection of related web pages, including multi-media content, typically identified with a common domain name and published on at least one web server. A website may be accessible via a public Internet Protocol(IP) network, such as the internet, or a private local area network(LAN), by referencing a uniform resource locator(URL) that identifies the site.

4.2 CLOUD

Cloud is a network of remote servers hosted on the internet and used to store, manage and process data in place of local servers or personal computers. Google cloud storage is designed for 99.9% durability. All storage classes offer very high availability. Cloud server is a central server aims on implementing services to other sub modules. The server evaluates the data it takes from the house, sends current status to the smart gadgets and vice-versa. A database is managed by the server and its status gets updated as per the changes done at home end.

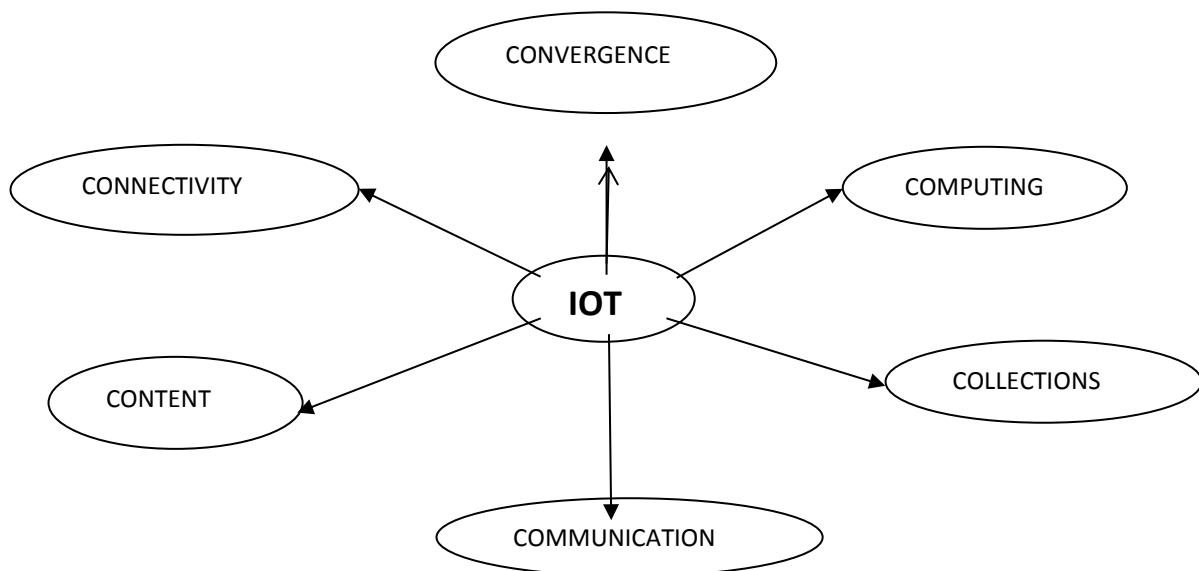


Figure 1.3. Objective of IoT

Figure 1.3 represents the main objective of IoT. IoT plays a major role in communication where the data can be accessed via internet. IoT is also used as a media for computing and storing the data in cloud. The contents can be collected and processed by various protocols that controls IoT.

4.3 ESP 8266

ESP 8266 is a system on chip (SoC) with capabilities for 2.4GHz. It is a UART to Wi-Fi module which provides an easy way to connect any small Microcontroller platform like arduino to internet wirelessly. It also includes 32bit microcontroller which can be programmed to act as a standalone Wi-Fi connected embedded platform.

The module has various variants; ESP8266-xx (01-13). Each module is just a development over the previous in terms of hardware capabilities with ESP8266-01 being the cheapest and the one with minimal features to ESP8266-13 being the most expensive with maximum features. The various features include number of GPIO pins, presence of shield, antenna, type of package (Through-hole or Surface mount), memory and handling external analog signals. The most basic board, the ESP8266-01 consist of 2 GPIO pins, UART communication, low powered 32-bit CPU and a PCB antenna. Other modules also have ADC input capabilities, SPI, I2C and more GPIO pins.

The ESP8266 in contrast can directly connect to the internet without the need for any extra, in between hardware and reducing interfacing issues. This means each sensor node can be directly accessed and does not depend on a central system to retrieve its data as far as the node is connected to the internet.

4.4 ARDUINO

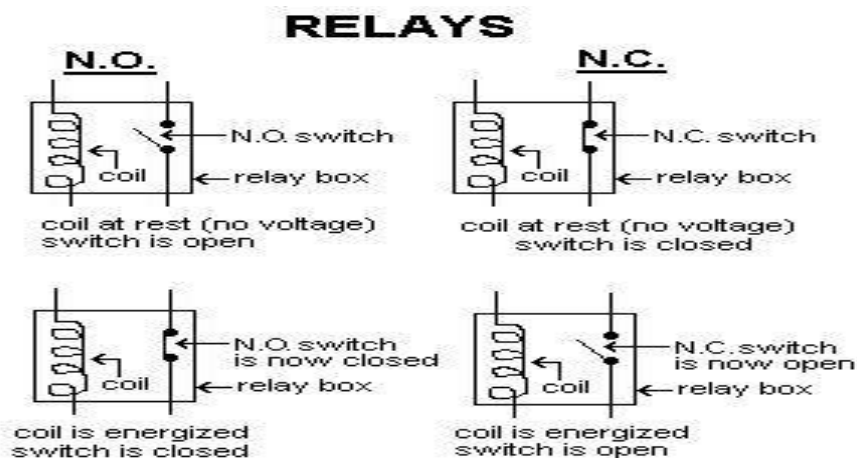
The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.



Figure 1.4 Arduino module

4.5 WORKING OF RELAY

Self-locking process is done by connecting the JP1 with shorting plug. The non-locking phase is achieved by disconnecting the JP1 and JP2 with shorting plug. Connect JP2 with shorting plug for interlocking. 2 channel interlocking and 2 channel inching is interfaced by establishing connection between JP1 and JP2.



5. ANALYSIS:

5.1 FLOW CHART

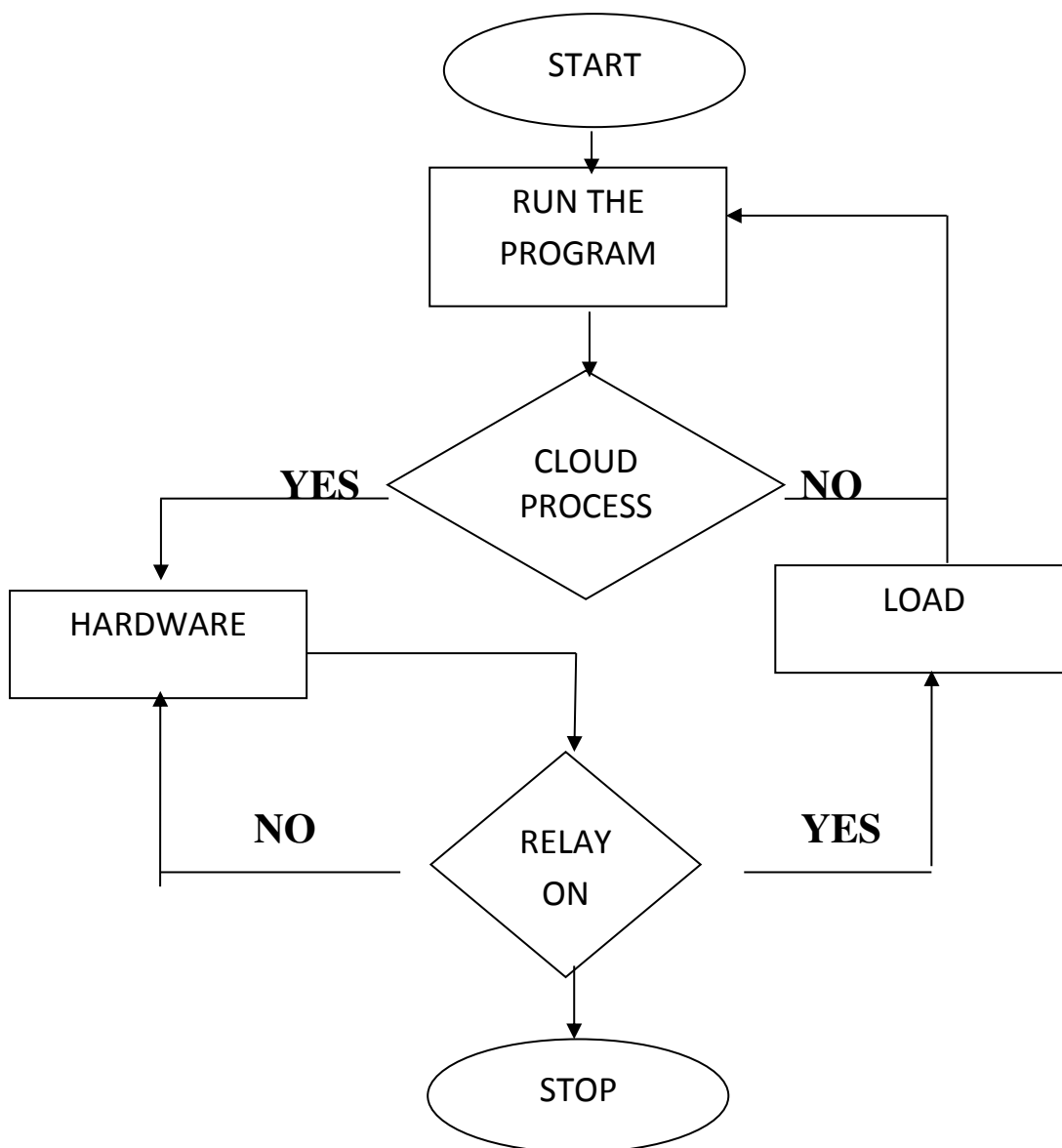


Figure 1.5 Flow chart of next gen emulator

Fig 1.5 shows the implementation of next gen smart emulator. The module when started implements the ON/OFF process which takes in the cloud. The relay module is interfaced with the 230v AC device and ESP8266 Wi-Fi transceiver. The relay is operated depending on the information from the cloud. The prototype when started, the process starts to run in the cloud.

The cloud sends the data to the hardware. The hardware checks the control of relay and based on the condition the hardware turns on/off.

6. FINDINGS:

Few of our findings to overcome the disadvantages of the existing system of home automation are mentioned as follows:

Multiple users share same bandwidth which will lead to interference when more number of users are using GSM service. For every SMS paying is needed an extra charges is paid to the organisations. Security and network issues may occur sometimes. If anybody wants information message has to be sent and for every new information message is sent again and again to the system[4].

Bluetooth has a maximum communication range of 100m in ideal condition. More may be needed in a home environment. It has high power consumption, so the batteries of devices need to be frequently recharged or replaced. Throughout all devices, when using Bluetooth internet, the connections can sometimes run very slow.[5] Application is connected after disconnect of the Bluetooth. When the new users want to connect, first download application software and then configuration must be done.

Simple facial recognition systems could be hacked using a photograph of an authorized person, has the system will not be able to distinguish between a picture and a real human. The four digit security pass key in itself proposes security vulnerability[6]. The toughest part of automation is interacting with device under test especially with Graphical User Interface (GUI). They require on-going maintenance [7].

7. RESULT:

The prototype presents the working module of the devices controlled with an embedded code. The embedded code is coded in such a way to control the relay. The relay is an electronic switch which operates with a 5v DC power supply. The relay in turn controls the AC device. The embedded code can switch from high to low or from low to high as per the requirement.

In computing, a code segment corresponds to a portion of an object file that contains executable instructions. The embedded code is stored in the object file. The loader places the program into memory, which is then executed. The code in memory is typically read only and has a fixed size. In embedded system the code is usually placed in read only memory (ROM), without the need of loading.



```
void setup()
{
  pinMode(12, OUTPUT);
  digitalWrite(12, HIGH);
}

void loop()
{
  digitalWrite(12, HIGH);
  delay(5000);
  digitalWrite(12, LOW);
  delay(5000);
}
```

Fig 1.6 Code to control relay

Fig 1.6 shows the code of the module that explains the control of the 230v AC devices via relay. The code is interfaced to the relay module with the help of Arduino UNO.

The setup() code explains the pins to which the devices are connected. In a 4-channel relay module, four types of 230v AC devices are connected and controlled with the help of arduino.cc software. The pin 7 is given high as it indicates the output pin of the Arduino.

The loop() code executes the ON/OFF process of the AC devices with a delay of five seconds. The individual devices can be also controlled independently. The code, when it is in high mode the relay is activated and the AC device is turned ON. The code, when it is in low mode the relay is deactivated and the AC device is turned OFF.



Fig 1.7 Arduino and relay connections

Fig 1.7 explains the connections between the Arduino UNO microcontroller and 4channel relay module. Relay module consists of a Vcc pin, ground pin and four output pins. The relay is to be provided with 5v DC supply and hence the Vcc pin of the relay is connected to the 5v DC supply pin in the Arduino module. The ground pin of the relay module and Arduino UNO are inter-locked. The output pin of the relay module is connected to the pin7 of the Arduino. The embedded code is coded for the output pin7 and when the microcontroller is uploaded with the code, the output pin is controlled and as a result the relay is controlled.



Fig 1.8 Relay and AC device connection

Fig 1.8 explains the connections between the relay module and 230v AC device. The earth connection of the AC socket is directly connected to the AC device's negative supply. The positive supply of the AC device is given as an input to the common pin of the relay module. The output is taken from the normally closed pin of the relay module and is connected to the positive supply of the AC socket. The interfacing of the AC device and relay module enables the control of the AC device with the embedded code.

Fig 1.9 shows the implementation of a relay controlled AC devices. The figure explains that although the AC supply is turned ON the the AC device (bulb) does not gets activated, as it is coded with the low mode.



Fig 1.9 Output of relay controlled AC devices

The following figure shows the activation of the AC device, as it is coded with a high mode. This explains the complete control of the AC device with an embedded code and relay module.

The ESP8266 module is programmed using the Arduino IDE. The ESP module will act as station and access point in this proposed system. So it has to connect to our router (PC) when acting as station. When we connect to the IP address of the module, a webpage will be displayed which runs on HTML. The HTML code is defined in our Arduino program.



Fig 1.10 Output of Webpage display

When the Wi-Fi gets disconnected, an error message such that ‘this site can’t be reached’ will appear. This gives awareness to the user about the status of 230 v AC devices that is to be controlled.

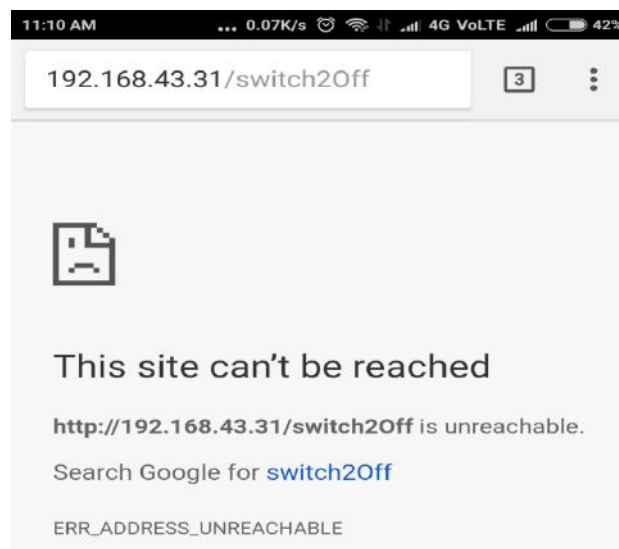


Fig 1.11 Output when Wi-Fi is disconnected.

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