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HOME AUTOMATION CONTROL USING RASPBERRY PI AND SMART PHONE THROUGH IOT

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Abstract - Internet of things is a technology of the future that has already started to touch our homes. Here we propose an IOT based home automation system using raspberry pi that automates home appliances and allows user to control them easily through internet from anywhere over the world. Our proposed system consists of a microcontroller based circuit that has lights and fan connected to it along with LCD display and Wi-fi connector interfaced with raspberry pi. Our system interacts with out online IOT system that IOT Gecko free web interface for controlling our home appliances with ease. After linking with IOT Gecko, the user is allowed to send load switching commands over IOT to our circuit.

Key Words: *Internet of things(IOT), Home automation, Raspberry pi, LCD display.*

1. INTRODUCTION

The project proposes an efficient implementation for IoT (Internet of Things) used for monitoring and controlling the home appliances via World Wide Web. Home automation system uses the portable devices as a user interface. They can communicate with home automation network through an Internet gateway, by means of low power communication protocols like Zigbee, Wi-Fi etc. This project aims at controlling home appliances via Smartphone using Wi-Fi as communication protocol and raspberry pi as server system. The user here will move directly with the system through a web-based interface over the web, whereas home appliances like lights, fan and door lock are remotely controlled through easy website. An extra feature that enhances the facet of protection from fireplace accidents is its capability of sleuthing the smoke in order that within the event of any fireplace, associates an alerting message and an image is sent to Smartphone. The server will be interfaced with relay hardware circuits that control the appliances running at home. The communication with server allows the user to select the appropriate device. The communication with server permits the user to pick out the acceptable device. The server communicates with the corresponding relays. If the web affiliation is down or the server isn't up, the embedded system board still will manage and operate the appliances domestically. By this we provide a climbable and price effective Home Automation system.

2. PROPOSED SYSTEM

In this proposed system we using a raspberry pi based home automation system. This system receives the commands over web server(particular predefined link).The command from the user can be anywhere through internet. When the raspberry processor receiving those command from the user. After this the processor now processes these instructions received from the user. It then displays these on an LCD display (which load). Also it operates the loads (lights and fan) for switch them on/off according to desired user commands. Thus we automate home appliances over internet using raspberry pi. We can also control the home appliances using switches when you are at home. The statuses are updated using server.

2.1 BLOCK DIAGRAM

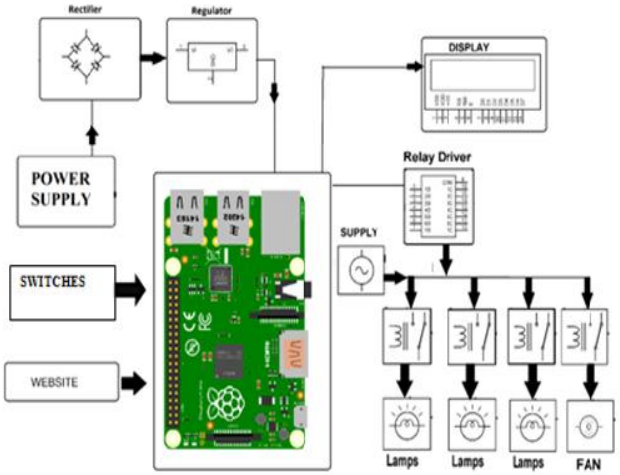


Fig 1: Block Diagram

3. MODULE DESCRIPTION

3.1 Power Supply

3.1.1 Transformer

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp. The advantages of using precision rectifier are it will give peak voltage output as DC, rest of the circuits will give only RMS output.

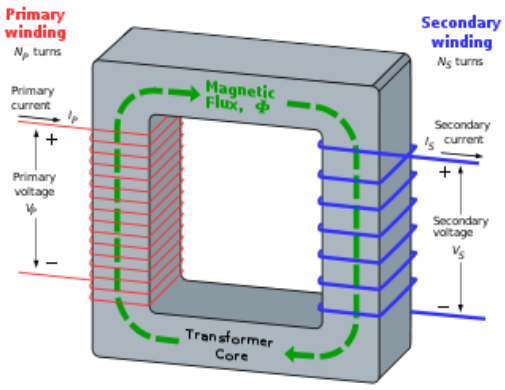


Fig 2: Transformer

3.1.2 Bridge Rectifier

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.

Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4.

3.1.3 Voltage Regulator IC

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts.

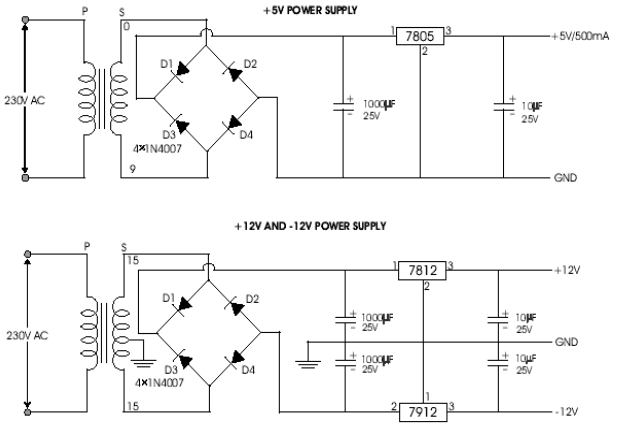


Fig 3 : Voltage Regulator Circuit

A fixed three-terminal voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated dc output voltage, Vo, from a second terminal, with the third terminal connected to ground.

3.2 Raspberry PI

The Raspberry Pi 3 Model B is the third generation Raspberry Pi. This powerful credit-card sized single board computer can be used for many applications and supersedes the original Raspberry Pi Model B+ and Raspberry Pi 2 Model B. Whilst maintaining the popular board format the Raspberry Pi 3 Model B brings you a more powerful processer, 10x faster than the first generation Raspberry Pi. Additionally it adds wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected designs.

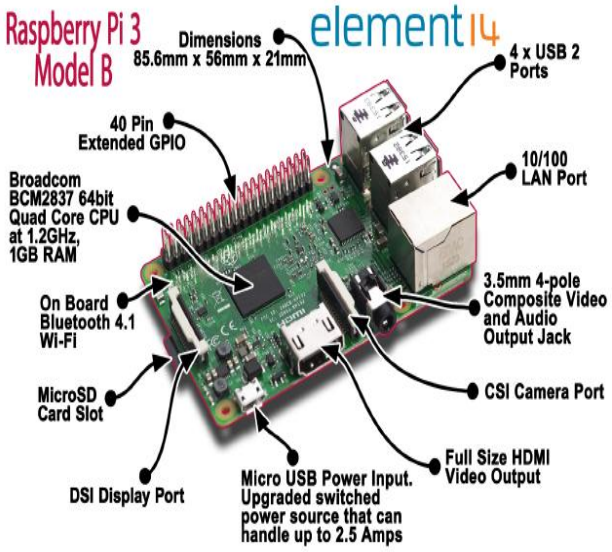


Fig 4: Raspberry Pi

3.2.1 GPIO

The Raspberry Pi 3 features the same 40-pin general-purpose input-output(GPIO) header as all the Pis going back to the Model B+ and Model A+. Any existing GPIO hardware will work without modification; the only change is a switch to which UART is exposed on the GPIO's pins, but that's handled internally by the operating system.

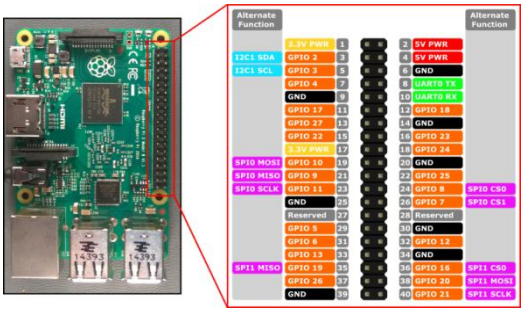


Fig 5: GPIO Pin

3.2.2 SYSTEM ON CHIP (SOC)

What is System on Chip? –A complex IC that integrates the major functional elements into a single chip or chipset.

- programmable processor
- on-chip memory
- accelerating function hardware (e.g. GPU)
- both hardware and software
- analogue components
- Benefits of SoC –Reduce overall system cost –Increase performance –Lower power consumption –Reduce size

3.2.2.1 SOC in Raspberry Pi: Broadcom BCM2835 SoC Multimedia processor

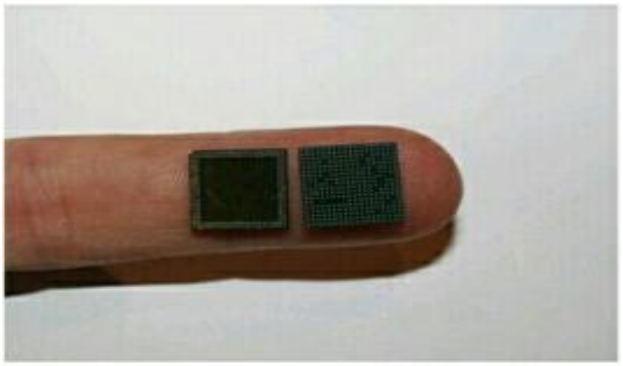


Fig 6: Single on Chip

- CPU –ARM 1176JZF-S (armv6k) 700MHz –RISC Architecture and low power draw –Not compatible with traditional PC software.
- GPU –Broadcom Video IV –Specialized graphical instruction sets.
- RAM –512MB (Model B rev.2) –256 MB (Model A, Model B rev.1)

3.2.3 CONNECTING AUDIO AND VIDEO

3.2.3.1 HDMI

- Digital signal
- Video and audio signal
- DVI cannot carry audio signal
- Up to 1920x1200 resolution

3.2.3.2 Composite RCA

- Analog signal
- 480i, 576i resolution

3.2.3.3 3.5mm Jack

Fig 7: HDMI, Audio & Video Jack

3.2.3.4 USB

- Two USB 2.0 ports in RPi
- Buy a powered USB hub

Fig 8: USB

Passive models are cheaper and smaller, but lack the ability to run current hungry devices like CD drives and external hard drives.

3.2.4 Storage

Form factor –SD, Mini SD, Micro SD

Types of Card –SDSC (SD): 1MB to 2GB –SDHC: 4GB to 32 GB – SDXD up to 2TB

Fig 9: SD Card

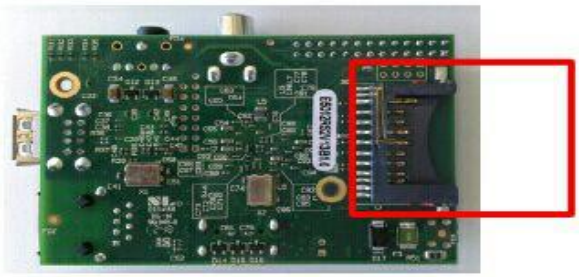


Fig 10: SD Card Slot

The card should be at least 2GB in capacity to store all the required files.

3.2.5 Wired Network

Fig 11: Ethernet

3.2.6 WIRELESS NETWORK

IEEE 802.11 Wi-Fi

Protocols

- 802.11 b, up to 11Mbps
- 802.11 g, up to 54Mbps
- 802.11 n, up to 300Mbps
- 802.11 ac (draft), up to 1Gbps

Frequency band - 2.4GHz, 5GHz

Fig 12: WiFi Modem

3.2.6.1 Low Speed Peripherals

1. General Purpose Input/Output (GPIO)

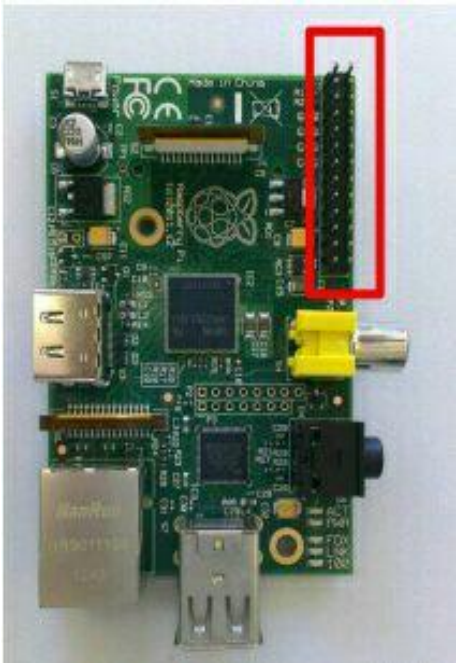


Fig 13: GPIO Pin

- Pins can be configured to be input/output
- Reading from various environmental sensors
- Ex: IR, video, temperature, 3-axis orientation, acceleration.
- Writing output to dc motors, LEDs for status

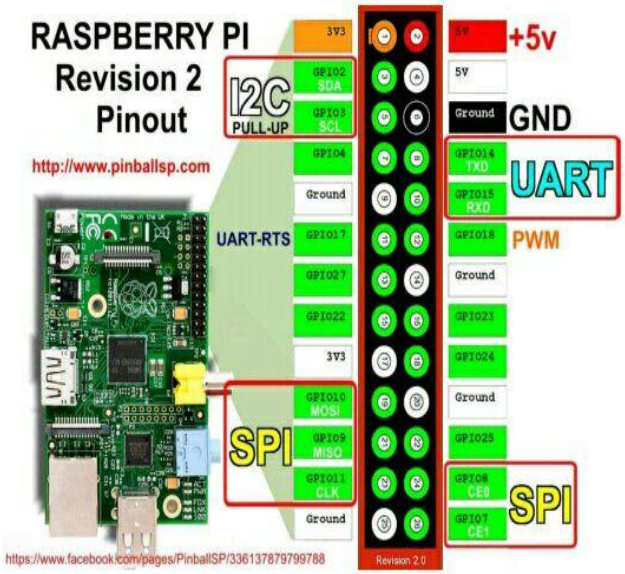


Fig 14: GPIO Pin Diagram

3.2.7 RASPBERRY PI SETUP

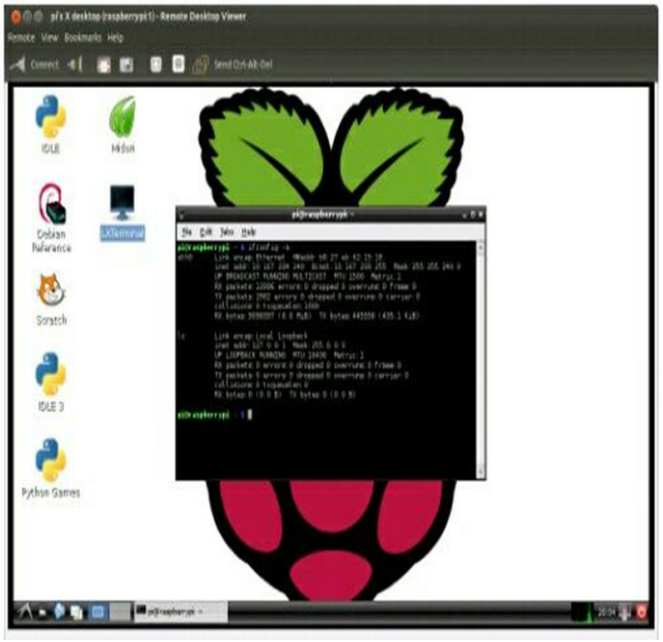


Fig 15 : Raspberry Pi Setup

3.2.7.1 Install and Start SSH

Update apt-get package index files:

–sudoapt - get update

Install SSH:

–sudoapt - get install ssh

Start SSH server:

–sudo/etc/init.d/sshstart

To start the SSH server every time the Pi boots up:

–sudoupdate-rc.dsshdefaults

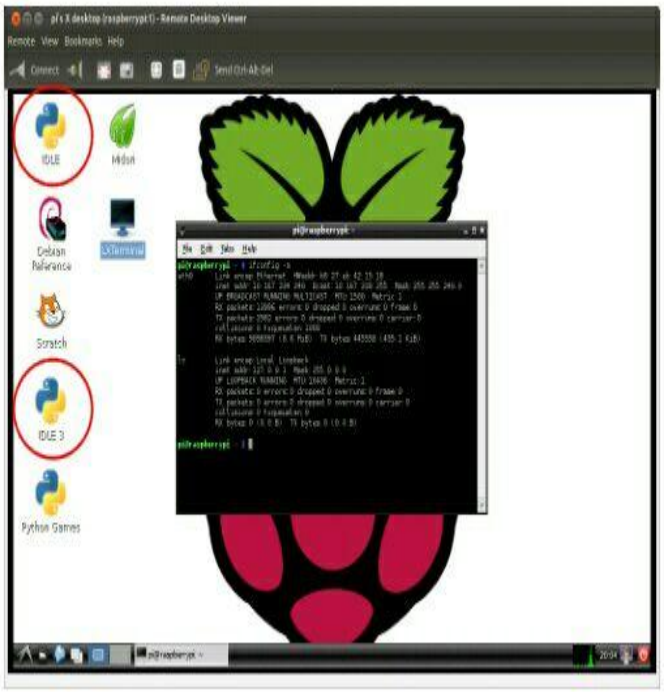


Fig 16: SSH Setup

3.2. 8 General Purpose Input / Output (GPIO)

- General Purpose Input/Output (GPIO) is a generic pin on a chip whose behavior can be controlled by the user at run time.
- The GPIO connector has a number of different types of connection:

- ✓ True GPIO (General Purpose Input Output) pins that you can use to turn LEDs on and off etc.
- ✓ I2C interface pins that allow you to connect hardware modules with just two control pins
- ✓ SPI interface with SPI devices, a similar concept to I2C but uses a different standard
- ✓ Serial Rx and Tx pins for communication with serial peripherals.

Fig 17: GPIO Pin

- GPIO pins can be used as both digital outputs and digital inputs.
- Output: turn a particular pin HIGH or LOW.
- Setting it HIGH sets it to 3.3V; setting it LOW sets it to 0V.
- Input: detect the pin being at HIGH or LOW . We can connect switches and simple sensors to a pin and check whether it is open or closed (that is, activated or not)

Fig 18: GPIO Pin Details

3.2.8.1 GPIO setup on Raspberry Pi

• Install Python 2 library Rpi.GPIO.

–A library that will let us control the GPIO pins.

• Install commands:

sudoapt-get update

sudoapt-get install python-dev

sudoapt-get install python-rpi.gpio

3.2.8.2 GPIO as Output

•Experiment 1: Controlling LED

–LED

–Breadboard

–Jumper wire

3.2.9 LED

•Current flows from the anode to cathode.

–Anode: longer pin

–Cathode: shorter pin

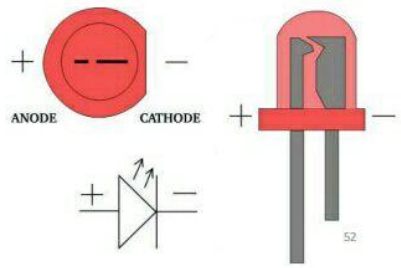


Fig 19: LED

•Use a multimeterto test the polarity

–Check resistance

–In both directions.

3.2.10 POWER SUPPLY

A transformer contains 2 magnetically coupled wire windings. One winding is called the primary. The primary is driven by the main AC supply. The other winding is called the secondary.

The secondary serves as the power input to the AC DC converter. This transformer and all of the other items needed to build the AC DC converter are readily available at electronic stores and hobby stores.

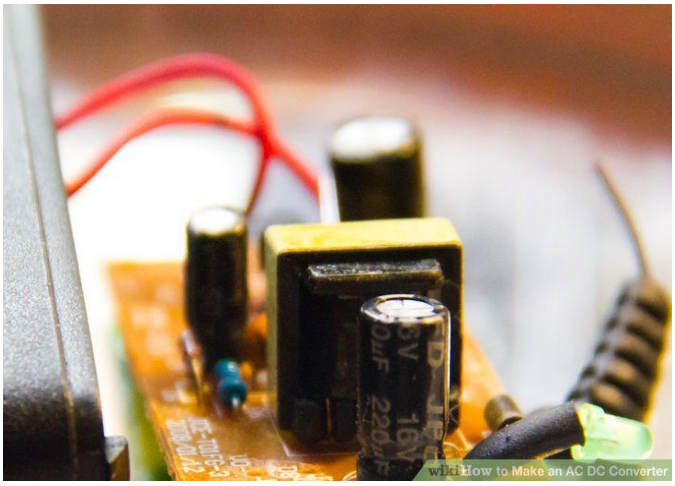


Fig 20: Transformer Board

Size the transformer windings. AC mains provide 120 volts AC. If 120 volts AC were directly converted to a DC voltage, the resulting DC voltage would be far too high a voltage for use by appliances and devices.

Fig 21: Transformer Coil

- The primary and secondary windings of the transformer are scaled to each other in order to produce a lower voltage on the secondary winding.
- Choose a secondary winding. The AC output of the secondary winding should be rated as the same voltage of DC that is being created.
- Wire the primary winding of the transformer to the main AC supply. This transformer connection has no polarity and may be connected either way.

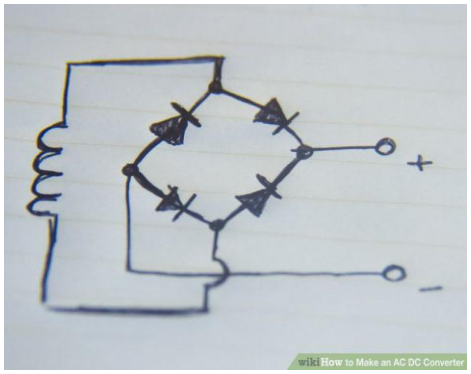


Fig 22: Bridge Rectifier

Connect the secondary winding of the transformer to a full wave bridge rectifier package. The transformer connections and the connections to the marked inputs of the rectifier package have no polarity and may be connected either way.

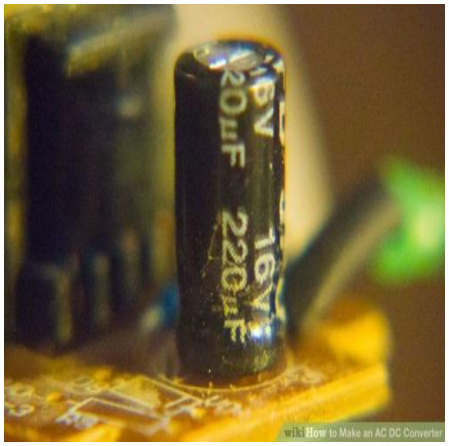


Fig 23: Capacitor

Attach a smoothing capacitor. Attach a polarized capacitor across the output connections of the rectifier. The positive terminal of the polarized capacitor must connect to the positive output of the regulator.

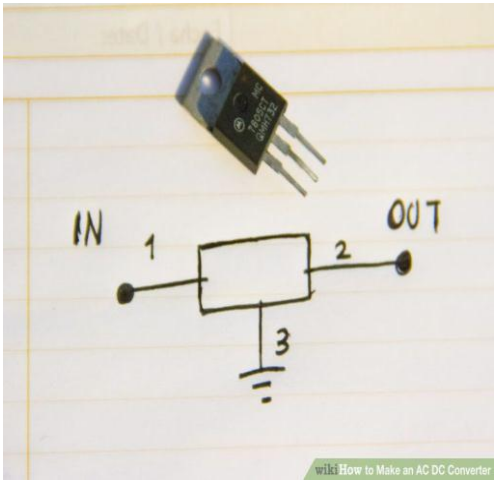


Fig 24: IC7805

This capacitor should be sized such that the capacitance in farads (F) is equal to (5 times the current to be supplied by the AC DC converter) divided by (transformer secondary rating times 1.4 times frequency). Frequency varies from country to country, but is typically either 50 Hertz (Hz) or 60 Hertz.

3.2.10.1 BRIDGE RECTIFIER

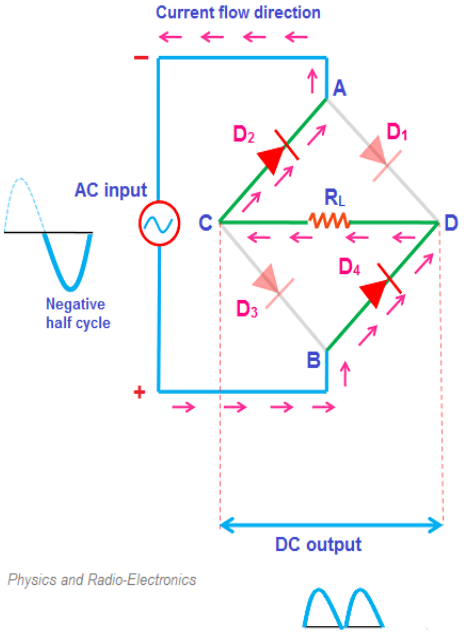


Fig B: Bridge rectifier during negative half cycle

Fig 25: Positive Output Wave

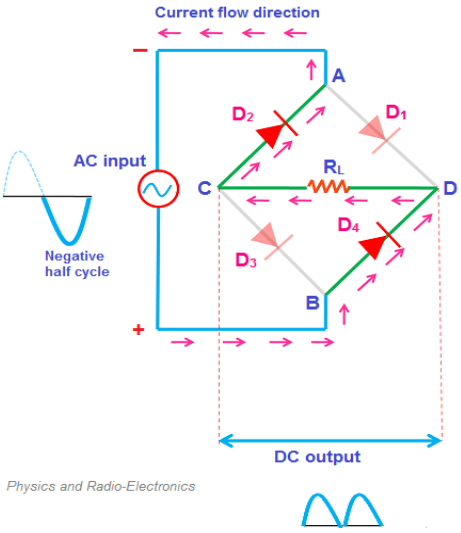


Fig B: Bridge rectifier during negative half cycle

Fig 26: Second Half Cycle

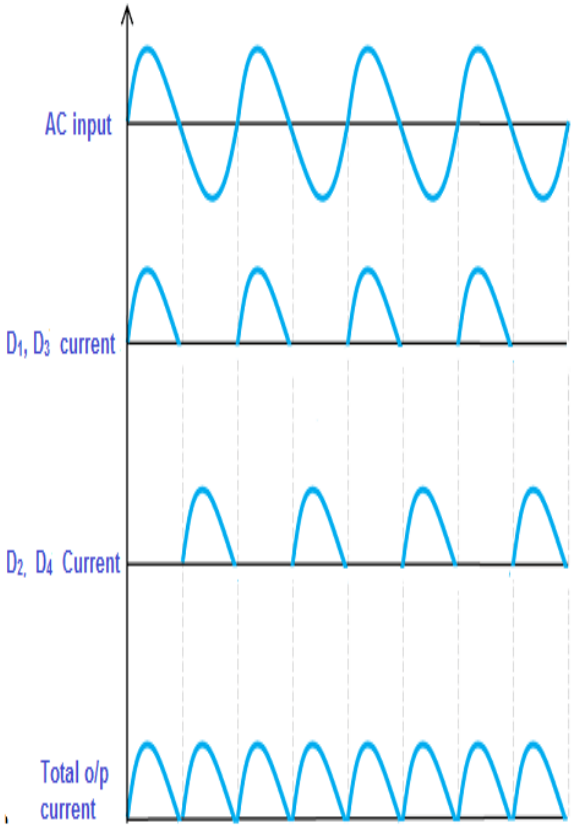
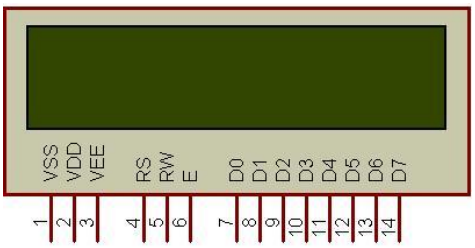


Fig 27: Output Wave

3.3 LIQUID CRYSTAL DISPLAY



Pin No.	Name	Description
Pin no. 1	D7	Data bus line 7 (MSB)
Pin no. 2	D6	Data bus line 6
Pin no. 3	D5	Data bus line 5
Pin no. 4	D4	Data bus line 4
Pin no. 5	D3	Data bus line 3
Pin no. 6	D2	Data bus line 2
Pin no. 7	D1	Data bus line 1
Pin no. 8	D0	Data bus line 0 (LSB)
Pin no. 9	EN1	Enable signal for row 0 and 1 (1st controller)
Pin no.10	R/W	0 = Write to LCD module 1 = Read from LCD module
Pin no.11	RS	0 = Instruction input 1 = Data input
Pin no.12	VEE	Contrast adjust
Pin no.13	VSS	Power supply (GND)
Pin no.14	VCC	Power supply (+5V)
Pin no.15	EN2	Enable signal for row 2 and 3 (2nd controller)
Pin no.16	NC	Not Connected

3.4 RELAY

A **relay** is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays.

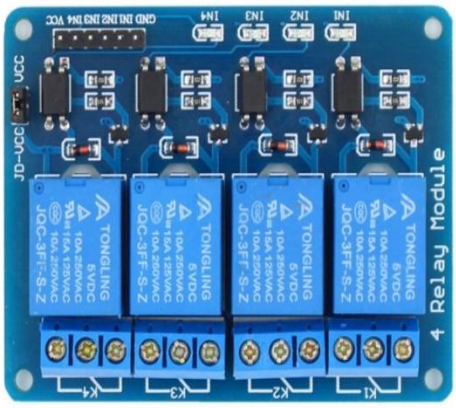


Fig 28: Relay Board

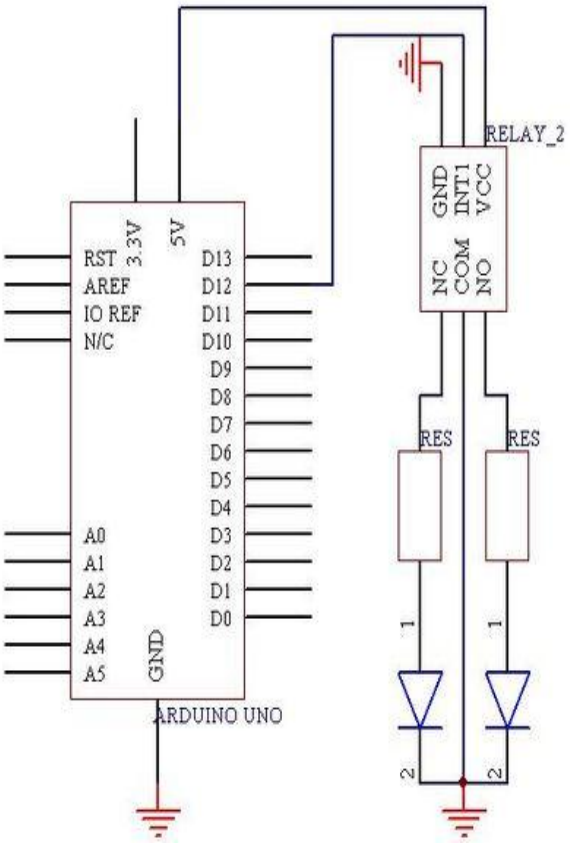


Fig 29: Relay Usage

3.4.1 Example Code

```
int Relay = 12;

void setup()

{

 pinMode(Relay, OUTPUT);     //Set Pin12 as output

}

void loop()

{

      digitalWrite(Relay, HIGH);   //Turn off relay

      delay(2000);

      digitalWrite(Relay, LOW);    //Turn on relay

      delay(2000);



}
```

4. PYTHON LANGUAGE

Python features a dynamic type system and automatic Python features a dynamic type system and automatic memory management. It supports multiple programming paradigms, including object oriented, imperative, functional and procedural, and has a large and comprehensive standard library.

4.1 SIMPLE PROGRAM

Python 2

1 line: Output

```
print 'Hello, world!'
```

2 lines: Input, assignment

```
name = raw_input('What is your name?\n')

print 'Hi, %s.' % name
```

3 lines: For loop, built-in enumerate function, new style formatting

```
friends = ['john', 'pat', 'gary', 'michael']

for i, name in enumerate(friends):

  print "iteration {iteration} is {name}".format(iteration=i, name=name)
```

4 lines: Fibonacci, tuple assignment

```
parents, babies = (1, 1)

while babies < 100:

  print 'This generation has {0} babies'.format(babies)

  parents, babies = (babies, parents + babies)
```

5 lines: Functions

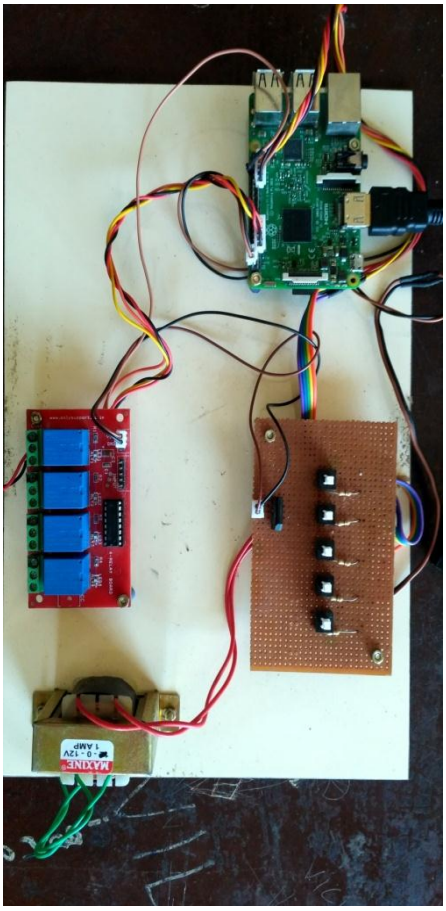
```
def greet(name):

  print 'Hello', name

greet('Jack')

greet('Jill')

greet('Bob')
```

5. APPLICATIONS OF HOME AUTOMATION

Rebuilding consumer expectations, home automation has been projected to target wide array applications for the new digital consumer. Some of the areas where consumers can expect to see home automation led IoT-enabled connectivity are:

- Lighting control
- HVAC
- Lawn/Gardening management
- Smart Home Appliances
- Improved Home safety and security
- Home air quality and water quality monitoring
- Natural Language-based voice assistants
- Better Infotainment delivery
- AI-driven digital experiences
- Smart Switches
- Smart Locks

6. IMPLEMENTATION



7. CONCLUSION

Home Automation is undeniably a resource which can make a home environment automated . People can control their electrical devices via these home automation devices and set up controlling actions through Mobile. In future this product may have high potential for marketing. Further it can be

demonstrated from computer instead of mobile phone for controlling the appliances of any large places like industries, hospitals, institution, etc centrally.

8. REFERENCES

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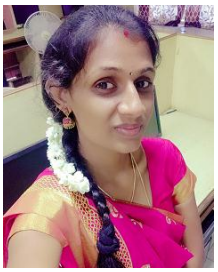
BIOGRAPHIES



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