USER MANUAL
FOR

RASPDUINO IOT SENSOR-DEVELOPMENT BOARD

Manufactured By,

Reg. Office and Works:

**4A sadguru niwas society 16/5/1,
Hingne khurd,sihagad road Pune-411051
Phone: 020 24356456/8956711765**

Email: support@logsun.com/info@logsun.com
Web:www.logsun.com | www.logsunonline.com

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INTRODUCTION:

IOT Meaning:-

IoT (Internet of Things) is an advanced automation and analytics system which exploits networking, sensing, big data, and artificial intelligence technology to deliver complete systems for a product or service. These systems allow greater transparency, control, and performance when applied to any industry or system.

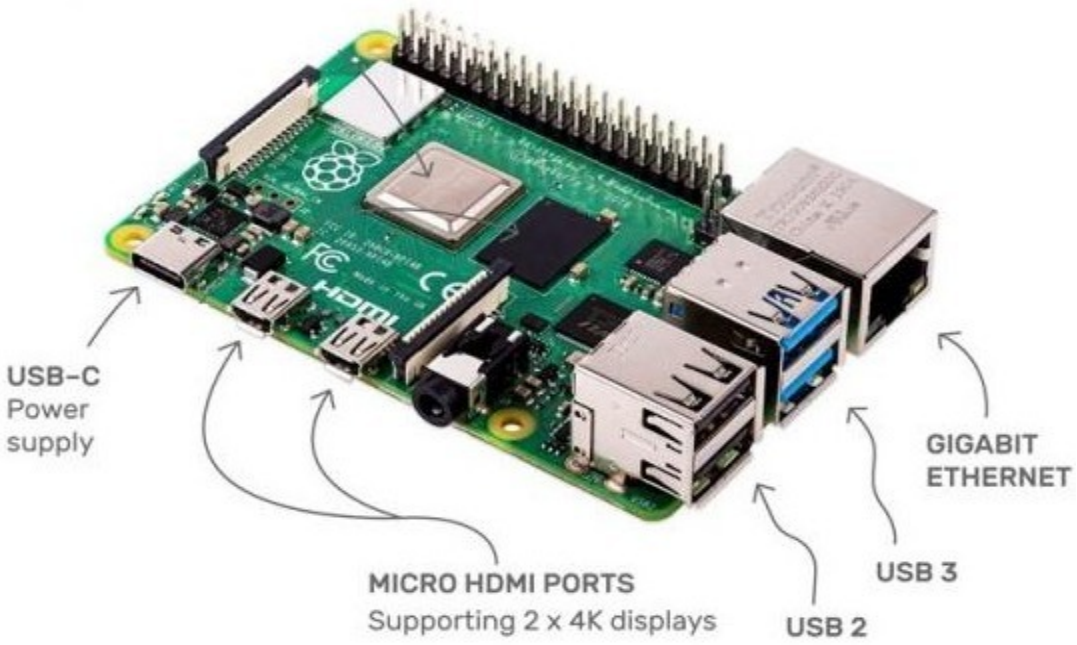
IoT systems have applications across industries through their unique flexibility and ability to be suitable in any environment. They enhance data collection, automation, operations, and much more through smart devices and powerful enabling technology.

How Does It Work:-

The Internet of Things (IoT), also sometimes referred to as the Internet of Everything (IoE), consists of all the web-enabled devices that collect, send and act on data they acquire from their surrounding environments using embedded sensors, processors and communication hardware. These devices, often called "connected" or "smart" devices, can sometimes talk to other related devices, a process called **machine-to-machine** (M2M) communication, and act on the information they get from one another.

Humans can interact with the gadgets to set them up, give them instructions or access the data, but the devices do most of the work on their own without human intervention. Their existence has been made possible by all the tiny mobile components that are available these days, as well as the always-online nature of our home and business networks.

CHAPTER 1. INTRODUCTION TO RASPBERRY PI



Raspberry Pi-4 Model-B

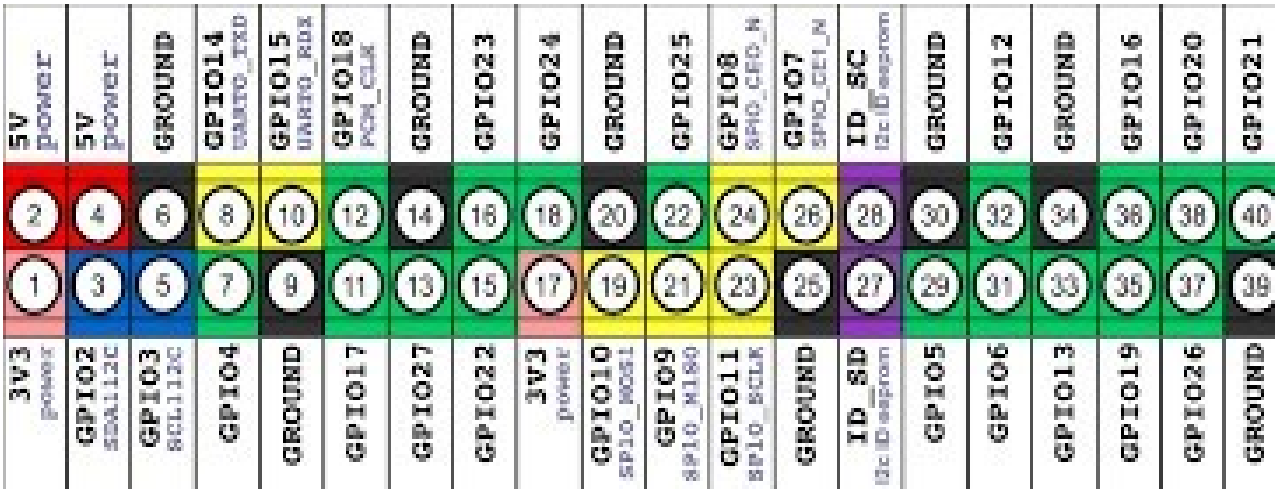
The Raspberry Pi 4 Model B is the latest product in the Raspberry Pi 4 range, boasting a 64-bit quad core Cortex –A72 processor running at 1.5 GHz. It has on board 802.11 ac Wifi, Bluetooth 5, full gigabit Ethernet. Also it has Two USB2.0 ports, two USB 3.0 ports,
1–8 GB of RAM, and dual-monitor support via a pair of micro HDMI (HDMI Type D) ports. The Pi 4 is powered via a USB-C port through 5V3A POWER SUPPLY.

Specification Details:

Processor: 64-BIT QUAD-CORE Cortex-A72 processor.
Memory: 4GB LPDDR4 SDRAM
Connectivity: **1.** IEEE 802.11.b/g/n/ac wireless LAN, Bluetooth 5.0.
2. Gigabit Ethernet port
3. Two USB 2.0 ports
4. Two USB 3.0 ports
Access: Extended 40-pin GPIO header
Video & sound: **1.** 2 micro HDMI ports (supports up to 4Kp60)

SD card support: Micro SD format for loading operating system and data storage
Input power: **1.** 5V/3A DC via micro USB connector
2. 5V DC via GPIO header
3. Power over Ethernet (PoE)–enabled (requires separate PoE HAT)
Environment: Operating temperature, 0–50°C
Compliance: For a full list of local and regional product approvals, please visit www.raspberrypi.org/products/raspberry - pi-4-model-b.

Raspberry Pi GPIO Details:



Configuration setting of Raspberry Pi

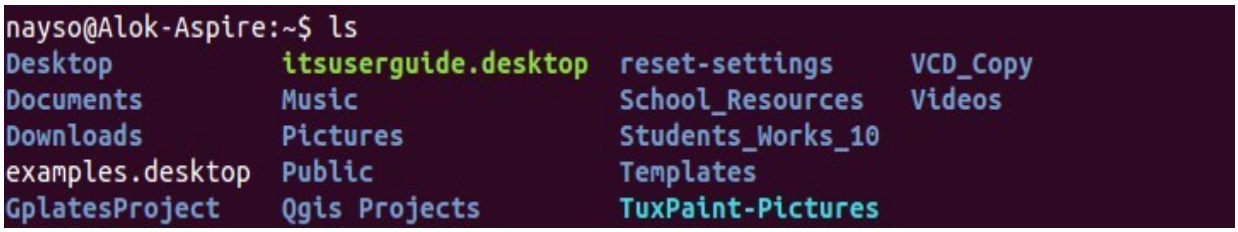
How to Install Operating System in Raspberry Pi SD Card

This Raspberry Pi is the best way to get started on working with the IoT (Internet Of Things) and to build your knowledge to expand it to other applications. So, we made a step-by-step guide for Pi beginners so you can learn various methods that can be used to make your application of choice.

We have divided the whole Raspberry Pi IoT project into two parts. The first part consists of setting up the Raspberry Pi and interfacing it with the sensors & actuators. The second part covers building the various applications and connecting it to the server.
If you aren't familiar with Linux and terminal, check out Basic Linux Commands for Beginners.

Basic Commands -

1. **ls** — Use the **"ls"** command to know what files are in the directory you are in. You can see all the hidden files by using the command **"ls".**



2. **cd** — Use the **"cd"** command to go to a directory. Remember, this command is case sensitive, and you have to type in the name of the folder exactly as it is. But there is a problem with these commands. Imagine you have a folder named "Raspberry Pi". In this case, when you type in **"cd Raspberry Pi"**, the shell will take the second argument of the command as a different one, so you will get an error saying that the directory does not exist. Here, you can use a backward slash. That is, you can use **"cd Raspberry\ Pi"** in this case. Spaces are denoted like this: If you just type **"cd"** and press enter, it takes you to the home directory. To go back from a folder to the folder before that, you can type "**cd** .." . The two dots represent back.

```
nayso@Alok-Aspire:~$ cd Downloads
nayso@Alok-Aspire:~/Downloads$ cd
nayso@Alok-Aspire:~$ cd Raspberry\ Pi
nayso@Alok-Aspire:~/Raspberry Pi$ cd ..
nayso@Alok-Aspire:~$
```

Intermediate Commands-

1. **echo** — The "**echo**" command helps us move some data, usually text into a file.
2. **cat —** Use the **cat** command to display the contents of a file. It is usually used to easily view programs.

```
nayso@Alok-Aspire:~/Desktop$ echo hello, my name is alok >> new.txt
nayso@Alok-Aspire:~/Desktop$ cat new.txt
hello, my name is alok
nayso@Alok-Aspire:~/Desktop$ echo this is another line >> new.txt
nayso@Alok-Aspire:~/Desktop$ cat new.txt
hello, my name is alok
this is another line
```

3. **nano, vi, jed — nano** and **vi** are already installed text editors in the Linux command line. The **nano** command is a good text editor that denotes keywords with color and can recognize most languages. And **vi** is simpler than **nano**. You can create a new file or modify a file using this editor. You can save your files after editing by using the sequence Ctrl+X, then Y (or N for no).
4. **sudo** — A widely used command in the Linux command line, **sudo** stands for "SuperUser Do". So, if you want any command to be done with administrative or root privileges, you can use the **sudo** command.

Note: We'll be remotely accessing the Raspberry Pi's terminal through SSH, so you won't need a dedicated monitor, mouse or keyboard in any part of this tutorial. You would also want to download the following software:

- Win32 Disk Imager
- PuTTY
- Advanced IP Scanner

Tips & Tricks:

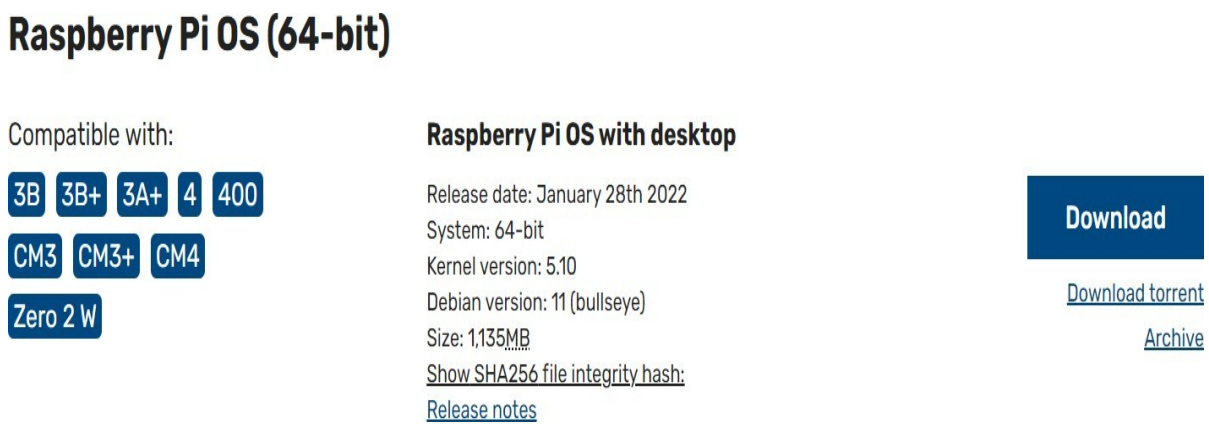
- You can use the **clear** command to clear the terminal if it gets filled up with too many commands.
- **TAB** can be used to fill up in terminal. For example, you just need to type "**cd Doc**" and then **TAB** and the terminal fills the rest up and makes it "**cd Documents**".

- **Ctrl+C** can be used to stop any command in terminal safely. If it doesn't stop with that, then **Ctrl+Z** can be used to force stop it.
- You can exit from the terminal by using the **exit** command.
- You can power off or reboot the computer by using the command **sudo halt** and **sudo reboot**.

Setting Up the Pi for the Raspberry Pi IoT Project:

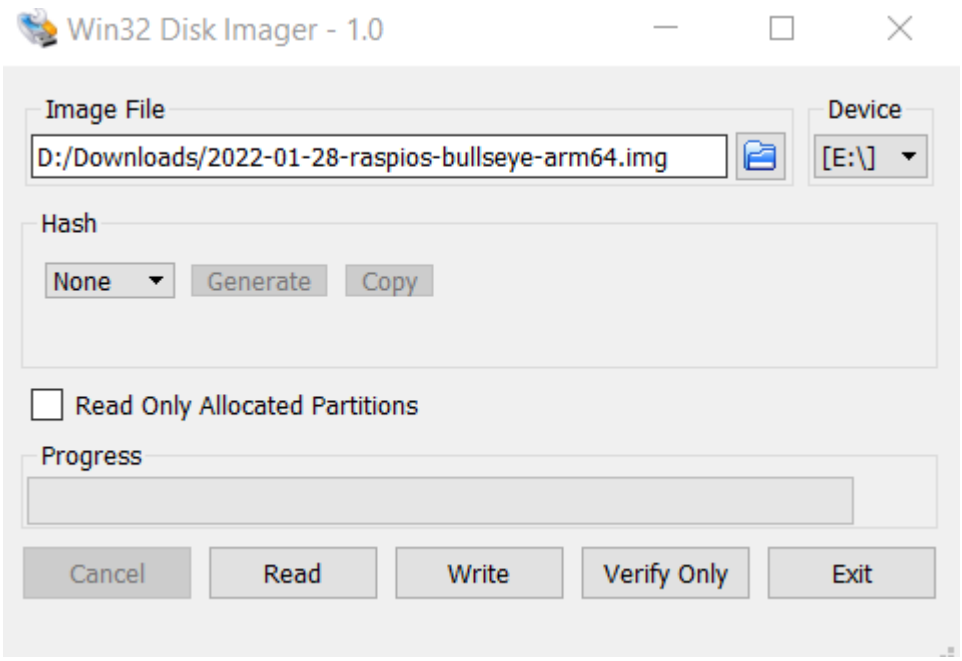
If you already have a Raspberry Pi set up, move over to the next step to start with your Raspberry Pi IoT project. Otherwise, download the Raspbian OS for your Pi. There are many other distributions you can use, but Raspbian remains the most common and convenient for beginners. Visit **https://www.raspberrypi.org/downloads/raspbian/** to download the Raspbian OS.

Extract the ***.img** file from the downloaded zip folder and write it to your SD card.

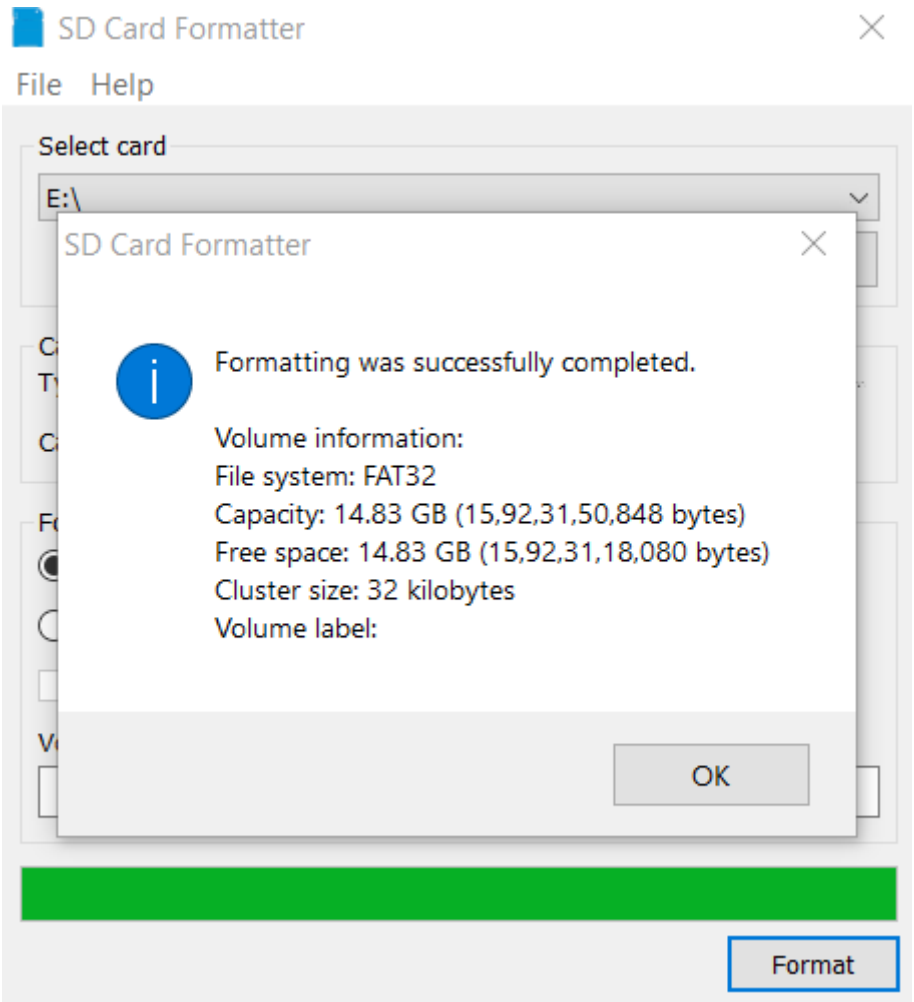


For Windows Users:

1. Insert the SD card reader with the SD card in it. Figure out the Drive assigned to it.
2. Run Win32 Disk Imager (you may have to run this as administrator), and select the extracted image file and the drive letter. Be very careful to select the correct drive—you do not want to unintentionally destroy other data. It should look something like this:



3. Click "Write". Wait for the process to complete and eject the SD card.



How to Connect Raspberry Pi on Windows Platform

Booting Your Raspberry Pi IoT System:

Getting a dedicated monitor, mouse, and keyboard to use your Raspberry Pi might become an unnecessary hassle. Access to the terminal is sufficient to get most things done. So we eliminate the need for extra hardware by logging into the Pi using your personal laptop through SSH. Latest versions of Raspbian come with SSH enabled by default, so you can run Pi remotely even while setting it up for the first time.

Settings for raspberry Pi: After using it first time(you can skip this step,we have already done this step)

1. Select location, language and time location.
2. Click on US keyboard and English Language.
3. Set a new password and don't keep it as "raspberry" as that's the default password and it won't change.
4. If you have internet access select your network and enter your password to connect.
5. Let the system check for software updates and install those updates*.
6. Click on Finish
7. Click on the Pi Menu > Preferences click on 'Raspberry Pi configuration'
8. Go to interfaces.
    1. All the interfaces are disabled by default.
    2. Enable all the interfaces except for Remote GPIO (Enable if you really need it).
    3. Click OK and it will ask you to reboot.
    4. Click on reboot.

*If the software update fails, then open terminal (Ctrl + Alt + T) Type "sudo apt-get update && sudo apt-get upgrade"
Press 'Y' and press enter if asked.

'update' will update the repositories and 'upgrade' will install all the new updates. Reboot once the process is complete.
Complete step 8 > 2 before reboot to avoid rebooting too many times.

Raspberry Pi 4 libraries/packages installation

1) Install AdaFruit Library for DHT22 Practical it is required.

1. Open Terminal (Ctrl + Alt + T).
2. Type "sudo apt-get update && sudo apt-get upgrade"
3. Type "sudo apt-get install python3-dev python3-pip"
4. Type "sudo python3 -m pip install --upgrade pip setup tools wheel"
5. Type "sudo pip3 install Adafruit_DHT"

Don't forget to add 'sudo' as it gives you root access.

2) Enable SSH for MQTT

1. **Type "sudo apt-get install python3-seria**l"
2. Copy "dmesg | grep tty" and paste.
    1. This will show you all the available ports.
    2. ttyAMA0 might be the only enabled port.
3. **Type "sudo rasp-config"**
    1. Use arrow pointer to select the correct option, then press tab to select **Yes** or **No** option.
    2. Select Interfacing Options
    3. Select P6 Serial
        1. Select ***NO*** for "Login shell access over serial"
        2. Select ***YES*** for "Enable serial port hardware"
        3. Select ***YES*** to Reboot now.

3) pcf8575 libraries installation
"pip install pcf8575"

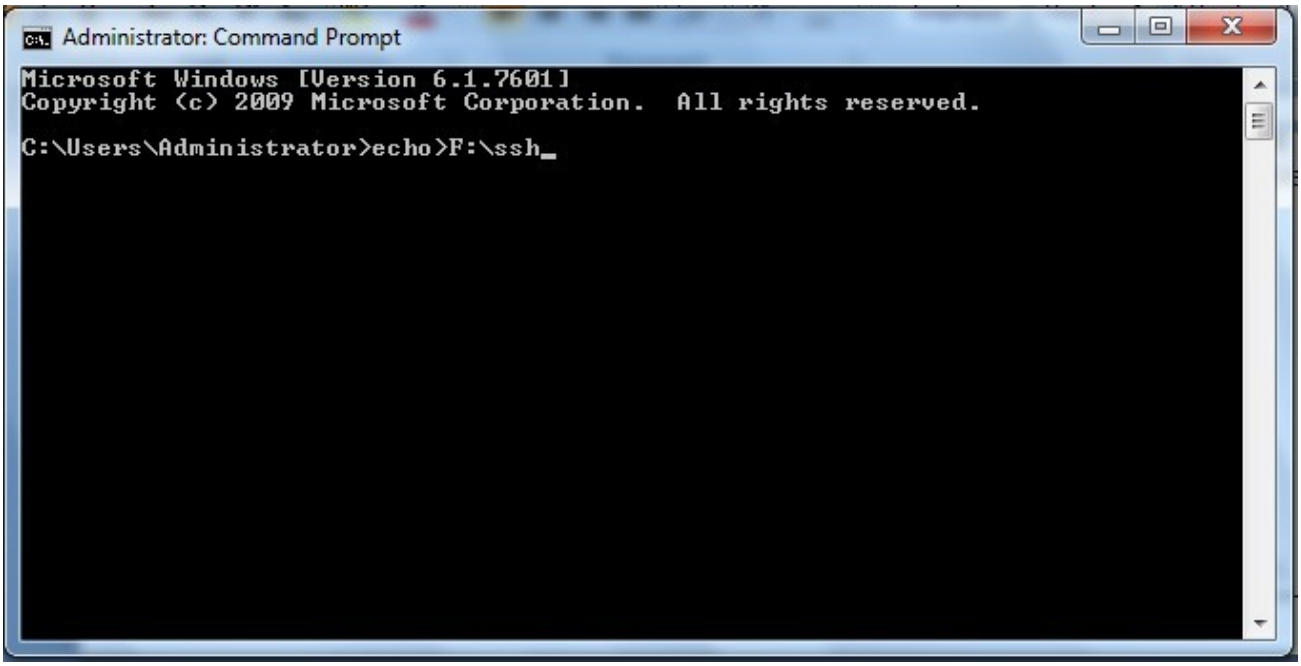
NOTE:

If above libraries didn't work/or you need to use other libraries than this then go to PyPI · The Python Package Index and use that library
to copy paste content in terminal window of raspberry pi the short cut is "ctrk+shift+v"

If SSH is not enabled then do the following procedure:

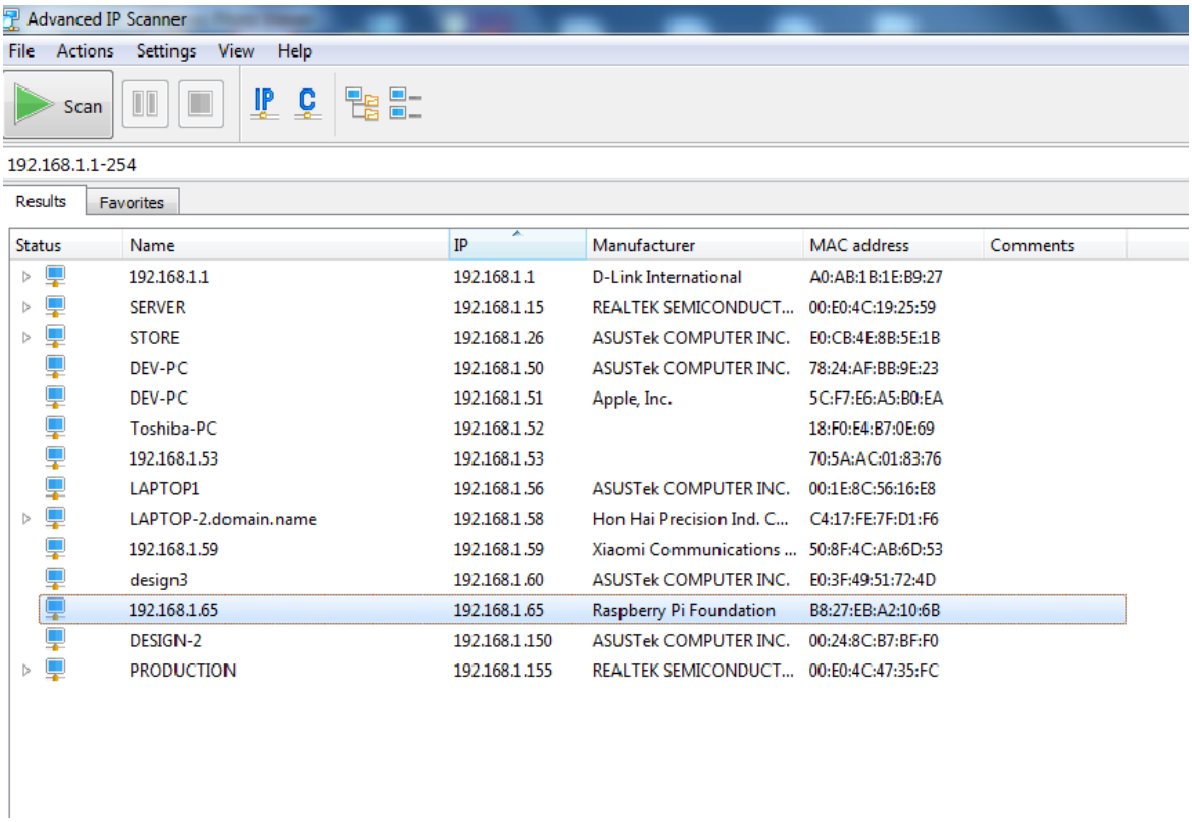
- Click on Start - All Programs – Accessories - Command Prompt
- Enter command : *echo>F:\ssh<Enter>*

You will see the window like this:

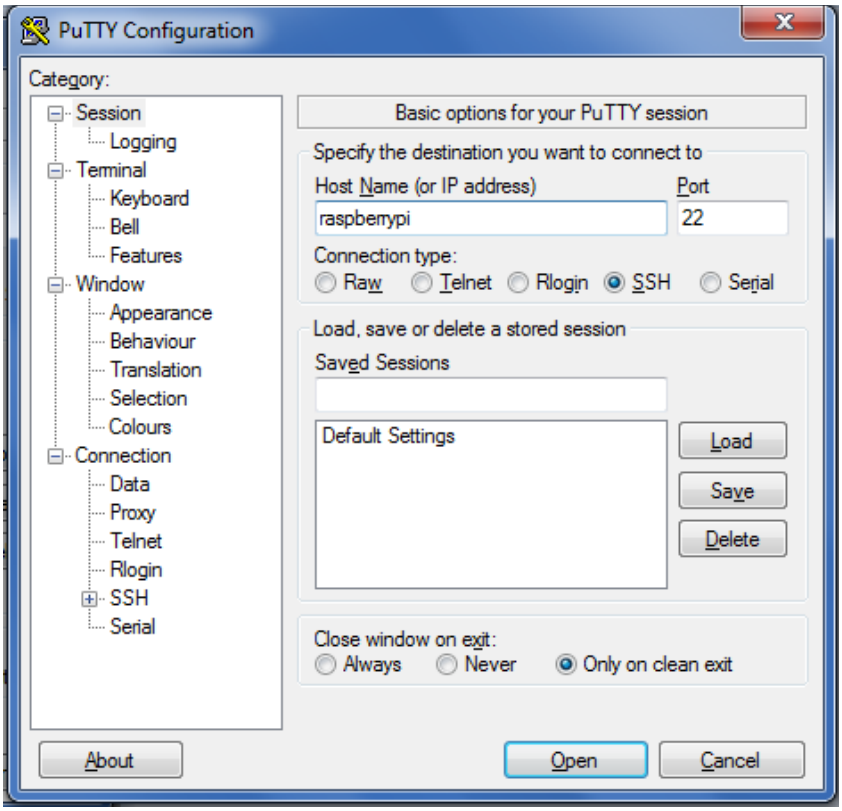


Note: *Here F is Removable Disk Drive Letter like of SD Card. Ensure your SD Card drive letter & make changes in above command accordingly.*

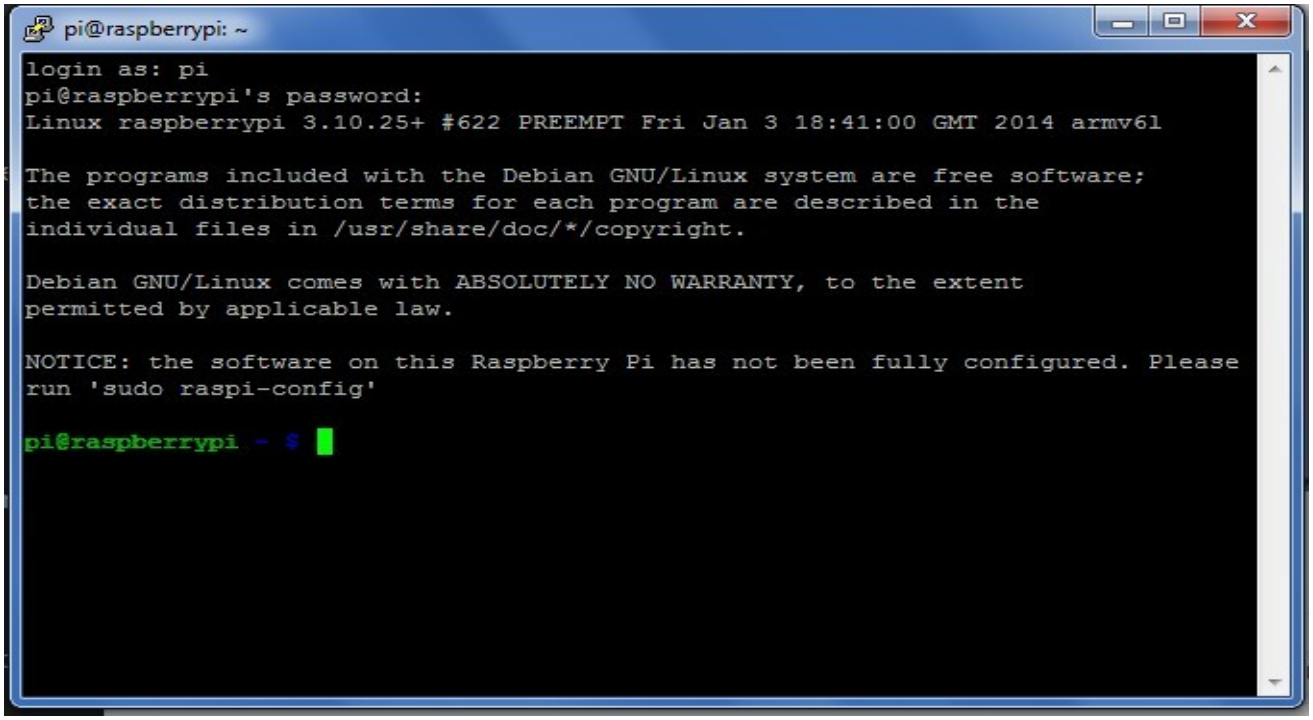
- **Get a router with DHCP enabled**. This is necessary because we want our Pi to have a unique IP address to be able to connect to it. Connect both your laptop and your Pi to the router via Ethernet cables. Your laptop and Pi now share a local area network and can identify each other using their unique IP address.
- To use SSH, you'll need the **IP address of your Pi**.
- Connect Raspberry pi with 5V power supply
- Open the Advance IP Scanner Software
- Run the Advanced IP Scanner. This will list out the IP addresses of all devices on your network and their manufacturer. You'll see something like this:



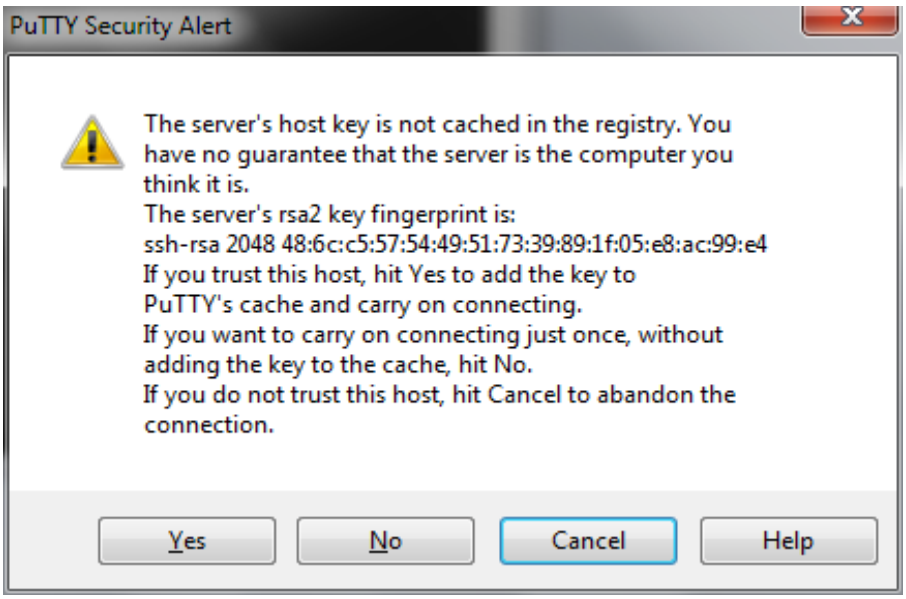
- Use PuTTY to access Pi's Terminal. Run PuTTY and simply enter the IP address determined in the above step.



Subsequently, you will receive a login prompt. Use login id as **pi** and password as **raspberry**.



Side Note: For first-time login, you'll receive a warning for a security alert. Click on "Yes" and proceed. You have now opened a terminal session on your Raspberry Pi, which can be accessed through your Windows laptop.



How to Connect Raspberry Pi on Linux Platform

- To know your Raspberry Pi IP address, turn ON your laptop/desktop Wi-Fi.
- Connect Ethernet cable between Raspberry Pi & laptop/desktop.
- Click on Wi-Fi icon.
- Click on VPN connection – configure VPN
- Click on add
- Choose connection type as Ethernet
- Click on create
- Connection name- Raspberry Pi (You can assign any name)
- Go to IP4 settings tab.
- Click on Method & select as share to other computers.
- Click on save.
- Yu will see Raspberry Pi Connected notification.
- Open your terminal window
- enter the following command: cat /var/lib/misc/dnsmasq.leases<Enter>
- You will get Raspberry Pi IP address.
- Now enter the following command : ssh pi@10.42.0.66 <Enter>
- Enter the password as raspberry.
- You'll receive a warning for a security alert. Click on "Yes" and proceed. You have now opened a terminal session on your Raspberry Pi, which can be accessed through your Windows laptop.

Please note that the cursor won't move forward while entering the password due to default settings.

CHAPTER3. EXPERIMENTS

EXPERIMENT No 1.

LCD DISPLAY

AIM: - To study the interfacing of LCD (16*2) with the Raspberry pi.

REQUIREMENTS:- Raspberry pi board, 40 pin FRC cable, 8 pin connector, 5v,3A power supply, LCD.

PROCEDURE:

1) Connect Raspberry pi on board. Connect TYPE C power cable to PI.

2) Connect the HDMI screen, mouse and keyboard to Raspberry pi.

3) Switch ON the power supply.

4) Connect 40 pin FRC cable from Raspberry pi to the 40 pin connector which is placed on the board. And connect 8 pin connector from the board to “LCD” section.

5) Open the saved folder on PI4 with name Raspberry Pi sample codes

6) Now we are into the folder **Raspberry Pi sample codes**.

7) To see the list of files into **Raspberry Pi sample codes** folder enter command >> **ls**

8) To run this specific program enter the command >> **python lcd.py**

9) If you want to see program enter the command >> **sudo nano lcd.py**

10) To exit from the program press **Ctrl-Z.**

11) You will observe that it displays “LOGSUN SYSTEMS” on LCD display.

Note: First connect relimate comnnector then run the program.

EXPERIMENT No 2.

I2C LCD DISPLAY

AIM: - To study the interfacing of I2C LCD (16*2) with the Raspberry pi.

REQUIREMENTS:- Raspberry pi board, 40 pin FRC cable, 4 pin connector, 5v,3A power supply, LCD.

PROCEDURE:

1) Connect Raspberry pi on board. Connect TYPE C power cable to PI.

2) Connect the HDMI screen, mouse and keyboard to Raspberry pi.

3) Switch ON the power supply.

4) Connect 40 pin FRC cable from Raspberry pi to the 40 pin connector which is placed on the board. And connect 4 pin connector from the board to “LCD” section.

5) Open the Terminal window of Raspberry pi and enter the command >>
cd /home/pi/Raspberry Pi sample codes .

6) Now we are into the folder

7) To see the list of files into **Raspberry Pi sample codes** folder enter command >> **ls**

8) To run this specific program enter the command >> **python lcd_pcf8574.py**

9) If you want to see program enter the command >> **sudo nano lcd_pcf8574.py**

10) To exit from the program press **Ctrl-Z.**

11) You will observe that it displays “**LOGSUN SYSTEMS, I2C DEMO**” on LCD display.

EXPERIMENT No 3.

LCD WITH KEYPAD INTERFACING

AIM: To study the interfacing of LCD and Keypad with Raspberry Pi.

REQUIREMENTS:- Raspberry pi board, 40 pin FRC cable, two 8 pin connectors, 5v,3A power supply, LCD, 4*4 matrix keypad.

PROCEDURE:

1) Connect Raspberry pi on board. Connect TYPE C power cable to PI.

2) Connect the HDMI screen, mouse and keyboard to Raspberry pi.

3) Switch ON the power supply.

4) Connect 40 pin FRC cable from Raspberry pi to the 40 pin connector which is placed on the board. Connect one 8-pin connector from the board to “KEYPAD” section and another 8-pin connector to “LCD” section.

5) Open the Terminal window of Raspberry pi and enter the command >>
cd /home/pi/Raspberry Pi sample codes .

6) Now we are into the folder**Raspberry Pi sample codes** .

7) To see the list of files into **Raspberry Pi sample codes** folder enter command >> **ls**

8) To run this specific program enter the command >> **python keypad.py**

9) If you want to see program enter the command >> **sudo nano keypad.py**

10) To exit from the program press **Ctrl-Z.**

11) You will observe that when you press a key (0-F) it will show on LCD display.

Experiment No 4.

STEPPER MOTOR WITH RASPBERRY PI

AIM: To study the interfacing of stepper motor with Raspberry pi.

REQUIREMENTS:- Raspberry pi board, 40 pin FRC cable, 8 pin connector, 5v,3A power supply, stepper motor, external12v dc power supply.

PROCEDURE:

1) Connect Raspberry pi on board. Connect TYPE C power cable to PI.

2) Connect the HDMI screen, mouse and keyboard to Raspberry pi.

3) Switch ON the power supply.

4) Connect 40 pin FRC cable from Raspberry pi to the 40 pin connector which is placed on the board. And connect 8 pin connector from the board to “STEPPER MOTOR” section; also connect the 12V power supply externally.

5) Open the Terminal window of Raspberry pi and enter the command >> **cd /home/pi/Raspberry Pi sample codes .**

6) Now we are into the folder **Raspberry Pi sample codes**

7) To see the list of files into **Raspberry Pi sample codes** folder enter command >> **ls**

8) To run this specific program enter the command >> **python stepper.py**

9) If you want to see program enter the command >> **sudo nano stepper.py**

10) To exit from the program press **Ctrl-Z**.

11) You will observe that when you run the program, the motor will automatically start rotating in forward direction.

Experiment No 5.

SERVO MOTOR WITH RASPBERRY PI

AIM: To study interfacing of servo motor with Raspberry pi.

REQUIREMENTS:- Raspberry pi board, 40 pin FRC cable, 4 pin connector, 5v,3A power supply.

INTRODUCTION: - Servo Motor is nothing but a simple electrical motor where rotation of the motor is required for just a certain angle not continuously for long period of time.

PROCEDURE:

1) Connect Raspberry pi on board. Connect TYPE C power cable to PI.

2) Connect the HDMI screen, mouse and keyboard to Raspberry pi.

3) Switch ON the power supply.

4) Connect 40 pin FRC cable from Raspberry pi to the 40 pin connector which is placed on the board. And connect 4 pin connector from the board to “SERVO” section.

5) Open the Terminal window of Raspberry pi and enter the command >>
cd /home/pi/Raspberry Pi sample codes .

6) Now we are into the folder **Raspberry Pi sample codes**

7) To see the list of files into **Raspberry Pi sample codes** folder enter command >> **ls**

8) To run this specific program enter the command >> **python servo.py**

9) If you want to see program enter the command >> **sudo nano servo.py**

10) To exit from the program press **Ctrl-Z.**

11) When we run the program the servo motor will start rotating in clockwise direction and after some time interval it will start rotating in Anti-clockwise direction.

Experiment No 6.

RELAY-BUZZER WITH RASPBERRY PI

AIM: To study interfacing of relay-buzzer with Raspberry pi.

REQUIREMENTS:- Raspberry pi board, 40 pin FRC cable, 4 pin connector, 5v,3A power supply.

INTRODUCTION: - A relay is an electrically operated switch. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. Buzzer is an audio signaling device which may be mechanical or electromechanical.

PROCEDURE:

1) Connect Raspberry pi on board. Connect TYPE C power cable to PI.

2) Connect the HDMI screen, mouse and keyboard to Raspberry pi.

3) Switch ON the power supply.

4) Connect 40 pin FRC cable from Raspberry pi to the 40 pin connector which is placed on the board. And connect 4 pin connector from the board to “RELAY-BUZZER” section.

5) Open the Terminal window of Raspberry pi and enter the command >>
cd /home/pi/Raspberry Pi sample codes .

6) Now we are into the folder **Raspberry Pi sample codes**. To see the list of files into SENSOR BOARD folder enter command >> **ls**

7) To run this specific program enter the command >> **python relay_buzzer.py**

8) If you want to see program enter the command >> **sudo nano relay_buzzer.py**

9) To exit from the program press **Ctrl-Z.**

10) You will observe that relay is ON for 5sec and OFF for 5 sec and buzzer will also ON at a time.

Experiment No 7.

ULTRASONIC SENSOR WITH RASPBERRY PI

AIM: To study interfacing of Ultrasonic Sensor with Raspberry pi.

REQUIREMENTS:- Raspberry pi board, 40 pin FRC cable, 4 pin connector, 5v,3A power supply.

PROCEDURE:

1) Connect Raspberry pi on board. Connect TYPE C power cable to PI.

2) Connect the HDMI screen, mouse and keyboard to Raspberry pi.

3) Switch ON the power supply.

4) Connect 40 pin FRC cable from Raspberry pi to the 40 pin connector which is placed on the board. And connect 4 pin connector from the board to “ULTRASONIC SENSOR” section.

5) Open the Terminal window of Raspberry pi and enter the command >>
cd /home/pi/Raspberry Pi sample codes .

6) Now we are into the folder **Raspberry Pi sample codes**

7) To see the list of files into SENSOR BOARD folder enter command >> **ls**

8) To run this specific program enter the command >> **ultralcd.py**If you want to see program enter the command >> **sudo nano ultralcd.py**

9) To exit from the program press **Ctrl-Z.**

10) When we run the program, ultrasonic sensor will show the distance of obstacle came in front of it and this distance displays on terminal window as well as LCD.

Experiment No 8.

RGB WITH RASPBERRY PI

AIM: To study interfacing of RGB with Raspberry pi.

REQUIREMENTS:- Raspberry pi board, 40 pin FRC cable, 6 pin connector, 5v,3A power supply.

INTRODUCTION: - RGB LED means red, blue and green LEDs. RGB LED products combine these three colors to produce over 16 million hues of light. Some colors are "outside" the triangle formed by the RGB LEDs.

PROCEDURE:

1) Connect Raspberry pi on board. Connect TYPE C power cable to PI.

2) Connect the HDMI screen, mouse and keyboard to Raspberry pi.

3) Switch ON the power supply.

4) Connect 40 pin FRC cable from Raspberry pi to the 40 pin connector which is placed on the board. And connect 5 pin connector from the board to "RGB" section.

5) Open the Terminal window of Raspberry pi and enter the command >>
cd /home/pi/Raspberry Pi sample codes .

6) Now we are into the folder **Raspberry Pi sample codes.**

7) To see the list of files into **Raspberry Pi sample codes** folder enter command >> **ls**To run this specific program enter the command >> **rgb.py**

8) If you want to see program enter the command >> **sudo nano rgb.py**

9) To exit from the program press **Ctrl-Z.**

10) When we run the program, LED will emit red, green and blue colors.

Experiment No 9.

DHT22 WITH RASPBERRY PI

AIM: To study interfacing of DHT22 with Raspberry pi.

REQUIREMENTS:- Raspberry pi board, 40 pin FRC cable, 4 pin connector, 5v,3A power supply.

INTRODUCTION:- The DHT22 is temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air.

PROCEDURE:

1) Connect Raspberry pi on board.Connect TYPE C power cable to PI.

2) Connect the HDMI screen, mouse and keyboard to Raspberry pi.

3) Switch ON the power supply.

4) Connect 40 pin FRC cable from Raspberry pi to the 40 pin connector which is placed on the board. And connect 4 pin connector from the board to “DHT22” section.
5) Open the Terminal window of Raspberry pi and enter the command >>
6) **cd /home/pi/Raspberry Pi sample codes .**
7) Now we are into the folder **Raspberry Pi sample codes.**

8) To see the list of files into Raspberry Pi sample codes folder enter command >> lsTo run this specific program enter the command >> DHT22.py

9) If you want to see program enter the command >> sudo nano DHT.py.

10) To exit from the program press Ctrl-Z.

11) Output able to see on serial terminal.

Experiment No 10.

PIR SENSOR WITH RASPBERRY PI

AIM: To study interfacing of PIR sensor with Raspberry pi.

REQUIREMENTS:- Raspberry pi ,40 pin FRC cable, 4 pin connector, 5v,3A power supply.

INTRODUCTION:- A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. A PIR-based motion detector is used to sense movement of objects.

PROCEDURE:

1) Connect Raspberry pi on board. Connect TYPE C power cable to PI.
2) Connect the HDMI screen, mouse and keyboard to Raspberry pi.
3) Switch ON the power supply.
4) Connect 40 pin FRC cable from Raspberry pi to the 40 pin connector which is placed on the board. And connect 4 pin connector from the board to “PIR” section.
5) Open the Terminal window of Raspberry pi and enter the command >>
   cd /home/pi/Raspberry Pi sample codes .
6) To see the list of files into Raspberry Pi sample codes folder enter command >> lsTo run this specific program enter the command >> PIR.py
7) If you want to see program enter the command >> sudo nano PIR.py.
8) To exit from the program press Ctrl-Z.
9) Output able to see on serial terminal.

Experiment No 11.

JOYSTICK WITH RASPBERRY PI

AIM: To study interfacing of Joystick with Raspberry pi.

REQUIREMENTS:- Raspberry pi ,40 pin FRC cable, 5 pin connector, 5v,3A power supply.

INTRODUCTION:- A joystick is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling.

PROCEDURE:

1) Connect Raspberry pi on board. Connect TYPE C power cable to PI.

2) Connect the HDMI screen, mouse and keyboard to Raspberry pi.

3) Switch ON the power supply.

4) Connect 40 pin FRC cable from Raspberry pi to the 40 pin connector which is placed on the board. And connect 5 pin connector from the board to "JOYSTICK" section.

5) Open the Terminal window of Raspberry pi and enter the command >>
cd /home/pi/Raspberry Pi sample codes .

6) Now we are into the folder **Raspberry Pi sample codes** To see the list of files into SENSOR BOARD folder enter command >> **ls**

7) To run this specific program enter the command >> **joystick.py**

8) If you want to see program enter the command >> **sudo nano joystick.py**

9) To exit from the program press **Ctrl-Z.**

10)

11) When you run the program, it will show the output voltages as direction in which you move the joystick. You can see the output on terminal window.

Experiment No 12.

BLUETOOTH SENSOR WITH RASPBERRY PI

AIM: To study interfacing of Bluetooth Sensor with Raspberry pi.

REQUIREMENTS:- Raspberry pi ,40 pin FRC cable,4 pin connector, 5v,3A power supply.
INTRODUCTION:- A Bluetooth device works by using radio waves instead of wires or cables to connect with your Smartphone or computer. Bluetooth is a wireless short-range communications technology standard found in millions of products.

PROCEDURE:

1) Connect Raspberry pi on board. Connect TYPE C power cable to PI.

2) Connect the HDMI screen, mouse and keyboard to Raspberry pi.

3) Switch ON the power supply.

4) Connect 40 pin FRC cable from Raspberry pi to the 40 pin connector which is placed on the board. And connect 4 pin connector from the board to "BLUETOOTH" section.

5) Open the Terminal window of Raspberry pi and enter the command >>
cd /home/pi/Raspberry Pi sample codes .

6) Now we are into the folder **Raspberry Pi sample codes**

7) To see the list of files into **Raspberry Pi sample codes** folder enter command >> **ls**To run this specific program enter the command >> **bluetooth.py**

8) If you want to see program enter the command >> **sudo nano bluetooth.py**

9) To exit from the program press **Ctrl-Z.**

10) Download any Bluetooth Application (E.g. Blue Chat) in your mobile device. Bluetooth sensor on board will connect to your mobile phone's Bluetooth and when you send any message from mobile using that application, you will get that message on your terminal window.

Experiment No 13.

WI-FI WITH RASPBERRY PI

AIM: To study interfacing of WI-FI with Raspberry pi.

REQUIREMENTS: - Raspberry pi, 40 pin FRC cable, 4 pin connector, 5v, 3A power supply.

INTRODUCTION:- The wireless sensor tag is a real-time, cloud based system, so any change you make from one device instantly appears on your other devices.

PROCEDURE:

1) Connect Raspberry pi on board Connect TYPE C power cable to PI. .

2) Connect the HDMI screen, mouse and keyboard to Raspberry pi.

3) Switch ON the power supply.

4) Connect 40 pin FRC cable from Raspberry pi to the 40 pin connector which is placed on the board. And connect 4 pin connector from the board to “WI-FI” section.

5) Open the Terminal window of Raspberry pi and enter the command >>
cd /home/pi/Raspberry Pi sample codes .
Now we are into the folder Raspberry Pi sample codes

6) To see the list of files into **Raspberry Pi sample codes** folder enter command >> **ls**

7) To run this specific program enter the command >> **wifi.py**

8) If you want to see program enter the command >> **sudo nano wifi.py**

9) To exit from the program press **Ctrl-Z.**

10) Go to terminal window and write AT on it, you will get the reply as AT OK for startup, AT+RST for restart and AT+GMR to view version information. This means Wi-Fi is connected successfully.

CHAPTER 4. FRC CONNECTOR DETAILS

1. 40 PIN FRC CONNECTOR (J9):

Pin No.	Description	Pin No.	Description
1	NC	2	VDD_5V
3	SDA	4	VDD_5V
5	SCL	6	GND
7	NC	8	RXGPIO_14
9	GND	10	TXGPIO_15
11	NC	12	GPIO_18
13	GPIO_27	14	GND
15	GPIO_22	16	GPIO_23
17	NC	18	GPIO_24
19	GPIO_10	20	GND
21	GPIO_9	22	GPIO_25
23	GPIO_11	24	GPIO_8
25	GND	26	GPIO_7
27	NC	28	NC
29	GPIO_5	30	GND
31	GPIO_6	32	GPIO_12
33	GPIO_13	34	GND
35	GPIO_19	36	GPIO_16
37	GPIO_26	38	GPIO_20
39	GND	40	GPIO_21

8 PIN CONNECTOR FOR KEYPAD (RJ1)

Pin No.	Description
1	GIO_4(GPIO_GCLK)

2	GIO_5
3	GIO_6
4	GIO_7(SPI_CE1_N)
5	GIO_8(SPI_CE0_N)
6	GIO_9(SPI_MISO)
7	GIO_10(SPI_MOSI)
8	GIO_11(SPI_CLK)

2. 8 PIN CONNECTOR FOR LCD (RJ2)

Pin No.	Description
1	5/3V
2	GIO_13
3	GIO_14(TXD0)
4	GIO_15(RXD0)
5	GIO_16
6	GIO_17(GPIO_GEN0)
7	GIO_18(GPIO_GEN1)
8	GND

3. 8 PIN CONNECTOR FOR STEPPER (RJ3)

Pin No.	Description
1	5/3V
2	GIO_19
3	GIO_20
4	GIO_21
5	GIO_22(GPIO_GEN3)
6	GIO_23(GPIO_GEN4)
7	GIO_24(GPIO_GEN5)
8	GND

4. 6 PIN CONNECTOR FOR RGB (RJ4)

Pin No.	Description
1	GIO_19
2	GIO_21
3	GIO_22(GPIO_GEN3)
4	GIO_23(GPIO_GEN4)

5	GIO_24(GPIO_GEN5)
6	GND

5. 4 PIN CONNECTOR FOR ULTRASONIC (RJ5)

Pin No.	Description
1	5/3V
2	GIO_21
3	GIO_22(GPIO_GEN3)
4	GND

6. 4 PIN CONNECTOR FOR BLUETOOTH (RJ11)

Pin No.	Description
1	5/3V
2	GPIO_14(TXD0)
3	GPIO_15(RXT0)
4	GND

7. 4 PIN CONNECTOR FOR SERVO MOTOR (RJ5)

Pin No.	Description
1	5/3V
2	GPIO_21
3	GPIO_22
4	GND

8. 4 PIN CONNECTOR FOR PIR SENSOR(RJ5)

Pin No.	Description
1	5/3V
2	GPIO_21
3	GPIO_22
4	GND

9. 4 PIN CONNECTOR FOR DHT22 (RJ6)

Pin No.	Description
1	5/3V
2	GPIO_4

3	GPIO_5
4	GND

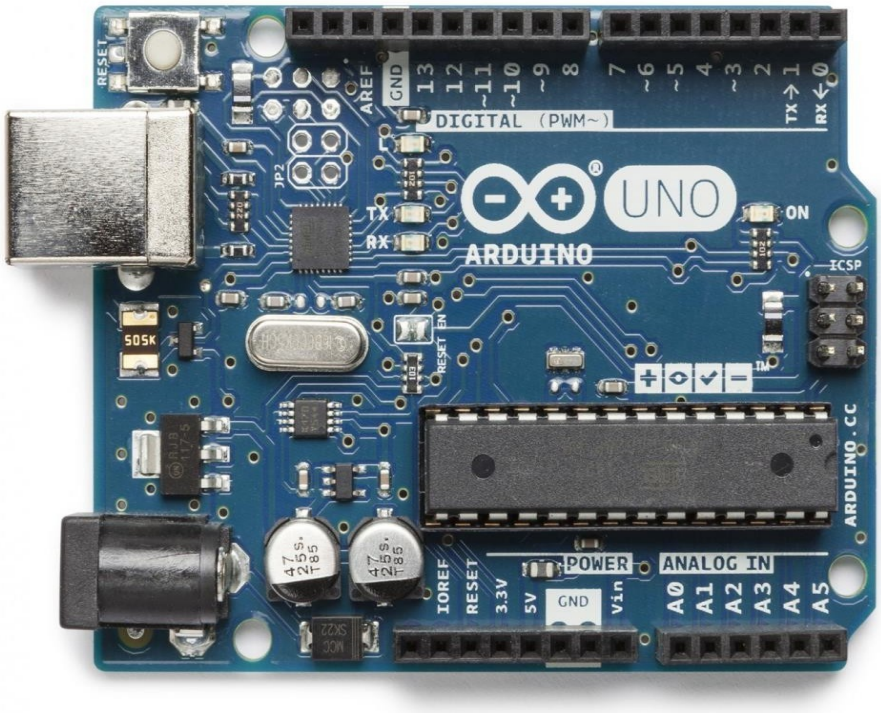
10. 4 PIN CONNECTOR FOR RELAY-BUZZER (RJ5)

Pin No.	Description
1	5/3V
2	GPIO_21
3	GPIO_22
4	GND

11. 4 PIN CONNECTOR FOR LCD-I2C (RJ12)

Pin No.	Description
1	5/3V
2	GPIO_2
3	GPIO_3
4	GND

CHAPTER 5. INTRODUCTION TO ARDUINO UNO



Arduino Uno

The **Arduino Uno** is a microcontroller board based on the ATmega328. Arduino is an open-source, prototyping platform and its simplicity makes it ideal for hobbyists to use as well as professionals. The Arduino Uno 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.

Power:-

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and VIN pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

VIN-

The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

5V-

This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.

3V3-

A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

GND- Ground pins.

Memory-

The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Input and Output-

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode (), digitalWrite (), and digitalRead () functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

Serial: 0 (RX) and 1 (TX)-

Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

External Interrupts: 2 and 3-

These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt () function for details.

PWM-

3, 5, 6, 9, 10 and 11. Provide 8-bit PWM output with the analog Write () function.

SPI-

10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.

LED: 13-

There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analog Reference () function. Additionally, some pins have specialized functionality:

TWI: A4 or SDA pin and A5 or SCL pin- Support TWI communication using the Wire library.

There are a couple of other pins on the board:

AREF-

Reference voltage for the analog inputs. Used with analog Reference().

Reset-

Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

SPECIFICATION

Microcontroller- ATmega328

Operating Voltage- 5V

Input Voltage (recommended)- 7-12V

Input Voltage (limits)- 6-20V.

Digital I/O Pins- 14 (of which 6 provide PWM output)

Analog Input Pins- 6

DC Current per I/O Pin- 40 mA .

DC Current for 3.3V Pin- 50 mA

Flash Memory- 32KB (ATmega328) of which 0.5 KB used by bootloader

SRAM- 2 KB (ATmega328)

EEPROM- 1 KB (ATmega328)

Clock Speed- 16 MHz

CHAPTER 6. SETTING FOR ARDUINO UNO TO USE AS DEVELOPMENT BOARD

INSTALL Arduino 1.8.3 -

The open source arduino software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, MAC os x, Linux. This software can be used with any arduino board.

1) DOWNLOAD-

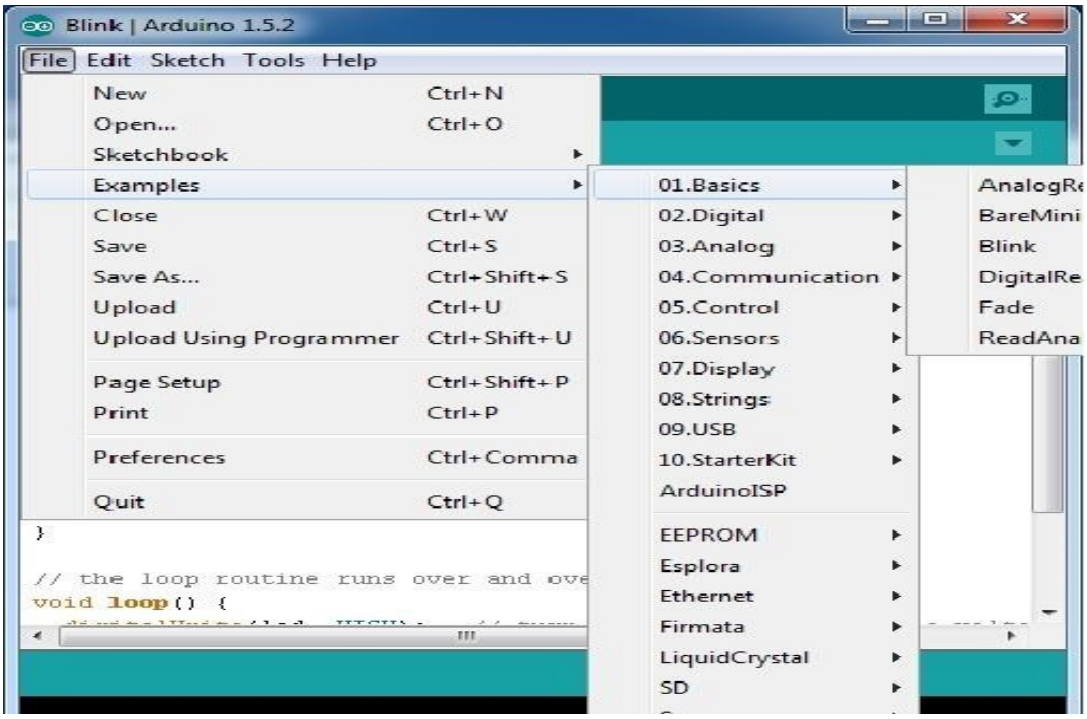
Download the software from-

https://www.arduino.cc/en/Main/Software

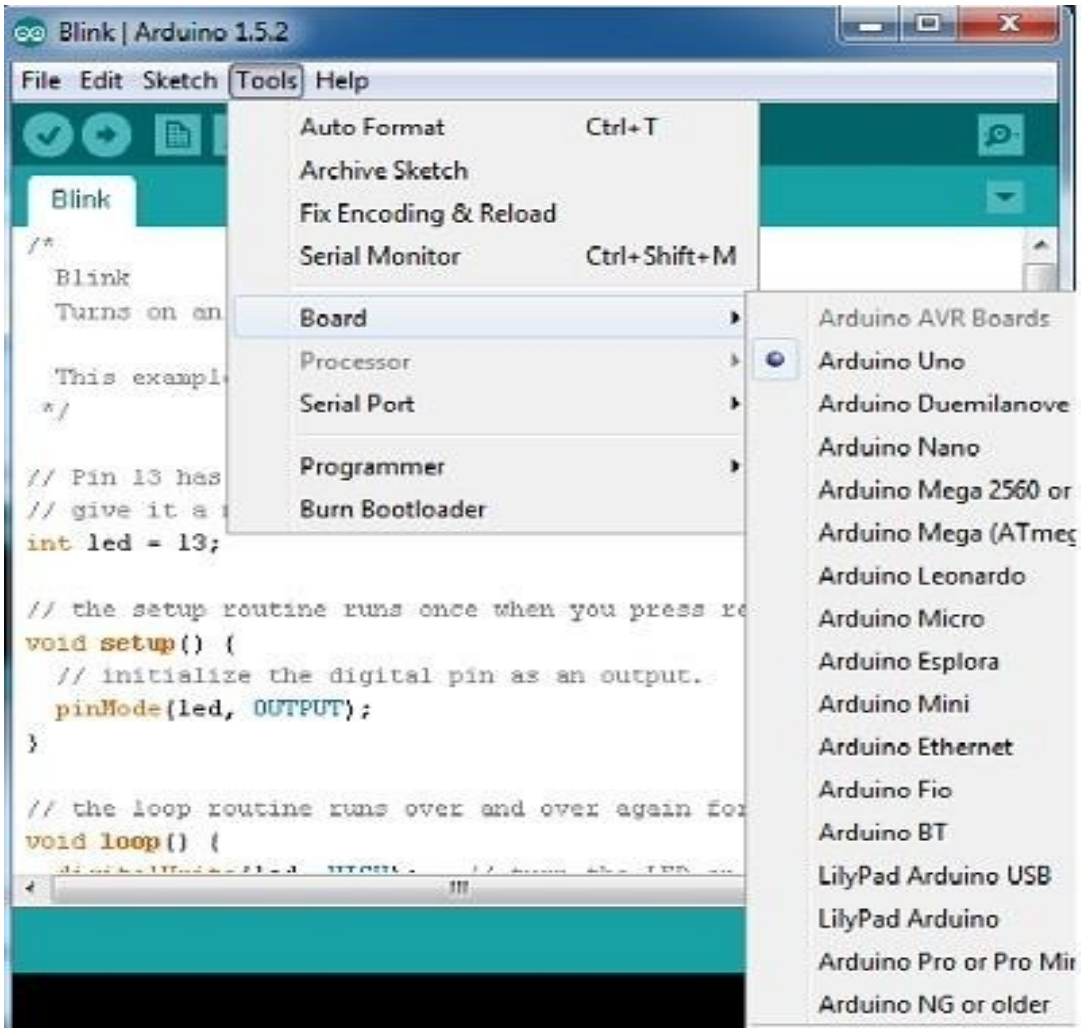
Launch and Blink-

After following the appropriate steps for your software install, we are now ready to test your first program with your Arduino board!

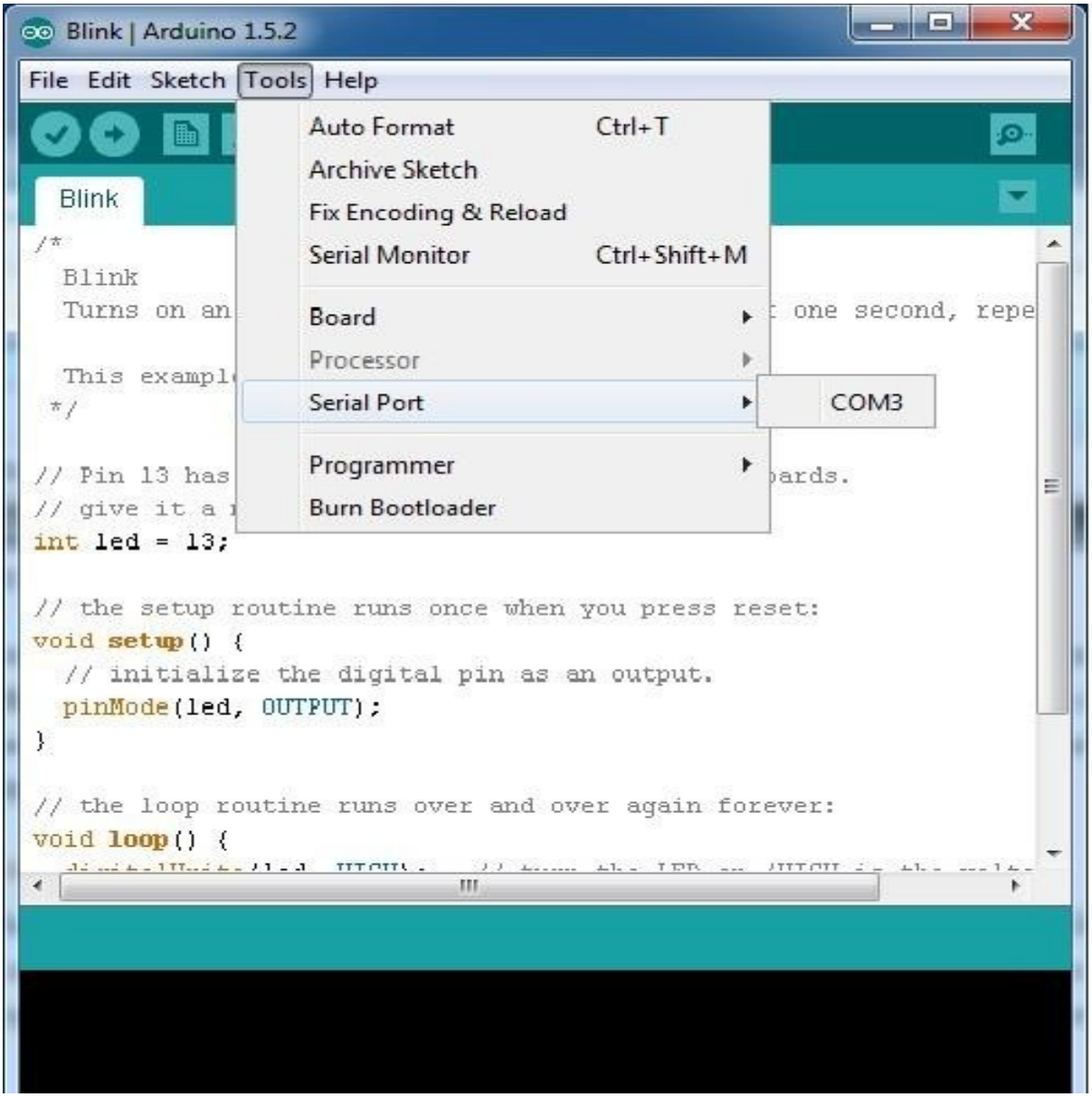
- Launch the Arduino application
- If you disconnected your board, plug it back in
- Open the Blink example sketch by going to: File > Examples > 1.Basics > Blink



- Select the type of Arduino board you're using: Tools > Board > your board type

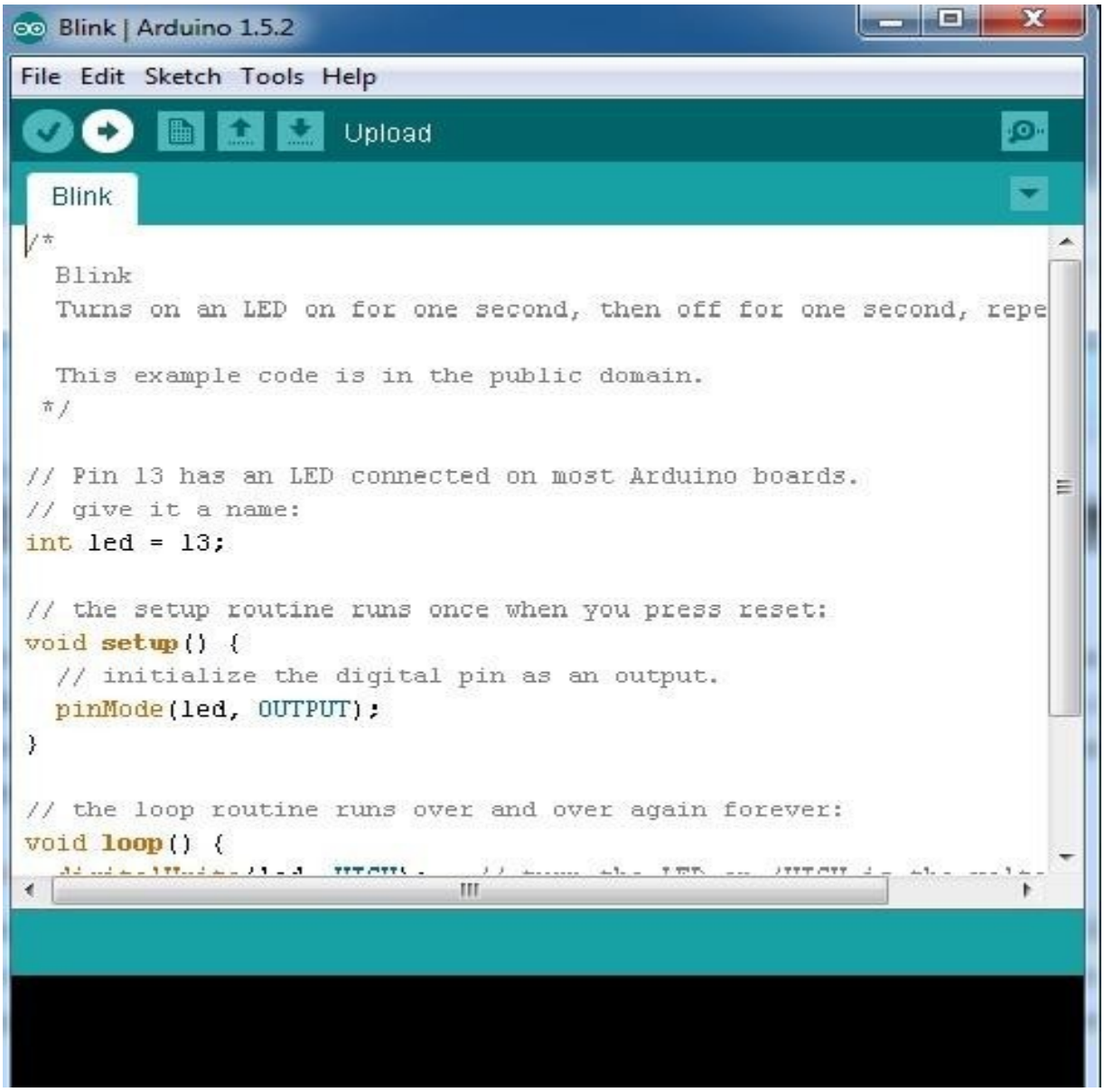


- Select the serial/COM port that your Arduino is attached to: Tools > Port > COMxx



- If you're not sure which serial device is your Arduino, take a look at the available ports, then unplug your Arduino and look again. The one that disappeared is your Arduino.

- With your Arduino board connected, and the Blink sketch open, press the 'Upload' button



- After a second, you should see some LEDs flashing on your Arduino, followed by the message ‘Done Uploading’ in the status bar of the Blink sketch.
- If everything worked, the on-board LED on your Arduino should now be blinking! You just programmed your first Arduino!

CHAPTER 7. EXPERIMENTS OF ARDUINO UNO

EXPERIMENT No 1.

LCD DISPLAY

AIM: To study the interfacing of LCD (16*2) with the Arduino Uno.

REQUIREMENTS: Arduino, 8 pin connector, 12V power supply or USB cable.

PROCEDURE:

1) Open the Arduino IDE. Connect USB cable to Arduino Uno.
2) Select Arduino Uno and COM port from **TOOL** section.
3) Now go to file ⟶ open particular "**.ino**" file of LCD program.
4) Compile the program and then upload it.
5) After uploading connect 8 pin connector from the board to "LCD" section.
6) You will observe that it displays "**LOGSUN SYSTEMS**" on LCD display.

THEORY:

Liquid crystal display:

LCD can be connected to the Raspberry pi through the GPIO pins. LCD is connected in the 4-bit mode. And the standard subroutine is given with the development board. So that the application can be easily demonstrated and also for further implementation the subroutine can be easily embedded for which one has to do very few changes. Wide range of instruction functions: Clear displays, cursor home, display ON/OFF, cursor ON/OFF, cursor shift, display shift.

EXPERIMENT No

2. I2C LCD

DISPLAY

AIM: To study the interfacing of I2C LCD (16*2) with the Arduino Uno.

REQUIREMENTS: Arduino, 4 pin connector, 12V power supply or USB cable.

PROCEDURE:

1) Open the Arduino IDE. Connect USB cable to Arduino Uno.
2) Select Arduino Uno and COM port from **TOOL** section.
3) Now go to file ⟶ open particular "**.ino**" file of lcd_i2c program.
4) Compile the program and then upload it.
5) After uploading, connect 4 pin connector from the board to "LCD" section.
6) You will observe that it displays "**LOGSUN SYSTEMS, I2C DEMO**" on LCD display.

EXPERIMENT No 3.

LCD WITH KEYPAD INTERFACING

AIM: To study the interfacing of LCD and Keypad with Arduino.

REQUIREMENTS: Arduino, two 8 pin connectors, 12V power supply or USB cable.

PROCEDURE:

1) Open the Arduino IDE. Connect USB cable to Arduino Uno.
2) Select Arduino Uno and COM port from **TOOL** section.
3) Now go to file → open particular "**.ino**" file of LCD Keypad program.
4) Compile the program and then upload it.
5) After uploading connect 8 pin connector from the board to "LCD-KEYPAD" section.
6) You will observe that when you press a key (0-F) it will show on LCD display.

EXPERIMENT NO 4.

INTERFACING STEPPER MOTOR WITH ARDUINO

AIM: To study the interfacing of stepper motor to Arduino.

REQUIREMENTS: Arduino, 8 pin connector, 12V power supply or USB cable, Stepper motor, 12v dc external power supply.

PROCEDURE:

1) Open the Arduino IDE. Connect USB cable to Arduino Uno.
2) Select Arduino Uno and COM port from **TOOL** section.
3) Now go to file ⟶ open particular "**.ino**" file of Stepper motor program.
4) Compile the program and then upload it.
5) After uploading connect 8 pin connector from the board to "STEPPER MOTOR" section.
6) You will observe that the motor will starts automatically and after some time it slows down and again its speed increases.

EXPERIMENT NO 5.

INTERFACING SERVO MOTOR WITH ARDUINO

AIM: To study the interfacing of stepper motor to Arduino.

REQUIREMENTS: Arduino, 4 pin connector, 12V power supply or USB cable, Servo motor.

PROCEDURE:

1) Open the Arduino IDE. Connect USB cable to Arduino Uno.
2) Select Arduino Uno and COM port from **TOOL** section.
3) Now go to file ⟶ open particular "**.ino**" file of Servo motor program.
4) Compile the program and then upload it.
5) After uploading connect 4 pin connector from the board to "SERVO-MOTOR" section.
6) You will observe that the motor will rotate in 0-90-180-360 degrees.

EXPERIMENT NO 6.

INTERFACING RELAY-BUZZER WITH ARDUINO

AIM: To study interfacing of relay with Arduino

REQUIREMENTS: - Arduino, 4 pin connector, 12V power supply or USB cable.

PROCEDURE:

1) Open the Arduino IDE. Connect USB cable to Arduino Uno.

2) Select Arduino Uno and COM port from **TOOL** section.

3) Now go to file ⟶ open particular "**.ino**" file of relay program.

4) Compile the program and then upload it.

5) After uploading connect 4 pin connector from AJ10 to the board to "RELAY-BUZZER" section.

6) You will observe that relay is ON for 5sec and OFF for 5 sec and buzzer will also ON at a time.

EXPERIMENT NO 7.

INTERFACING ULTRASONIC SENSOR WITH ARDUINO

AIM: To study interfacing ultrasonic sensor with Arduino

REQUIREMENTS: - Arduino, 4 and 8 pin connector, 12V power supply or USB cable.

PROCEDURE:

1) Open the Arduino IDE. Connect USB cable to Arduino Uno.

2) Select Arduino Uno and COM port from **TOOL** section.

3) Now go to file → open particular "**.ino**" file of relay program.

4) Compile the program and then upload it.

5) After uploading connect 4 pin connector from the board to "ULTRASONIC" section and 8 pin connector to "LCD" section.

6) When we run the program, ultrasonic sensor will show the distance of obstacle came in front of it and this distance displays on LCD.

EXPERIMENT NO 8.

INTERFACING RGB WITH ARDUINO

AIM: To study interfacing of RGB with Arduino

REQUIREMENTS:- Arduino, 5 pin connector, 12V power supply or USB cable.

PROCEDURE:

1) Open the Arduino IDE. Connect USB cable to Arduino Uno.
2) Select Arduino Uno and COM port from **TOOL** section.
3) Now go to file ⟶open particular "**.ino**" file of relay program.
4) Compile the program and then upload it.
5) After uploading connect 4 pin connector from the board to "RGB" section.
6) You will observe that LED will emit red, green and blue colors.

EXPERIMENT NO 9.

INTERFACING DHT22 WITH ARDUINO

AIM: To study interfacing of DHT22 with Arduino

REQUIREMENTS:- Arduino, 4 pin connector, 12V power supply or USB cable.

PROCEDURE:

1) Open the Arduino IDE. Connect USB cable to Arduino Uno.
2) Select Arduino Uno and COM port from **TOOL** section.
3) Now go to file ⟶ open particular "**.ino**" file of relay program.
4) Compile the program and then upload it.
5) After uploading connect 4 pin connector from the board to "DHT22" section.
6) You can observe that DHT22 sensor will show the temperature and humidity on LCD display.

EXPERIMENT NO 10.

INTERFACING PIR SENSOR WITH ARDUINO

AIM: To study interfacing of PIR with Arduino

REQUIREMENTS:- Arduino, 4 pin connector, 12V power supply or USB cable.

PROCEDURE:

1) Open the Arduino IDE. Connect USB cable to Arduino Uno.
2) Select Arduino Uno and COM port from **TOOL** section.
3) Now go to file ⟶ open particular "**.ino**" file of relay program.
4) Compile the program and then upload it.
5) After uploading connect 4 pin connector from the board to "PIR" section.
6) You can observe that PIR sensor detects motion in its field and it shows on terminal window whether the motion is detected or not.

EXPERIMENT NO 11.

INTERFACING JOYSTICK WITH ARDUINO

AIM: To study interfacing of Joystick with Arduino

REQUIREMENTS:- Arduino, 5 pin connector, 12V power supply or USB cable.

PROCEDURE:

1) Open the Arduino IDE. Connect USB cable to Arduino Uno.
2) Select Arduino Uno and COM port from **TOOL** section.
3) Now go to file ⟶ open particular "**.ino**" file of relay program.
4) Compile the program and then upload it.
5) After uploading connect 5 pin connector from the board to "JOYSTICK" section.
6) It will show the output voltages as direction in which you move the joystick. You can see the output on terminal window.

EXPERIMENT NO 12.

INTERFACING OF BLUETOOTH WITH ARDUINO

AIM: To study interfacing of Bluetooth with Arduino

REQUIREMENTS:- Arduino, 4 pin connector, 12V power supply or USB cable.

PROCEDURE:

1) Open the Arduino IDE. Connect USB cable to Arduino Uno.
2) Select Arduino Uno and COM port from **TOOL** section.
3) Now go to file ⟶ open particular "**.ino**" file of relay program.
4) Compile the program and then upload it.
5) After uploading connect 4 pin connector from the board to "BLUETOOTH" section.
6) Download any Bluetooth Application (E.g. Blue Chat) in your mobile device. Bluetooth sensor on board will connect to your mobile phone's Bluetooth and when you send any message from mobile using that application, you will get that message on your terminal window.

EXPERIMENT NO 13.

INTERFACING OF WI-FI WITH ARDUINO

AIM: To study interfacing of WI-FI with Arduino

REQUIREMENTS:- Arduino, 4 pin connector, 12V power supply or USB cable.

PROCEDURE:

a. Open the Arduino IDE. Connect USB cable to Arduino Uno.

b. Select Arduino Uno and COM port from **TOOL** section.

c. Now go to file ⟶ open particular "**.ino**" file of relay program.

d. Compile the program and then upload it.

e. After uploading connect 4 pin connector from the board to "WI-FI" section.

f. Go to terminal window and write AT on it, you will get the reply as AT OK for startup, AT+RST for restart module, AT+GMR for version information. This means Wi-Fi is connected successfully.

CHAPTER 8. PIN CONNECTOR DETAILS

I. 8 PIN CONNECTOR FOR KEYPAD(AJ1)

Pin No.	Description
1	IO_0
2	IO_1
3	IO_2
4	IO_3
5	IO_4
6	IO_5
7	IO_6
8	IO_7

II. 8 PIN CONNECTOR FOR LCD(AJ2)

Pin No.	Description
1	5/3V
2	IO_13
3	IO_12
4	IO_11
5	IO_10
6	IO_9
7	IO_8
8	GND

III. 8 PIN CONNECTOR FOR STEPPER(AJ3)

Pin No.	Description
1	5/3V
2	IO_13
3	IO_12
4	IO_11
5	IO_10
6	IO_9

7	IO_8
8	GND

IV.6 PIN CONNECTOR FOR RGB(AJ4)

Pin No.	Description
1	AD_4
2	AD_3
3	AD_2
4	AD_1
5	AD_0
6	GND

V. 5 PIN CONNECTOR FOR JOYSTICK(AJ5) to J6

Pin No.	Description
1	5/3V
2	AD_0
3	AD_1
4	IO_2
5	GND

VI.4 PIN CONNECTOR FOR LCD_I2C(AJ12)

Pin No.	Description
1	5/3V
2	AD_4
3	AD_5
4	GND

VII. 4 PIN CONNECTOR FOR SERVO(AJ6)

Pin No.	Description
1	5/3V
2	AD_3
3	AD_2
4	GND

VIII. 4 PIN CONNECTOR FOR RELAY_BUZZER(AJ9)

Pin No.	Description
1	5/3V
2	IO_6
3	IO_7
4	GND

IX.4 PIN CONNECTOR FOR DHT22(AJ10)

Pin No.	Description
1	5/3V
2	IO_6
3	IO_7
4	GND

X. 4 PIN CONNECTOR FOR BLUETOOTH(AJ10)

Pin No.	Description
1	5/3V
2	IO_6
3	IO_7
4	GND

XI.4 PIN CONNECTOR FOR WI-FI (AJ10)

Pin No.	Description
1	5/3V
2	IO_6
3	IO_7
4	GND

XII. 4 PIN CONNECTOR FOR ULTRASONIC(AJ11)

Pin No.	Description
1	5/3V
2	IO_6
3	IO_7
4	GND

XIII. 4 PIN CONNECTOR FOR PIR(AJ10)

XIV. Pin No.	Description
1	5/3V
2	IO_6
3	IO_7
4	GND