Electronics 101 Series

Introduction to Raspberry Pi

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The **Raspberry Pi** is a low cost, credit-card sized single board computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. Apart from this, Raspberry Pi has 40 GPIO pins which enable hardware enthusiasts to use the board to its fullest.

Versions of Pi:

- Raspberry Pi 1 model B
- Raspberry Pi 1 model A
- Raspberry Pi 1 model B+
- Raspberry Pi 1 model A+
- Raspberry Pi Zero
- Raspberry Pi 2
- Raspberry Pi 3 model B
- Raspberry Pi Zero W
- Raspberry Pi Compute Module (2/3)

Alternatives to Raspberry Pi:

- Intel Edison
- CloudBit
- Banana-Pi
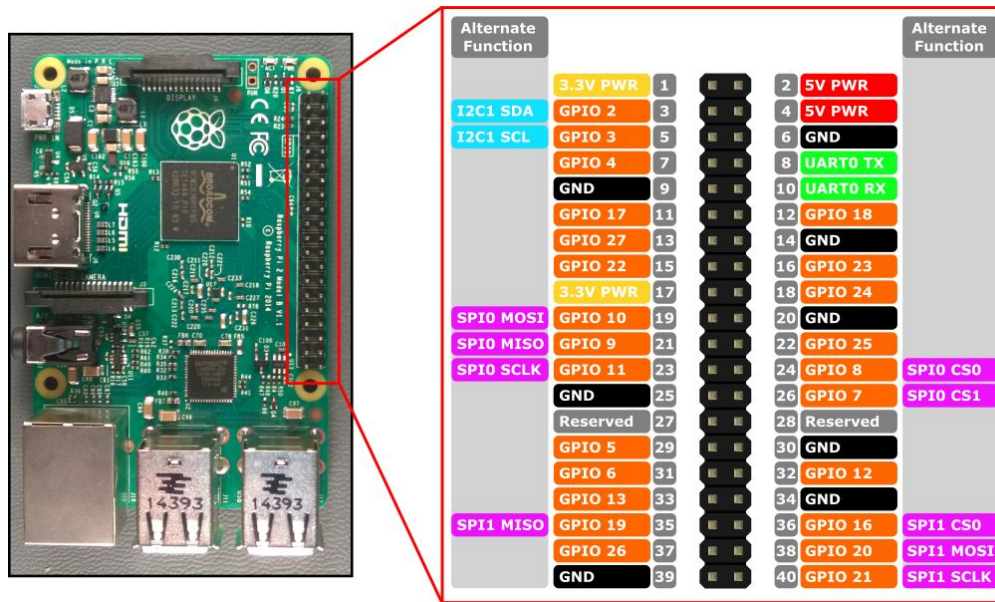- Orange-Pi
- Nano PC-T3
- BeagleBone
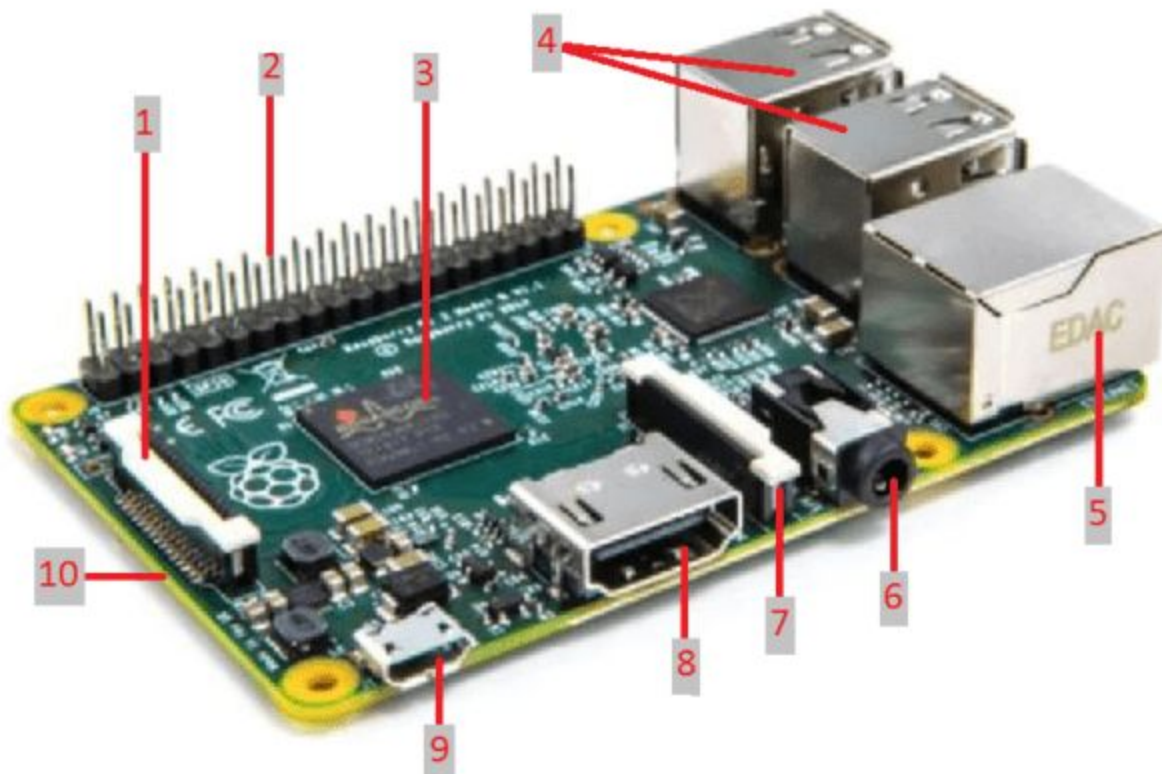
Anatomy of Raspberry Pi:

1. DSI:
   The Display Interface (DSI) is used to connect the display directly to the Raspberry Pi board.

2. GPIO Pins:
   These are 40 GPIO (General Purpose Input Output) pins, these pins can be directly accessed on Raspberry Pi. These are used in the projects to connect Raspberry Pi to the electronic circuits, sensors and control them. These pins can be turned on or off, based on the requirement when the Raspberry is running.

Alternate Function						Alternate Function
	3.3V PWR	1		2	5V PWR	
I2C1 SDA	GPIO 2	3		4	5V PWR	
I2C1 SCL	GPIO 3	5		6	GND	
	GPIO 4	7		8	UART0 TX	
	GND	9		10	UART0 RX	
	GPIO 17	11		12	GPIO 18	
	GPIO 27	13		14	GND	
	GPIO 22	15		16	GPIO 23	
	3.3V PWR	17		18	GPIO 24	
SPI0 MOSI	GPIO 10	19		20	GND	
SPI0 MISO	GPIO 9	21		22	GPIO 25	
SPI0 SCLK	GPIO 11	23		24	GPIO 8	SPI0 CS0
	GND	25		26	GPIO 7	SPI0 CS1
	Reserved	27		28	Reserved	
	GPIO 5	29		30	GND	
	GPIO 6	31		32	GPIO 12	
	GPIO 13	33		34	GND	
SPI1 MISO	GPIO 19	35		36	GPIO 16	SPI1 CS0
	GPIO 26	37		38	GPIO 20	SPI1 MOSI
	GND	39		40	GPIO 21	SPI1 SCLK

3. ARM Processor:

   It's the heart of the Raspberry Pi 3, the Broadcom BCM2837 1.2 GHz quad-core ARM Cortex-A53 CPU with 1GB RAM. It is also coupled with a 400MHz GPU.

4. USB Ports:

   The USB (Universal Serial Bus) ports are used to connect the standard accessories such as keyboard, mouse, Wifi adapter etc. It has 4 USB ports. (It is recommended to use a powered USB hub to power all the USB devices like keyboard and mouse etc. because powering (connecting) these devices directly to the Raspberry Pi would leave the Pi underpowered, leading to a shorter component life and even nonfunctioning Pi.)

5. Ethernet Connection:

      You can connect Pi to a network or home modem/ router, using an Ethernet cable.The Raspberry Pi has 10/100 MBPS Ethernet,Bluetooth 4.0.

6. 3.5 MM Audio / Video Jack:

      This 3.5 mm audio jack is normally used to attach the headphones or the speakers. Raspberry Pi also carries composite video, using a compatible cable.

7. CSI (Camera Serial Interface):

      This interface is used to attach Raspberry Pi 1 camera module directly to the motherboard via a CSI connection.

8. HDMI:

HDMI connection enables you to hook up Raspberry Pi to the most modern Monitors and digital Televisions. It carries both the video and audio. (Note, in case you have old monitors having VGA port, you would need HDMI to VGA port adapter to hook up your Raspberry Pi to the old monitor).

9. USB Power:

This port is used to power on Pi. You can use a 5V 2000mA Micro USB power supply and compatible cable to power up the Pi.

10. Mini SD Card Slot:

Raspberry Pi does not have secondary storage. You need to use mini SD cards to store the data and OS. These SD cards with OS need be inserted into SD card slot before powering up Pi.

Booting and Installing OS on to the Pi 3:

- https://www.raspberrypi.org/downloads/raspbian/
  Open the link and download Raspbian Stretch Desktop settle and extract it.

- Download Win32 Disk Manager
  https://sourceforge.net/projects/win32diskimager/files/

- Format the SD card
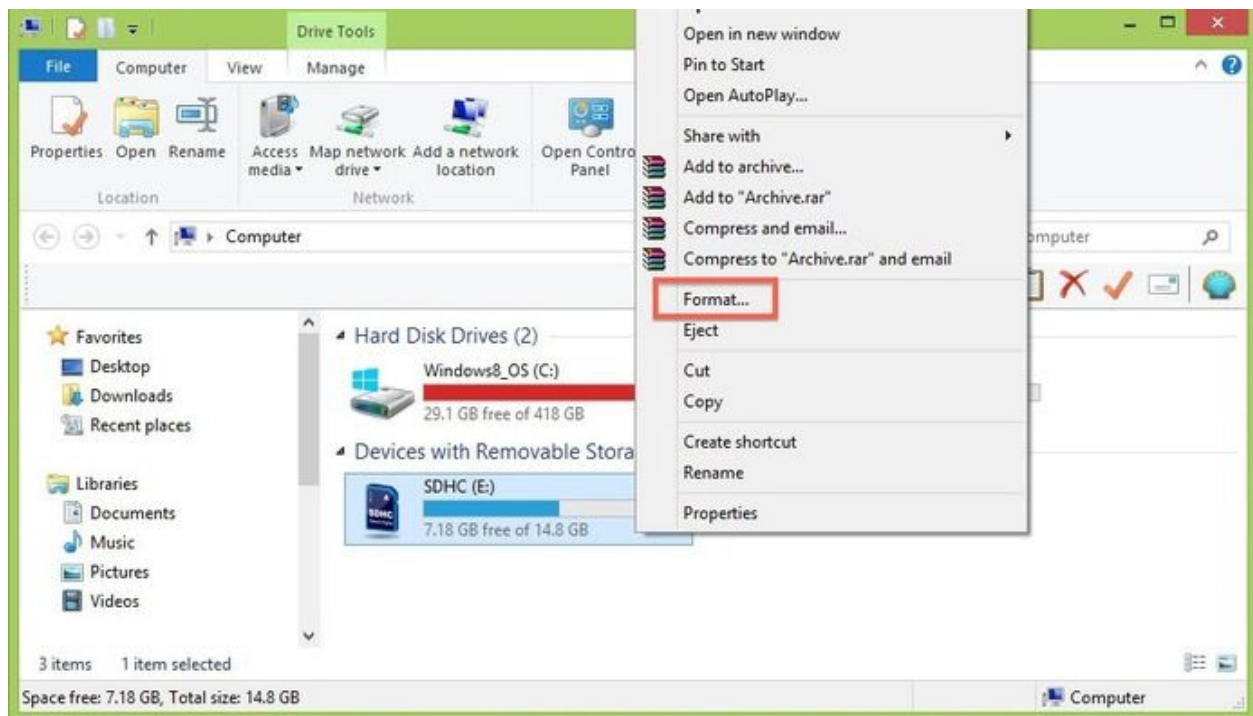
- Open WIN32 and select the SD drive and browse your disk image file from the extracted raspbian stretch image.
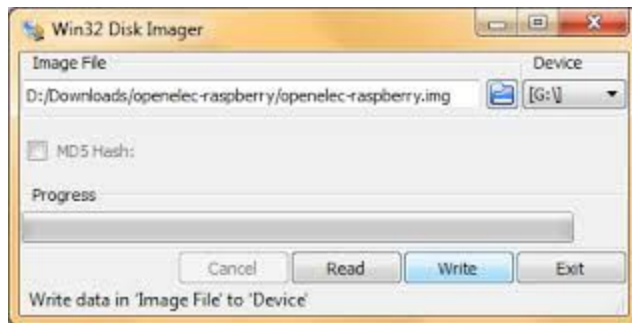
- Write the image file.

- Load the SD on to the RasPi 3

Once the above steps are done, it is time to power up the Pi. Connect the Pi to an external power adapter, a keyboard, a mouse and a display (Monitor). Once the power is given, the Pi will automatically switch on.

On the first boot, the Pi will reboot the file system so that all of the microsd card is made accessible to the user which was not the case in earlier software versions.

After the Pi successfully boots up, the following steps are to be done to ensure updation of the Pi to the latest software sources. This would take a while depending on internet connection.

- Open the Terminal

- Install the packages and upgrade them
  sudo apt-get update
  sudo apt-get upgrade

Now to ensure that python is correctly installed on the Pi, we will run the classic Hello World program on the Pi.
- Create a file by using the command
        sudo nano example.py

- Write the below code for printing hello world
        print "hello world";
        Press Ctrl+O and press Enter and Ctrl+X

- Run the file using command python example.py

- Hello World will be printed on to the Terminal

To test the Raspi 3 and it's GPIO pin, we will try a simple LED Blink Program.

LED Blink:
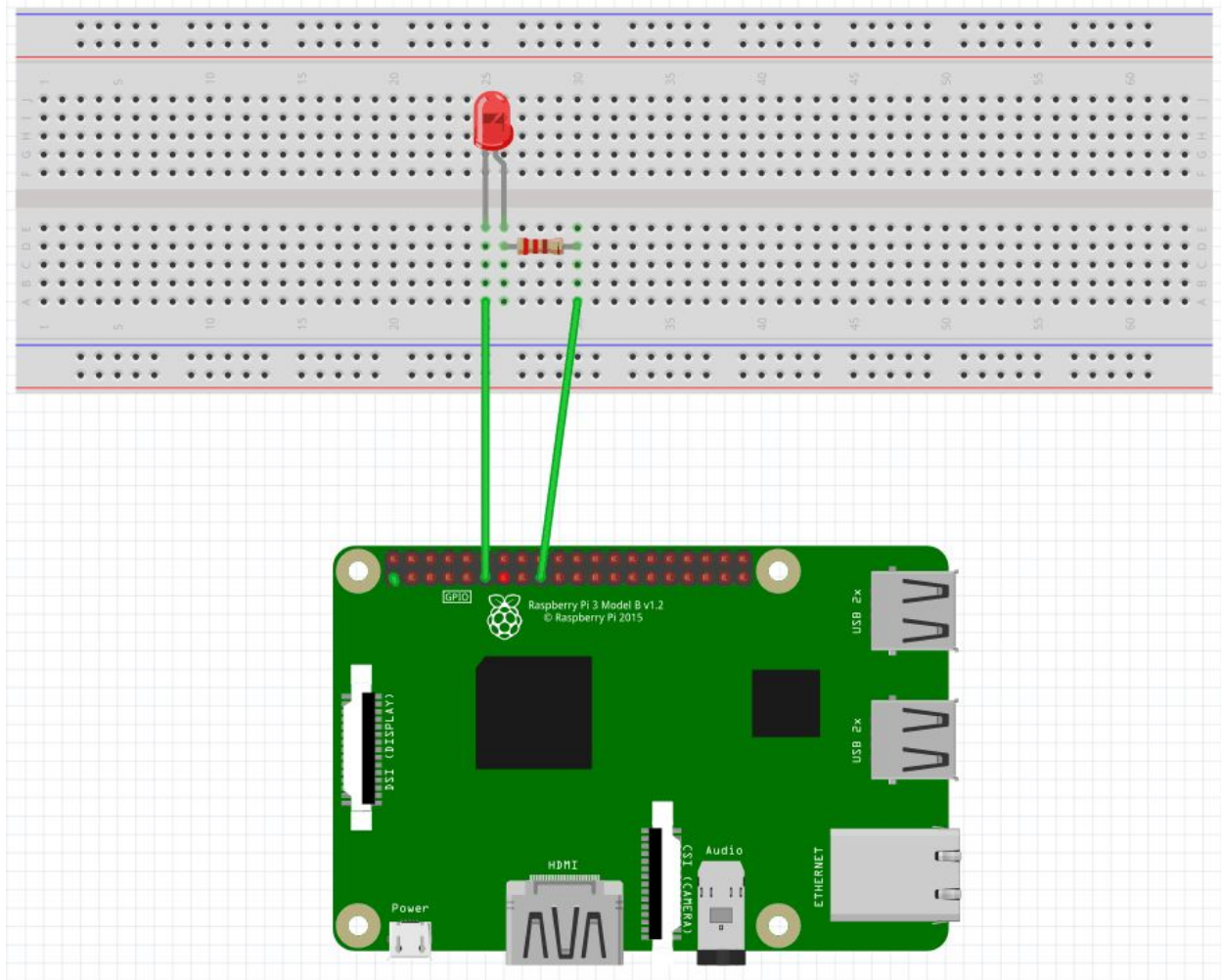
- For blinking the LED using python connect the anode of the LED to the gpio pin (11) of pi and cathode to the ground through a resistor as shown

- Copy and Paste the Blink program in the file created using command
  sudo nano example.py
  Python Program for LED blinking:

```
import time
import RPi.GPIO as GPIO        ## Import GPIO library
GPIO.setmode(GPIO.BOARD)       ## Use board pin numbering
GPIO.setup(11, GPIO.OUT)       ## Setup GPIO Pin 11 to OUT
while True:
```

```
GPIO.output(11,True)   ## Turn on Led
time.sleep(1)          ## Wait for one second
GPIO.output(11,False)  ## Turn off Led
time.sleep(1)          ## Wait for one second
```

THANK YOU