

# Raspberry Pi

Date of Submission: 12-12-2022

Date of Acceptance: 28-12-2022

## I. Introduction:

The name Raspberry Pi was chosen with “Raspberry” as an ode to tradition of naming early computer companies after fruit. Here, “Pi” is for Python Programming Language. Raspberry Pi, developed by Raspberry Pi Foundation in association with Broadcom, is a series of small single-board computers and perhaps the most inspiring computer available today. It is widely used to make gaming devices, fitness gadgets, weather stations, and much more. But apart from that, it is used by thousands of people of all ages who want to take their first step in computer science. It is one of the best-selling British computers and most of the boards are made in the Sony factory in Pencoed, Wales.

### Generations and Models :

In 2012, the company launched the Raspberry Pi and the current generations of regular Raspberry Pi boards are Zero, 1, 2, 3, and 4. Generation 1 Raspberry Pi had the following four options:

1. Model A
2. Model A +
3. Model B
4. Model B +

Among these models, the **Raspberry Pi B models** are the original credit-card sized format. On the other hand, the **Raspberry Pi A models** have a smaller and more compact footprint and hence, these models have the reduced connectivity options.

**Raspberry Pi Zero models**, which come with or without GPIO (general-purpose input output) headers installed, are the most compact of all the Raspberry Pi boards types.

### Requirements :

To use your Raspberry Pi board, you need to buy a few other bits and pieces. Following is the checklist of what else we might need:

#### 1. Monitor

The Raspberry Pi uses a high-definition multimedia interface (HDMI) connection for video feed, and you can connect your monitor directly with this interface connection, if your monitor has an HDMI socket.

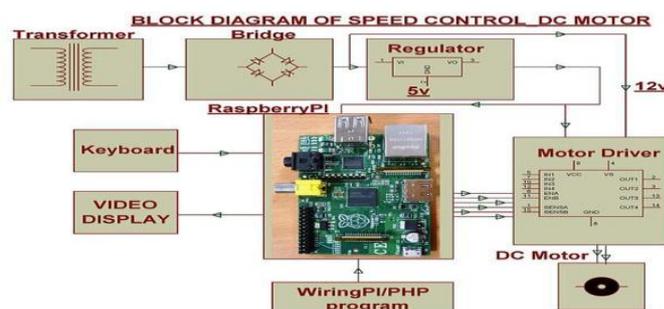
#### 2. Television

In the similar way, if you have High Definition Television (HD TV), you can also connect it to your Raspberry Pi using an HDMI socket. It will give you a crisper picture.

#### 3. USB hub

Depending on the model, Raspberry Pi has 1, 2, or 4 Universal Serial Bus (USB) sockets. You should consider using powered USB to connect other devices to your Raspberry Pi at the same time.

## BLOCK DIAGRAM



#### 4. Keyboard and Mouse

Raspberry Pi only supports the USB keyboards and mouse. If you are using keyboards and mouse with PS/2 connectors, you need to replace them with Raspberry Pi.

#### 5. SD or Micro SD card

As we know that the Raspberry Pi does not have a hard drive, so we need to use SD cards or Micro SD cards (depending on the model) for storage.

#### 6. USB Wi-Fi adapter

If you are going to use model A and A+ then, you need to buy a USB Wi-Fi adapter for connecting to the internet. This should be done because these Raspberry models do not have an Ethernet socket.

#### 7. External hard drive

If you want to share your collection of music and movies, you need to use an external hard drive with your Raspberry Pi model. You can connect the same by using a powered USB cable.

#### 8. Raspberry Pi Camera Module

The Raspberry Pi camera module originated at Raspberry Pi foundation. It is an 8MP (megapixel) fixed focus camera that can be used to shoot high-definition video and take still photos. For wildlife photography at night, it provides another version without an infrared filter.

#### 9. Speakers

The Raspberry Pi has a standard audio out socket. This socket is compatible with headphones and speakers that use a 3.5mm audio jack. We can plug headphones directly to it.

#### 10. Power supply

For power supply, it uses a Micro USB connector. Hence theoretically, it is compatible with a mobile phone and tablet charger.

#### 11. Cables

Following are some of the cables, which you need for the connections to the Raspberry Pi computer:

- HDMI cable
- HDMI-to-DVI adapter, if you are using a Digital Visual Interface (DVI) monitor. · RCA cable, if you want to connect to an older television.
- Audio cable
- Ethernet cable

#### NOOBS Software :

NOOBS means **new-out-of-box software** and it is the easiest way to get started with the Raspberry Pi. It is easy to copy NOOBS to your SD or Micro SD card. Once copied, it provides us with a simple menu for installing various operating systems. There is an option to buy a card with NOOBS already installed on it, but it is always useful to know how to create your own NOOBS cards.

#### Ports and Sockets :

You should make sure that you have to face your Raspberry Pi in the right way. Most components and sockets, with the help of which you connect it, are sticking out at the top side whereas the back side is relatively flat. The spiky GPIO (general-purpose input output) pins should be at the top left. Let us have a look at the diagrams below representing the location of connectors and main integrated circuits (ICs) on the Raspberry Pi boards.

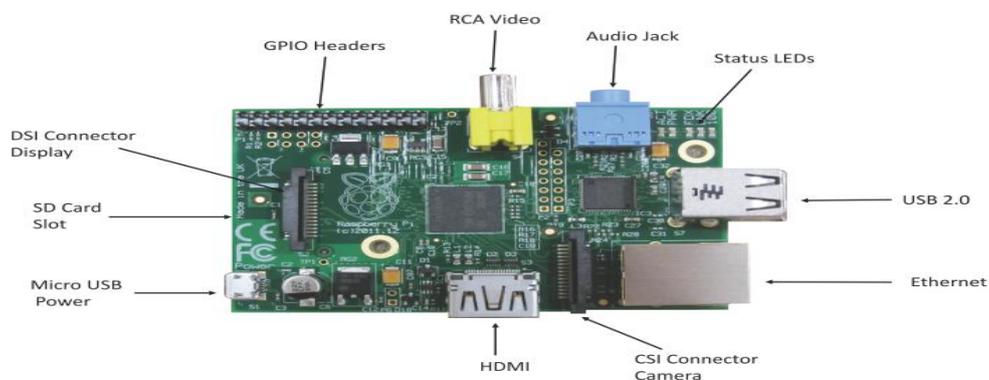


Diagram For **Raspberry Pi Model B**

#### Connect Raspberry Pi to Devices

The respective processes to connect your Raspberry Pi board to different devices is explained below in detail. Let us begin by understanding how to connect a display device to your Pi board.

**Display device :**

Depending on the screen type, you have two ways to connect the display device to your Pi board. In these two ways, we are assuming that you are going to use either monitor or television. Apart from these two ways, there is an official Pi touchscreen that connects using the display socket. Let us check how we can connect an HDMI display and television, as explained below.

**HDMI or DVI display :**

The HDMI connector is on the top surface of your Raspberry Pi board. But for the Raspberry Pi Zero model, you need to use an adapter that converts Mini HDMI to an HDMI socket. For connecting, insert one end of the HDMI cable in the board or Pi ZERO connector and the other end into your monitor. On the other hand, if you are using a DVI display, an adapter should be used.

**Television :**

If the TV you are using is having a HDMI socket, you can use that for optimal results. But if in case, your TV does not have an HDMI socket, you need to use the composite video socket. On the Raspberry Pi Model-A and Model-B, the composite video socket is placed on the top edge of the board. It is a round, yellow-and-silver sockets.

**Keyboard and Mouse :**

On Raspberry Pi Model B+, Model Pi 2, and Model Pi 3 the keyboard and mouse can be directly connected. They should work fine. But for earlier models of Raspberry Pi, you should use an external USB hub to connect keyboard and mouse. Because with this, the devices will not draw too much power from the Pi board, and we can reduce the risk of heat and other problems caused by devices.

**Audio devices :**

Raspberry Pi's audio socket is a small black or blue box. On Model A and Model B, it is stuck along the top edge of the board. Whereas, on Model B+, Pi 2 and Pi 3, it is stuck along the bottom edge of the board.

**Internet router :**

All the Raspberry Pi models other than Model A, A+, and Zero have an Ethernet socket. You can find the socket on the right edge of the Raspberry board. To connect to the internet, you can use a standard Ethernet cable in this socket. In case if you are using a router with DHCP (Dynamic Host Configuration Protocol) support, your Raspberry Pi will automatically connect to the internet. On the other hand, if you have a Wi-Fi adapter then, you can plug into a USB socket of Raspberry Pi and it will be ready to use whenever you turn on your board.

**Power :**

Once you are done with connecting all the necessary and required devices, it is time to connect your Raspberry Pi to power and turn it on. For this, you need to use the Micro USB power socket. To safeguard your board from damage, you need to provide a steady **5v of power**. Keep in mind that Raspberry Pi board has no on/off switch. It means, whenever you connect it with power, it will start working. If you want to turn it off, you just need to disconnect it. So, if you want to save your data, you should proceed with caution and should shut down the Raspberry Pi first.

**Turn on Raspberry Pi :**

Connect with the power and turn on your Raspberry Pi board. There will be a rainbow of colours on screen. Afterwards, it will start to run the NOOBS software on the Memory card. You will get a choice of OS to install. Raspbian, a version of a Linux distribution called Debian, is the distribution that is recommended by the Raspberry Pi foundation. It has been optimized for the Raspberry Pi board.

Most of the Raspberry Pi users start with Raspbian and it includes:

- Graphical Desktop software.
- Web browser.
- Development and programming tools like Scratch, Python etc.

It has two versions, one with the PIXEL desktop and other is termed as Raspbian Lite, with a more minimal installation.

**Windows 10 IOT Core :**

As the name implies, it is the version of Windows which is designed to support the IoT (Internet of things) devices. It is actually different from the windows desktop experience we are familiar with. Once installed, it will give us the following two versions:

**RTM version:** It is the release to manufacturing (RTM) version. It is recommended to use because it is a stable version as compared to the Pre-release version. · **Pre-release version:** Another is pre-release version, which is less stable as compared to RTM version.

**TLXOS :**

This is ThinLinX's thin client software. It is a trial version and enables the Raspberry Pi to work as a virtual desktop. By using ThinLinX, we can also manage one or more Raspberries centrally.

**Python 2 and Python 3 :**

Raspberry Pi provides us the Python programming language, which can be found under Programming in the Application menu. We can also use the **Thonny IDE** (integrated development environment) which provides the Pi users, an alternative way of creating Python programs.

**Python games :**

Raspberry Pi has games such as Reversi, Four in a Row, a sliding puzzle game as well as a snake game. These all are built in Python programming language and can be found in the Game section of the Application menu.

**Scratch :**

Raspberry Pi foundation provides us a simple programming language called Scratch, which is approachable for the peoples of all ages. You can use it to create games and animations. It can also be used to manage electronic projects. You can find it under the Programming section of the Application menu.

**Sense HAT emulator :**

As the name implies, it has some built-in sensors that can be used for creating experiments and other projects. It is an add-on for the Raspberry Pi users, which can be found under the Programming section of the Application menu.

**Shutdown :**

Shutdown, a top-level option in the Application menu, can be used for switching off your Raspberry Pi, before you remove the power. With this, we will also get the options to log out as well as restart your Pi computer.

**Sonic Pi :**

It is another programming language provided by Raspberry Pi foundation which is mainly used for creating music. You can also find it under the Programming section of the Application menu.

**Terminal :**

Terminal is a window that let us issue the instructions from a command line without leaving your PIXEL desktop environment. There are two ways through which you can reach the terminal window. One is to get it in the Accessories part of the Programs menu and other is to use the button on the taskbar.

**Wolfram :**

Wolfram is a programming language provided by Raspberry Pi foundation. It aims to incorporate knowledge, so that the programmers can get results quickly. You can get more information about this at [www.wolfram.com/language](http://www.wolfram.com/language). It is under the Programming section of the Application menu.

**Running programs :**

Even after installing, some of the programs won't appear on the Application menu. You can use the **Run option** to run those programs. Follow the below given steps:

**Step 1:** First, we need to open the Application menu. For this, click the icon at top left of the desktop.

**Step 2:** Now, we need to select the Run option from this menu.

**Step 3:** Run option will give you a dialog box. You can type the name of the program, which you want to open, and then press Enter.

**Connect GPIO to Raspberry Pi :**

Following are some simple rules to reduce the risk of damaging your Raspberry Pi board, while using the GPIO connector:

- Do not try to put more than 3.3V on any GPIO pin.
- Do not try to draw more than 3mA per output. Although, you can draw more but to increase the life of your Pi Board, you should restrict upto 3mA.
- You should not poke the GPIO connector with a screwdriver when the Raspberry Pi board is powered up.
- 5V power is enough for your Raspberry Pi. Don't try to provide more power than that.
- You should not try to draw more than a total of 50mA from the 3.3V supply pins.

**Output of GPIO pins :**

To set up the output of GPIO pins and to read the input values by using Python, you need to install **RPi.GPIO** python library.

**Install RPi.GPIO python library :**

To install RPi.GPIO python library, type the following commands on terminal window of your Raspberry Pi:

```
sudo apt-get install python-dev
sudo apt-get install python-rpi.gpio
```

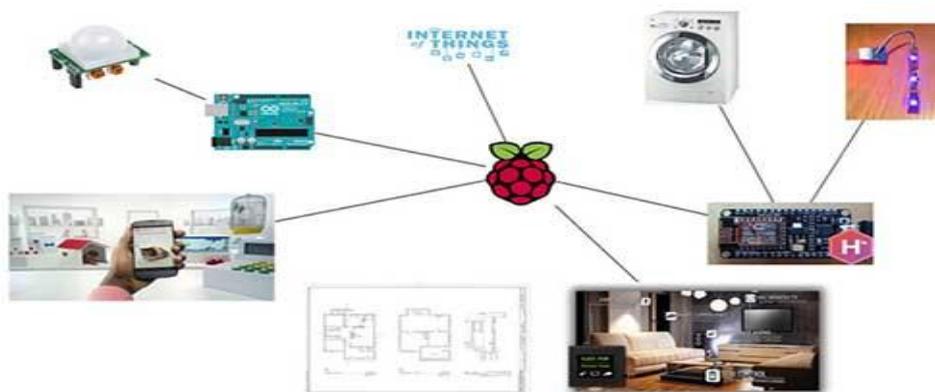
**Grisbi :**

Grispi is a free application with the help of which you can keep track of your regular and one-off payments. It is mainly used to manage your home accounts on your Raspberry Pi computer. The format in which most of the banks enable us to download bank statements, can be easily used in Grisbi. To install it or update it, you can search it on the ADD/REMOVE software menu. You can also use the following shell command to install/update it:

```
sudo apt-get install grisbi
```

**Applications of Raspberry Pi :**

**1 Home Automation System:** The Raspberry Pi system can easily host some of the most power packed home automation applications. It can be used to attach sensors, relays, cameras, and lights with computer or phone. You can easily control your home remotely. If you want to extend its functionalities, just add Arduino or some equally potent board and bingo!! .



**Fig. : Home Automation System Based On Raspberry Pi**

**2. AI Assistant:** ‘Magpi’, the official Raspberry Pi magazine, recently partnered with Google to release a hardware kit that allows users to integrate natural language voice commands through Google’s CCloud Speech API as well as Google Assistant SDK.

The kit includes many things includes cardboard case, button, microphone, and speaker. The cardboard case can house your person lo-fi Google Home version.



**Fig.: Raspberry Pi Based Google AI Assistant**

**3. Wireless Print Server:** The worst thing about technology is that it becomes obsolete in no time and gets replaced by new ones. Remember, how we all were in love with Windows 7, some of us are even very much loyal to it even after Windows 10 is in the game. What wouldn’t you give to keep some of your favorite techs alive, isn’t it? Raspberry can take care of some of such issues. If you have any old printer that you loved but it is non-functional now due to lack of wireless connectivity feature, Raspberry Pi can take care of that flaw now. You just need Raspberry Pi connected with your home network along with a few print server software.



**Fig.: Raspberry Pi Zero As Wireless Print Server**

**References :**

- [1]. Programming the Raspberry Pi, Second Edition: Getting Started with Python 2nd Edition
- [2]. DK Workbooks: Raspberry Pi Projects: An Introduction to the Raspberry Pi Computer Paperback –
- [3]. Raspberry Pi Cookbook: Software and Hardware Problems and Solutions 2nd Edition
- [4]. Learning Python with Raspberry Pi 1st Edition
- [5]. Coding: Raspberry Pi & Python: Step By Step Guide From Beginner To Advanced: Two Manuscripts In One

XXXXXXXXX, et. al. "Raspberry Pi." *IOSR Journal of Computer Engineering (IOSR-JCE)*, 24(6), 2022, pp. 33-38.