Raspberry Pi

Fundamentals of the Raspberry Pi:

The Raspberry Pi is not a single specific computer. Rather, it is a family of single board computers (SBC). Each SBC has different properties and capabilities.

The Raspberry Pi is a tiny computer about the size of a deck of cards. It uses what's called a system on a chip, which integrates the CPU and GPU in a single integrated circuit, with the RAM, USB ports, and other components soldered onto the board for an all-in-one package.

Generations:

There have been four generations of Raspberry Pi: Pi 1, Pi 2, and Pi 3, Pi4and there has generally been a Model A and a Model B of most generations. Model A is a cheaper variant and tends to have reduced RAM and ports like USB and Ethernet.

The first iteration of Raspberry Pi — the model 1 A — had a single-core ARM processor, 256MB RAM, 1 USB port, composite video out, HDMI output, and no networking capabilities. The latest model, the Raspberry Pi 3 model B, contains a quad-core processor, 1GB RAM, four USB ports, ethernet, in-built Wi-Fi, and a 40-pin header for controlling external circuits.

With so many different Pi computers available, it can be a daunting task to choose the best one for a project. If you are new to the Raspberry Pi, it's best to go for the most feature-filled version as it will allow you to do the largest variety of projects. The Raspberry Pi 3 Model B provides networking, a decent CPU, and plenty of GPIO. Projects that do not require networking but require display and GPIO work well with the cheaper Raspberry Pi 1 range while projects that only require a minimal system can use the Raspberry Pi Zero.

Why Raspberry Pi?

Microcontrollers are, in general, very good for controlling I/O and handling signals quickly. However, they often lack in CPU power, RAM, and software functionality. The Raspberry Pi is a single board computer that combines the power of a PC with the I/O strengths of a microcontroller.

While the Raspberry Pi is not as fast with I/O as a microcontroller nor as powerful as a mainstream PC, it provides a very capable platform, allowing users to create

complex computer programs that can easily interface with hardware using commonly used languages such as Python, Java, and C++.

Components:

Once your Raspberry Pi is chosen it's important to learn a few things about it, starting with a look at the different parts on the PCB and what each part does.
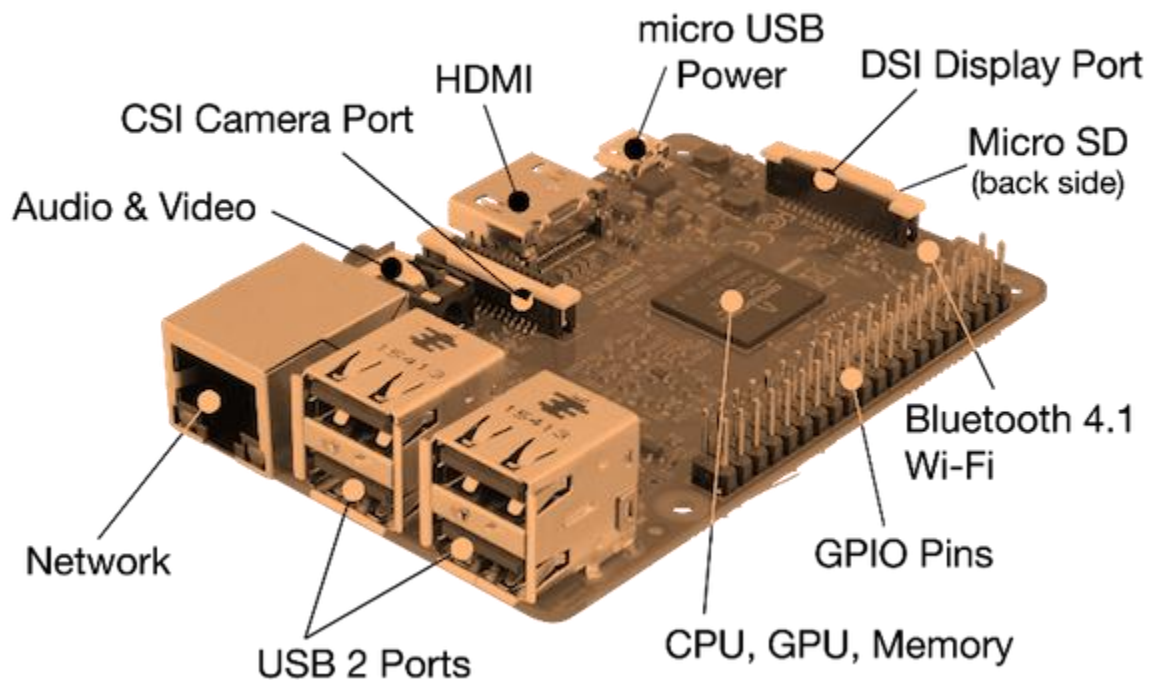
Parts of the Raspberry Pi

GPIO

GPIO is arguably the most important feature of the Raspberry Pi and is the equivalent of GPIO pins on the Arduino. These pins can be used in programs to read electrical signals from circuits as well as provide electrical signals for controlling circuits. Be very careful when using GPIO as they are easily damaged and use 3.3V logic. If you intend to control external devices that draw more than

20mA current, you should use a driver circuit (see 3.3 connecting I/O). This includes devices such as relays, inductors, and high brightness LEDs.

DSI Display Port

The DSI display port allows the Raspberry Pi to connect to a serial display similar to those used in tablets. Such display modules are available with touch controls and in common sizes such as 7 inches.

CSI Camera Port

The CSI camera port is a connector that allows the Raspberry Pi to connect to a Raspberry Pi camera module. Generic web cameras will not work as they commonly have only a USB connector.

MicroSD Slot

This slot is used to house the microSD card that holds the Raspberry Pi operating system. The microSD card does not come with the Pi. This SD card also holds all files, folders, documents, and pictures created by the user. It is essentially the hard drive of the computer.

HDMI / USB / Network

These slots are used to connect the Pi to an HDMI screen, USB devices such as mice and keyboards, and to an ethernet connection for internet access. However, the Raspberry Pi 3 comes with integrated Wi-Fi so there is often no need for the ethernet connector.

Micro USB Power

Power to the Raspberry Pi can be provided using either a micro USB lead to the micro USB connector (recommended) or 5V can be directly fed into the 5V GPIO pin.

The reason behind Raspberry Pi's immense success is that you can use it in unimaginable ways. From computing platforms to full-fledged arcade machines, Raspberry Pi can sit behind every electronic project that requires a computing brain.

Applications:

Here are some examples of Raspberry Pi Projects:

Desktop Computer:

Building a full-fledged desktop computer out of a Raspberry Pi should ring excitement bells in your ears. It is arguably one of the best raspberry pi projects for system enthusiasts as they will gain first-hand experience on how to build a system from almost ground zero. If you have a keen interest in raspberry pi projects involving computing, we recommend you check this project right now. I am giving you some highlights of this project

➢ Connect an HDMI monitor for being used as a display to your Pi.
➢ Add the necessary peripheral devices, namely keyboard, and mouse.
➢ Shift your board inside a solid metal case for safety.
➢ Install a cooler to take the heat off of your raspberry pi board.

Home Automation System:

A home automation project is arguably one of the best Raspberry Pi projects for senior developers. All those skills and experiences that you have been gaining all these years will come together to automate your home appliances. You can handle

such home automation raspberry pi projects in numerous ways. Adding an Arduino board may accelerate further power to the system.

- ➢ You need to set up a Relay Circuit for your Raspberry first.
- ➢ Use the GPIO pin no. 6 of your pi board for connecting the relay circuit.
- ➢ Make smart use of protocols like MQTT and APIs of thing speak for connecting a large number of devices and sensors.

Security:

consider building an HD camera surveillance system that captures live video whenever something moves in the monitored area. You can use Pi camera you used for the time lapse project or might opt-in for a more powerful one. This is one of the best raspberry pi projects

- ➢ You should be able to live stream from any web browser or mobile devices.
- ➢ The camera should be able to record motion into a video file on demand.
- ➢ The Raspberry Pi Camera Module for such Raspberry pi projects is recommended.
- ➢ Use this motion detection software to configure the motion capture functionality.
- ➢ For additional challenges, make your motion camera to send out a notification whenever it captures certain images or videos.

Minecraft:

It is one of the best Raspberry Pi projects for you if you are a fan of the online sandbox game. Minecraft, since its release, has become a household name and is one of the top gaming projects of Microsoft today. Raspberry comes with a dedicated Pi version of this fantastic game, which you can build your own Minecraft server raspberry pi projects. For this project, you'll only require a working Pi board and a fast LAN cable.

- ➤ Your system needs to be up to date before proceeding with Minecraft installation.

- ➤ The Java runtime and build tools are required to run the game on your Pi.

- ➤ Launch the server and connect to it from another computer on the home network to test your work.

Weather:

By building your weather station that collects and analyze atmospheric data, you will not only learn the fundamentals of Raspberry Pi but also increase your experience for later raspberry pi projects. You can choose from a vast number of physical sensors and complimentary Python libraries to control their functioning.

- ➤ Your choice of Pi board should have built-in wireless support, or you can also use a Wi-fi dongle.

- ➤ Among other essential hardware choices, we recommend the BME280 sensor for analyzing pressure, temperature, and humidity; a rain gauge, wind vane, and an anemometer.

- ➤ Oracle Raspberry Pi Weather Station software for leveraging powerful Python APIs can be utilized

- ➤ Apart from other general prototyping tools, you can also make use of a 3D printer for crafting.