

Arduino is an 8-bit microcontroller development board with a USB programming interface to connect to a computer and additional connection sockets to external electronics like sensors, motors, speakers, diodes etc. It has got both input and output pins, the input pins can be either be digital (0-13) or analogue (A0-A5), while the output pins are only digital (0-13) [2]. Arduino board design is open source and it also has an open source integrated development environment which has a cross-compiler, a debugger and a serial monitor to control the inputs and outputs. Arduino can either be powered through the USB connection from the computer, from a 9V battery, or from a power supply.

Raspberry Pi is a computer-based development board which runs on a Linux distribution referred to as Raspbian Linux. It can work and be connected like any computer to a mouse, keyboard, and screen perform computing functions. Raspberry Pi B+ board has 32-bit processor, four USB ports, HDMI port, Ethernet port, Audio port, CSI camera connector, and micro SD card slot. It also has 40 general-purpose input/output. Raspberry Pi comes in different models, Model 2 lacks an embedded Wi-Fi but a Wi-Fi adapter can be used via the USB port to get internet connectivity. New models of Raspberry Pi 3 have integrated Wi-Fi module in its board making it easier to configure internet connectivity.

Differences between Raspberry Pi and Arduino

Both Arduino and Raspberry Pi are good teaching tools for students, beginners and hobbyists. Let us see some of the differences between Raspberry Pi and Arduino.

- The main difference between them is: Arduino is microcontroller board, while Raspberry Pi is a microprocessor based mini computer (SBC).
- The Microcontroller on the Arduino board contains the CPU, RAM and ROM. All the additional hardware on Arduino Board is for power supply, programming and IO Connectivity. Raspberry Pi SBC has all features of a computer with a processor, memory, storage, graphics driver, connectors on the board.
- Raspberry Pi needs an Operating System to run. Arduino doesn't need any operating system. All you need is a binary of the compiled source code.
- Raspberry Pi comes with a fully functional operating system called Raspberry Pi OS (previously known as Raspbian OS). Although Pi can use different operating systems, Linux is preferred by Raspberry Pi Foundation. You can install Android, if you want. Arduino does not have any operating system. You just need a firmware instructing the Microcontroller what task to do.
- The clock speed of Arduino is 16 MHz while the clock speed of Raspberry Pi is around 1.2 GHz.
- Raspberry Pi is good for developing software applications using Python, while Arduino is good for interfacing Sensors and controlling LEDs and Motors.
- This doesn't mean we cannot connect sensors and LEDs to Raspberry Pi. To encourage learning programming by controlling hardware, the Raspberry Pi consists of a 40-pin GPIO, through which you can connect different electronic components like LEDs, Buttons, Sensors, Motors etc. On Arduino, the GPIO is called as Digital IO (for digital Input and Output) and Analog IN (for Analog Input).

- Using Arduino Shields, which plug into the Arduino Pin headers, you can add a dedicated feature or functionality like a Motor Driver, Ethernet Connection, SD Card Reader, Wi-Fi, Touchscreens, cameras etc. to Arduino. While Raspberry Pi is a self-contained board, you can add external hardware like Touchscreen, GPS, RGB panels etc. to Raspberry Pi. The Raspberry Pi Hardware Attached on Top or HAT Expansion Boards are inspired by Arduino Shields, using which you can add additional functionality to Raspberry Pi. They are connected to the GPIO Pins.
- The power requirements of Raspberry Pi and Arduino are completely different. Even though they both are powered by USB (micro-USB or USB Type C for Raspberry Pi and USB Type B for Arduino), Raspberry Pi needs more current than Arduino. So, you need a power adapter for Raspberry Pi but you can power Arduino from the USB port of a Computer.
- Power interruption for Raspberry Pi may cause damage to the hardware, software or applications. In case of Arduino, if there is any power cut it again restarts. So, Raspberry Pi must be properly shutdown before disconnecting power.
- Arduino uses Arduino IDE for developing the code. While Raspberry Pi can use Python IDLE, Eclipse IDE or any other IDE that is supported by Linux. You can also program using the terminal itself with any text editor like Vim.
- Using the open-source hardware and software files of Arduino, you can essentially create your own Arduino board. This is not possible with Raspberry Pi as it is not open-source.
- The cost of original Arduino UNO is \$23 but there are several clones of Arduino which are available for less than \$4. Coming to Raspberry Pi, the original Raspberry Pi SBC was around \$35, but the latest Raspberry Pi 4 Model B is available in different price points (\$35, \$55 or \$75) depending on the memory configuration.

Comparison of Raspberry Pi vs Arduino

Let us now see the comparison of Raspberry Pi vs Arduino in a tabular form.

Raspberry Pi	Arduino
Raspberry Pi is a Single Board Computer or SBC	Arduino is a Microcontroller based development board
It is based on Broadcom SoC, an ARM Cortex A Series Microprocessor	It is based on Atmel Microcontrollers. Arduino UNO uses ATmega328P Microcontroller
A Debian based Linux Distribution called Raspberry Pi OS is needed to boot the Raspberry Pi	As it is a Microcontroller, there is no need for an operating system
Raspberry Pi SBC can perform multiple tasks simultaneously due to its powerful processor and Linux based OS	Arduino is usually used for running a single task (or a very small no. of simple tasks) repeatedly, over and over again
All the necessary components like Processor, RAM, Storage, Connectors, GPIO Pins, etc. are situated on the Raspberry Pi Board itself	The Microcontroller on the Arduino Board (like ATmega328P) contains the Processor, RAM, ROM. The board contains supporting hardware (for power and data) and GPIO

	Pins
The cost of original Raspberry Pi SBC was \$35. Subsequently, all the base variants of newer Raspberry Pi versions are priced at \$35 only	The cost of original Arduino UNO is \$23
Both the hardware and firmware of Raspberry Pi are closed-source i.e., it is not available for general use	Arduino is developed as open-source hardware and software from the beginning. You can easily get complete information on Arduino's hardware and software
Raspberry Pi SBC has several GPIO Pins (the famous 40-pin Raspberry Pi GPIO), using which you can connect different sensors, IO Devices, etc.	GPIO is an important peripheral of any Microcontroller and Arduino UNO is no exception. In Arduino terminology, these pins are called Digital IO (to connect LEDs and Buttons) and Analog IN (to connect analog devices)
Using the 40-pin GPIO Pins, you can add additional features / functionalities to Raspberry Pi with HAT (Hardware Attached on Top) expansion boards	A similar way to add extra features and functionalities in Arduino is using Arduino Shields (which are also connected through the IO Pins)
As Raspberry Pi is essentially a computer, you have to properly shutdown after using it or before powering it down	As Arduino is a Microcontroller board, you can plug and unplug the power as you want
The main programming languages for developing application in Raspberry Pi are Python, Scratch, Ruby, C, C++	Arduino can be programmed using C or C++ Programming Languages
The logic level of Raspberry Pi's GPIO is 3.3V. So, be careful when connecting hardware to the GPIO Pins	Arduino's logic level is 5V. As most of the sensors and modules are designed for Arduino, there won't be any problem connecting them to Arduino. But double check every module and connection just to be on the safe side
Raspberry Pi must be powered using an USB Power Adapter as it requires 5V 2A or 5V 3A power	Arduino can be powered from a computer's USB Port (make sure the USB Port's current limit is not exceeded)
You can easily connect to internet using Wi-Fi or Ethernet	For Arduino, you need additional module or shields to connect to internet
Raspberry Pi has the hardware for Bluetooth board	There is no wireless connectivity in case of Arduino (at least on board)

Arduino and Raspberry Pi are the most popular boards among the students, hobbyists and professionals. Experienced and professionals know the utility and differences between the two. But beginners and students often get confused between them, like which board to use for their project or which board is easy to learn or why should they use Arduino over Pi and vice versa. So here I am covering mostly all the aspects which make them easy to take the decision over the choice of **Arduino vs. Raspberry Pi**.

Raspberry Pi is a fully functioned computer, a **system-on-chip (SoC)** device, which runs on a Linux operating system specially designed for it, named **Rasbian**. Rasbian is the official OS for Raspberry Pi, where other third party OSes like Firefox OS, **Android**, RISC OS, Ubuntu Mate etc. can be installed on Pi, even **Windows 10** version is also available for Pi. Like a computer, It has memory,

processor, USB ports, audio output, graphic driver for HDMI output and as it runs on Linux, most of the linux software applications can be installed on it. It has several models and revisions like Raspberry Pi, Raspberry Pi 2, Raspberry Pi Model B+ etc.

Arduino is a **microcontroller**, which is not as much powerful as Raspberry Pi, and can be considered as a one component on computer system. But it is a great hardware for electronics projects. It doesn't need any OS and software applications to run, we just need to write few lines of code to make it use. There are many Arduino boards like [Arduino UNO](#), Arduino PRO, Arduino MEGA, Arduino DUE etc.

Although they are quite different but there are some similarities in terms of their inception. They both are invented in European countries, like Raspberry Pi is developed by Eben Upton in UK and Arduino is developed by Massimo Banzi in Italy. Both the inventors are teachers and they develop these hardware platforms as a design learning tool for their students. Raspberry pi was first introduced in year 2012 while Arduino in 2005.

To understand the **difference between Arduino and Raspberry Pi**, we adopted an approach where we will discuss the merits and demerits of both the hardwares over each other. So first we are starting with:

Advantages of Arduino over Raspberry Pi:

Simplicity:

It's very **easy to interface analog sensors, motors** and other electronic components with Arduino, with just few lines of code. While in Raspberry pi, there is much overhead for simply reading those sensors, we need to install some libraries and softwares for interfacing these sensors and components. And the coding in Arduino is simpler, while one needs to have knowledge of Linux and its commands for using the Raspberry pi.

Robustness:

Raspberry Pi runs on a OS so it must be properly shut down before turning OFF the power, otherwise OS & applications may get corrupt and Pi can be damaged. While **Arduino is just a plug and play device** which can be turned ON and OFF at any point of time, without any risk of damage. It can start running the code again on resuming the power.

Power consumption:

Pi is a powerful hardware, it needs continuous 5v power supply and it is difficult to run it on Batteries, while **Arduino needs less power** can easily be powered using a battery pack.

Price:

Obviously **Arduino is cheaper** than Raspberry Pi, Arduino costs around \$10-20 depending on the version, while price of Raspberry is around \$35-40.

Advantages of Raspberry Pi over Arduino:

One can think that Arduino is the best, after reading its merits over Raspberry Pi, but wait, it's completely depends on your project that which platform should be used. Raspberry Pi's power and its easiness is the main attraction of it, over Arduino. Below we will discuss some of its advantages over Arduino:

Powerfulness:

This is the main advantage of Raspberry Pi. Pi is capable of doing **multiple tasks** at a time like a computer. If anyone wants to build a complex project like an advanced robot or the project where things need to be controlled from a web page over internet then Pi is the best choice. Pi can be converted into a webserver, VPN server, print server, database server etc. Arduino is good if you just want to blink a LED but if you have hundreds of LEDs needs to be controlled over web page, then Pi is the best suited.

Raspberry Pi is **40 times faster** than Arduino, with PI, you can send mails, listen music, play videos, run internet etc. Also as we have stated earlier that it has memory, processor, USB ports, Ethernet port etc. and it doesn't require external hardwares for most of the functions. It can be accessed **via SSH** and file can be easily transferred over **FTP**.

Networking:

Raspberry Pi has the **built in Ethernet port**, through which you can directly connect to the networks. Even Internet can easily be run on Pi using some USB Wi-Fi dongles. While in Arduino, it's very difficult to connect to network. External hardwares need to be connected and properly addressed using code, to run network using Arduino. External Boards called "**Shields**" needs to be plugged in, to make Arduino, as functional as Pi, with a proper coding to handle them.

Don't need deep electronics knowledge:

For Arduino you definitively need a electronic background, and need to know about embedded programming languages. But to start with Pi you don't need to dive into the coding languages and a small knowledge of electronics and its components is enough.

Besides those advantages, one advantage is that **OS can be easily switched** on the single Raspberry Pi board. Pi uses SD card as flash memory to install the OS, so just by swapping the memory card you can switch the operating system easily.

Example:

We can understand the need of Arduino or Pi through example. Like if you want answer any phone call automatically with a prerecorded message, then Arduino is the way. But at the same time if you want to block the robocallers or spam callers then? Then Raspberry Pi comes into picture, which can either filter the spam calls using spam callers database over the internet or it can also put a captcha type of verification for human callers.

So Arduino is suited for **repeated type of work** like open the door while anyone at the gate but Raspberry Pi can do more complex things like only open the door for authorized people. Raspberry Pi has huge potential in the world of [Internet of Things](#), where machines will directly interact and control another machines, without human intervention.

Conclusion:

Some people say that Arduino is best for beginners but I am not agree with it, a beginner can start with any one of them. Choice is just depend on your project and your background. I am concluding it with, how to make choice between these two, for your next project:

You should choose Arduino if:

- You are from electronics background or if you are a beginner and really want to learn about electronics and its components.
- Your project is simple, especially networking is not involved.
- Your project is more like a electronics project where software applications are not involved, like Burglar alarm, voice controlled light.
- You are not a computer geek who is not much interested in software and Linux.

You should choose Raspberry Pi If:

- Your project is complex and networking is involved.
- Your project is more like a software application, like a VPN server or Webserver.
- Don't have good knowledge of electronics.
- Have good knowledge about Linux and software.

Although they both have their own pros and cons, but they can also be used together to make the best out of them. Like Pi can collect the data over the network and take decisions, and command the Arduino to take the proper action like rotate a motor.