

# Preface

## About RexQualis

RexQualis Inc. is a professional manufacturer of electronic components products, involved in development, design, production and saleing. We are committed to helping customer quickly realize the creative idea and product prototypes, making it easy to get started for enthusiasts of programing and electronics and launching innovative open source products. Our services include:




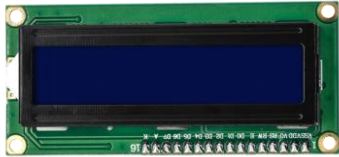





- Electronic components and modules
- Learning kit for Arduino
- Learning kit for Raspberry Pi
- Product customization service
- Robot kits









Official Website: [www.rexqualis.com](http://www.rexqualis.com)



## About the REXQualis Ultimate Starter Kit








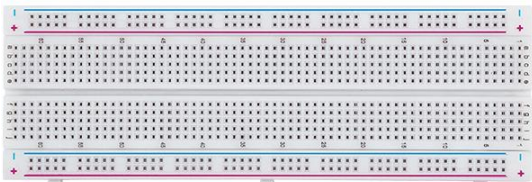



This REXQualis Ultimate Starter Kit Compatible with the Raspberry Pi 4 Model B, 3 Model A+, 3 Model B+, 3 Model B, 2 Model B, 1 Model B+, 1 Model A+, zero W and zero. It includes a large number of components, sensors and chips that can help to create various interesting phenomena. In this process, you can learn some basic knowledge about programming.

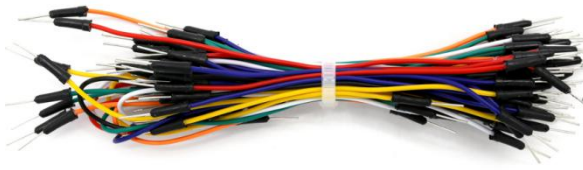






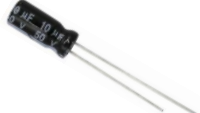




# Packing List







1		T Type GPIO Breakout board 1pcs
2		Power Supply Module 1pcs
3		RC522 RFID Module 1pcs
4		LCD1602 Module 1pcs
5		Real Time Clock Module 1pcs
6		Ultrasonic Sensor 1pcs
7		DHT11 Temperature and Humidity Module 1pcs
8		IR Receiver 1pcs
9		Sound Sensor Module 1pcs

10		Rotary Encoder Module 1pcs
11		PCF8591 Module 1pcs
12		Raindrops Module 1pcs
13		MQ-2 Gas Sensor Module 1pcs
14		MPU-6050 Module 1pcs
15		Joystick Module 1pcs
16		HC-SR501 PIR Sensor 1pcs
17		Stepper Motor 1pcs

18		ULN2003 Stepper Motor Driver Board 1pcs
19		Servo Motor (SG90) 1pcs
20		3-6V Motor 1pcs
21		Fan Blade 1pcs
22		Membrane Switch 1pcs
23		Remote 1pcs
24		CD with Tutorial 1pcs
25		4 Digit 7-Segment Display 1pcs

26		1 Digit 7-Segment Display 1pcs
27		LED Matirx 1pcs
28		LED Bar Graph 1pcs
29		Relay 1pcs
30		Active Buzzer 1pcs
31		Passive Buzzer 1pcs
32		Potentiometer 2pcs
33		Breadboard 1pcs
34		40 Pin Rainbow Cable 1pcs
35		20 Pin M-F Dupont Wire 1pcs
36		20 Pin F-F Dupont Wire 1pcs

37		Jumper Wires 65pcs
38		Battery Clip 1pcs
39		74HC595 2pcs
40		L293D 1pcs
41		Tilt Switch 1pcs
42		Photoresistor 2pcs
43		Button 5pcs
44		10UF 50V 5pcs
45		100UF 50V 5pcs
46		S8050 5pcs
47		S8550 5pcs
48		Thermistor 2pcs

49		22PF 5pcs
50		100NF 5pcs
51		1N4007 5pcs
52		RGB LED 2pcs
53		WHITE LED 5pcs YELLOW LED 5pcs BLUE LED 5pcs GREEN LED 5pcs RED LED 5pcs
54		10 ohm Resistor 10pcs 100 ohm Resistor 10pcs 220 ohm Resistor 30pcs 330 ohm Resistor 10pcs 1k ohm Resistor 10pcs 2k ohm Resistor 10pcs 5k1 ohm Resistor 10pcs 10k ohm Resistor 10pcs 100k ohm Resistor 10pcs 1M ohm Resistor 10pcs



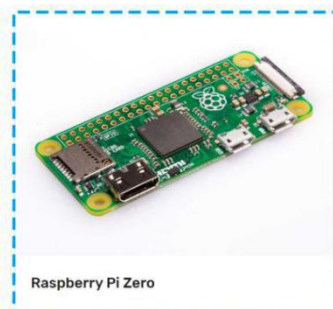
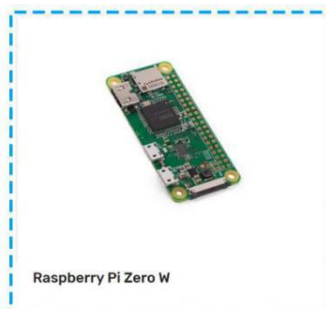
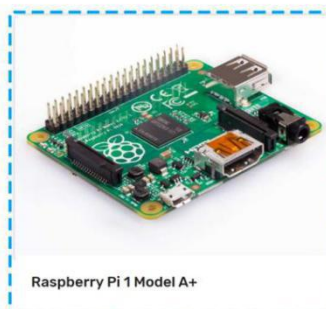
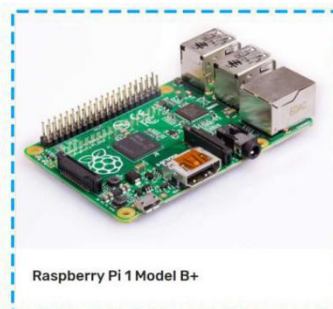
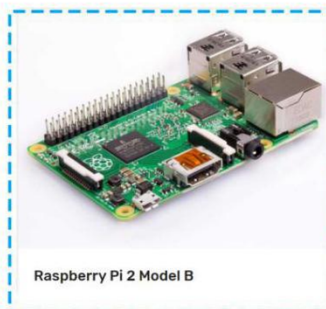
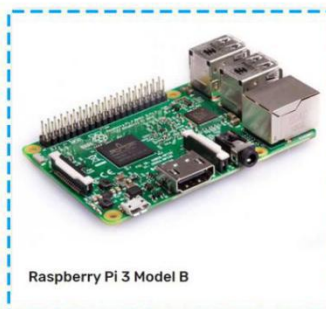
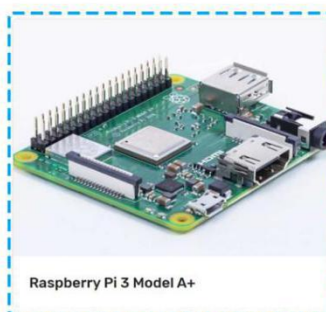
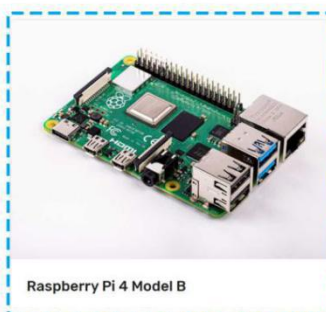
# What Do We Need?

## Required Components

### Raspberry Pi

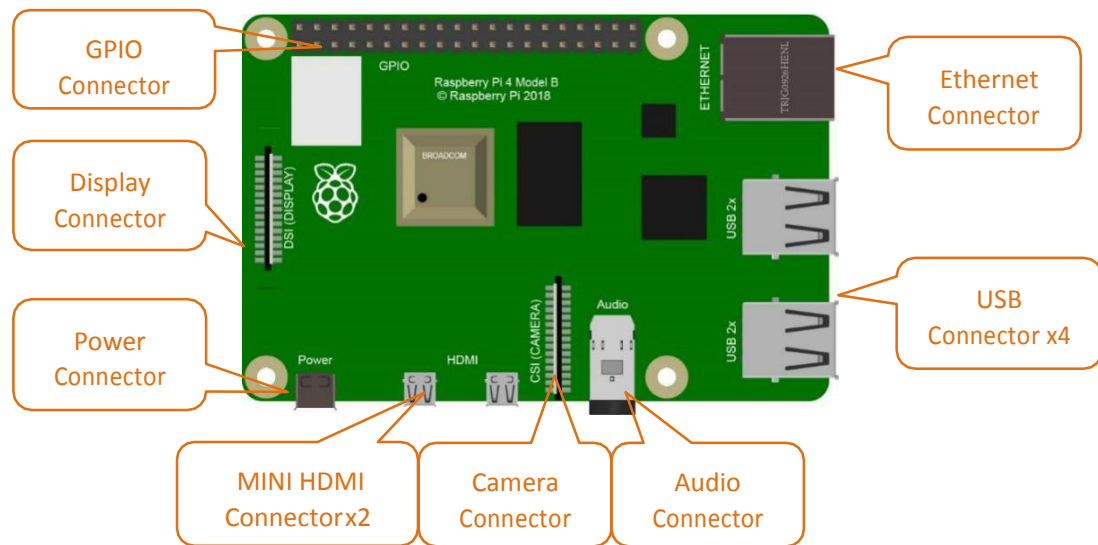
Raspberry Pi, a micro-computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is widely used in desktop workstation, media center, smart home, robots, and even the servers, etc. It can do almost anything, which continues to attract fans to explore it. Additionally, it is easy to operate just like Arduino, that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python.

Our kit applies to the following versions of the product of Raspberry Pi :

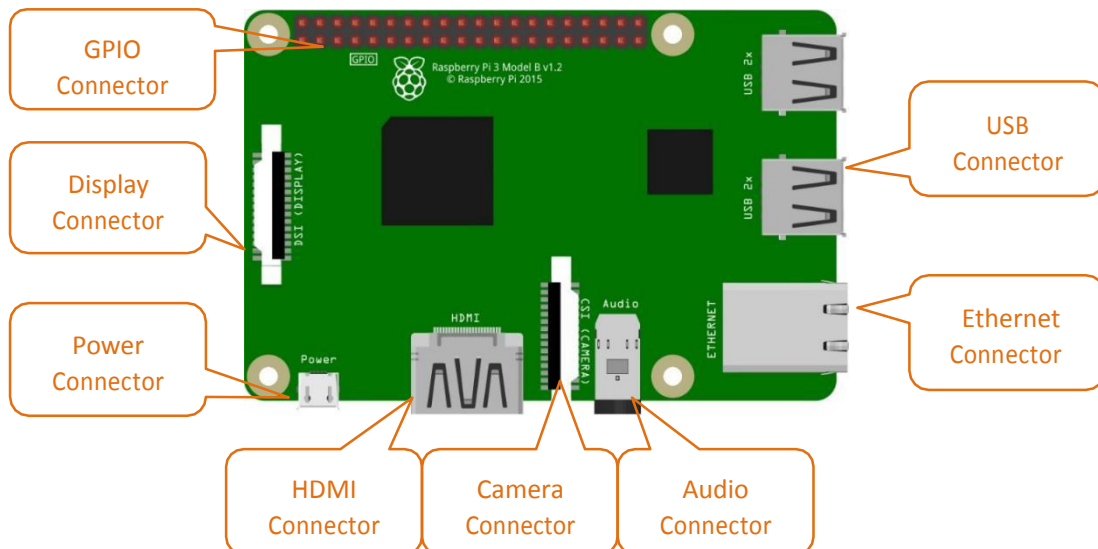




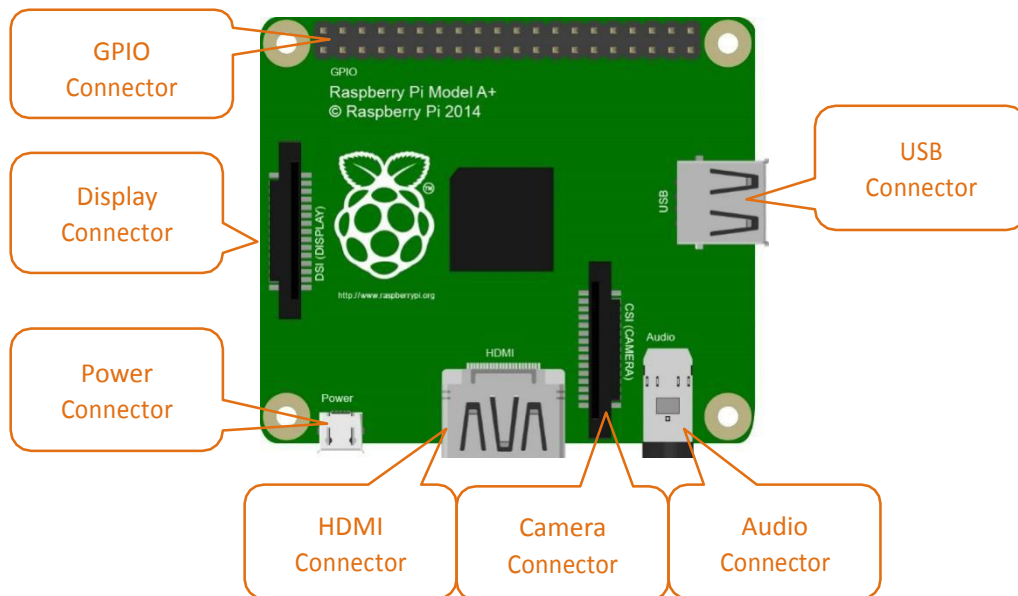
Hardware interface diagram of RPi 4B is shown below:



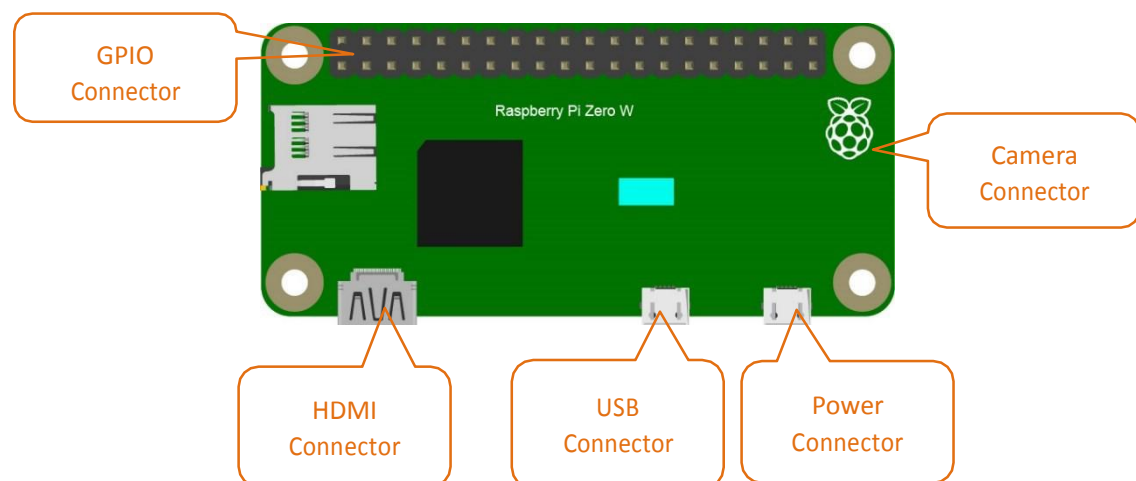
Hardware interface diagram of RPi 3B+/3B/2B/1B+ are shown below:



Hardware interface diagram of RPi 3A+/A+ is shown below:



Hardware interface diagram of RPi Zero/Zero W is shown below:



## Power Adapter

To connect to a power socket, the Raspberry Pi has a micro USB port (the same found on many mobile phones). Power requirement of different versions of Raspberry Pi is shown in following table:

Product	Recommended PSU current capacity	Maximum total USB peripheral current draw	Typical bare-board active current consumption
Raspberry Pi Model A	700mA	500mA	200mA

Raspberry Pi Model B	1.2A	500mA	500mA
Raspberry Pi Model A+	700mA	500mA	180mA
Raspberry Pi Model B+	1.8A	600mA/1.2A (switchable)	330mA
Raspberry Pi 2 Model B	1.8A	600mA/1.2A (switchable)	350mA
Raspberry Pi 3 Model B	2.5A	1.2A	400mA
Raspberry Pi 3 Model A+	2.5A	Limited by PSU, board, and connector ratings only.	350mA
Raspberry Pi 3 Model B+	2.5A	1.2A	500mA
Raspberry Pi 4 Model B	3.0A	1.2A	600mA
Raspberry Pi Zero W/WH	1.2A	Limited by PSU, board, and connector ratings only.	150mA
Raspberry Pi Zero	1.2A	Limited by PSU, board, and connector ratings only	100mA

The specific current requirements of each model are dependent on the use case: the PSU recommendations are based on typical maximum current consumption, the typical current consumption is for each board in a desktop computer configuration. The Raspberry Pi Model A, A+, and B can supply a maximum of 500mA to downstream USB peripherals. If

you wish to connect a high-power USB device, it is recommended that you connect a powered USB hub to the Raspberry Pi and connect your peripherals to the USB hub. The Raspberry Pi B+ and 2 Model B can supply 600mA/1.2A to downstream USB peripherals, switchable by a firmware setting. This allows the vast majority of USB devices to be connected directly to these models, assuming the upstream power supply has sufficient available current. Very high-current devices or devices which can draw a surge current such as certain modems and USB hard disks will still require an external powered USB hub. The power requirements of the Raspberry Pi increase as you make use of the various interfaces on the Raspberry Pi. The GPIO pins can draw 50mA safely (note that that means 50mA distributed across all the pins: an individual GPIO pin can only safely draw 16mA), the HDMI port uses 50mA, the Camera Module requires 250mA, and keyboards and mice can take as little as 100mA or as much as 1000mA! Check the power rating of the devices you plan to connect to the Raspberry Pi and purchase a power supply accordingly. If you're not sure, we would advise you to buy a powered hub.

This is the typical amount of power (in ampere) drawn by different Raspberry Pi models during standard processes:

		<b>Raspberr y Pi 1B+</b>	<b>Raspberr y Pi 2B</b>	<b>Raspberr y Pi 3B</b>	<b>Raspberr y Pi Zero</b>	<b>Raspberr y Pi 4B</b>
Boot	Max	0.26	0.40	0.75	0.20	0.85
	Avg	0.22	0.22	0.35	0.15	0.7
Idle	Avg	0.20	0.22	0.30	0.10	0.6
Video playback (H.264)	Max	0.30	0.36	0.55	0.23	0.85
	Avg	0.22	0.28	0.33	0.16	0.78
Stress	Max	0.35	0.82	1.34	0.35	1.25
	Avg	0.32	0.75	0.85	0.23	1.2
Halt				0.10	0.055	0.023

		Raspberr y Pi 1B+	Raspberr y Pi 2B	Raspberr y Pi 3B	Raspberr y Pi Zero	Raspberr y Pi 4B
current						

## Micro SD Card

Your Raspberry Pi needs an SD card to store all its files and the Raspbian operating system. You will need a micro SD card with a capacity of at least 8 GB.

## Optional Components

For different Raspberry Pi, the optional items are slightly different. But all of their aims are to convert the special interface to standard interface of standard Raspberry Pi.

	Pi Zero	Pi A+	Pi Zero W	Pi 3A+	Pi B+/2B	Pi 3B/3B+	Pi 4B
<b>Monitor</b>	Yes						
<b>Mouse</b>	Yes						
<b>Keyboard</b>	Yes						
<b>Mini-HDMI to HDMI converter or wire</b>	Yes	No	Yes	No	No	No	No
<b>Micro-HDMI to HDMI converter &amp; wire</b>	No						Yes
<b>Micro-USB to USB-A Receptacles converter &amp; wire (Micro USB OTG wire)</b>	Yes	No	Yes	No			
<b>USB HUB</b>	Yes	Yes	Yes	Yes	No	No	
<b>USB transferring to Ethernet interface</b>	select one from two or select two from two		optional		Internal Integration	Internal Integration	
<b>USB Wi-Fi receiver</b>			Internal Integration		optional		

## Screen

To view the desktop environment of Raspberry Pi, you need to use the screen that can be

a TV screen or a computer monitor. If the screen has built-in speakers, the Pi plays sounds via them.

## **Mouse & Keyboard**

When you use a screen , a USB keyboard and a USB mouse are also needed.

## **HDMI**

The Raspberry Pi has a HDMI output port that is compatible with the HDMI ports of most modern TV and computer monitors. If your screen has only DVI or VGA ports, you will need to use the appropriate conversion line.

## **Sound or Earphone**

The Raspberry Pi is equipped with an audio port about 3.5 mm that can be used when your screen has no built-in speakers or when there is no screen operation.



# Preparation

Depending on the different devices you use, you can start up the Raspberry Pi in different methods. If you have a separate screen for Raspberry Pi, follow the instructions in this chapter. Otherwise, please find the corresponding steps in the following chapters.

## If You Have A Screen

If you have a screen, you can use the NOOBS (New Out Of Box System) to install the Raspbian system.

### Hardware Required

- ✓ 1 \* Raspberry Pi
- ✓ 1 \* 2.5A Power Adapter
- ✓ 1 \* Monitor
- ✓ 1 \* Monitor Power Adapter
- ✓ 1 \* HDMI cable
- ✓ 1 \* Micro SD card
- ✓ 1 \* Mouse
- ✓ 1 \* Keyboard
- ✓ 1 \* Personal Computer

### Procedures

#### Step 1

To download NOOBS from your PC, you can choose NOOBS or NOOBS LITE - the only difference is that there is a built-in offline Raspbian installer in NOOBS, while the NOOBS LITE can only be operated online. Here, you are suggested to use the former. Here is the download address of Noobs: <https://www.raspberrypi.org/downloads/noobs/>

## NOOBS

Beginners should start with NOOBS – New Out Of the Box Software. You can purchase a pre-installed NOOBS SD card from many retailers, such as [Pimoroni](#), [Adafruit](#) and [The Pi Hut](#), or download NOOBS below and follow the [software setup guide](#) and [NOOBS setup guide video](#) in our help pages.

**NOOBS** is an easy operating system installer which contains [Raspbian](#) and [LibreELEC](#). It also provides a selection of alternative operating systems which are then downloaded from the internet and installed.

**NOOBS Lite** contains the same operating system installer without Raspbian pre-loaded. It provides the same operating system selection menu allowing Raspbian and other images to be downloaded and installed.



### NOOBS

Offline and network install

Version: 3.2.1  
Release date: 2019-09-30

[Download Torrent](#) [Download ZIP](#)



### NOOBS Lite

Network install only

Version: 3.2  
Release date: 2019-07-10

[Download Torrent](#) [Download ZIP](#)

SHA-256: 9d040a0b2795e940cab848c612a9ccfd739cf7ea5fcb1d42141f93cef SHA-256: 6e2c42097566c59c174fd7b7fad5ab4123df9c86521c207d24c2e8cc7ce4078 809bf19

## Step 2

Format the SD card. If there are some important files in the SD card of Raspbian, please backup them first.

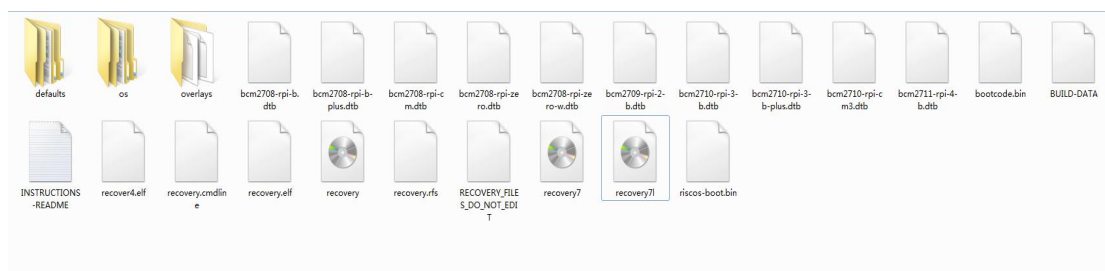
## Step 3

Next, you will need to extract the files from the NOOBS zip archive you downloaded from the Raspberry Pi website.

Find the downloaded archive — by default, it should be in your Downloads folder.

Double-click on it to extract the files, and keep the resulting Explorer/Finder window open.

Finally Select all the files in the NOOBS folder and copy them to the SD card.



## Step 4

All the files transferred, the SD card pops up.

## Step 5

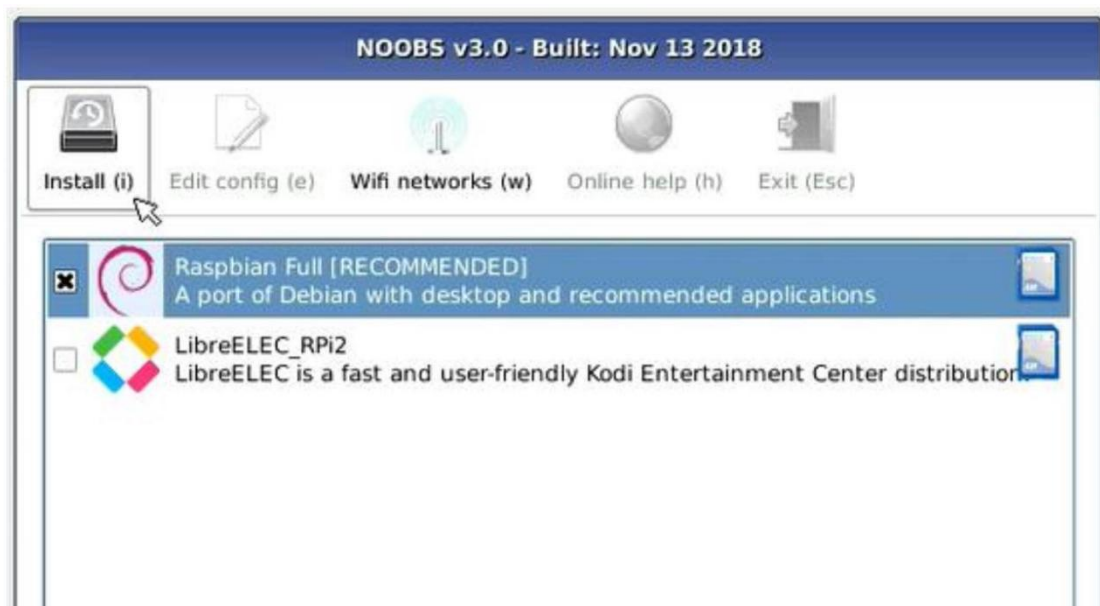
Insert the SD card into the Raspberry Pi. In addition, connect the screen, keyboard and mouse to it. Finally power up the Raspberry Pi with a 3A power adapter.



## Step 6

It will go to the NOOBS interface after starting up. If you use NOOBS LITE, you need to select Wi-Fi networks (w) first. Tick the checkbox of the Raspbian and click Install in the top left corner. The NOOBS will help to conduct the installation automatically.

This process will take a few minutes.



## Step 7

When the installation is done, the system will restart automatically and the desktop of the system will appear.



## Step 8

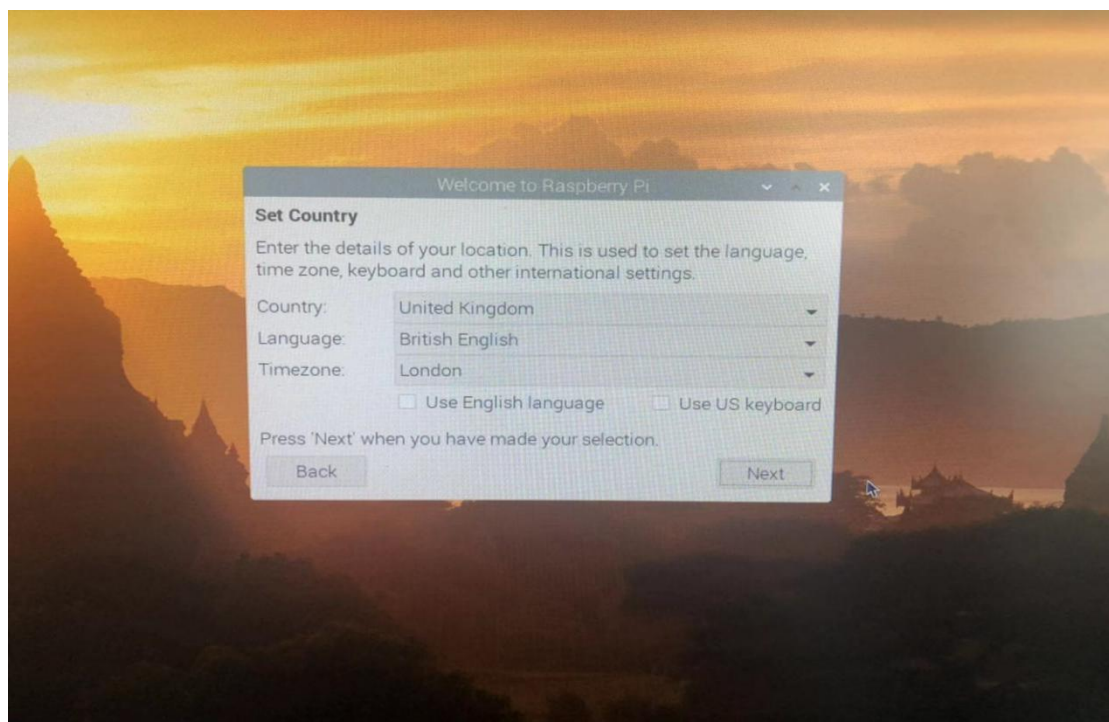
If you run Raspberry Pi for the first time, the application of "Welcome to Raspberry Pi"

pops up and guides you to perform the initial setup.



## Step 9

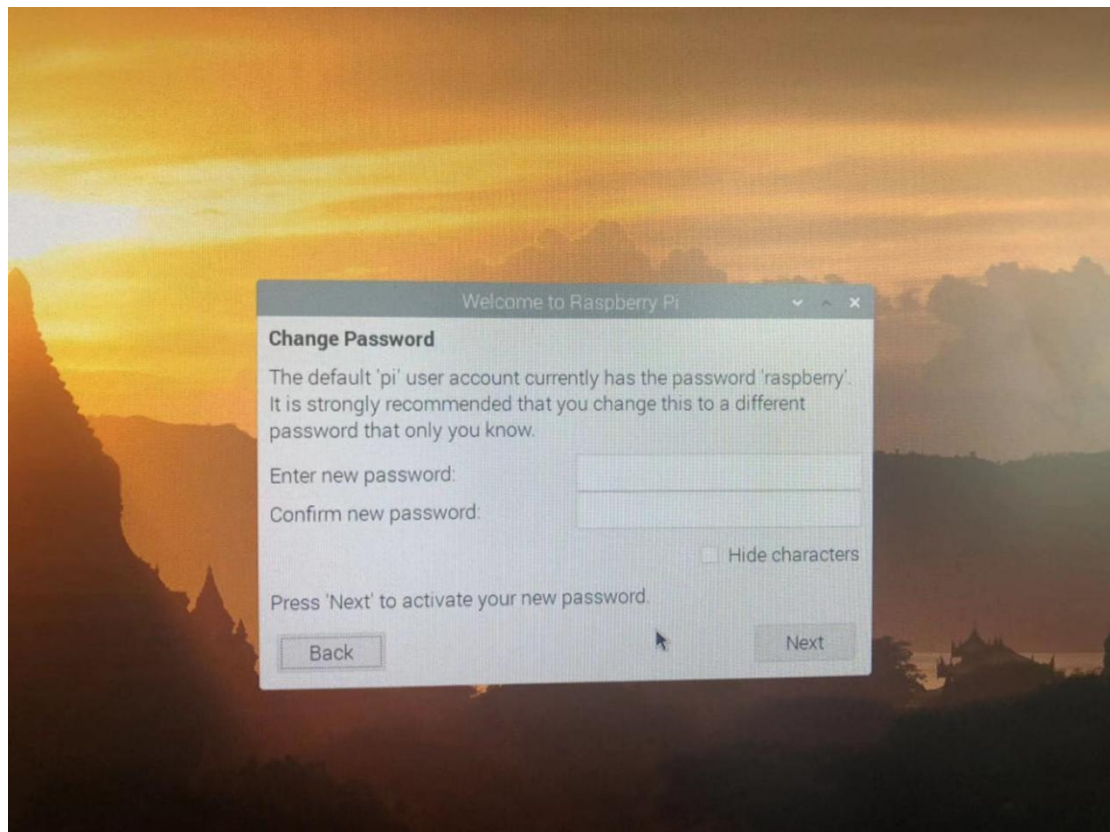
Set country/region, language and time zone, and then click “next” again.



## Step 10

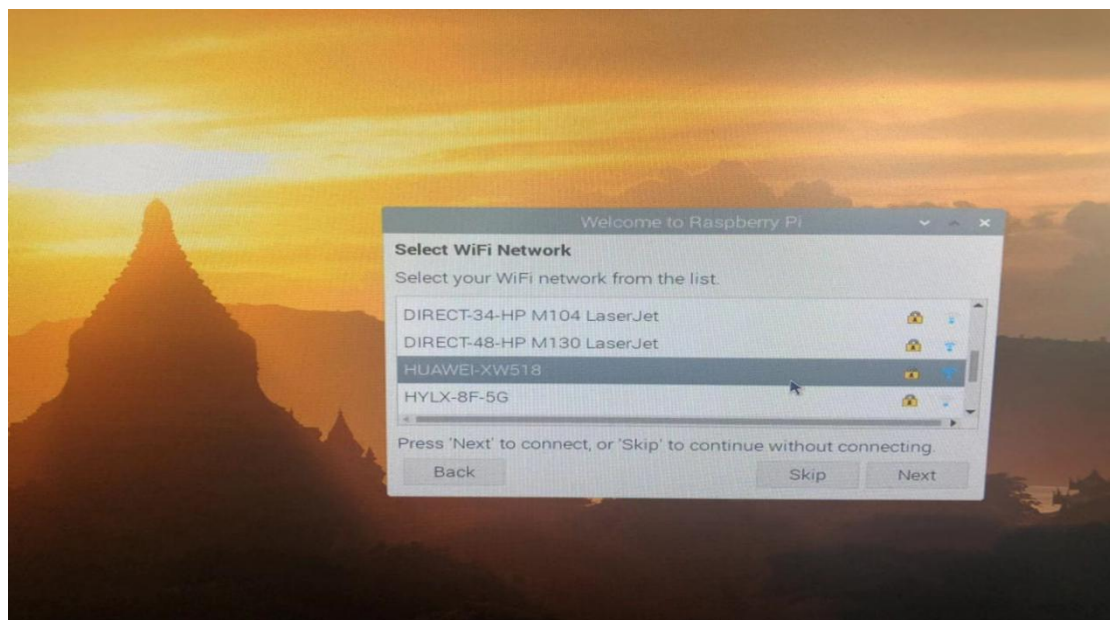
Input the new password of Raspberry Pi and click “Next” .





## Step 11

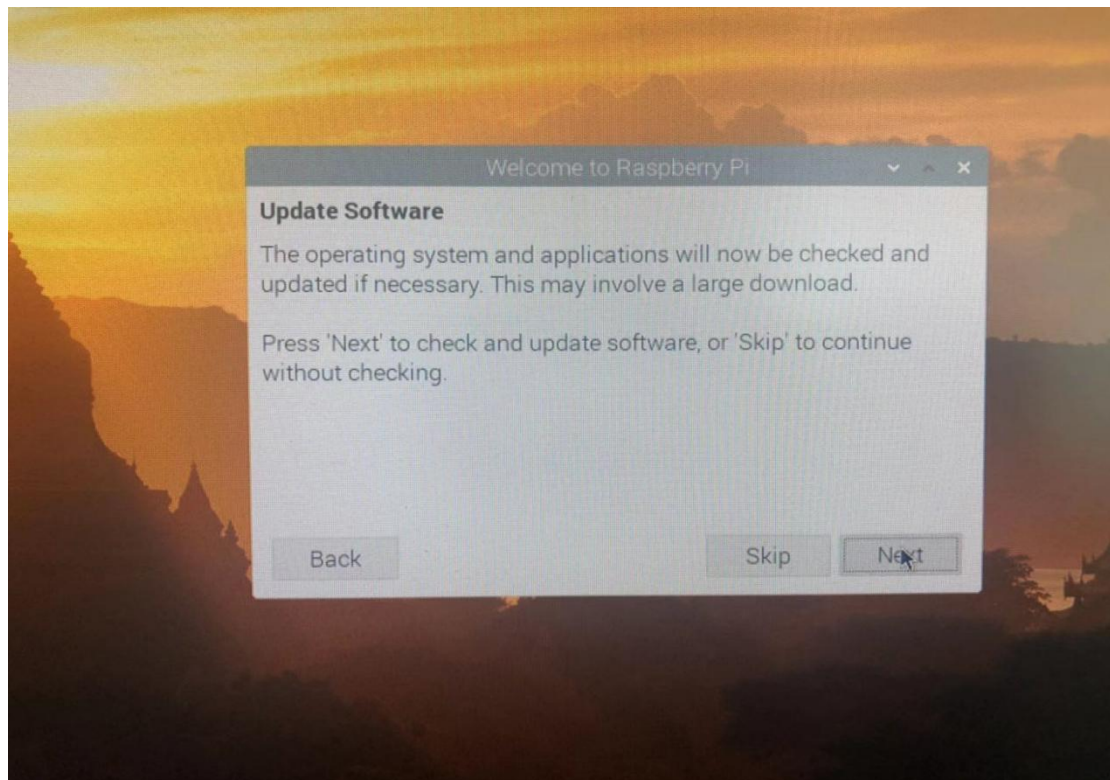
Connect the Raspberry Pi to WIFI and click "Next".



## Step 12

Retrieve update.





## Step 13

Click "Done" to complete the Settings.



Now we can run the Raspberry Pi.

Note: You can check the complete tutorial of NOOBS on the official website of the Raspberry Pi: <https://www.raspberrypi.org/help/noobs-setup/>.

## If You Have No Screen

If we don't have a screen, we can directly write the raspbian system to the SD card and we can control the Raspberry Pi on PC remotely by directly modifying the configuration file of the network settings in the SD card.

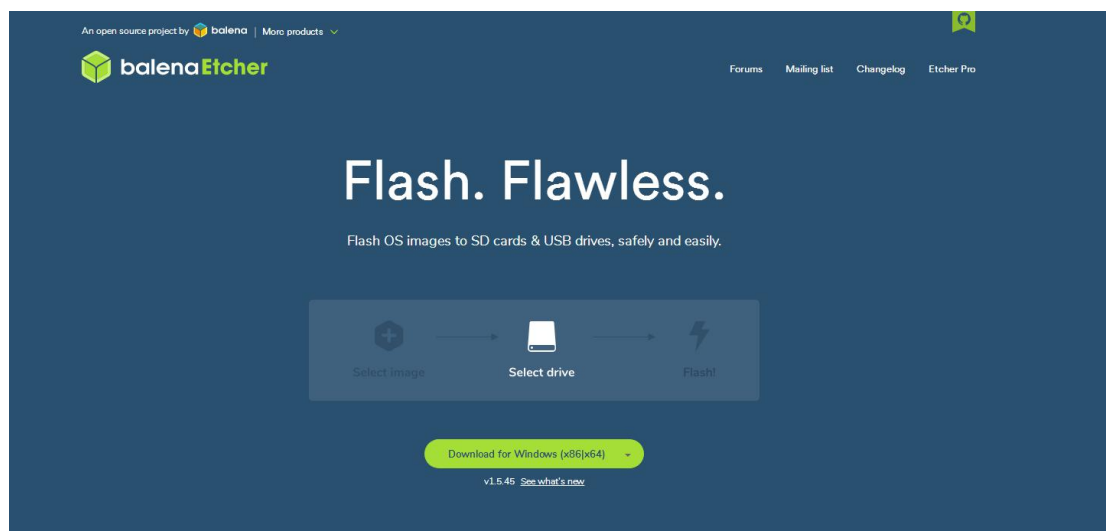
## Hardware Required

- ✓ 1 \* Raspberry Pi
- ✓ 1 \* 3A or 2.5A Power Adapter
- ✓ 1 \* Micro SD card
- ✓ 1 \* Personal Computer

## Burn System

### Step 1


Prepare the tool of image burning. Here we use the Etcher. You can download the software from the link: <https://www.balena.io/etcher/>



### Step 2

Download the complete image on the official website by clicking this

link: <https://www.raspberrypi.org/downloads/raspbian/>. There are three different kinds of Raspbian Stretches available, among which the Raspbian Stretch with desktop will be the best choice if you have no other special requirements.




**Raspbian Buster with desktop and recommended software**  
Image with desktop and recommended software based on Debian Buster

Version: September 2019  
Release date: 2019-09-26  
Kernel version: 4.19  
Size: 2541 MB

[Release notes](#)

[Download Torrent](#) [Download ZIP](#)

SHA-256: 549da0fa9ed52a8d7c2d66cb06afac9fe856638b06d8f23df4e6b72e67ed4cea




**Raspbian Buster with desktop**  
Image with desktop based on Debian Buster

Version: September 2019  
Release date: 2019-09-26  
Kernel version: 4.19  
Size: 1123 MB

[Release notes](#)

[Download Torrent](#) [Download ZIP](#)

SHA-256: 2c4067d59acf891b7aa1683cb1918da78d76d2552c02749148d175fa7f766842



**Raspbian Buster Lite**  
Minimal image based on Debian Buster

Version: September 2019  
Release date: 2019-09-26  
Kernel version: 4.19  
Size: 435 MB

[Release notes](#)

[Download Torrent](#) [Download ZIP](#)

SHA-256: a50237c2f718bd8d806b96df5b9d2174ce8b789eda1f03434ed2213bbca6c6ff

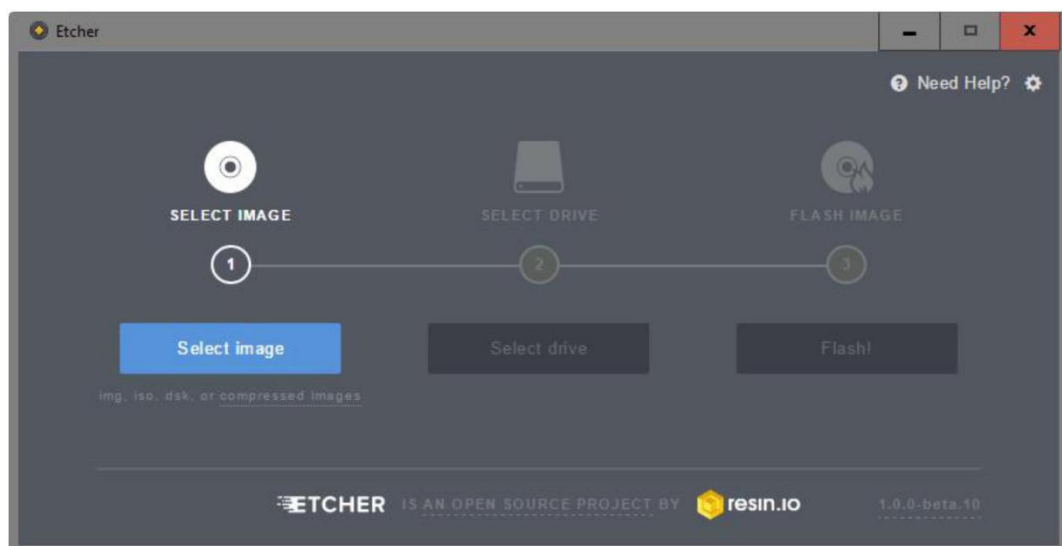
## Step 3

Unzip the package downloaded and you will see [the xxx-xx-xx-raspbian-stretch.img](#) file inside.

**Note:** DO NOT extract the file.

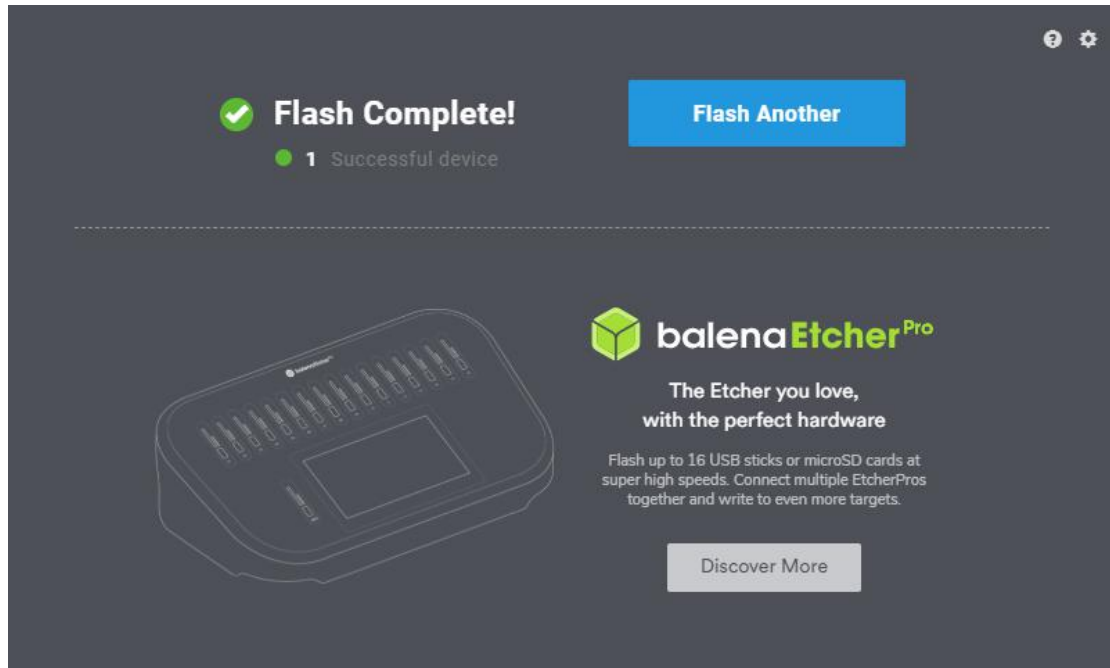
## Step 4

With the application of Etcher, flash the image file, raspbian into the SD card.



## Step 5

At this point, raspbian is installed; however, if you want to apply it, what you need to do next is to complete the settings accordingly.



## Connect the Raspberry Pi to the Internet

There are two methods to help get the Raspberry Pi connected to the network: the first one is using a network cable, the other way is using WIFI. We will talk in detail about how to connect via WIFI as below.

Since the 3B and above version of the product, Raspberry Pi has a built-in Wifi function. If what you use is the early version of Raspberry Pi, a USB WIFI Adapter is needed. Log in the website, [https://elinux.org/RPi\\_USB\\_Wi-Fi\\_Adapters](https://elinux.org/RPi_USB_Wi-Fi_Adapters) for more.

If you want to use the WIFI function, you need to modify a WIFI configuration file `wpa-supPLICANT.conf` in the SD card by your PC that is located in the directory `/etc/wpa-supPLICANT/`.

If your personal computer is working on a linux system, you can access the directory directly to modify the configuration file; however, if your PC use Windows system, then you can't access the directory and what you need next is to go to the directory, `/boot/` to create a new file with the same name, `wpa-supPLICANT.conf`.



Input the following content in the file.

```
ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev

update_config=1

country=GB

network={

    ssid="WiFi"

    psk="Rexqualis"

    key_mgmt=WPA-PSK

    priority=1

}
```

You need to replace “WiFi” with your custom name of WiFi and “Rexqualis” with your password. By doing these, the Raspbian system will move this file to the target directory automatically to overwrite the original WIFI configuration file when it runs next time.

## Start SSH

To use the function of remote control of the Raspberry Pi, you need to start SSH firstly that is a more reliable protocol providing security for remote login sessions and other network services. Generally, SSH of Raspberry Pi is in a disabled state. Additionally, if you want to run it, you need to create a file named SSH under directory /boot/.



Now, the Raspbian system is configured. When the SD card is inserted into the Raspberry Pi, you can use it immediately.

## Get the IP Address

After the Raspberry Pi is connected to WIFI, we need to get the IP address of it. There are many ways to know the IP address, and two of them are listed as follows.

1. Checking via the router

If you have permission to log in the router(such as a home network), you can check the addresses assigned to Raspberry Pi on the admin interface of router.

The default hostname of the system, Raspbian is raspberrypi, and you need to find it. (If you are using ArchLinuxARM system, please find alarmpi.)

## 2. Network Segment Scanning

You can also use network scanning to look up the IP address of Raspberry Pi. You can apply the software, [Advanced IP scanner](#) and so on.

Scan the IP range set, and the name of all connected devices will be displayed. Similarly, the default hostname of the Raspbian system is raspberrypi, now you need to find the hostname.

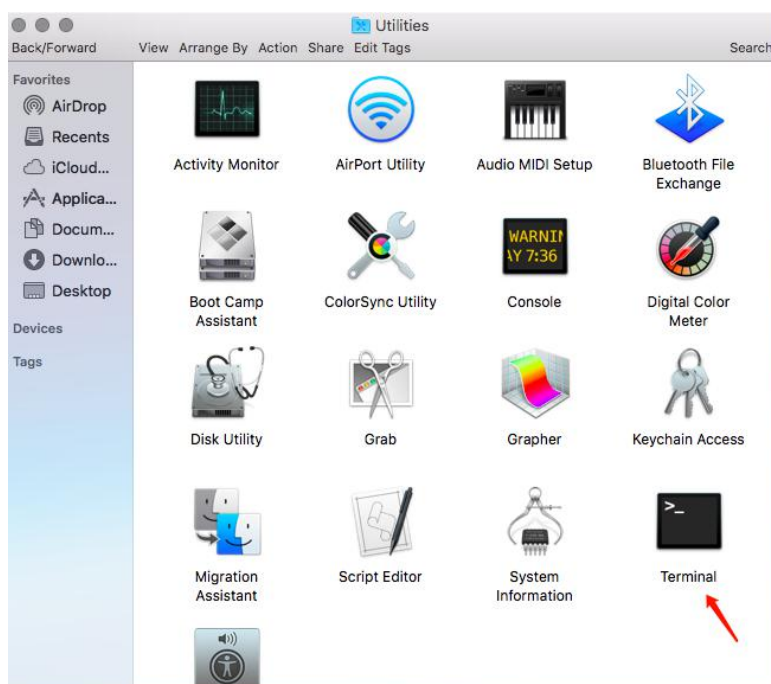
## Use the SSH Remote Control

We can open the Bash Shell of Raspberry Pi by applying SSH. Bash is the standard default shell of Linux. The Shell itself is a program written in C that is the bridge linking the customers and Unix/Linux. Moreover, it can help to complete most of the work needed.

## For Linux or/Mac OS X Users

### Step 1

Go to Applications->Utilities, find the Terminal, and open it.





## Step 2

Type in `ssh pi@ip_address`. "pi" is your username and "ip\_address" is your IP address. For example:

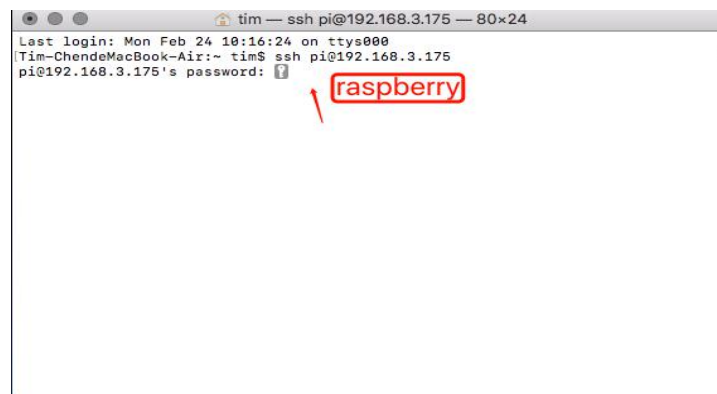
```
ssh pi@192.168.3.175
```

## Step 3

Input "yes".

## Step 4

Input the passcode and the default password is **raspberrypi**.

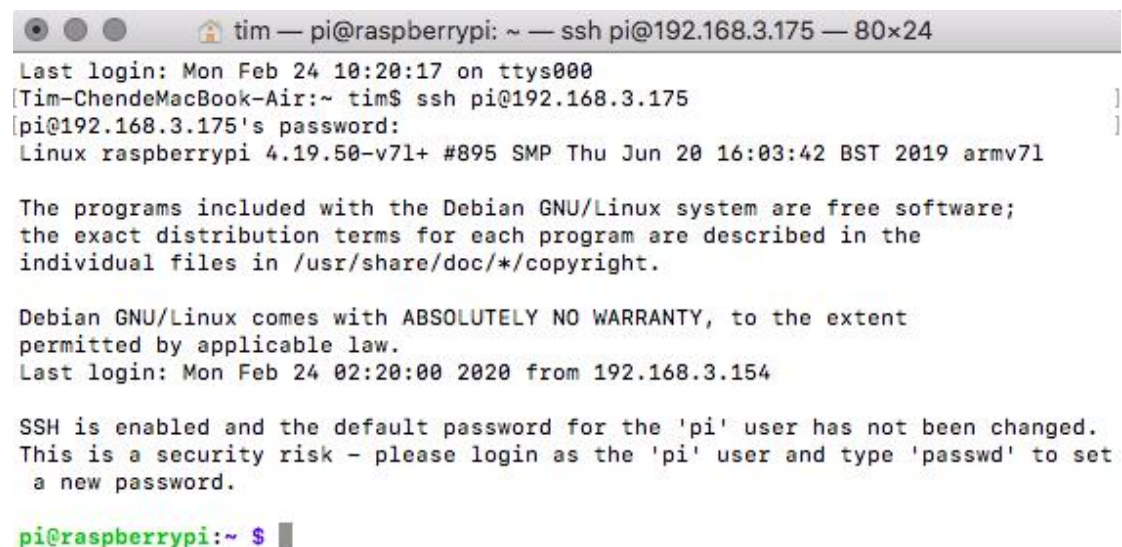


A terminal window titled "tim — ssh pi@192.168.3.175 — 80x24". The output shows the last login time and the command being executed. The password prompt is visible, and the word "raspberrypi" is entered and highlighted with a red box and an arrow.

```
tim — ssh pi@192.168.3.175 — 80x24
Last login: Mon Feb 24 10:16:24 on ttys000
Tim-ChendeMacBook-Air:~ tim$ ssh pi@192.168.3.175
pi@192.168.3.175's password: raspberrypi
```

## Step 5

We now get the Raspberry Pi connected and are ready to go to the next step.



A terminal window titled "tim — pi@raspberrypi: ~ — ssh pi@192.168.3.175 — 80x24". The output shows the last login time, the command being executed, and the system information. The password prompt is visible, and the word "raspberrypi" is entered and highlighted with a red box and an arrow.

```
tim — pi@raspberrypi: ~ — ssh pi@192.168.3.175 — 80x24
Last login: Mon Feb 24 10:20:17 on ttys000
Tim-ChendeMacBook-Air:~ tim$ ssh pi@192.168.3.175
pi@192.168.3.175's password: raspberrypi
Linux raspberrypi 4.19.50-v7l+ #895 SMP Thu Jun 20 16:03:42 BST 2019 armv7l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Mon Feb 24 02:20:00 2020 from 192.168.3.154

SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to set
a new password.

pi@raspberrypi:~ $
```

Note: When you input the password, the characters do not display on window accordingly, which is normal. What you need is to input the correct passcode.

## For Windows Users

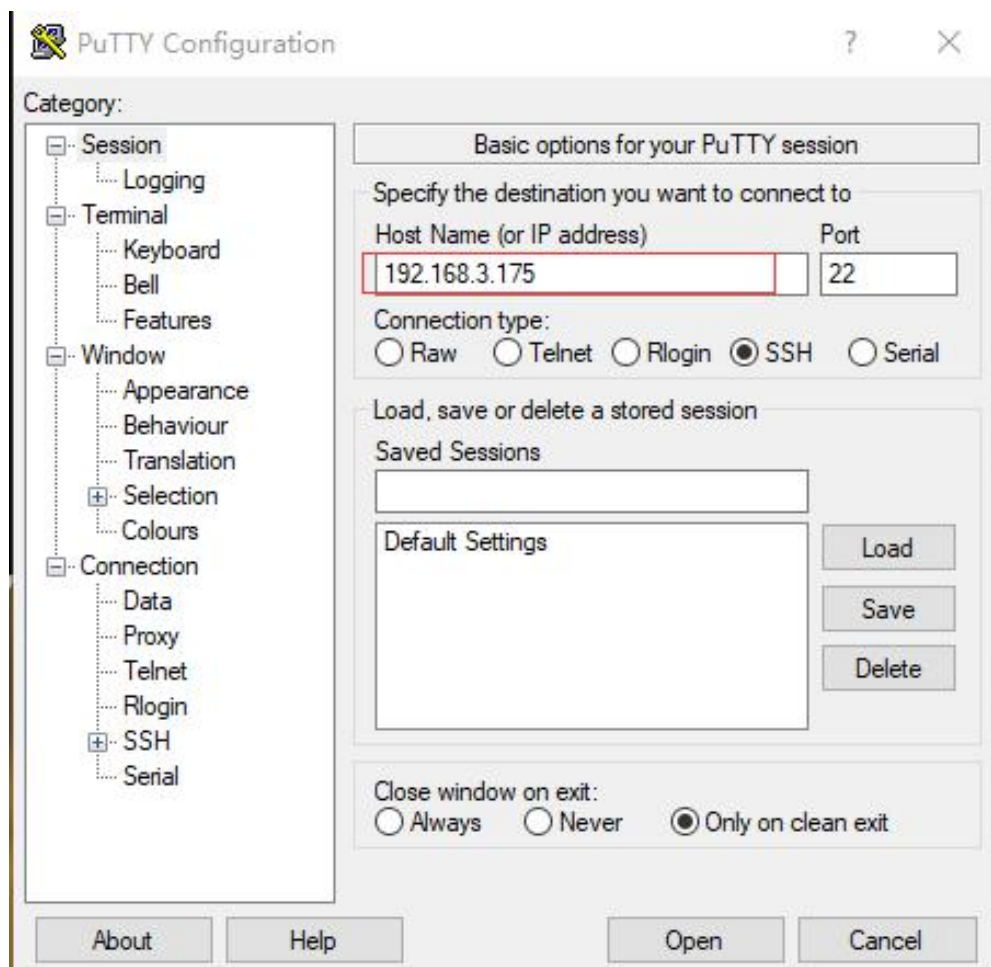
If you're a Windows user, you can use SSH with the application of some software. Here, we recommend PuTTY.

### Step 1

Download PuTTY.

### Step 2

Open PuTTY and click Session on the left tree-alike structure. Enter the IP address of the RPi in the text box under Host Name (or IP address) and 22 under Port (by default it is 22).

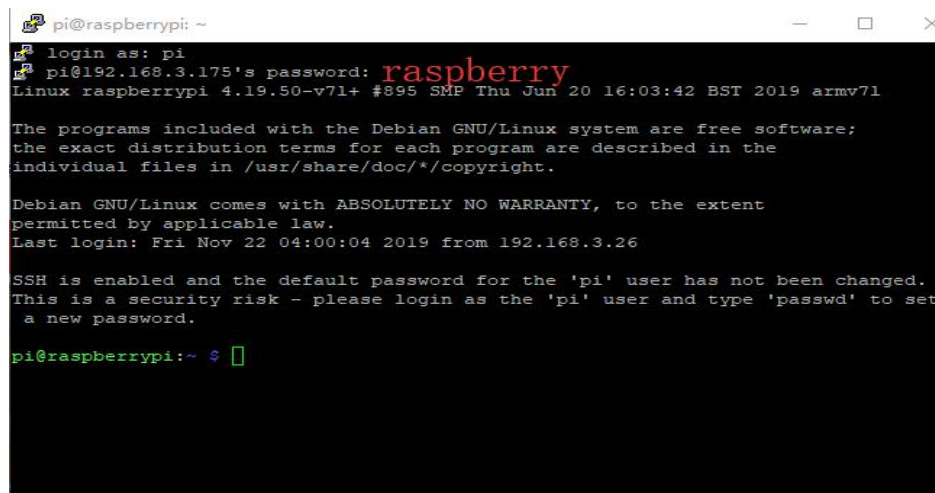


### Step 3

Click Open. Note that when you first log in to the Raspberry Pi with the IP address, there prompts a security reminder. Just click Yes.

## Step 4

When the PuTTY window prompts “login as:”, type in “pi”(the user name of the RPi), and password: “raspberrypi” (the default one, if you haven't changed it).



```
pi@raspberrypi: ~  
login as: pi  
pi@192.168.3.175's password: raspberrypi  
Linux raspberrypi 4.19.50-v7l+ #895 SMP Thu Jun 20 16:03:42 BST 2019 armv7l  
  
The programs included with the Debian GNU/Linux system are free software;  
the exact distribution terms for each program are described in the  
individual files in /usr/share/doc/*/copyright.  
  
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent  
permitted by applicable law.  
Last login: Fri Nov 22 04:00:04 2019 from 192.168.3.26  
  
SSH is enabled and the default password for the 'pi' user has not been changed.  
This is a security risk - please login as the 'pi' user and type 'passwd' to set  
a new password.  
pi@raspberrypi:~ $
```

## Step 5

Here, we get the Raspberry Pi connected and it is time to conduct the next steps.

**Note:** When you input the password, the characters do not display on window accordingly, which is normal. What you need is to input the correct password.

## Remote Desktop

If you are not satisfied with using the command window to control the Raspberry Pi, you can also use the remote desktop function, which can help us manage the files in the Raspberry Pi easily. There are two ways to control the desktop of the Raspberry Pi remotely : VNC and XRDP.

### VNC

You can use the function of remote desktop through VNC.

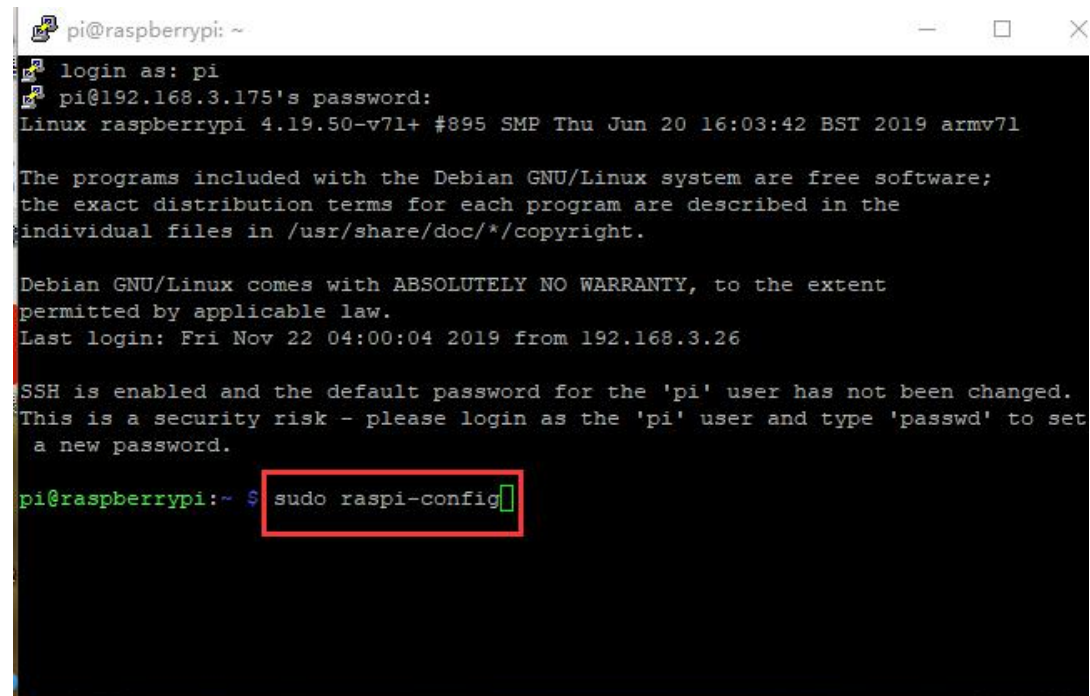
### Enable VNC service

The VNC service has been installed in the system. By default, VNC is disabled. You need to enable it in config.

## Step 1

Input the following command:

```
sudo raspi-config
```



```
pi@raspberrypi: ~
login as: pi
pi@192.168.3.175's password:
Linux raspberrypi 4.19.50-v7l+ #895 SMP Thu Jun 20 16:03:42 BST 2019 armv7l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

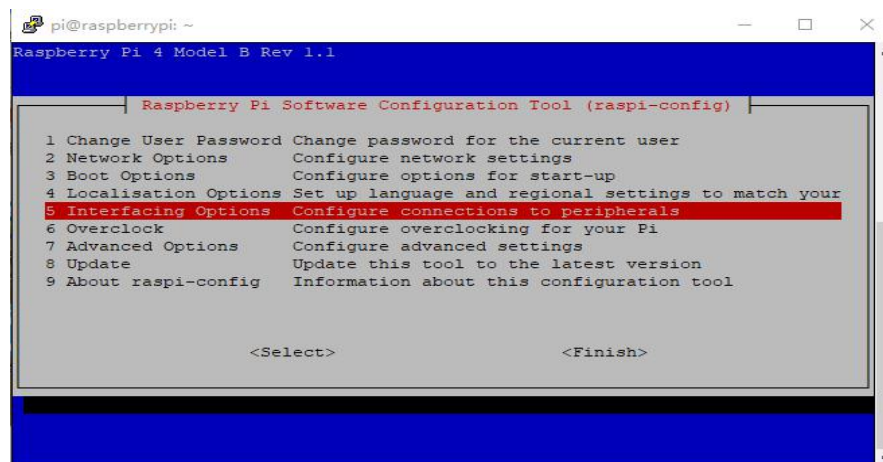
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Fri Nov 22 04:00:04 2019 from 192.168.3.26

SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to set
a new password.

pi@raspberrypi:~$ sudo raspi-config
```

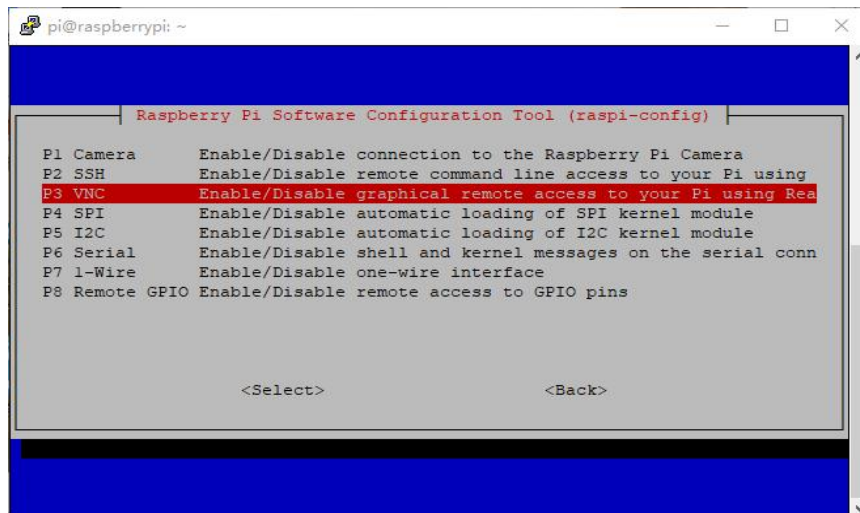
## Step 2

On the config interface, select “Interfacing Options” by the up, down, left and right keys on the keyboard.



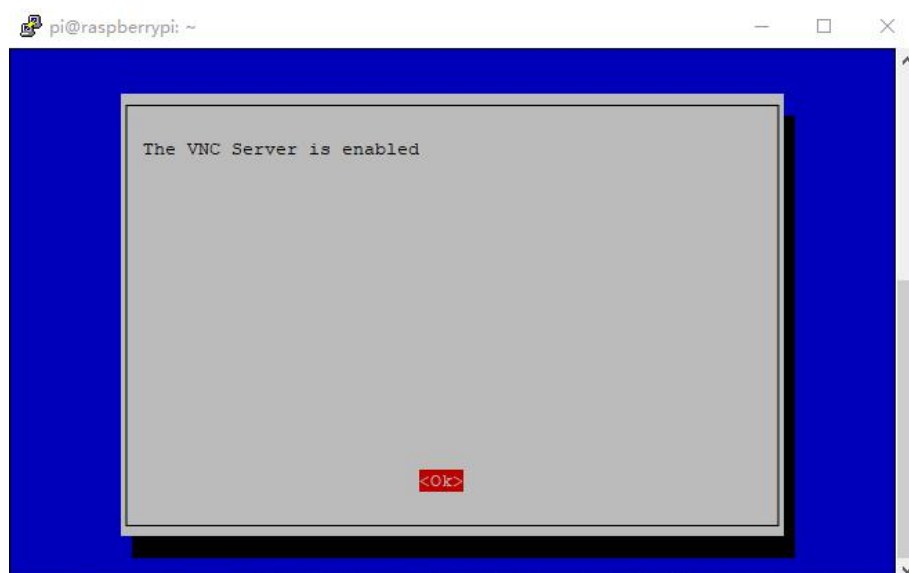
## Step 3

Select VNC.



## Step 4

Select Yes -> OK -> Finish to exit the configuration.



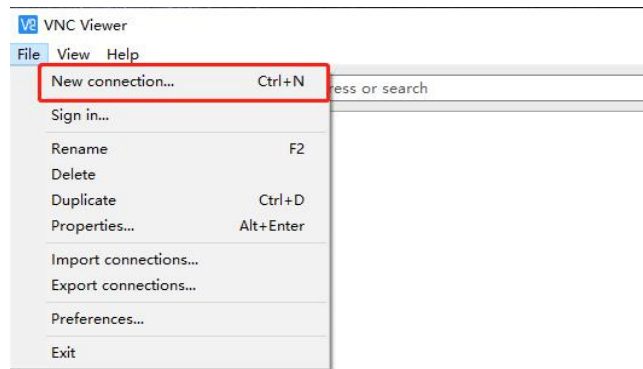
## Login to VNC

### Step 1

You need to install the VNC Viewer on personal computer. After the installation is done, open it.

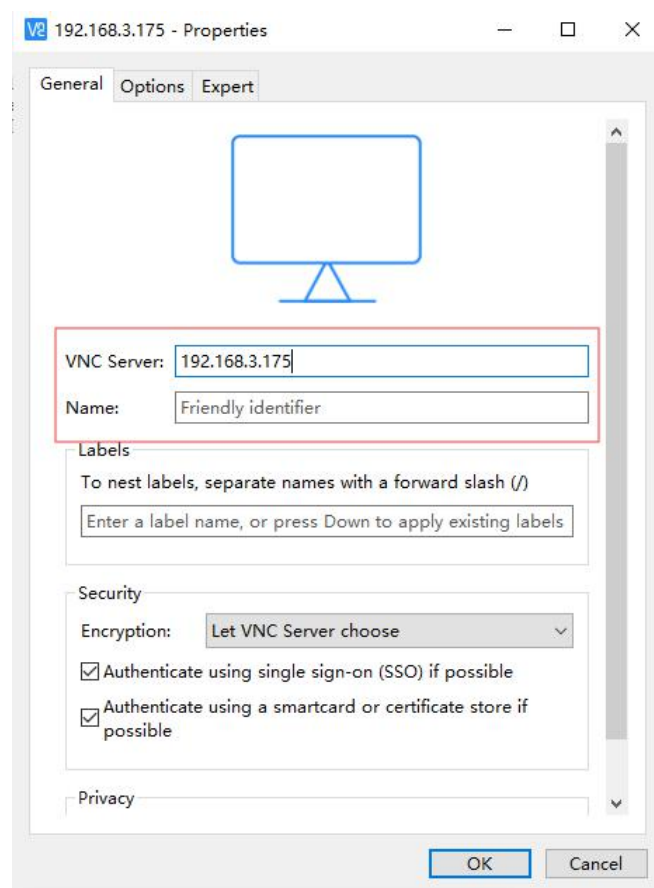
### Step 2

Then select "New connection".



## Step 3

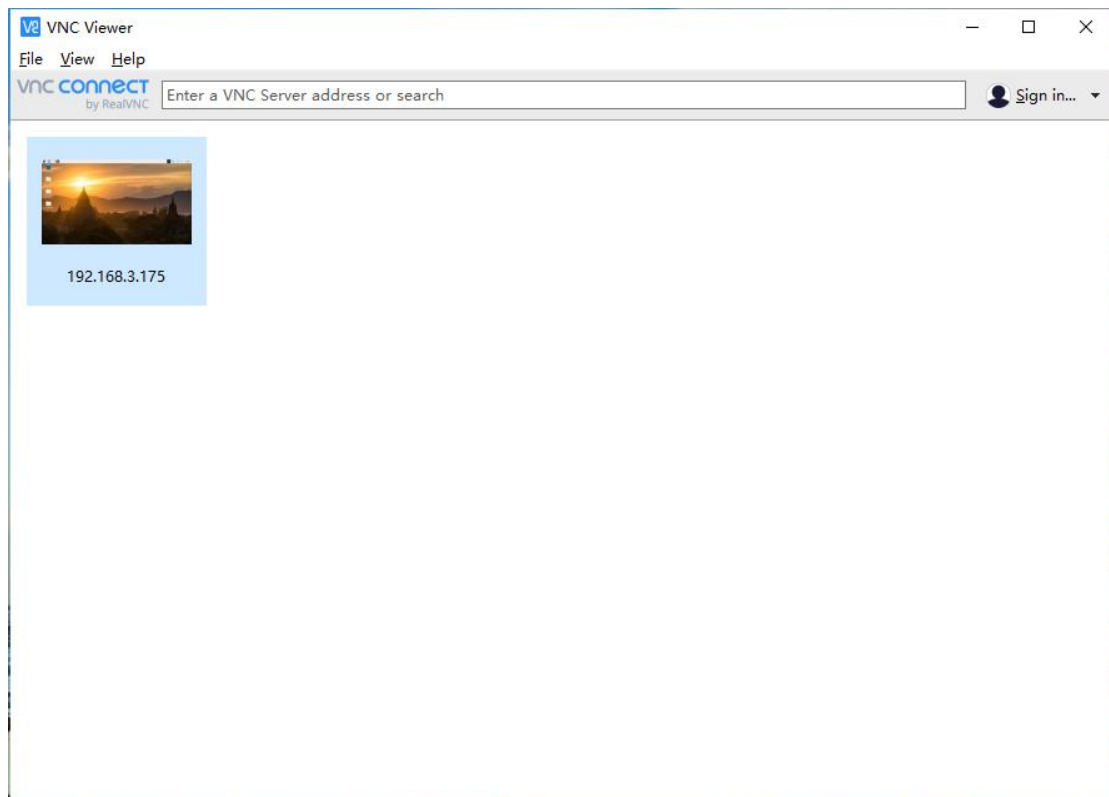
Input IP address of Raspberry Pi and any Name.





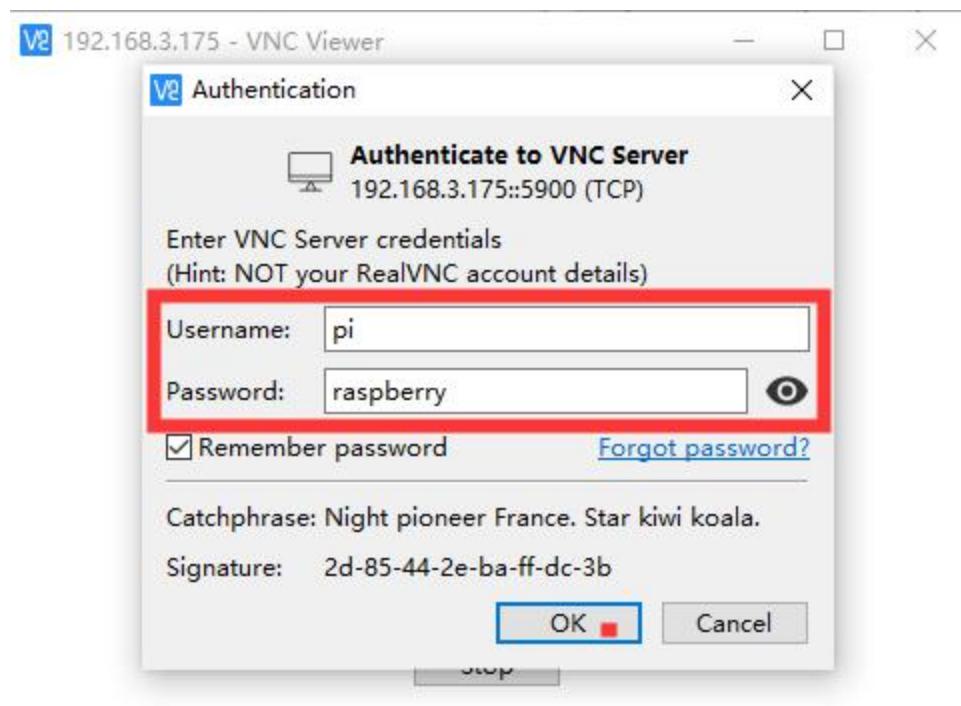
## Step 4

Double click the connection just created:



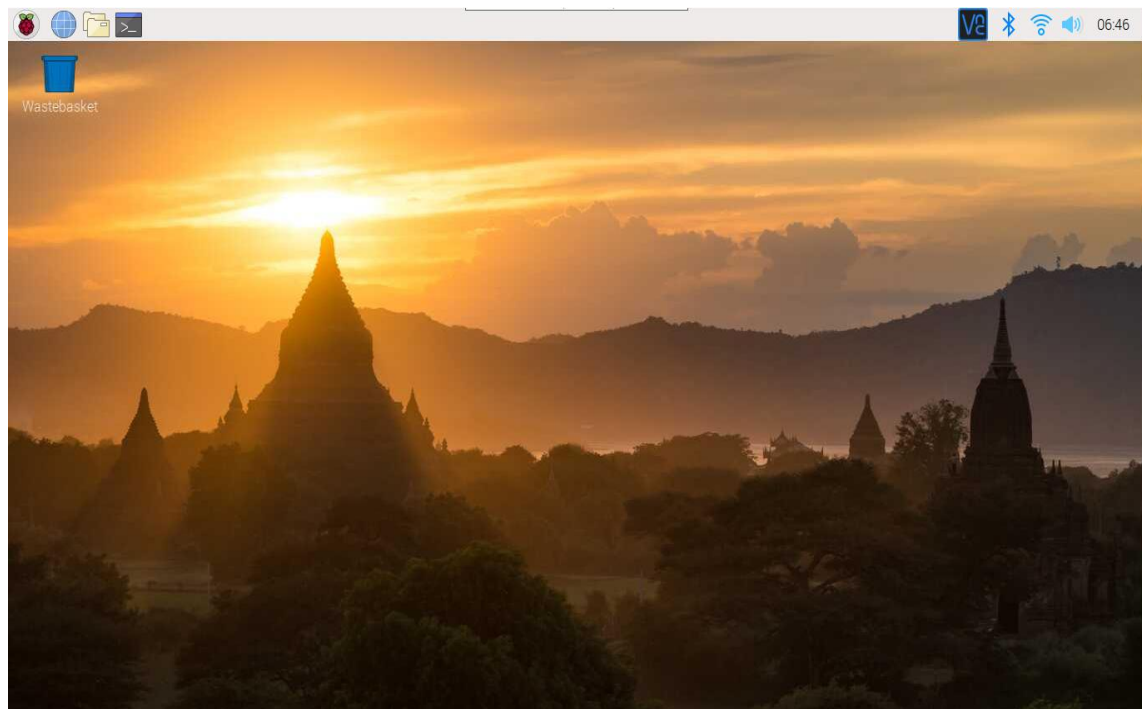
## Step 5

Enter Username (pi) and Password (raspberry by default).



## Step 6

Now you can see the desktop of the Raspberry Pi:



## XRDP

xrdp provides a graphical login to remote machines using RDP (Microsoft Remote Desktop Protocol).

## Install XRDP

### Step 1

Login to Raspberry Pi by using SSH.

### Step 2

Input the following instructions to install XRDP.

```
sudo apt-get update
```

```
sudo apt-get install xrdp
```

### Step 3

Later, the installation starts.

Enter "Y", press key "Enter" to confirm.

```
pi@raspberrypi: ~  
Hit:1 http://archive.raspberrypi.org/debian buster InRelease  
Get:2 http://raspbian.raspberrypi.org/raspbian buster InRelease [15.0 kB]  
Reading package lists... Done  
E: Repository 'http://raspbian.raspberrypi.org/raspbian buster InRelease' change  
d its 'Suite' value from 'testing' to 'stable'  
N: This must be accepted explicitly before updates for this repository can be ap  
plied. See apt-secure(8) manpage for details.  
pi@raspberrypi:~$ sudo apt-get install xrdp  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
The following additional packages will be installed:  
  libglul-mesa ssl-cert x11-apps x11-session-utils xbitmaps xfonts-75dpi  
  xfonts-base xfonts-scalable xorg xorg-docs-core xorgxrdp xrdp  
Suggested packages:  
  openssl-blacklist mesa-utils xorg-docs x11-xfs-utils guacamole  
  xrdp-pulseaudio-installer  
The following NEW packages will be installed:  
  libglul-mesa ssl-cert x11-apps x11-session-utils xbitmaps xfonts-75dpi  
  xfonts-base xfonts-scalable xorg xorg-docs-core xorgxrdp xrdp  
0 upgraded, 12 newly installed, 0 to remove and 127 not upgraded.  
Need to get 11.0 MB of archives.  
After this operation, 17.8 MB of additional disk space will be used.  
Do you want to continue? [Y/n]
```

## Step 4

After the installation is completed, you can use Windows remote desktop applications to login to your RPi.

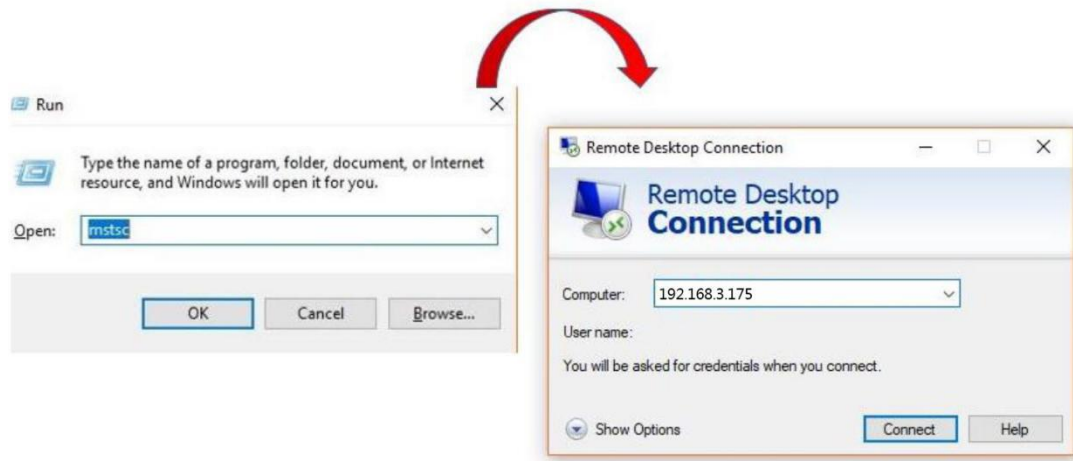
## Login to XRDP

### Step 1

If you are a Windows user, you can use the Remote Desktop feature that comes with Windows. If you are a Mac user, you can download and use Microsoft Remote Desktop from the APP Store, and there is not much difference between the two. The next example is Windows remote desktop.

### Step 2

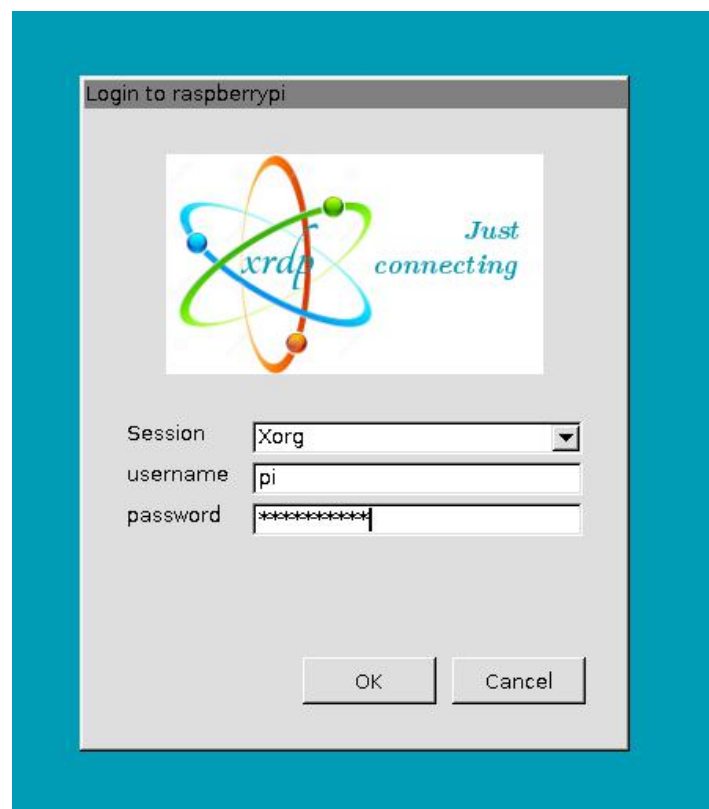
Type in "mstsc" in Run (WIN+R) to open the Remote Desktop Connection, and input the IP address of Raspberry Pi, then click on "Connect".



### Step 3

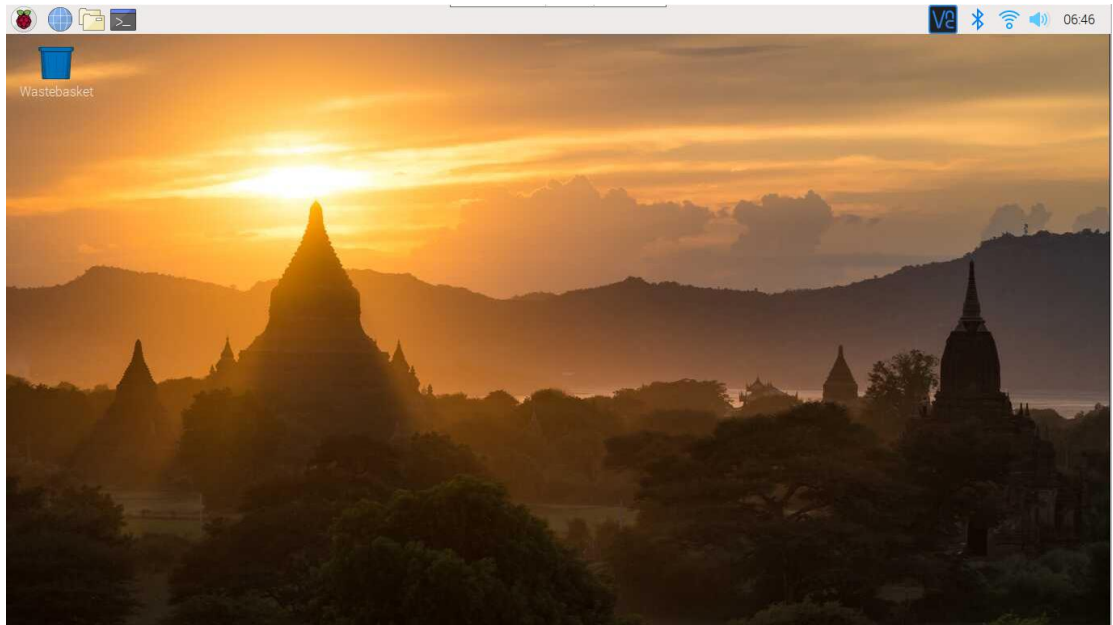
There will be xrdp login screen. Enter the user name and password of RPi and click OK.

By default, the user name of Raspberry Pi is "pi" and the password is "raspberrypi".



### Step 4

Here, you successfully login to RPi by using the remote desktop.



# Libraries

Two important libraries are used in programming with Raspberry Pi, and they are wiringPi and RPi.GPIO. The Raspbian OS image of Raspberry Pi installs them by default, so you can use them directly.

## RPi.GPIO

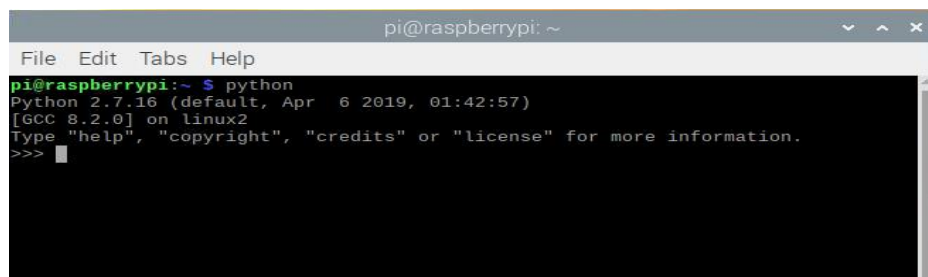
If you are a Python user, you can program GPIOs with API provided by RPi.GPIO.

RPi.GPIO is a module to control Raspberry Pi GPIO channels. This package provides a class to control the GPIO on a Raspberry Pi. For examples and documents, visit

<http://sourceforge.net/p/raspberry-gpio-python/wiki/Home/>

Test whether RPi.GPIO is installed or not, type in python:

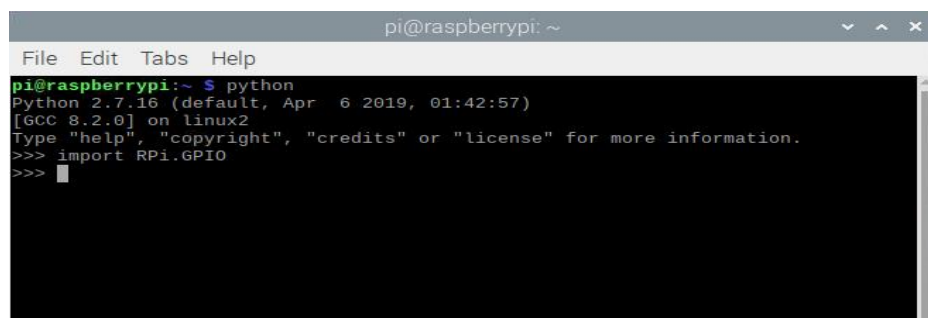
`python`



```
pi@raspberrypi: ~  
File Edit Tabs Help  
pi@raspberrypi:~ $ python  
Python 2.7.16 (default, Apr 6 2019, 01:42:57)  
[GCC 8.2.0] on linux2  
Type "help", "copyright", "credits" or "license" for more information.  
>>> 
```

In Python CLI, input “ import RPi.GPIO ”, If no error prompts, it means RPi.GPIO is installed.

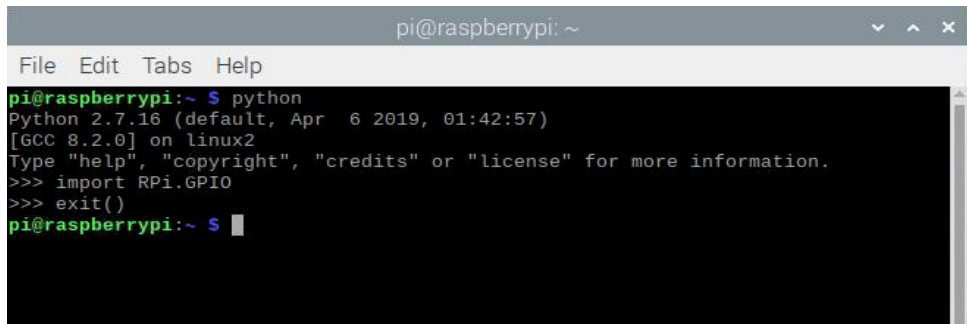
`import RPi.GPIO`



```
pi@raspberrypi: ~  
File Edit Tabs Help  
pi@raspberrypi:~ $ python  
Python 2.7.16 (default, Apr 6 2019, 01:42:57)  
[GCC 8.2.0] on linux2  
Type "help", "copyright", "credits" or "license" for more information.  
>>> import RPi.GPIO  
>>> 
```

If you want to quit python CLI, type in:

`exit()`

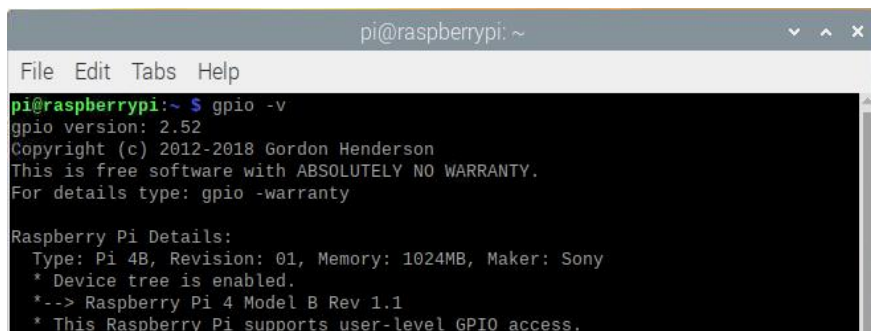
A terminal window titled 'pi@raspberrypi: ~' with a menu bar (File, Edit, Tabs, Help). The command 'python' is entered, followed by the Python 2.7.16 shell. The user enters 'import RPi.GPIO' and 'exit()' to return to the shell prompt.

```
pi@raspberrypi:~ $ python
Python 2.7.16 (default, Apr  6 2019, 01:42:57)
[GCC 8.2.0] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> import RPi.GPIO
>>> exit()
pi@raspberrypi:~ $
```

## WiringPi

wiringPi is a C language GPIO library applied to the Raspberry Pi platform. It complies with GUN Lv3. The functions in wiringPi are similar to those in the wiring system of Arduino. They enable the users familiar with Arduino to use wiringPi more easily. wiringPi includes lots of GPIO commands which enable you to control all kinds of interfaces on Raspberry Pi. You can test whether the wiringPi library is installed successfully or not by the following instructions.

`gpio -v`

A terminal window titled 'pi@raspberrypi: ~' showing the output of the 'gpio -v' command. The output displays the version (2.52), copyright (2012-2018 Gordon Henderson), and Raspberry Pi details (Pi 4B, Revision: 01, Memory: 1024MB, Maker: Sony).

```
pi@raspberrypi:~ $ gpio -v
gpio version: 2.52
Copyright (c) 2012-2018 Gordon Henderson
This is free software with ABSOLUTELY NO WARRANTY.
For details type: gpio -warranty

Raspberry Pi Details:
  Type: Pi 4B, Revision: 01, Memory: 1024MB, Maker: Sony
  * Device tree is enabled.
  *--> Raspberry Pi 4 Model B Rev 1.1
  * This Raspberry Pi supports user-level GPIO access.
```

If the message above appears, the wiringPi is installed successfully.

`gpio readall`



```

pi@raspberrypi:~ $ gpio readall
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| BCM | wPi |   Name   | Mode | V | Physical | V | Mode |   Name   | wPi | BCM |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 2 | 8 | 3.3v |   |   | 1 | 2 |   |   | 5v |   |   |
| 3 | 9 | SDA.1 | ALT0 | 1 | 3 | 4 |   |   | 5v |   |   |
| 4 | 7 | SCL.1 | ALT0 | 1 | 5 | 6 |   |   | 0v |   |   |
| 4 | 7 | GPIO. 7 | IN | 1 | 7 | 8 | 1 | IN | TxD | 15 | 14 |
|   |   | 0v |   |   | 9 | 10 | 1 | IN | RxD | 16 | 15 |
| 17 | 0 | GPIO. 0 | OUT | 1 | 11 | 12 | 0 | OUT | GPIO. 1 | 1 | 18 |
| 27 | 2 | GPIO. 2 | OUT | 1 | 13 | 14 |   |   | 0v |   |   |
| 22 | 3 | GPIO. 3 | OUT | 0 | 15 | 16 | 0 | OUT | GPIO. 4 | 4 | 23 |
|   |   | 3.3v |   |   | 17 | 18 | 0 | OUT | GPIO. 5 | 5 | 24 |
| 10 | 12 | MOSI | OUT | 1 | 19 | 20 |   |   | 0v |   |   |
| 9 | 13 | MISO | ALT0 | 0 | 21 | 22 | 0 | IN | GPIO. 6 | 6 | 25 |
| 11 | 14 | SCLK | ALT0 | 0 | 23 | 24 | 1 | OUT | CE0 | 10 | 8 |
|   |   | 0v |   |   | 25 | 26 | 1 | OUT | CE1 | 11 | 7 |
| 0 | 30 | SDA.0 | IN | 1 | 27 | 28 | 1 | IN | SCL.0 | 31 | 1 |
| 5 | 21 | GPIO.21 | IN | 1 | 29 | 30 |   |   | 0v |   |   |
| 6 | 22 | GPIO.22 | IN | 1 | 31 | 32 | 0 | IN | GPIO.26 | 26 | 12 |
| 13 | 23 | GPIO.23 | IN | 0 | 33 | 34 |   |   | 0v |   |   |
| 19 | 24 | GPIO.24 | IN | 0 | 35 | 36 | 0 | IN | GPIO.27 | 27 | 16 |
| 26 | 25 | GPIO.25 | IN | 0 | 37 | 38 | 0 | IN | GPIO.28 | 28 | 20 |
|   |   | 0v |   |   | 39 | 40 | 0 | IN | GPIO.29 | 29 | 21 |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| BCM | wPi |   Name   | Mode | V | Physical | V | Mode |   Name   | wPi | BCM |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+

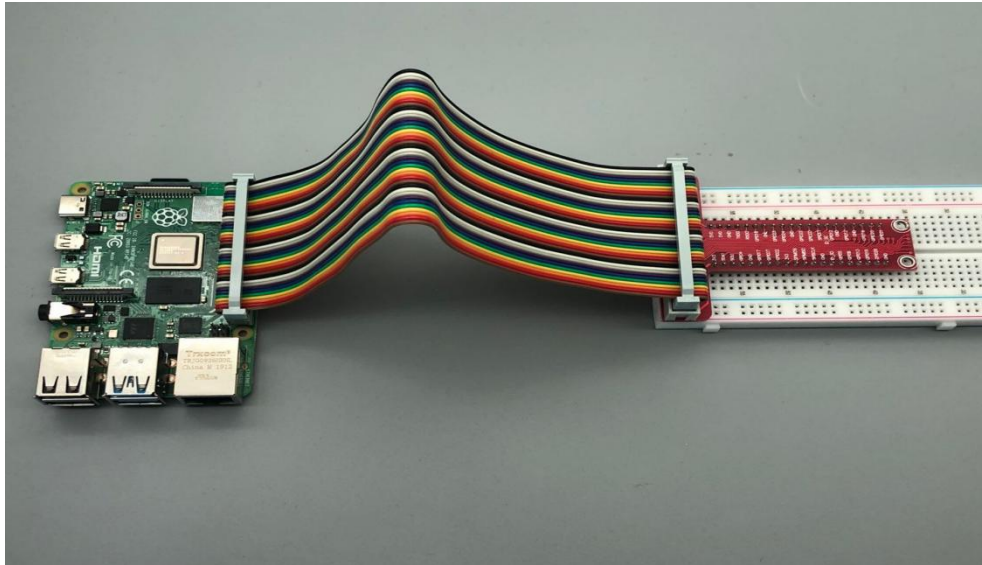
```

For more details about wiringPi, you can refer to: <http://wiringpi.com/download-and-install/>

# Raspberry Pi GPIO Extension Board

We apply the GPIO Extension Board to extend the pins of Raspberry Pi to the breadboard and avoid damage caused by frequent plugging and unplugging.

Here, we apply a 40-pin GPIO development board and a 40-pin GPIO cable. In case of the potential risk of short circuit, you must build your circuit in strict accordance with the following picture.



To improve your understanding of the relationship of the marked pins on 40-pin GPIO Extension Board and the pins of Raspberry Pi, we have drawn the following comparison chart.

Name	WiringPi	BCM	GPIO Extension Board				BCM	WiringPi	Name
3.3V	3V3	3V3	3V3	5V0	5.0V	5.0V	5.0V	5V	
SDA	8	2	SDA1	5V0	5.0V	5.0V	5.0V	5V	
SCL	9	3	SCL1	GND	GND	GND	GND	0V	
GPIO7	7	4	GPIO4	TXD0	14	15	TXD		
0V	GND	GND	GND	RXD0	15	16	RXD		
GPIO0	0	17	GPIO17	GPIO18	18	1	GPIO1		
GPIO2	2	27	GPIO27	GND	GND	GND	0V		
GPIO3	3	22	GPIO22	GPIO23	23	4	GPIO4		
3.3V	3.3V	3.3V	3.3V	GPIO24	24	5	GPIO5		
MOSI	12	10	SPIMOSI	GND	GND	GND	0V		
MISO	13	9	SPIMISO	GPIO25	25	6	GPIO6		
SCLK	14	11	SCLK	SPICE0	8	10	CEO		
0V	GND	GND	GND	SPICE1	7	11	CE1		
IN_SDA	30	0	ID_SD	ID_SC	1	31	ID_SCL		
GPIO21	21	5	GPIO5	GND	GND	GND	0V		
GPIO22	22	6	GPIO6	GPIO12	12	26	GPIO26		
GPIO23	23	13	GPIO13	GND	GND	GND	0V		
GPIO24	24	19	GPIO19	GPIO16	16	27	GPIO27		
GPIO25	25	26	GPIO26	GPIO20	20	28	GPIO28		
0V	GND	GND	GND	GPIO21	21	29	GPIO29		

# Download the Code

Before you download the code, please note that the example code is ONLY test on Raspbian. We provide two methods for download:

Method 1: Use git clone (Recommended)

Log into Raspberry Pi and then change directory to /home/pi.

```
cd /home/pi/
```

Note: cd to change to the intended directory from the current path. Informally, here

is to go to the path /home/pi/.