

Lesson 1 Hardware Control

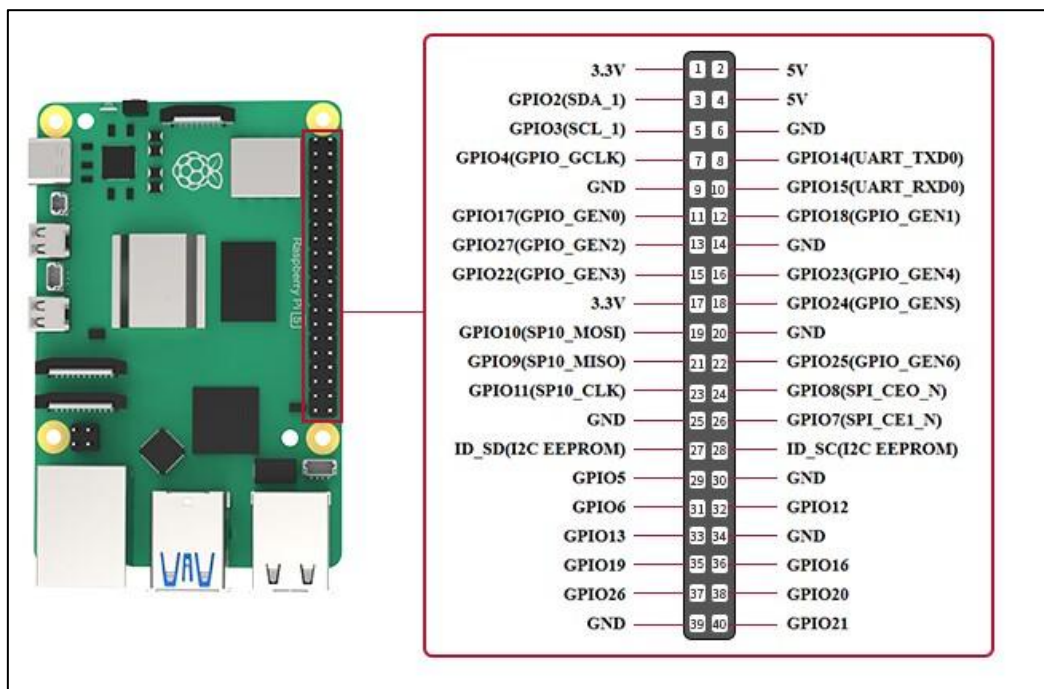
Environment Setup

1. GPIO Brief Introduction

GPIO (General Purpose Input/Output) port on Raspberry Pi is a set of pins used for connecting and controlling external electronic components. It is provided with multiple functions and can be used as digital and analog inputs and outputs.

2. GPIO Port Introduction

Raspberry Pi 5 features a 40-pin GPIO header with a voltage of 3.3v. Therefore, you should avoid connecting any voltage level higher than 3.3v to the GPIO pins on the Raspberry Pi 5 without using a voltage level converter. The functions of GPIO pins are shown in the following diagram:



3. GPIO Library Installation

Raspberry Pi GPIO library is a user-space library used to control the GPIO (General Purpose Input/Output) pins. It is based on the GPIOLIB abstract layer of the GPIO character device interface in the Linux kernel with a simple and flexible API. This allows developers to easily use C language and other programming languages to configure and control GPIO. Here is a demonstration of how to install the GPIO library.

1) Press “Ctrl+Alt+T” to open the command line terminal, then enter “pinout” and press “Enter” to view the pin numbers.

The screenshot shows a terminal window on a Raspberry Pi. The title bar reads 'pi@raspberrypi: ~'. The menu bar includes 'File', 'Edit', 'Tabs', and 'Help'. The command prompt is 'pi@raspberrypi:~\$' and the command 'pinout' has been entered. The output of the command is as follows:

```

Description      : Raspberry Pi 5B rev 1.0
Revision         : c04170
SoC              : BCM2712
RAM              : 4GB
Storage          : MicroSD
USB ports        : 4 (of which 2 USB3)
Ethernet ports   : 1 (1000Mbps max. speed)
Wi-fi            : True
Bluetooth        : True
Camera ports (CSI) : 2
Display ports (DSI): 2
  
```

Below the text output is a schematic diagram of the Raspberry Pi 5B rev 1.0. The diagram is green and shows various components and connectors. Key components labeled include: J8 (USB2), J14 (USB3), J7 (Net), J2 (bat), uart, pwr, hd, m0, m1, SoC, RAM, RP1, and fan. The diagram also shows the location of the Wi-Fi and Bluetooth modules.

```

J8:
  3V3 (1) (2) 5V
  GPIO2 (3) (4) 5V
  GPIO3 (5) (6) GND
  GPIO4 (7) (8) GPIO14
  GND (9) (10) GPIO15
  GPIO17 (11) (12) GPIO18
  GPIO27 (13) (14) GND
  GPIO22 (15) (16) GPIO23
  3V3 (17) (18) GPIO24
  GPIO10 (19) (20) GND
  GPIO9 (21) (22) GPIO25
  GPIO11 (23) (24) GPIO8
  GND (25) (26) GPIO7
  GPIO0 (27) (28) GPIO1
  GPIO5 (29) (30) GND
  GPIO6 (31) (32) GPIO12
  GPIO13 (33) (34) GND
  GPIO19 (35) (36) GPIO16
  GPIO26 (37) (38) GPIO20
  GND (39) (40) GPIO21

J2:
  RUN (1)
  GND (2)

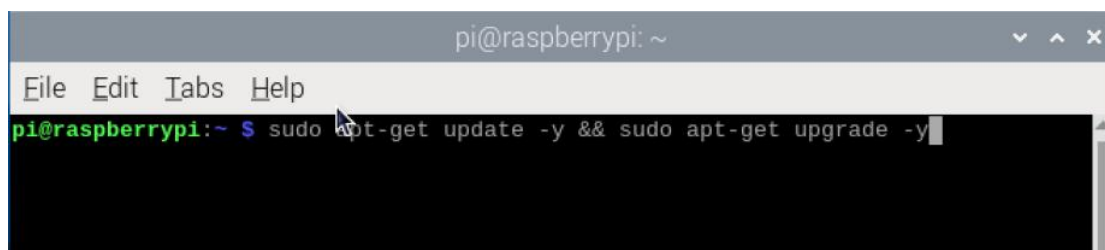
J7:
  COMPOSITE (1)
  GND (2)

J14:
  TR01 TAP (1) (2) TR00 TAP
  TR03 TAP (3) (4) TR02 TAP

For further information, please refer to https://pinout.xyz/

```

2) Enter the “`sudo apt-get update -y && sudo apt-get upgrade -y`” command to update the operation system and software packages.



```

pi@raspberrypi: ~
File Edit Tabs Help
pi@raspberrypi:~ $ sudo apt-get update -y && sudo apt-get upgrade -y

```

3) Enter the “`sudo apt-get autoremove -y && sudo apt-get autoclean -y`”

&& sudo apt-get clean -y” command to clean the unnecessary software packages and cache files in the system.



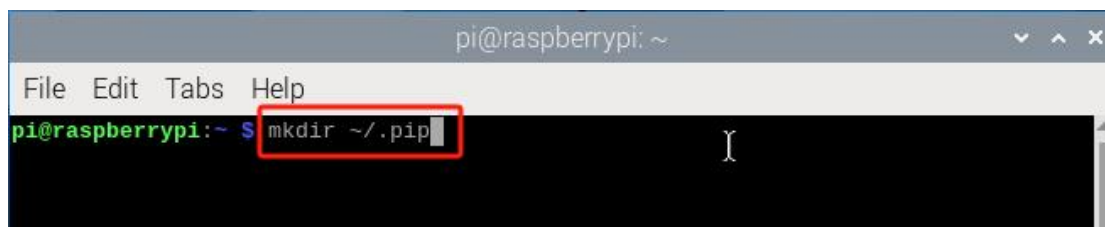
```
pi@raspberrypi: ~  
File Edit Tabs Help  
pi@raspberrypi:~ $ sudo apt-get autoremove -y && sudo apt-get autoclean -y && sudo apt-get clean -y
```

4) Enter the “sudo apt-get remove --purge --auto-remove firefox geany -y” command to clean “Firefox” and “Geany” software packages in the system.



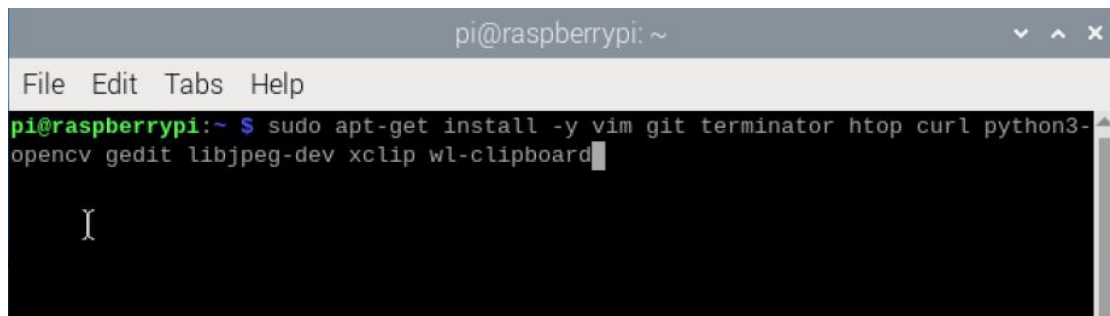
```
pi@raspberrypi: ~  
File Edit Tabs Help  
pi@raspberrypi:~ $ sudo apt-get remove --purge --auto-remove firefox geany -y
```

5) Enter the “sudo apt-get install -y vim git terminator htop curl python3-opencv gedit libjpeg-dev xclip wl-clipboard” command to install multiple software packages.



```
pi@raspberrypi: ~  
File Edit Tabs Help  
pi@raspberrypi:~ $ mkdir ~/.pip
```

6) Enter the “mkdir ~/.pip” command to create a directory named “.pip” in home directory.



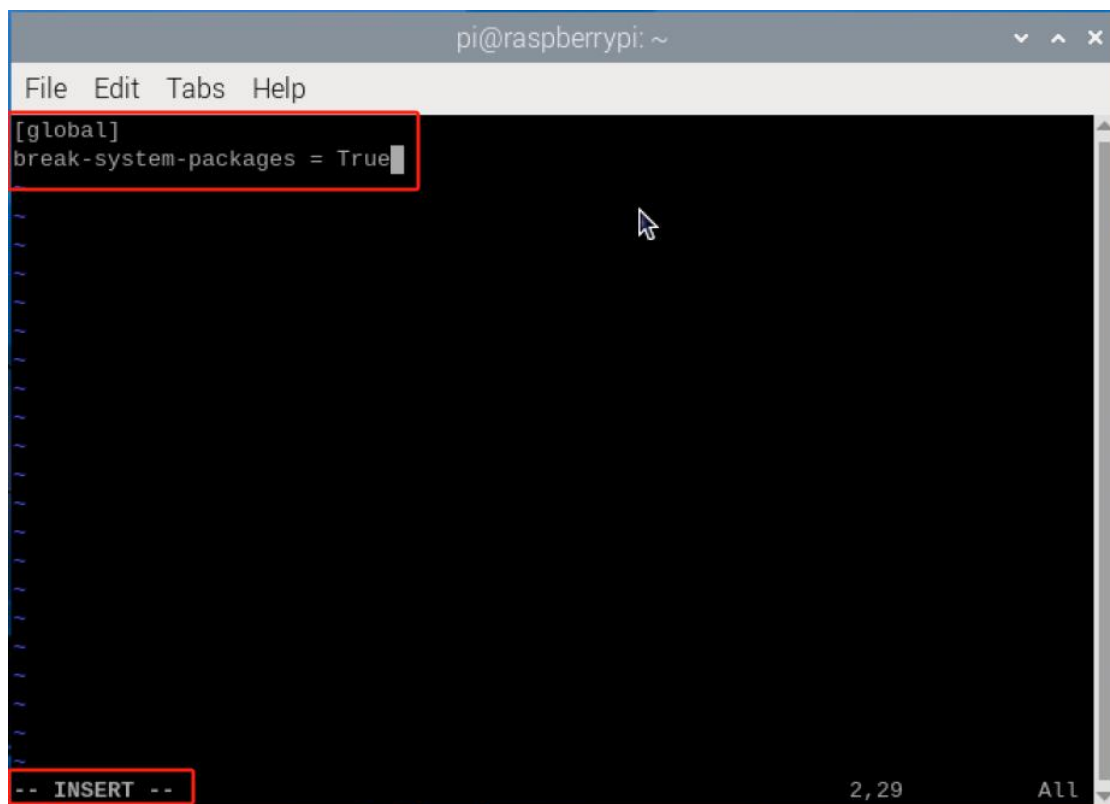
```
pi@raspberrypi: ~  
File Edit Tabs Help  
pi@raspberrypi:~ $ sudo apt-get install -y vim git terminator htop curl python3-  
opencv gedit libjpeg-dev xclip wl-clipboard
```

7) Enter the “vim ~/.pip/pip.conf” command to open the “pip.conf” file.



```
pi@raspberrypi: ~  
File Edit Tabs Help  
pi@raspberrypi:~ $ vim ~/.pip/pip.conf
```

8) Press the “i” key to enter the editable mode and enter the following code.



```
pi@raspberrypi: ~  
File Edit Tabs Help  
[global]  
break-system-packages = True
```

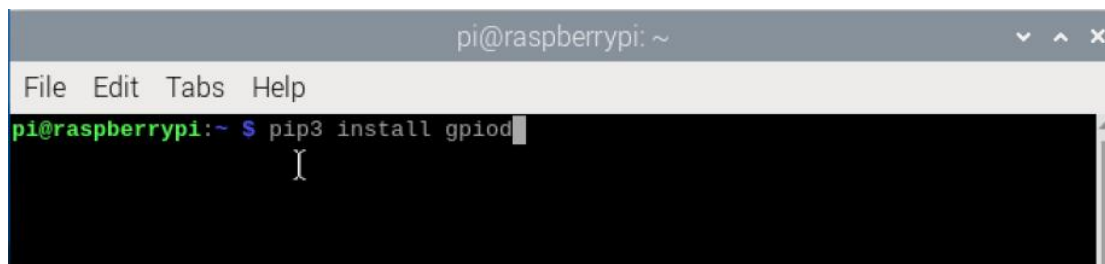
-- INSERT --

2, 29 All

9) After that, press “Esc” key to enter the “:wq”, then press “Enter” to save the file and exit.



10) Enter the “pip3 install gpiod” command to install the “gpiod” Library.



11) After the installation is complete, enter the “gpiodetect” to scan the GPIO port in the system. If the installation is successful, you can see the corresponding information about the GPIO controller and the port.

