

Table of Contents



- [1. What is Raspberry Pi?](#)
- [2. Models of Raspberry Pi](#)
- [3. Setting Up Raspberry Pi](#)
 - [What You Need:](#)
 - [Steps:](#)
- [4. First Boot & Configuration](#)
- [5. Useful Commands](#)
- [6. Enable SSH for Remote Access](#)
- [7. GPIO \(General Purpose Input/Output\)](#)
 - [Pinout Diagram \(Important Pins\):](#)
- [8. Basic Python GPIO Control](#)
- [9. Install and Update Software](#)
- [10. Connecting to WiFi \(CLI\)](#)
- [11. Install VNC \(Remote Desktop\)](#)
- [12. Basic Projects to Try](#)
- [13. Camera Module \(PiCam\)](#)
- [14. I2C and SPI \(For Sensors/Modules\)](#)
- [15. Backup and Restore Raspberry Pi](#)
- [16. Python Libraries for Raspberry Pi](#)
 - [Example Project: Temperature Logger](#)

1. What is Raspberry Pi?

- Raspberry Pi is a low-cost, credit-card-sized computer developed by the Raspberry Pi Foundation.
 - Used For:
 - Learning to program
 - IoT projects
 - Robotics
 - Home automation
 - Media centers
-

2. Models of Raspberry Pi

- Raspberry Pi 5 (2GB/4GB/8GB RAM)
 - Raspberry Pi 4 (2GB/4GB/8GB RAM)
 - Raspberry Pi 3 Model B/B+
 - Raspberry Pi Zeros (Compact version)
 - Raspberry Pi Picos (Microcontroller)
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3. Setting Up Raspberry Pi

What You Need:

- Raspberry Pi Board
- microSD Card (16GB+ recommended)
- Power Supply (USB-C for Pi 4, Micro-USB for Pi 3)
- HDMI Cable and Monitor
- Keyboard & Mouse
- Internet (Ethernet/WiFi)

Steps:

1. Download Raspberry Pi OS:
<https://www.raspberrypi.org/software/>
 2. Flash OS to microSD:
Use Raspberry Pi Imager or balenaEtcher to write the OS to the card.
 3. Insert microSD Card: Insert into Pi's slot.
 4. Connect Peripherals: Attach keyboard, mouse, and HDMI.
 5. Power On: Connect power. Pi will boot.
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4. First Boot & Configuration

`sudo raspi-config`

- Change User Password

- Set WiFi (Network Options)
 - Enable SSH, I2C, SPI (Interface Options)
 - Expand Filesystem (Advanced)
 - Set Locale and Timezone
-

5. Useful Commands

```
sudo apt update && sudo apt upgrade # Update system
sudo reboot                         # Reboot
sudo shutdown -h now                # Shutdown
ifconfig                            # Show IP address
ping google.com                     # Test internet connection
```

6. Enable SSH for Remote Access

1. Run:

```
sudo systemctl enable ssh
sudo systemctl start ssh
```

2. Connect via SSH (from another computer):

```
ssh pi@<Raspberry_Pi_IP>
```

Default Login:

- Username: pi
 - Password: raspberry
-

7. GPIO (General Purpose Input/Output)

- 40-Pin Header (Raspberry Pi 4/3): Used for electronics and sensors.
- Voltage Levels:

- 3.3V Logic (Pins can be damaged by 5V)
- GPIO Pins: Control LEDs, read sensors.

Pinout Diagram (Important Pins):

Pin	Function
1 (3.3V)	Power
2 (5V)	Power
6 (GND)	Ground
7 (GPIO4)	General Purpose I/O
11 (GPIO17)	Control LEDs/Sensors

8. Basic Python GPIO Control

```
import RPi.GPIO as GPIO
import time

GPIO.setmode(GPIO.BCM) # Use BCM pin numbering
GPIO.setup(18, GPIO.OUT)

while True:
    GPIO.output(18, GPIO.HIGH) # LED On
    time.sleep(1)
    GPIO.output(18, GPIO.LOW)  # LED Off
    time.sleep(1)
```

- Run Script:

```
python3 led.py
```

9. Install and Update Software

```
sudo apt install python3-pip # Install pip for Python 3
sudo apt install git         # Install Git
```

```
pip3 install flask
```

```
# Install Flask (Web Development)
```

10. Connecting to WiFi (CLI)

```
sudo nano /etc/wpa_supplicant/wpa_supplicant.conf
```

Add:

```
network={
    ssid="Your_WiFi_Name"
    psk="Your_WiFi_Password"
}
```

Save and reboot:

```
sudo reboot
```

11. Install VNC (Remote Desktop)

```
sudo apt install realvnc-vnc-server
```

```
sudo systemctl enable vncserver-x11-serviced
```

- Access the Pi desktop from another computer using VNC Viewer.
-

12. Basic Projects to Try

- LED Blinking
- Temperature Sensor (DS18B20)
- Web Server (Flask or Node-RED)
- Media Center (Install Kodi)
- Home Automation (Relays, Sensors)

13. Camera Module (PiCam)

`sudo raspi-config`

- Enable Camera Interface.
- Capture Image:

`raspistill -o image.jpg`

- Record Video:

`raspivid -o video.h264 -t 10000 # 10 seconds`

14. I2C and SPI (For Sensors/Modules)

`sudo raspi-config`

- Enable I2C or SPI under Interface Options.
- Install tools:

`sudo apt install i2c-tools`

- Detect I2C Devices:

`i2cdetect -y 1`

15. Backup and Restore Raspberry Pi

- Backup SD Card (Linux/Mac):

`sudo dd if=/dev/sdX of=backup.img bs=4M`

- Restore Backup:

```
sudo dd if=backup.img of=/dev/sdX bs=4M
```

16. Python Libraries for Raspberry Pi

- GPIO Control: RPi.GPIO
 - Sensors (I2C): smbus2
 - Web Development: Flask
 - AI/ML: TensorFlow Lite
 - GUI: tkinter
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Example Project: Temperature Logger

```
import Adafruit_DHT
import time

sensor = Adafruit_DHT.DHT11
pin = 4 # GPIO pin

while True:
    humidity, temperature = Adafruit_DHT.read_retry(sensor, pin)
    if humidity is not None and temperature is not None:
        print(f"Temp: {temperature:.1f}C Humidity: {humidity:.1f}%")
    else:
        print("Failed to retrieve data.")
    time.sleep(2)
```