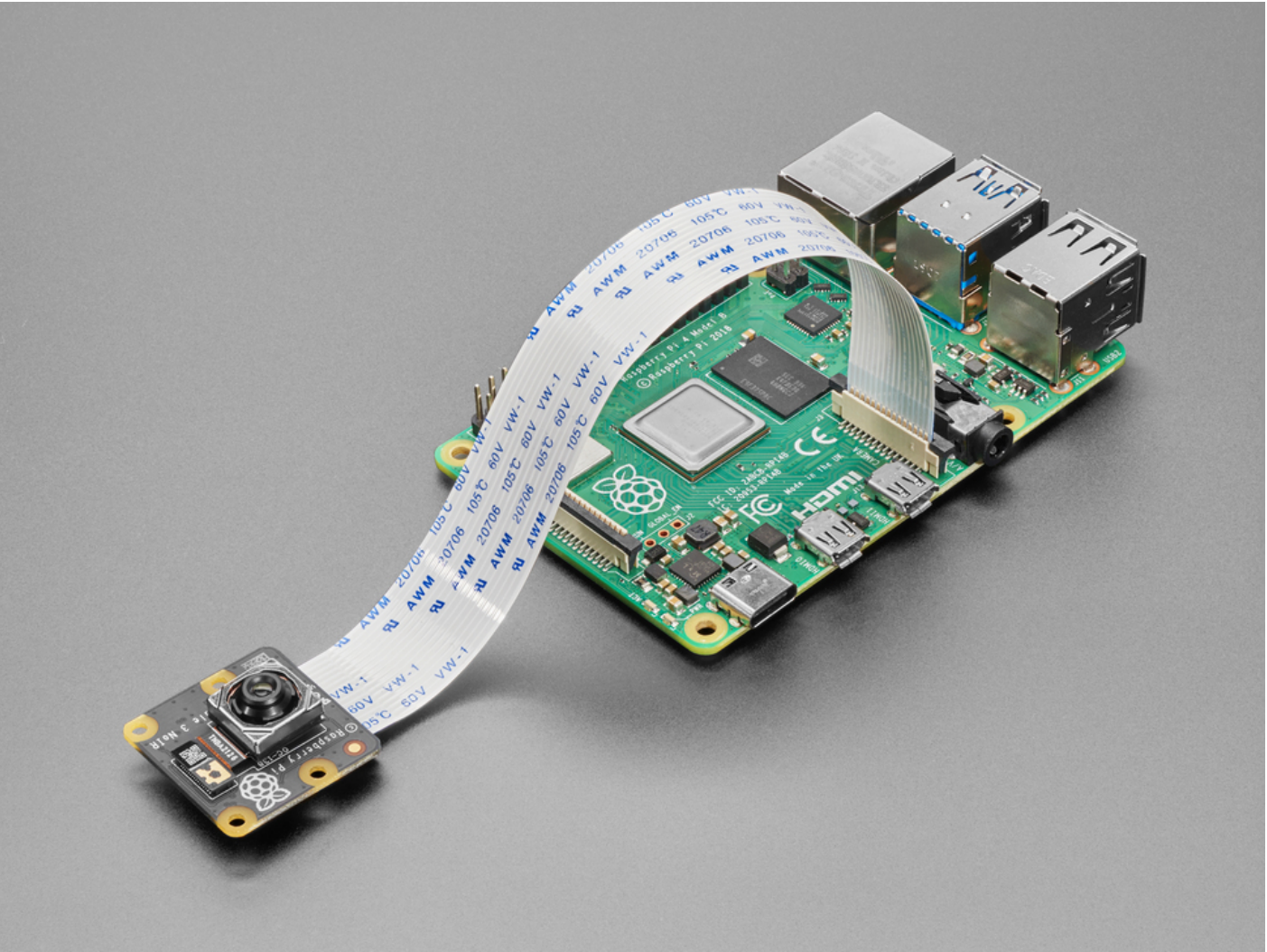


How to use Raspberry Pi Camera Module 3

What is Raspberry Pi Camera Module 3?

This tutorial will walk you through setting up and using the Raspberry Pi Camera Module 3 Noir on a Raspberry Pi 5, but other Pi like Pi 3 and Pi 4 will work as well.



Camera Module 3 — Key Features

Feature	Description
Sensor	Sony IMX708
Resolution	12MP (4608 × 2592)
Autofocus	<input type="checkbox"/> Yes (PDAF or EDOF depending on model)

Feature	Description
HDR	☐ Available on certain models
FoV Variants	Standard & Wide-angle
IR Version	Available (NoIR version)
Interface	CSI-2 via 22-pin MIPI ribbon cable
OS Support	Raspberry Pi OS Bookworm or later

Requirements

Hardware

- Raspberry Pi (Pi 3 or later)
- Camera Module 3 (ensure it's a v3 model)
- Camera ribbon cable (22-pin), **Pi5 will need a 22pin to 15pin ribbon cable**
- Power supply & HDMI or SSH access

Software

- Raspberry Pi OS Bookworm (64-bit recommended)
- Camera support via libcamera stack
- picamera2 Python library

Physical Connection

1. Power off your Pi.
2. Locate the CSI camera port on the board (next to the HDMI ports).
3. Gently lift the connector latch.
4. Insert the ribbon cable on the Pi: **the blue tab faces the Ethernet port**, metal pins toward HDMI.
5. Insert the ribbon cable on the camera: **blue side usually faces away from the camera sensor**.
6. Close the latch and ensure it's snug.
7. Power on the Pi.

Enable I2C communication

1. `sudo raspi-config`
2. Interface Options -> I2C -> Enable
3. `sudo reboot`

Update OS & Install Required Packages

```
sudo apt update && sudo apt upgrade -y  
sudo apt install -y libcamera-apps python3-picamera2 python3-opencv
```

Test Camera via Terminal

1. Basic Camera Preview (HDMI required): `libcamera-hello`
2. Take a Photo: `libcamera-jpeg -o test.jpg`
3. Record a Video (10 seconds): `libcamera-vid -t 10000 -o test.h264`

Testing Code

Python Code Using picamera2

This code will pop a new window of live preview with autofocus.

```
from picamera2 import Picamera2  
from libcamera import controls  
import time  
  
picam2 = Picamera2()  
picam2.start(show_preview=True)  
  
# Enable continuous autofocus  
picam2.set_controls({"AfMode": controls.AfModeEnum.Continuous})  
  
print("Camera feed started. Press Ctrl+C to stop.")  
try:  
    while True:  
        time.sleep(1)  
except KeyboardInterrupt:  
    picam2.stop()  
    print("Camera stopped.")
```

Face Detection Example with OpenCV

1. Download the Haar Cascade XML and saved it in a folder called `haarcascades`. `wget -P ~ https://github.com/opencv/opencv/raw/master/data/haarcascades/haarcascade_frontalface_default.xml`

```
import cv2  
import numpy as np  
from picamera2 import Picamera2  
from libcamera import controls  
import warnings
```

```
# Suppress the specific warning from OpenCV
warnings.filterwarnings("ignore", category=UserWarning, module="cv2")

# Initialize the Picamera2 instance
picam2 = Picamera2()

# Start the camera (no preview for better performance during processing)
picam2.start()

# Set autofocus to continuous mode
picam2.set_controls({"AfMode": controls.AfModeEnum.Continuous})

# Manually specify the path to the Haar Cascade file
face_cascade = cv2.CascadeClassifier('/home/pi/haarcascades/haarcascade_frontalface_default.xml') # Adjust
this path if necessary

# Check if the cascade classifier is loaded properly
if face_cascade.empty():
    print("Error loading Haar Cascade classifier. Make sure the path is correct.")
    exit()

# Start capturing frames and detecting faces
while True:
    # Capture a frame from the camera
    frame = picam2.capture_array()

    # Check if the frame was captured successfully
    if frame is None:
        print("Failed to capture frame.")
        break

    # Convert the image to grayscale (required for Haar Cascade)
    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)

    # Detect faces in the image
    faces = face_cascade.detectMultiScale(gray, 1.1, 4)

    # Loop through the faces and draw rectangles around them
    for (x, y, w, h) in faces:
        # Draw a thin rectangle (face bounding box) around the detected face
```

```
cv2.rectangle(frame, (x, y), (x + w, y + h), (0, 255, 0), 2)

# Show the frame with the face(s) detected
# Convert the frame to a simpler BGR format or grayscale
frame = cv2.cvtColor(frame, cv2.COLOR_BGR2RGB) # Convert to RGB
cv2.imshow("Face Detection", frame)

# If the 'q' key is pressed, exit the loop
if cv2.waitKey(1) & 0xFF == ord('q'):
    break

# Clean up
picam2.stop() # Stop the camera
cv2.destroyAllWindows() # Close all OpenCV windows
```

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