**Raspberry Pi Camera Module 2 & 3 Setup Guide**

**Hardware Setup:**

1. Connect the Raspberry Pi Camera Module to the CSI port on the Raspberry Pi board.
2. Ensure the ribbon cable is securely connected with the blue side facing away from the board.
3. Power on the Raspberry Pi and access it via SSH or directly using a monitor.

**Enable Camera Interface:** Run the following command and enable the camera interface:

sudo raspi-config

* Navigate to **Interfacing Options**.
* Select **Camera** and enable it.
* Reboot the Raspberry Pi:

sudo reboot

**Checking Camera Detection:** Run the following command to verify the camera is detected:

libcamera-hello

If the camera is detected, you'll see a preview window appear. If not, recheck the cable connections and camera enablement settings.

**Installing Required Libraries for Image Processing:** For Python and YOLOv8 integration, install the following packages using a virtual environment:

**Step 1: Create a Virtual Environment**

python3 -m venv yolov8-env

source yolov8-env/bin/activate

**Step 2: Install Required Packages**

pip install ultralytics numpy opencv-python

**Basic Camera Test with Python:**

import cv2

# Initialize the camera

cap = cv2.VideoCapture(0)

if not cap.isOpened():

print("Error: Could not open camera.")

exit()

while True:

ret, frame = cap.read()

if not ret:

print("Error: Failed to capture image.")

break

cv2.imshow('Camera Feed', frame)

# Press 'q' to exit

if cv2.waitKey(1) & 0xFF == ord('q'):

break

cap.release()

cv2.destroyAllWindows()

**YOLOv8 Integration for Object Detection:**

from ultralytics import YOLO

import cv2

model = YOLO('yolov8n.pt')

cap = cv2.VideoCapture(0)

while True:

ret, frame = cap.read()

if not ret:

break

results = model(frame)

annotated\_frame = results[0].plot()

cv2.imshow('YOLOv8 Detection', annotated\_frame)

if cv2.waitKey(1) & 0xFF == ord('q'):

break

cap.release()

cv2.destroyAllWindows()

**Object Detection with Saving Results:**

from ultralytics import YOLO

import cv2

model = YOLO('yolov8n.pt')

cap = cv2.VideoCapture(0)

frame\_count = 0

while True:

ret, frame = cap.read()

if not ret:

break

results = model(frame)

annotated\_frame = results[0].plot()

cv2.imshow('YOLOv8 Detection', annotated\_frame)

# Save captured frames with detection results

cv2.imwrite(f'detection\_{frame\_count}.jpg', annotated\_frame)

frame\_count += 1

if cv2.waitKey(1) & 0xFF == ord('q'):

break

cap.release()

cv2.destroyAllWindows()

**Common Issues and Solutions:**

1. **libcamera-hello not found:**
   * Run sudo apt install -y libcamera-apps.
2. **Camera not detected:**
   * Ensure the camera is connected properly, and enabled via raspi-config.
3. **pip install errors in system Python:**
   * Use a virtual environment as shown above to avoid this error.

**Future Enhancements:**

* Add image capturing and saving functionality.
* Integrate OpenCV functions to apply filters and edge detection.
* Combine with YOLOv8 for real-time object detection and tracking.