Code Workflow: YOLO-Based Person Counter

1. Import Libraries

   - cv2: Handles video processing and drawing.

   - numpy: For numerical operations.

   - csv: Saves entry/exit logs.

   - time: Generates timestamps.

   - scipy.spatial.distance: Calculates the distance between detected objects for tracking.

2. Load YOLO Model

   - The YOLOv4 model is loaded using cv2.dnn.readNet().

   - Output layers are extracted to process detections.

3. Load Class Names

   - Reads coco.names to get object categories (e.g., person, car, dog).

4. Initialize Video Capture

   - Opens a CCTV video file using cv2.VideoCapture().

   - Retrieves frame width and height.

5. Define the Counting Line

   - A vertical line is placed at the middle of the frame.

6. Initialize Counters and Tracking Variables

   - entry_count and exit_count are set to zero.

- tracked_objects stores detected persons with unique IDs.
- next_person_id assigns IDs to new people.

7. Create and Open CSV File for Logging
- A person_log.csv file is created with headers: Timestamp, Person_ID, Action.

8. Define Log Function
- When a person enters or exits, the function logs:
  - Timestamp
  - Person ID
  - Action ("Entered" or "Exited")

9. Process Each Video Frame
- Converts the frame into a YOLO-compatible format.
- Runs the YOLO model to detect objects.
- Filters detections to keep only "person" objects.

10. Assign Unique IDs and Track Movement
- Matches new detections with previously tracked persons using Euclidean distance.
- Assigns a new ID if no match is found.

11. Check if Person Crosses the Counting Line
- If a person moves left to right, they entered.
- If a person moves right to left, they exited.
- Updates entry_count and exit_count accordingly.
- Logs the event in person_log.csv.

12. Draw Bounding Boxes and Labels

- Draws a blue rectangle around each detected person.
- Labels them as "Person {ID}".

13. Draw Virtual Counting Line

- A green vertical line is displayed at the center.

14. Display Video and Process Frames Continuously

- Reads each frame, detects persons, updates counters, and logs data.
- The processed video is displayed in a window.
- Press 'q' to exit.

15. Release Resources

- Closes video capture and destroys all OpenCV windows.

Summary:

- Detects people using YOLOv4.
- Tracks their movement and assigns unique IDs.
- Counts people entering/exiting an area.
- Logs data into person_log.csv with timestamps.
- Displays real-time detection with bounding boxes.