

Lab 9 - Object Detection with OpenCV (Python)

Tigist Wondimneh
GSR/5506/17

Github - [Link](#)

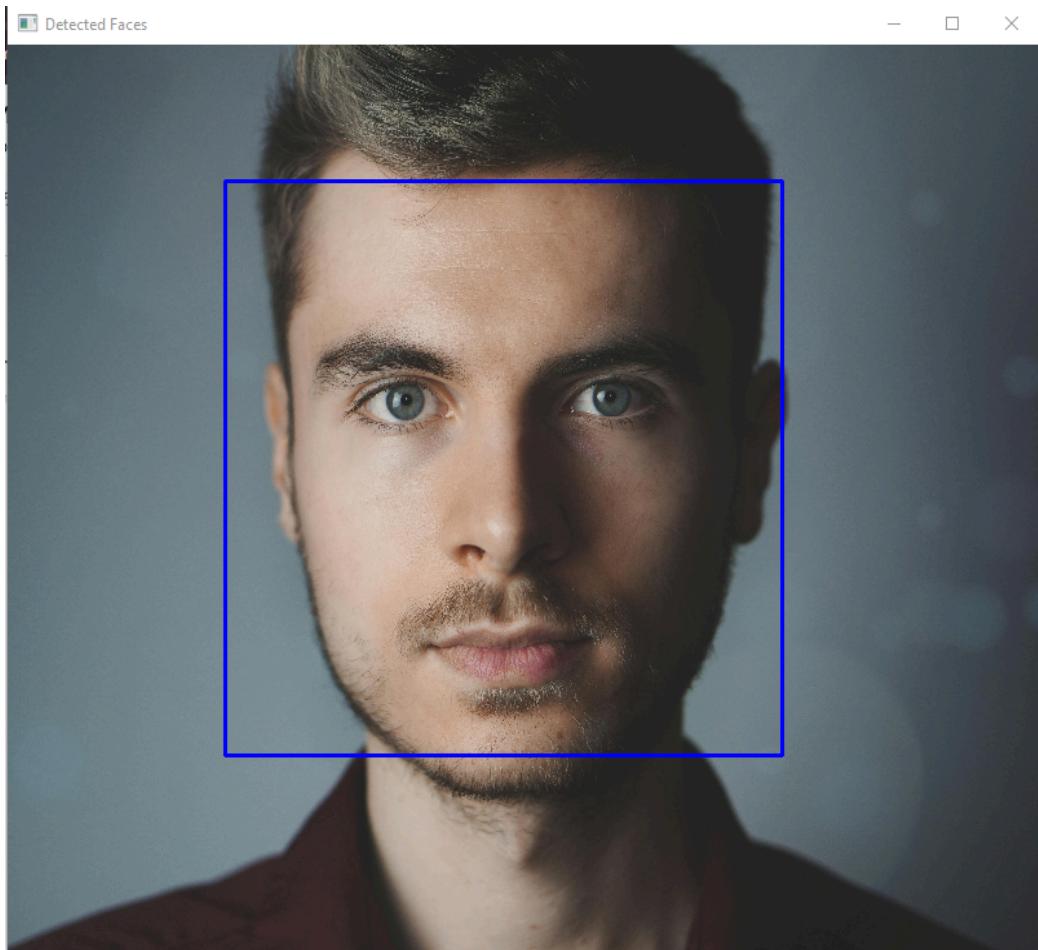
1. Objective

To implement and analyze classical object detection techniques in OpenCV using **Haar Cascades** and **HOG + SVM**, and to extend the work with suggested exercises.

2. Experiments & Results

2.1 Face Detection with Haar Cascades

- Implemented using `haarcascade_frontalface_default.xml`.
- Input: static image of faces.
- Output: bounding boxes drawn around detected faces.

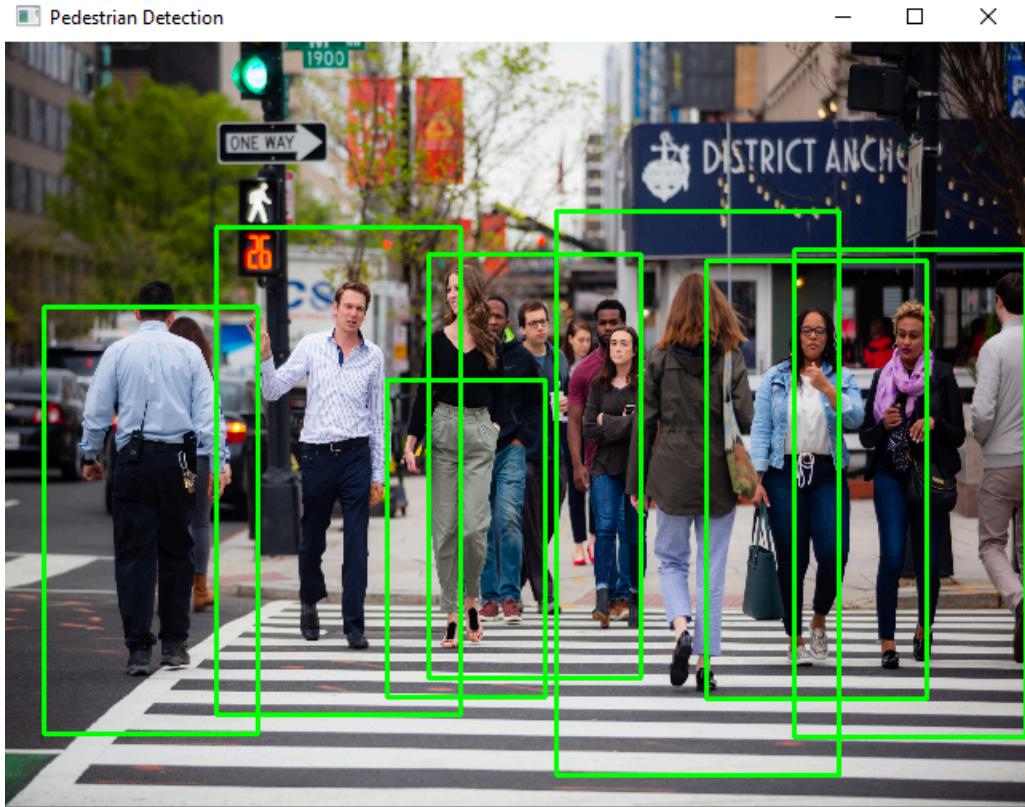


Summary:

- Faces were successfully detected with rectangular bounding boxes.
- Performance is fast, but accuracy is sensitive to lighting and image orientation.

2.2 Pedestrian Detection with HOG + SVM

- Implemented using `cv2.HOGDescriptor()` with the default people detector.
- Input: pedestrian image.
- Output: bounding boxes around detected people.

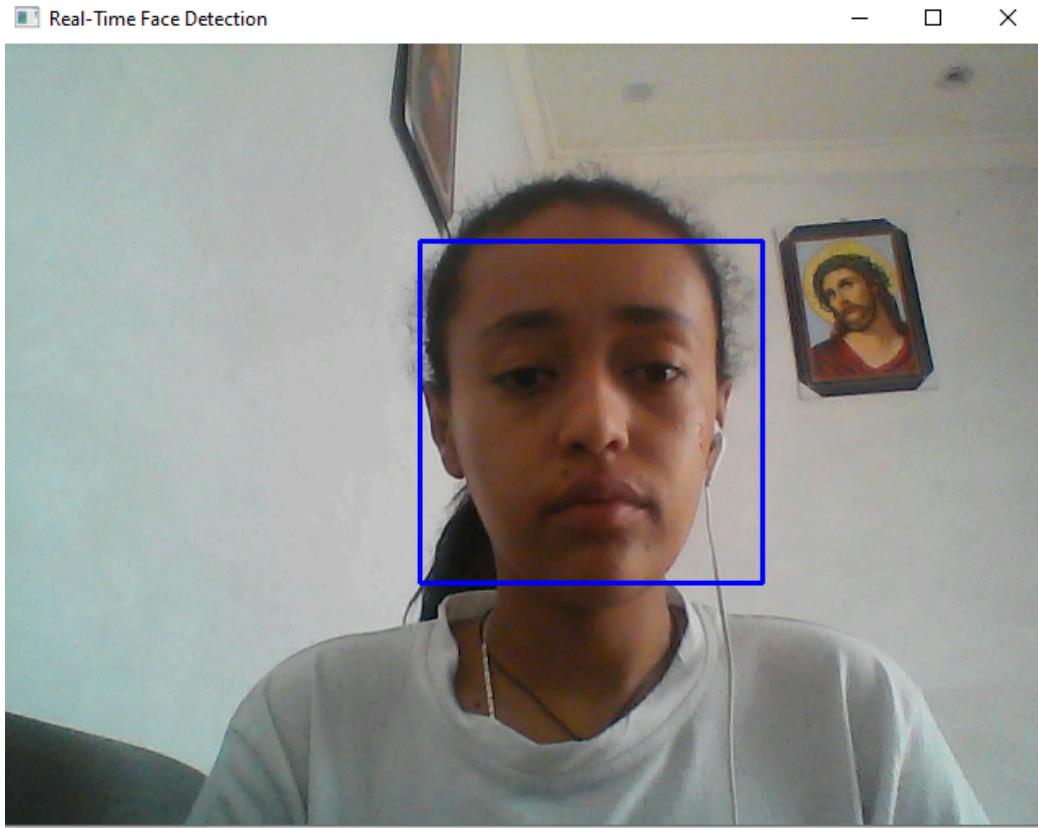


Summary:

- Pedestrians were detected with green bounding boxes.
- The detector works well for upright, full-body pedestrians.
- False positives may occur in cluttered backgrounds.

2.3 Real-Time Face Detection with Webcam

- Implemented live detection using Haar cascades.
- Input: webcam feed.
- Output: bounding boxes around faces in real time.



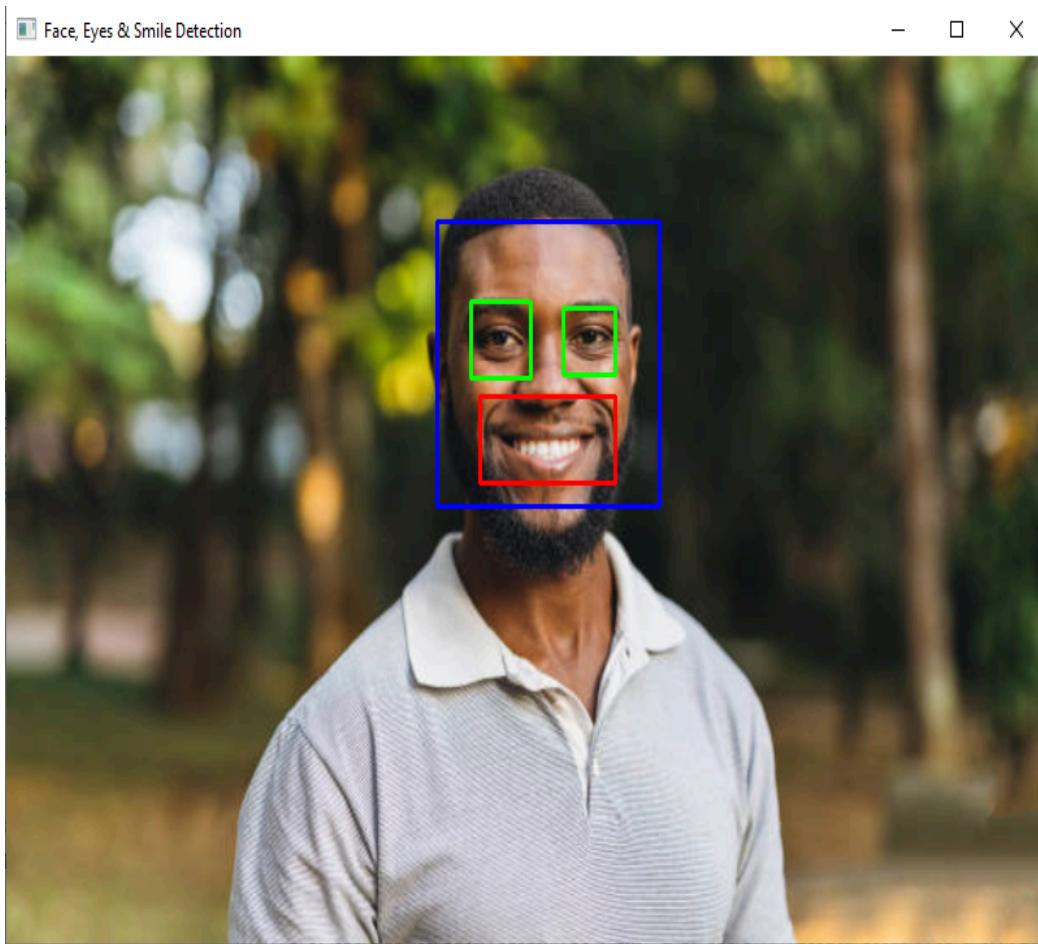
Summary:

- Real-time detection works at good speed on CPU.
- Accuracy decreases in poor lighting or when faces are tilted.

3. Suggested Exercises

3.1 Detect Eyes or Smiles

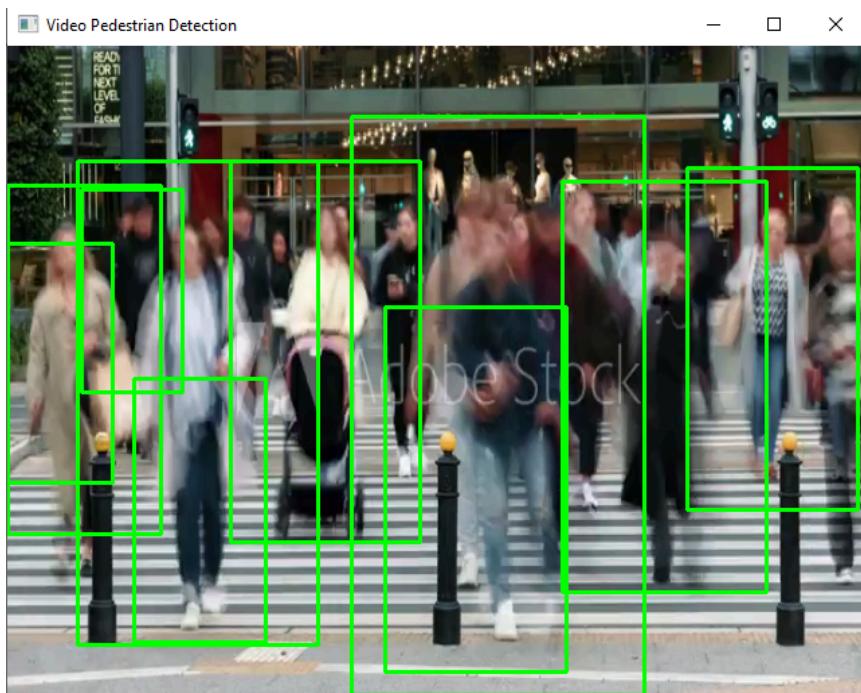
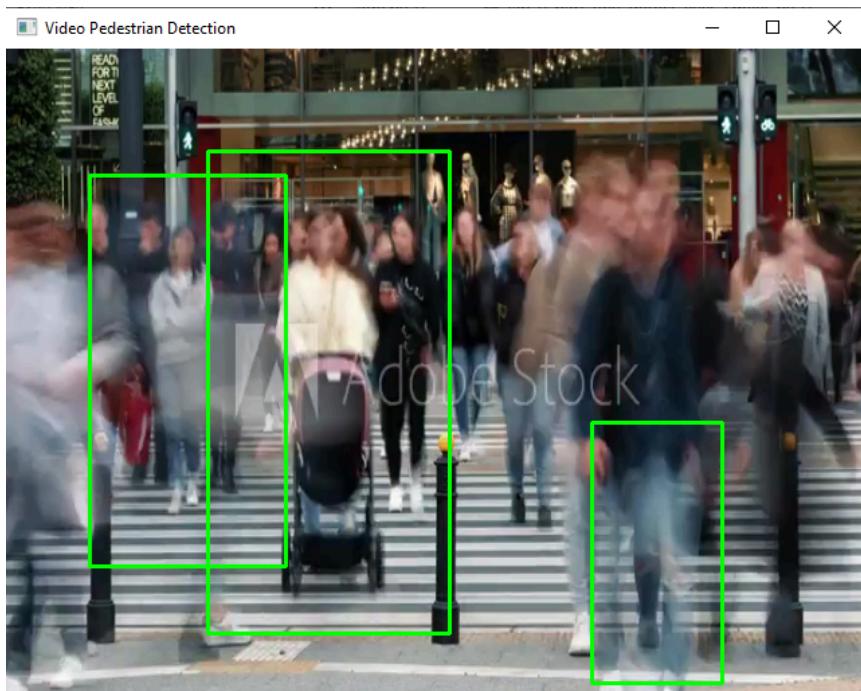
- Implemented using `haarcascade_eye.xml` and `haarcascade_smile.xml`.



Summary:

- Eyes and smiles can be detected.
- Smile detection is more prone to false positives.

3.2 Detect People from a Video File

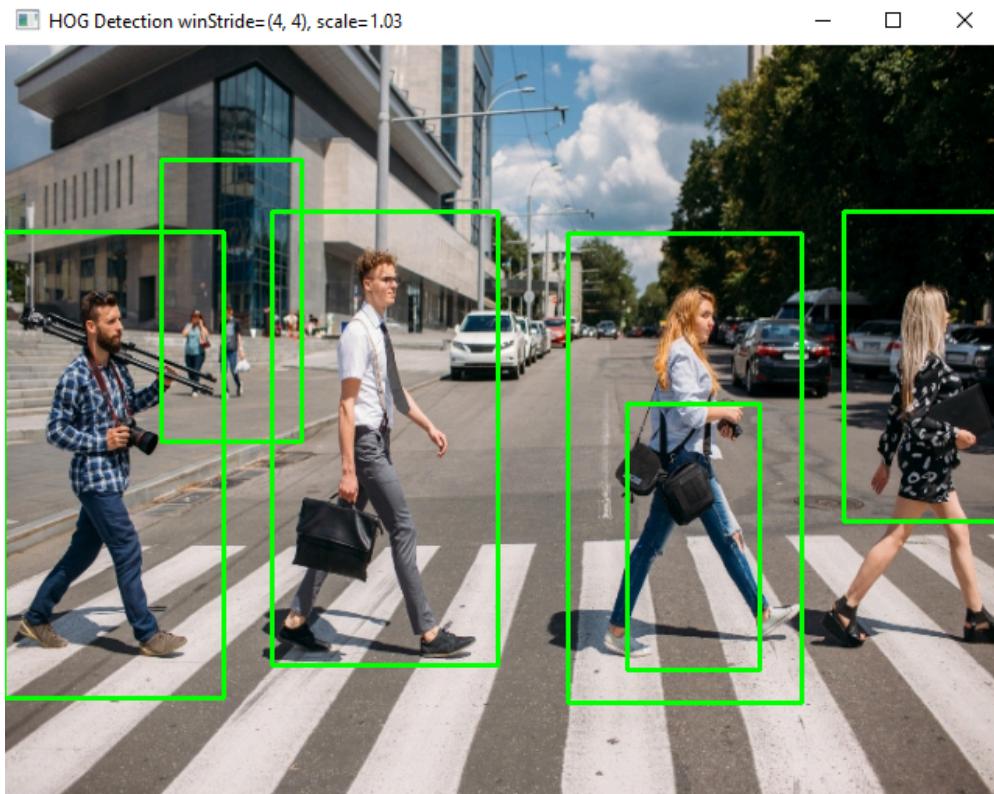


Summary:

- Pedestrian detection worked frame-by-frame.
- Accuracy depends on resolution and camera angle.

3.3 Tuning HOG Parameters

- Adjusted parameters such as `winStride`, `padding`, and `scale`.

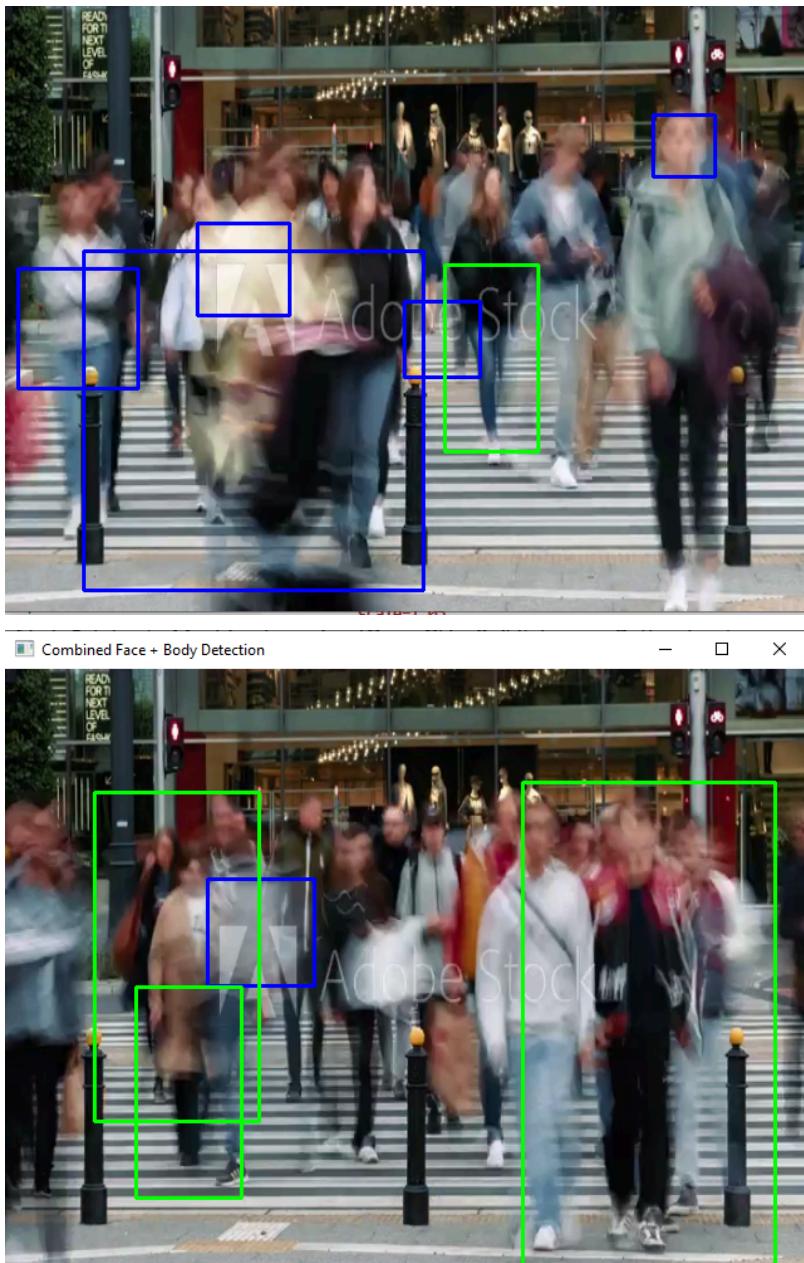


Summary:

- Smaller `winStride` increases accuracy but reduces speed.
- Larger `scale` makes detection faster but misses smaller pedestrians.

3.4 Combined Face + Body Detection

- Integrated Haar face detection with HOG pedestrian detection in the same pipeline.



Summary:

- Both faces and bodies detected simultaneously.
- Useful for surveillance and crowd analysis applications.

4. Summary

- Haar Cascades are **fast but less robust** to variations in lighting and pose.

- HOG + SVM is **more robust** for pedestrian detection, especially in controlled environments.
- Combining detectors improves versatility but may increase computational cost.
- Classical methods run in real time on CPUs, but deep learning-based detectors would provide higher accuracy.