LAB 3

1 Introduction:

The purpose of this lab is to practice embedded application development. There are various I/O interfaces on the E9V3 board, you need to use some of these interfaces to develop an application. The basic requirement is to get input, process it, and generate an output that may be used for a certain predefined purpose. For example, taking a video signal, processing it, and doing something based on the processed result. Due to the quick advance in both processor performance and signal processing algorithms, pattern recognition—more specifically, face recognition—has become mature and popular, and we could easily find it being used in some security applications such as passport control in the airport. Similarly, safety-oriented recognition has also become popular in real-world deployments, such as helmet detection on construction sites, PPE compliance monitoring, and traffic rider safety. In this lab, you need to implement a system that performs face recognition and helmet detection.

Deadline: Nov. 6th, 2025

2 Requirements:

2.1 Take a video input from the video camera, which is connected to the board, so the video can be displayed on the monitor (HDMI or LCD is both fine).

2.2 Detecting a human face, which can be done by using public domain algorithms.

2.3 Extract features from the detected human face, it can also be done by using public domain algorithms.

2.4 Based on the detected features, try to design an algorithm that can identify an individual, such as yourself. The algorithm must extract certain features which can be processed for identification purposes.

2.5 Design an algorithm capable of detecting whether a person is wearing a helmet. This functionality can be implemented using existing public domain algorithms.

3 Grading Criteria:

3.1 Real-time Facial Recognition (30%)

3.1.1 Detect three people simultaneously using the camera: two group members and the others, Display student IDs for group members and "unknown" for others.

3.1.2 Three evaluation criteria

(1) Able to detect three faces — required to draw bounding boxes around the three faces. (10%)

(2) Able to accurately and in real-time recognize three faces — must identify the two group members by student ID and label others as “unknown”; significant delays are acceptable. **The recognition time must not exceed 30 seconds.** (10%)

(3) Able to accurately and in **real-time** recognize three faces, with minimal delay when the camera moves. **The recognition time must not exceed 10 seconds.** (10%)

3.1.3 Important Notes

※**In 3.1.2 (2)**, the face-recognition delay is measured between frames.

※**In 3.1.2 (3)**, the face-recognition delay means the time it takes after you move for the detector to re-acquire and correctly redraw the bounding box on your face.

※**In 3.1.2 (2) and (3),** the output must be stable: the bounding box and label should not jitter or flicker.

3.2 Helmets Detection (65%)

3.2.1 Given a hidden photo, accurately detect whether 10 people are wearing helmets correctly. (15%)

3.2.2 Performance (50%)
Evaluate each group’s count accuracy on the hidden test photo. Groups are ranked class-wide by count accuracy, and points are assigned according to rank.

3.2.3 Important Notes

※The hidden test photo will be revealed in the final week (11/6). Before then, you may test your model with self-prepared images to verify counting accuracy.

※The hidden test photo would be a **JPG file (within 6000*4000 pixels)**.

※On the day of the final demo (November 6), all teams will present their demos at **8:50 PM**. Each team has **only one chance to demo**, so please make sure your program can generate the result **within 20 minutes** and **save it as a JPG file**. The demo results will be announced before the next class.

※During the final demo, you need to **immediately display the detected image on the screen** once your image detection program finishes running, and **save the detection output as a JPG file** so that you can upload it to E3.

※In the detection result, you **only need to label people wearing helmets**. You do **not** need to label those **without helmets**. An example is shown in the figure below.

※In this lab, the make-up demo scoring for all other parts follows Lab0. However, the scoring for **3.2.2** is as follows:

- Demo on site: 100% of the points
- Demo in the next week: 60% of the points
- Late submission: 40% of the points

3.3 Report (5%, due 11/20)

You also need to hand in a project report (either in English or Chinese) that describes your system, including how you design the recognition algorithm, and how your system works. It does not need many pages but should be concise and easy to understand by readers.