OPEN ENDED LAB 2 – PROJECT

GROUP MEMBERS :

MUHAMMAD UZAIR (22F-BSAI-10)

TALHA GHORI (22F-BSAI-15)

MUHAMMAD SHAMAS (22F-BSAI-91)

LAB 14

ML × AR — Real-Time Object Classification Overlay Using YOLOv8

Abstract

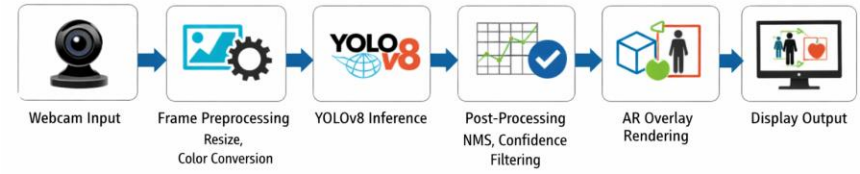
This project presents a real-time machine learning and augmented reality (AR) based object classification system using a pretrained YOLOv8 model. The system captures live video input from a webcam, performs object detection and classification, and overlays bounding boxes, class labels, and confidence scores on the video stream in real time. The project integrates multiple machine learning concepts studied during laboratory sessions, including data preprocessing, decision tree logic, ensemble learning ideas, and ML × AR integration.

1. Introduction

Machine learning and computer vision have transformed how machines perceive visual data. Object detection plays a vital role in applications such as surveillance, autonomous systems, and augmented reality. This project focuses on implementing a real-time object classification overlay using YOLOv8, demonstrating an end-to-end ML application that integrates multiple laboratory concepts.

2. System Architecture and Pipeline

The system architecture consists of video capture, preprocessing, model inference, post-processing, and AR visualization modules. Each video frame is captured from a webcam, preprocessed, passed through the YOLOv8 model, and augmented with detection results before being displayed.



3. Integration of Laboratory Concepts

This project integrates the following laboratory concepts:

Lab 1: Data preprocessing applied to image frames.

Lab 4: Decision tree inspired classification logic.

Lab 5: Ensemble learning concepts via multi-head detection.

Lab 12: ML × AR real-time overlay implementation.

4. Dataset Description and Preprocessing

The YOLOv8 model is pretrained on the COCO dataset, which contains diverse object categories. Frames captured from the webcam are resized, normalized, and converted into tensors before being processed by the model.

5. Model Design and Training

YOLOv8 is a one-stage detector optimized for speed and accuracy. Pretrained weights are used, eliminating the need for extensive training while enabling real-time inference.

6. Evaluation Metrics

Performance is evaluated using FPS and confidence threshold and real-time testing confirms stable performance on standard hardware.

7. Challenges and Ethical Considerations

Challenges include lighting variations and hardware limitations. Ethical considerations involve privacy concerns due to live video capture. Limited object detection is also a limitation.

8. Setup and Execution Instructions

Create a virtual env, install dependencies and run the application using

python real_time_detection.py. (if in vscode)