# Computer Vision Project: Bullseye Detection Using Computer Vision and Deep Learning

## Introduction

Accurate detection of bullseye patterns is essential for tasks like autonomous navigation, target tracking, and precision analysis. This project focuses on developing a robust, real-time bullseye detection system capable of identifying red and white bullseye patterns across varying environmental conditions using computer vision and deep learning techniques.

## Dataset Creation

### ❖ Data Collection

- Collected over *800* images of red and white bullseyes from:
  - Online sources
  - Public-dataset on Roboflow

### ❖ Diversity Considerations

- Lighting conditions: Bright light, low light,
- Angles: Frontal, tilted, partial visibility
- Backgrounds: Clean, cluttered, textured, outdoor
- Noise
- Horizontal and Vertical flips

Exported to yolov8 format and made annotations of bounding boxes for images using Roboflow only.

## Model Training Workflow

- YOLOv8n (nano) model selected for faster inference & light-weight usage.
- data.yaml file made for yolo
- Used Ultralytics YOLOv8 library
- Trained for 3 epochs.

## Model Evaluation and Results

| **Metric** | **Value** |
|---|---|
| Precision (P) | 0.999 |
| Recall (R) | 1.0 |
| mAP@0.5 | 0.995 |
| mAP@0.5:0.95 | 0.87 |

## Interpretation:

- Extremely high Precision & Recall indicates almost no false positives or false negatives.
- mAP@0.5:0.95 of 0.87 indicates strong performance even at stricter IoU thresholds.
- However, with so much accuracy I thought data must be overfitting, So, I checked using some images not having bullseye and model didn’t detect bullseye
- But, it detected bullseye of other colour like blue and white bullseye as my dataset didn’t contain any image to train model that not to detect other colour.
- So, I made other model named ’best1.pt’ using more better dataset such that it didn’t detect any other colour bullseye.

## Model Optimization for Real-Time

Conversion to ONNX using model.export(format='onnx')

(However, I am unable to convert to onnx format in my laptop due to some error of missing libraries)

Real-time Inference Without OpenCV: model.predict(source=0, show=True, conf=0.5)

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