

# Gym Band Detection and Color Identification Project

## Overview

This project involves detecting gym bands and identifying their colors using computer vision techniques. The project is divided into several key phases, from data collection and augmentation to model training and local hosting.

## Steps and Methodology

### 1. Data Collection

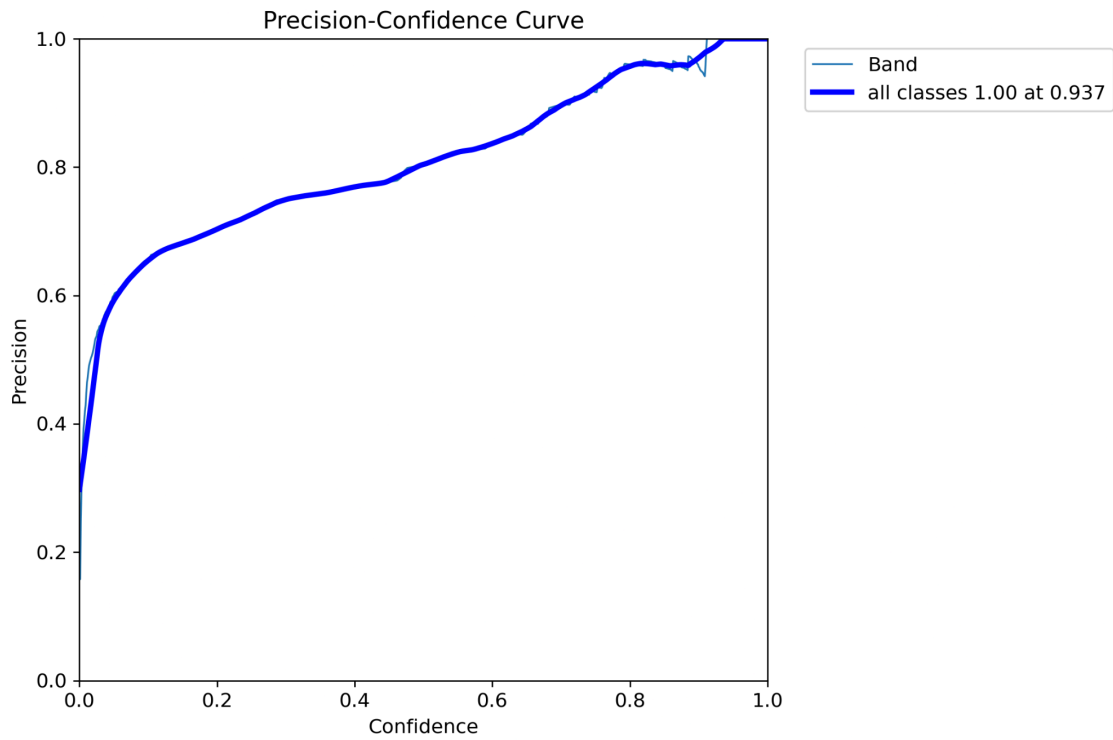
- **Initial Dataset:** Started with 134 images.
- **Augmentation:** Increased dataset size to approximately 800 images using various augmentation methods. Employed Keras's `ImageDataGenerator` to apply different augmentation techniques like,
  - `Brightness_range`,
  - `horizontal_flip`
  - `vertical_flip`
  - `shear_range`
  - `Zoom_range`
  - `rotation_range`

### 2. Data Annotation

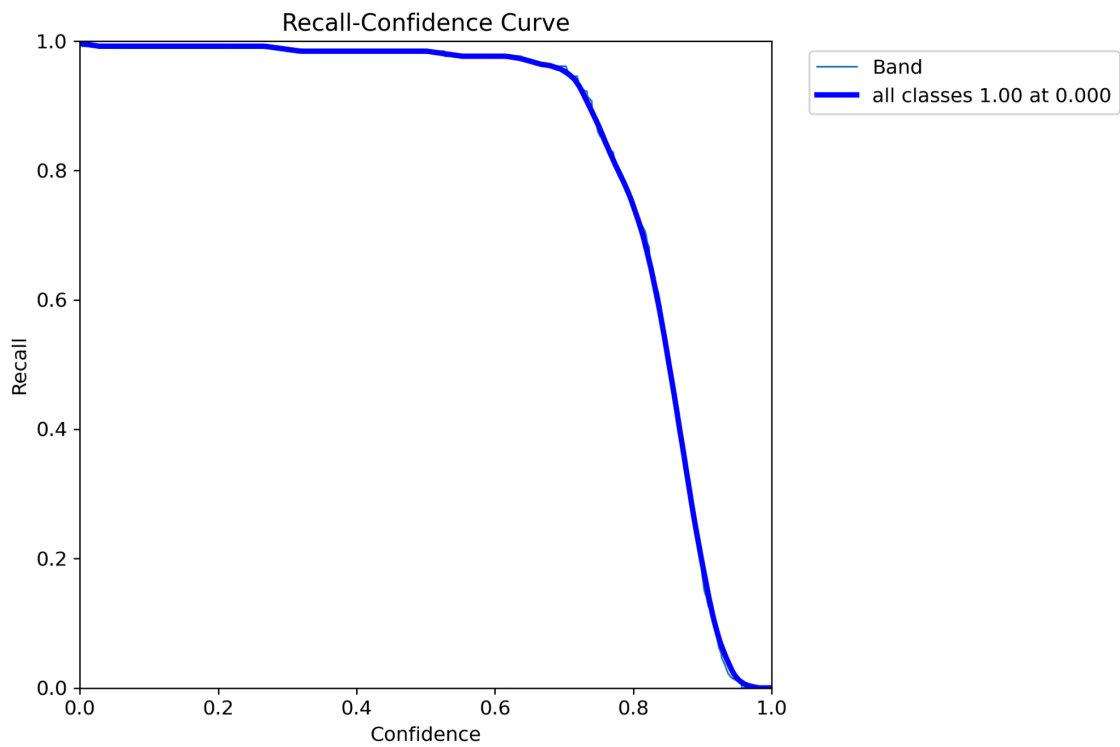
- **Tool Used:** Labellmg library for annotating images.

### 3. Object Detection

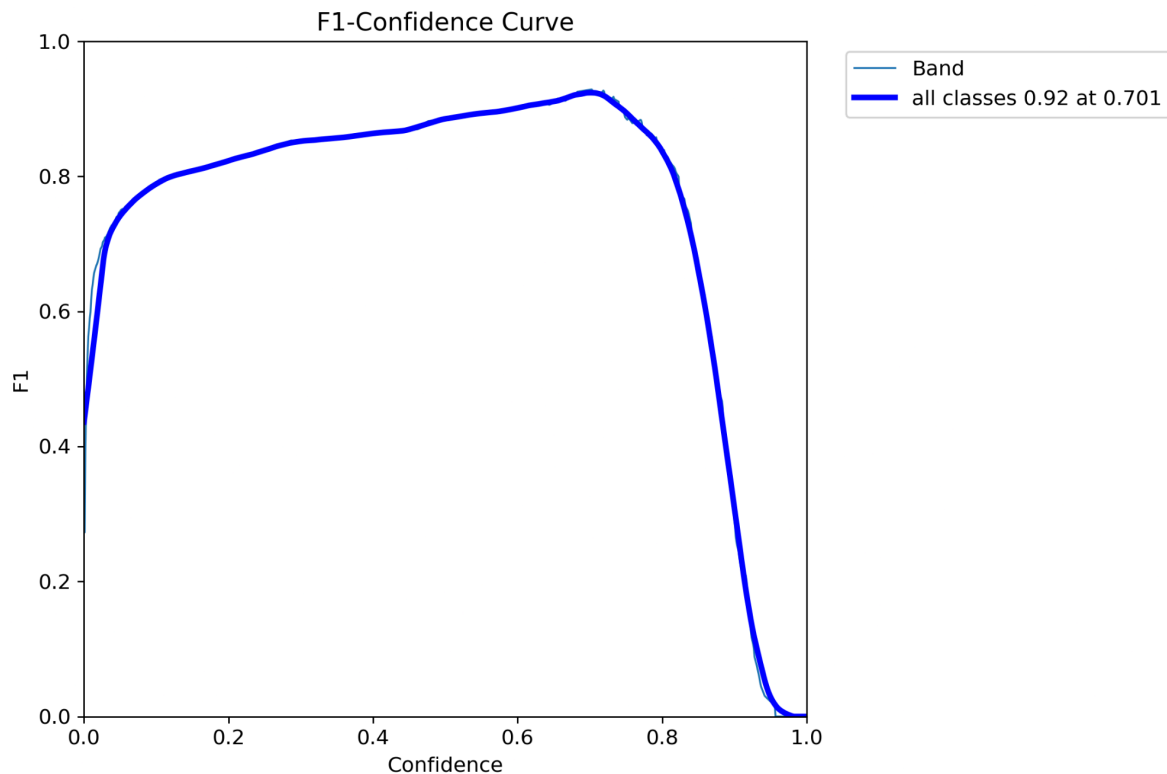
- **Ultralytics open source**
- **Model Used:** YOLOv8 with the pretrained `yolov8s.pt` model.
- **Performance:** Achieved over 77% accuracy on validation dataset.
- **Epoch : 30**
- **Training validation ratio : 80:20**
- **Evaluation report:**
  - **Precision :** How many of the predicted boxes are correctly done is **89.4%**



- **Recall : How many actual objects were detected is 96.1%**



- **F1 score : Single matrix balance both precision and recall 92% at an optimal threshold value(0.7)**



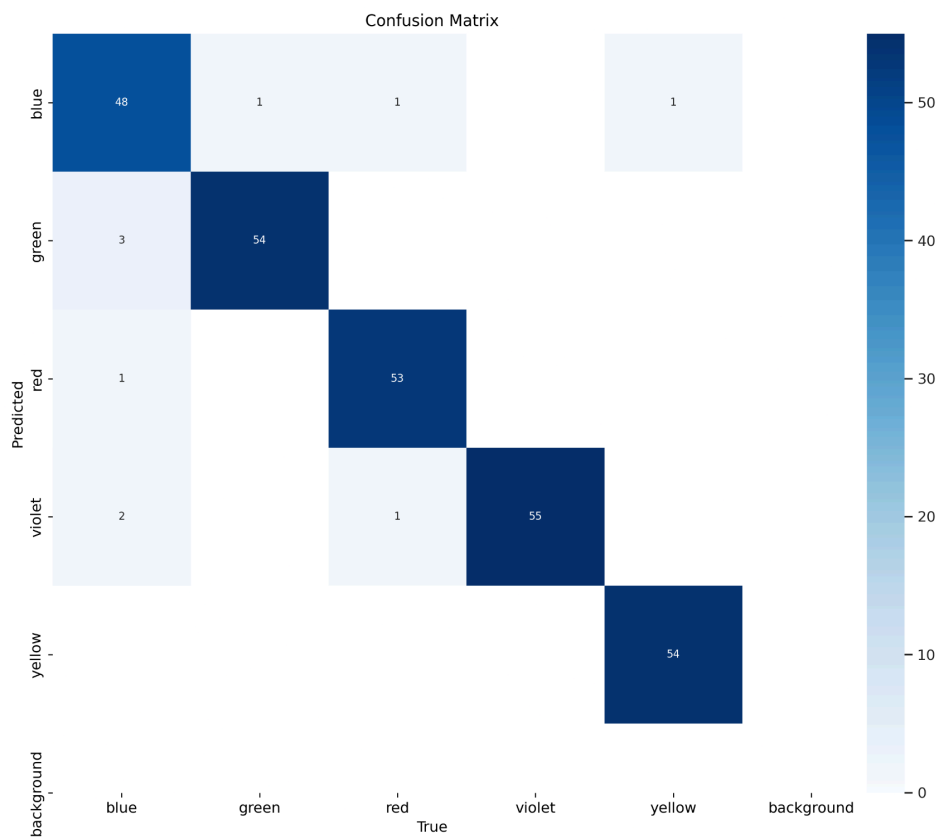
- **Training results: val - 126 images, 4 background total 130 images.**

```
Ultralytics YOLOv8.2.84 Python-3.10.12 torch-2.4.0+cu121 CUDA:0 (Tesla T4, 15102MiB)
Model summary (fused): 168 layers, 3,005,843 parameters, 0 gradients, 8.1 GFLOPs
Class  Images  Instances  Box(P   R   mAP50  mAP50-95): 100% 5/5 [00:03<00:00, 1.55it/s]
all      130       129      0.894  0.961  0.954   0.761
```

- **mAP50(mAP50 is the mean Average Precision calculated using a single IoU threshold of 0.50) :** a predicted bounding box is considered correct if its IoU with the ground truth box is greater than or equal to 0.50. This means the predicted box must overlap with the ground truth box by at least 50% to be considered a true positive , and after the training got 95% .
- **mAP50-95 (mean Average Precision averaged across IoU thresholds from 0.50 to 0.95) :** This metric evaluates the model's performance over a range of IoU thresholds, providing a more comprehensive view of how well the model performs at various levels of overlap. It is a more stringent measure compared to mAP50, as it considers stricter criteria for what constitutes a correct detection, and got 76%.
- For more details please have a look at the [detection\\_training.iynb](#)

## 4. Band Color Classification

- **Ultralytics open source**
- **Model Used:** YOLOv8-classification with the pretrained [yolov8s-cls.pt](#) model.
- **Dataset:** Created a balanced dataset with cropped band images. 1056 train, 274 val.
- **Colors Identified:** Blue, Green, Red, Yellow, Violet.
- **Performance:** Achieved over 90% accuracy in validation dataset.
- **Epoch : 50**
- **Training validation ratio : 80:20**
- **Evaluation report :**
  - **Confusion matrix with validation data for all classes**



After analyzing the confusion matrix i got the results,

- **Precision - 95%**
- **Recall - 96%**
- **F1 score - 96%**
- **Accuracy - 96%**
- For more details have a look at the [classification\\_training.ipynb](#)

## 5. Local Hosting

- **Platform:** Streamlit for basic front-end UI experience.

## Challenges Faced

- Color Identification Challenges:
  - Initially used OpenCV methods, converting colors to HSV (high saturation value) color space and defining color values in HSV format.
  - Faced issues with background objects affecting analysis.
  - Switched to image classification, which performed better than the initial OpenCV methods.
- Data Quality and Quantity:
  - Encountered issues with the limited amount and quality of data.
  - Attempted to collect data from external sources like Google and Bing but primarily retrieved advertisement/marketing images, which were unsuitable for the project.
  - Resolved data scarcity with augmentation techniques.

## Conclusion

The project successfully integrates gym band detection and color identification with good accuracy metrics. Future improvements could benefit from more high-quality real-time data.

## GitHub Repository

For detailed code, please visit the [GitHub project link](#).