Human and PPE Detection for Isolation Ward Safety

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Abstract

This project focuses on developing a model that detects humans and evaluates their attire to ensure they are wearing appropriate safety measures, such as PPE kits, before entering isolation wards. The technologies utilized include Python, YOLO, OpenCV, XML, argparse, and tqdm for efficient data handling and model deployment.

1 Introduction

The safety of healthcare workers and patients in isolation wards is paramount. Ensuring that individuals entering these wards are wearing complete personal protective equipment (PPE) can significantly reduce the risk of infection. This project aims to develop a robust detection system to automatically verify if individuals are wearing the necessary PPE components.

2 Technologies Used

The project utilized several technologies: Python was used for scripting and data manipulation. YOLO (You Only Look Once) was employed for object detection due to its accuracy and real-time performance. OpenCV was used for image processing and drawing bounding boxes. XML was used for handling annotations, argparse facilitated command-line argument parsing, and tqdm provided progress bars to track processing status.

3 Methodology

3.1 Dataset Preparation

The dataset was prepared by gathering images and their corresponding XML annotations. The images were split into training and validation sets to train the YOLO models effectively.

3.2 Model Training

Two YOLO models were trained: one for detecting humans and another for detecting PPE components. The models were fine-tuned to achieve high accuracy in detecting the necessary objects.

3.3 Inference and Validation

The trained models were used to perform inference on new images. The detections were processed using OpenCV to draw bounding boxes and annotate the confidence scores. The results were saved for further analysis.

4 Results

The system successfully detected humans and evaluated their attire to ensure compliance with PPE requirements. The following tables summarize the metrics for both the person detection model and the PPE detection model:

Table 1: Person Detection Model Summary

Description	**Value**
Layers	168
Parameters	3,007,598
Gradients	0
GFLOPs	8.1

5 Conclusion

This project demonstrates the feasibility of using advanced computer vision techniques to enhance safety protocols in isolation wards. By automating the

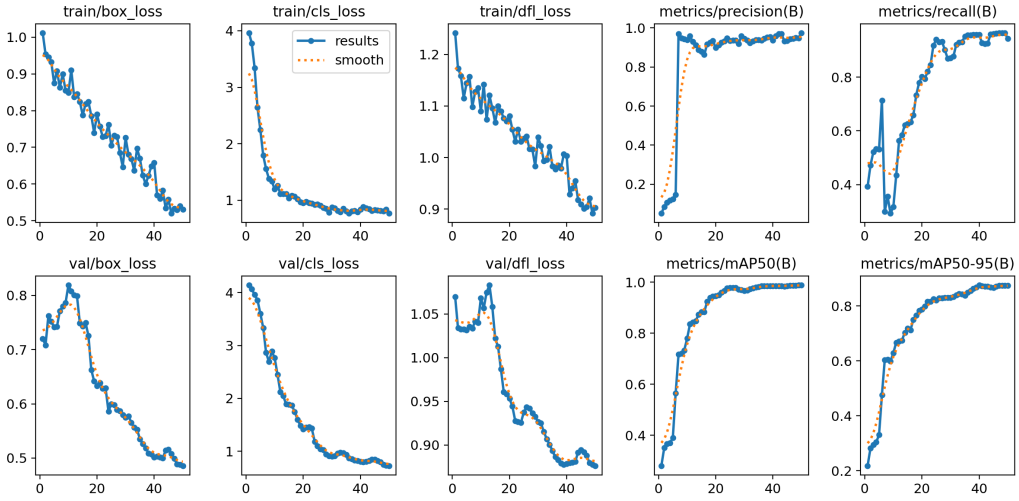

Figure 1: Results - Person Detection Model

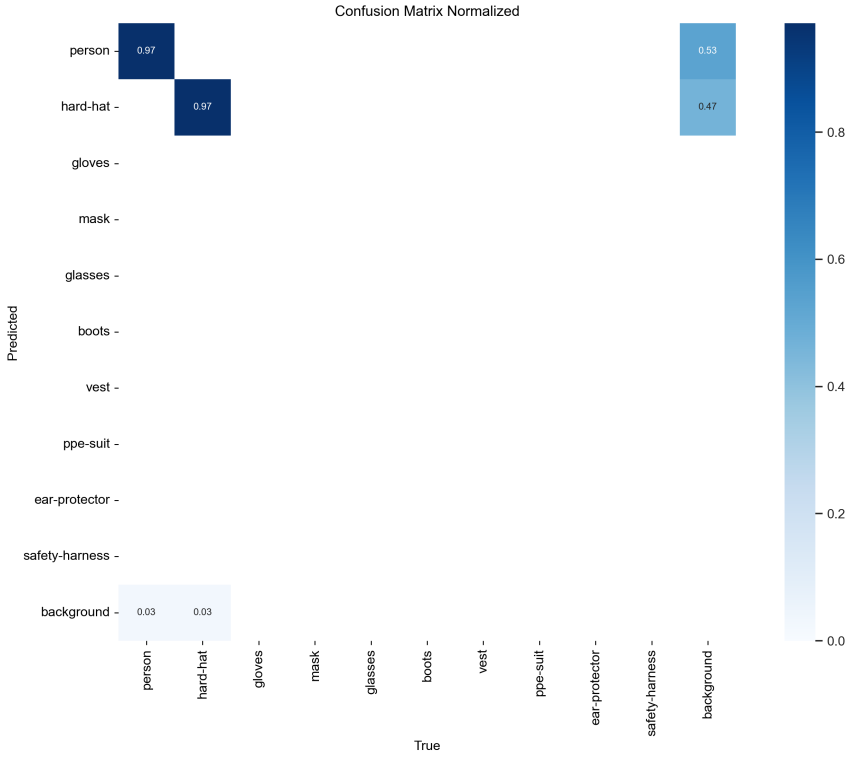

Figure 2: Confusion Matrix - Person Detection Model

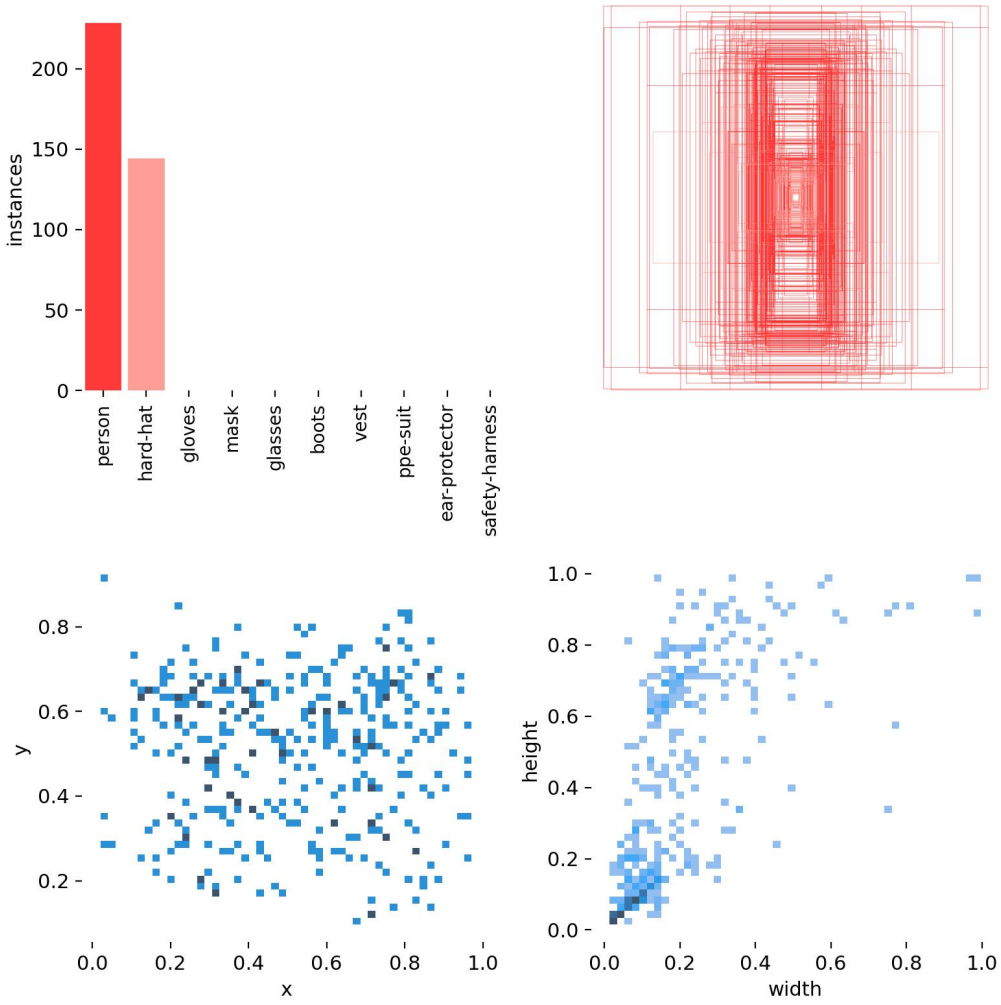

Figure 3: Labels - Person Detection Model

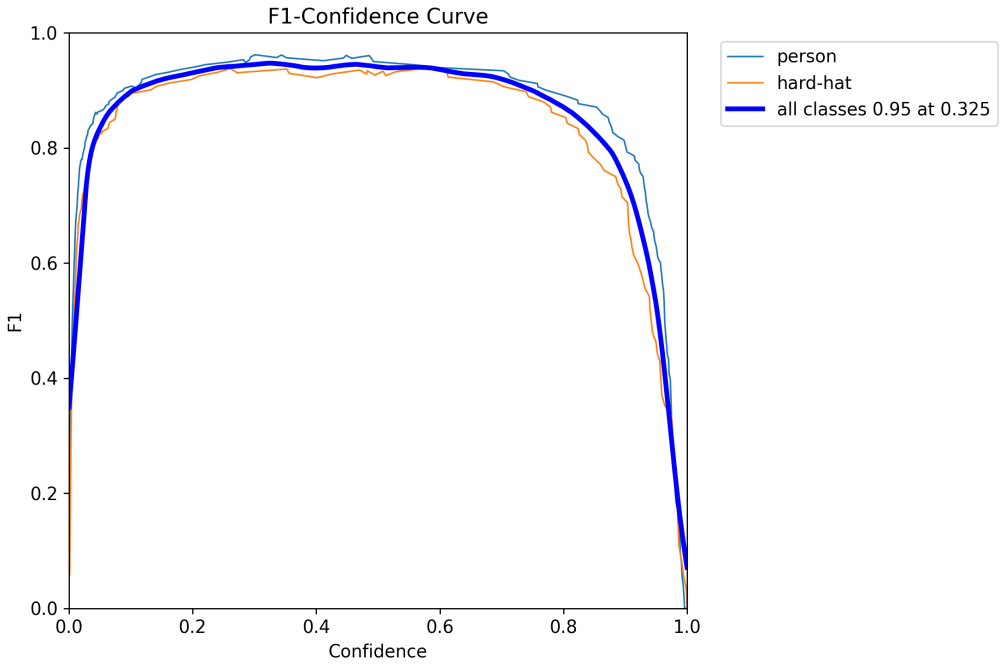

Figure 4: F1 Curve - Person Detection Model

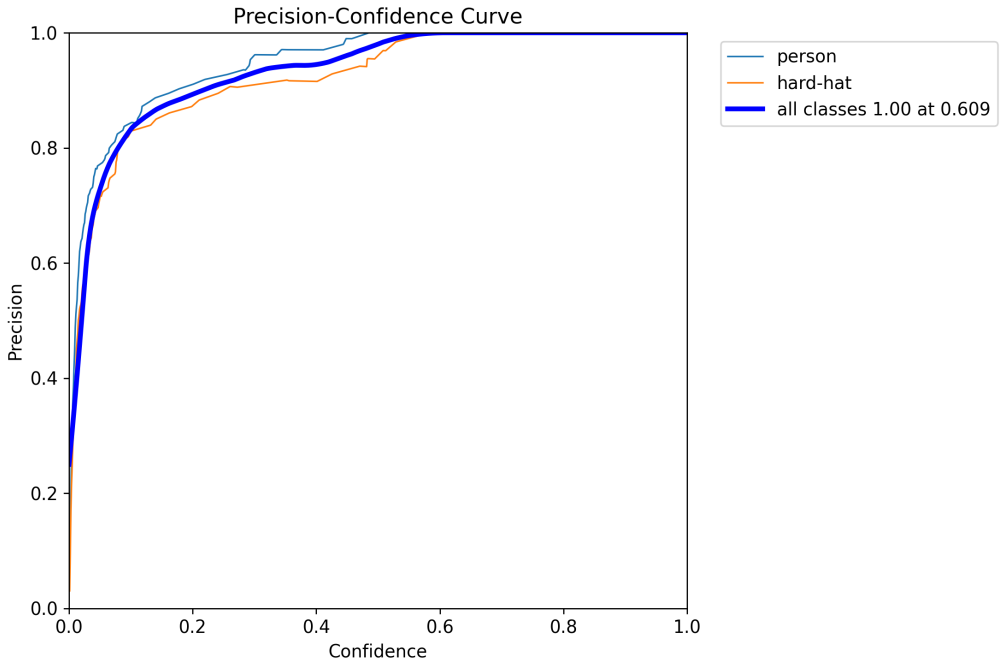

Figure 5: Precision Curve - Person Detection Model

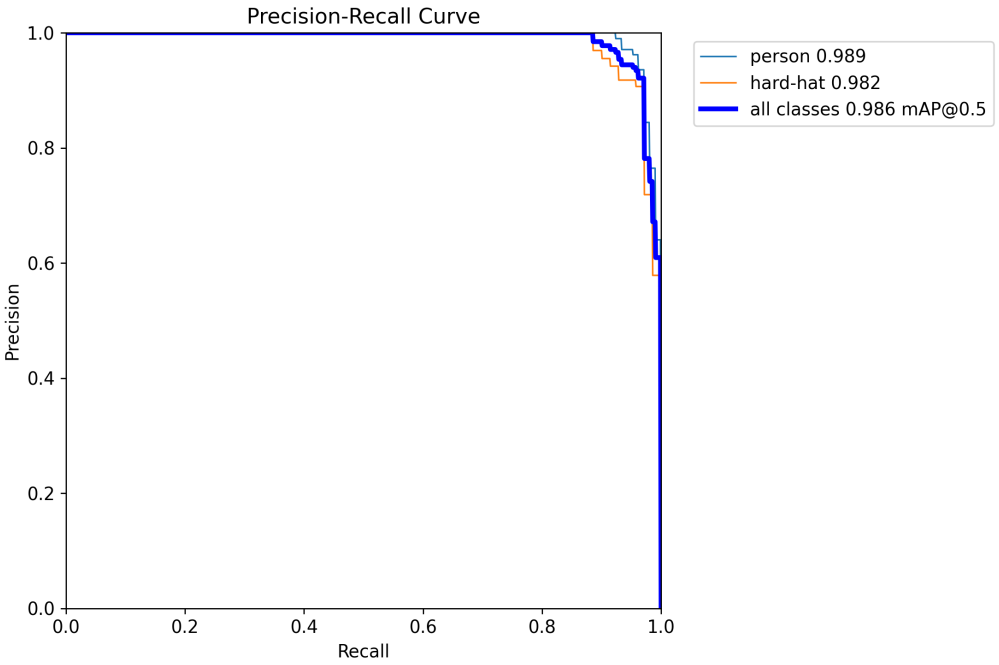

Figure 6: PR Curve - Person Detection Model

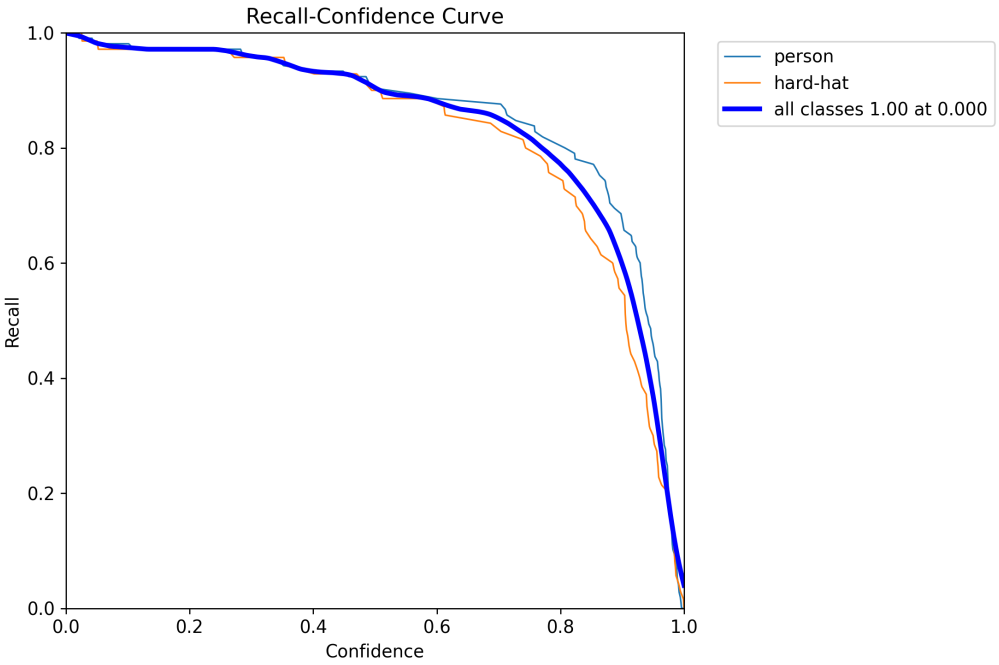

Figure 7: R Curve - Person Detection Model

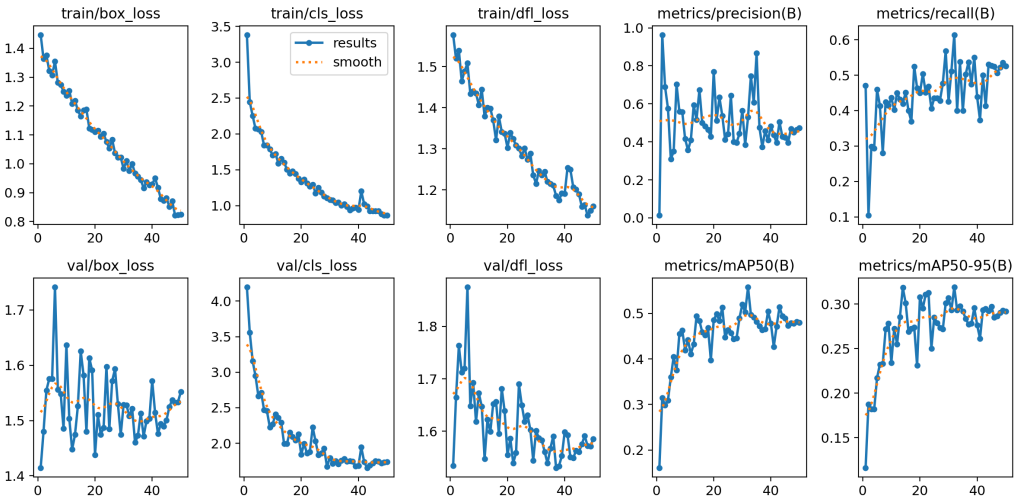

Figure 8: Results - PPE Detection Model

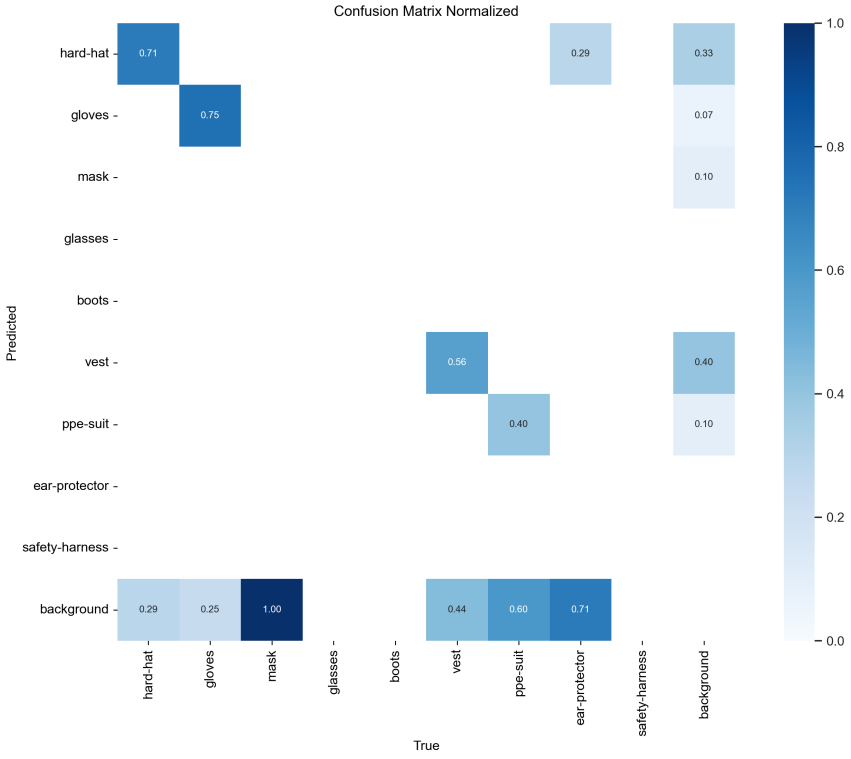

Figure 9: Confusion Matrix - PPE Detection Model

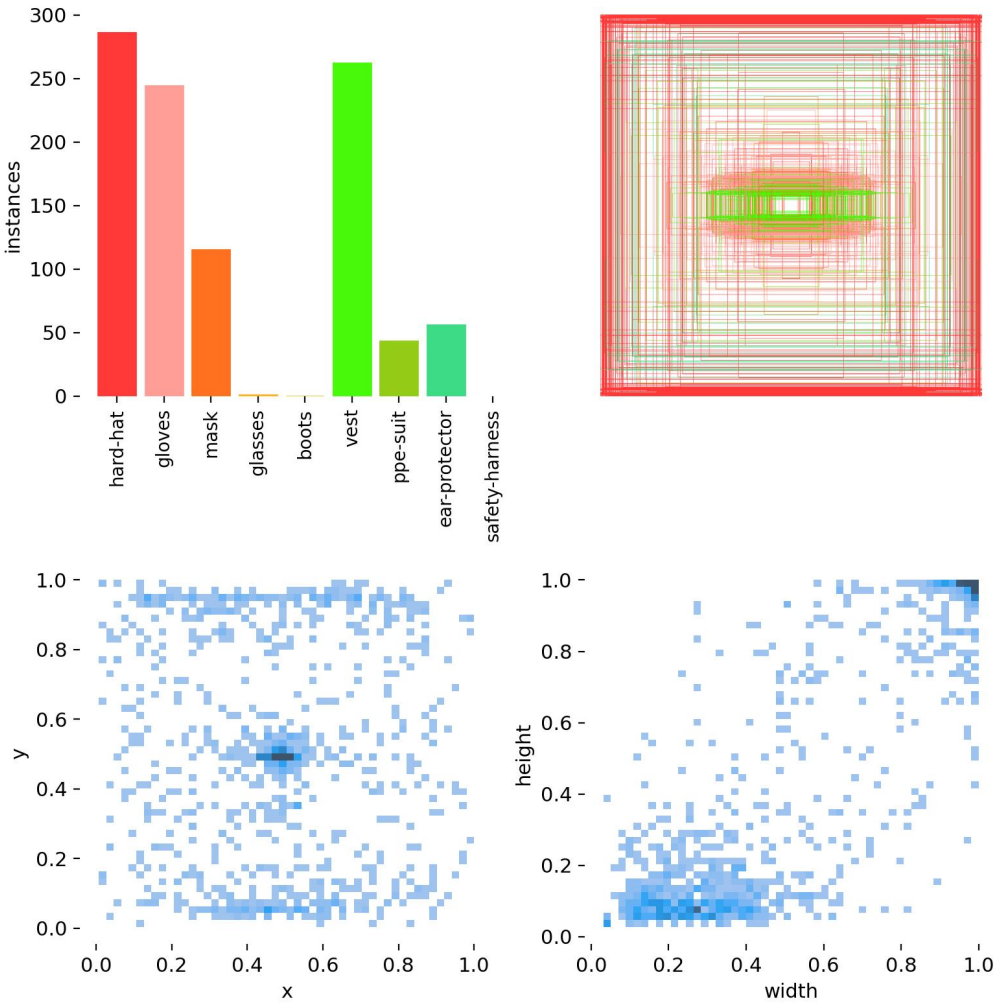

Figure 10: Labels - PPE Detection Model

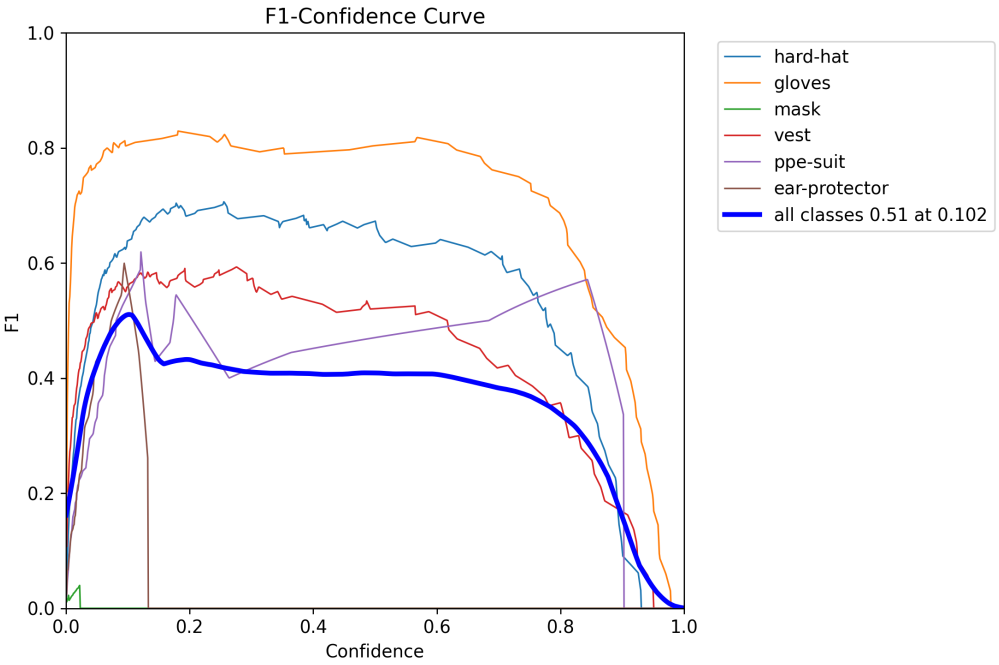

Figure 11: F1 Curve - PPE Detection Model

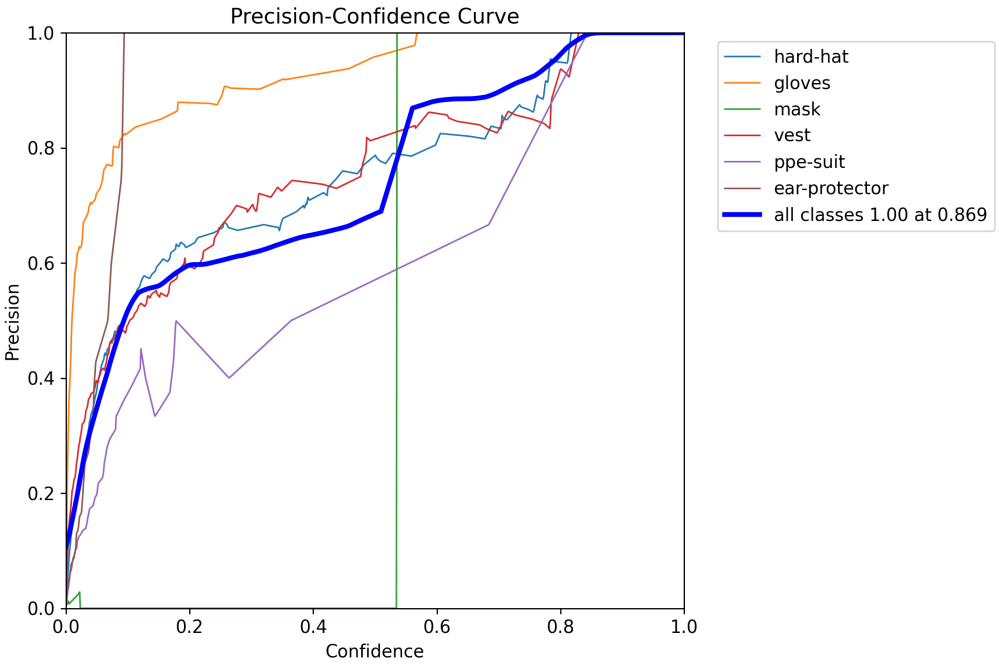

Figure 12: Precision Curve - PPE Detection Model

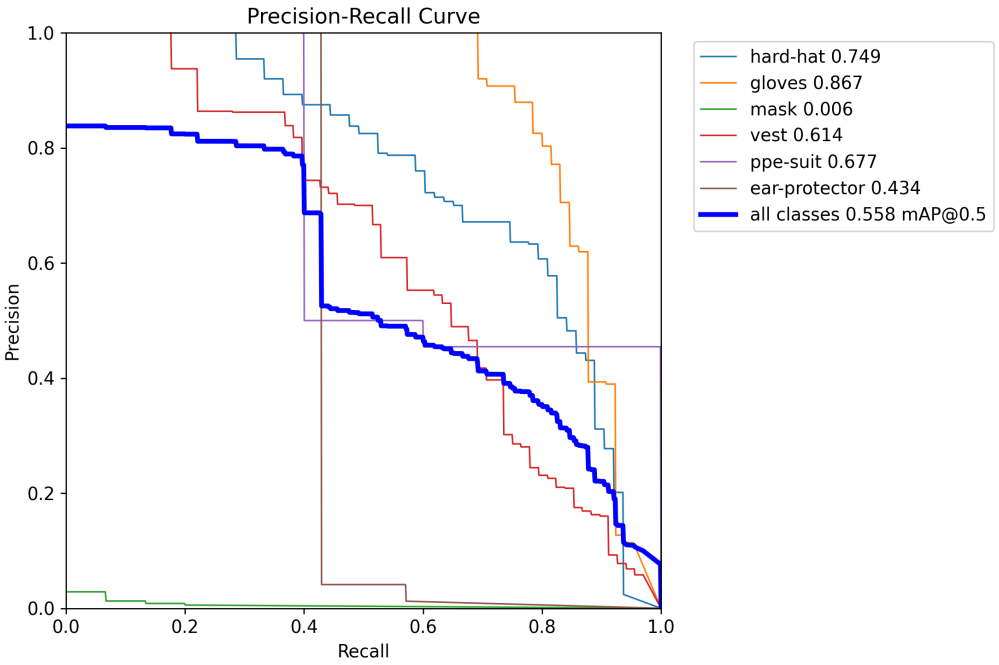

Figure 13: PR Curve - PPE Detection Model

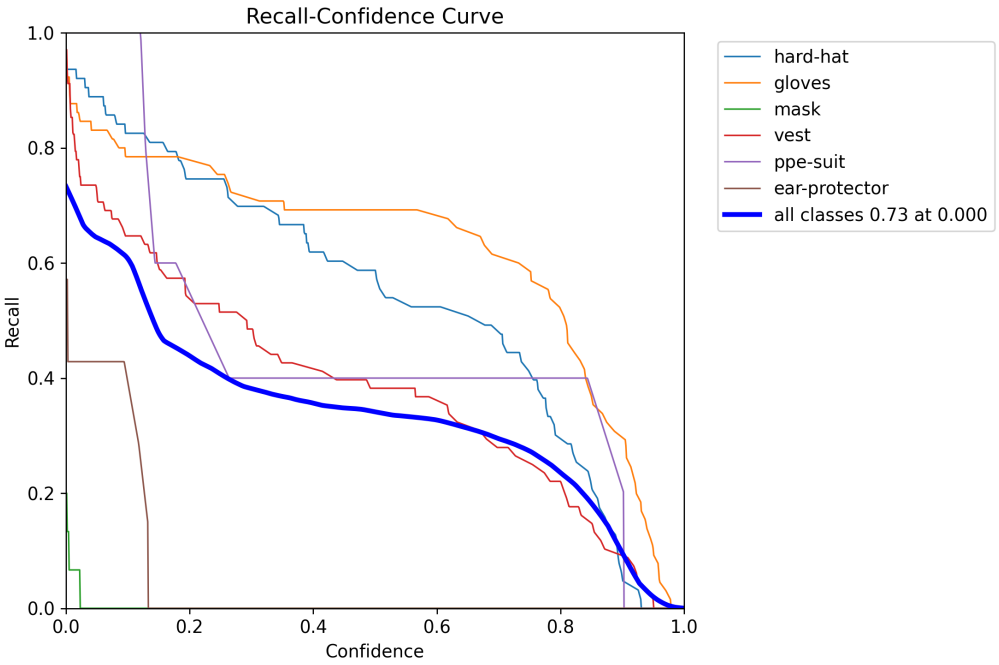

Figure 14: R Curve - PPE Detection Model

Table 2: Person Detection Performance

Class	Images	Instances	Box P	R	mAP50	mAP
All	38	175	0.936	0.959	0.986	0.876
Person	38	105	0.962	0.960	0.989	0.916
Hard-hat	38	70	0.911	0.957	0.982	0.836

Table 3: Person Detection Speed Performance

Process	Time (ms)
Preprocess	2.0
Inference	392.9
Loss	0.0
Postprocess	6.3

Table 4: PPE Detection Model Summary

Description	Value
Layers	168
Parameters	3,007,403
Gradients	0
GFLOPs	8.1

Table 5: PPE Detection Performance

Class	Images	Instances	Box P	R	mAP50	mAP
All	117	223	0.528	0.612	0.558	0.319
Hard-hat	117	63	0.501	0.825	0.749	0.556
Gloves	117	65	0.823	0.785	0.867	0.562
Mask	117	15	0.000	0.000	0.00554	0.00225
Vest	117	68	0.478	0.647	0.614	0.331
PPE-suit	117	5	0.366	1.000	0.677	0.249
Ear-protector	117	7	1.000	0.416	0.434	0.213

detection of PPE compliance, healthcare facilities can ensure higher safety standards with reduced manual effort.

Table 6: PPE Detection Speed Performance

Process	**Time (ms)**
Preprocess	1.5
Inference	182.8
Loss	0.0
Postprocess	0.2

6 References

- YOLO: `https://pjreddie.com/darknet/yolo/`
- OpenCV: `https://opencv.org/`