



Daing Muhammad Irfan



# Suspicious Object Detection Model on Trains and Public Spaces

A solution to boost safety in train cabins and public areas using advanced machine learning algorithms to detect potential threats

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# Background

## TRAIN RIDERSHIP

Total number of commuters on the NSL, EWL, and CCL annually. In 2022, 511 million and 142 million commuters travelled with us on the NSEWL and CCL respectively.

⑧ North-South and East-West Lines

⑨ Circle Line

Jan - Mar 2023

139 MILLION COMMUTERS ⑧

40 MILLION COMMUTERS ⑨

2022

511 MILLION COMMUTERS ⑧

142 MILLION COMMUTERS ⑨

## List of suspicious activities

- On 9 December 2001, the Internal Security Department (ISD) arrested six Singaporean JI members, thwarting plans to attack Yishun MRT station
- Jail for man who took 26 upskirt videos at MRT stations and on trains using hidden camera
- Outrage of modesty (OM) cases increased to 773 in the first half of 2022, from 739 cases in the same period last year

653 Million

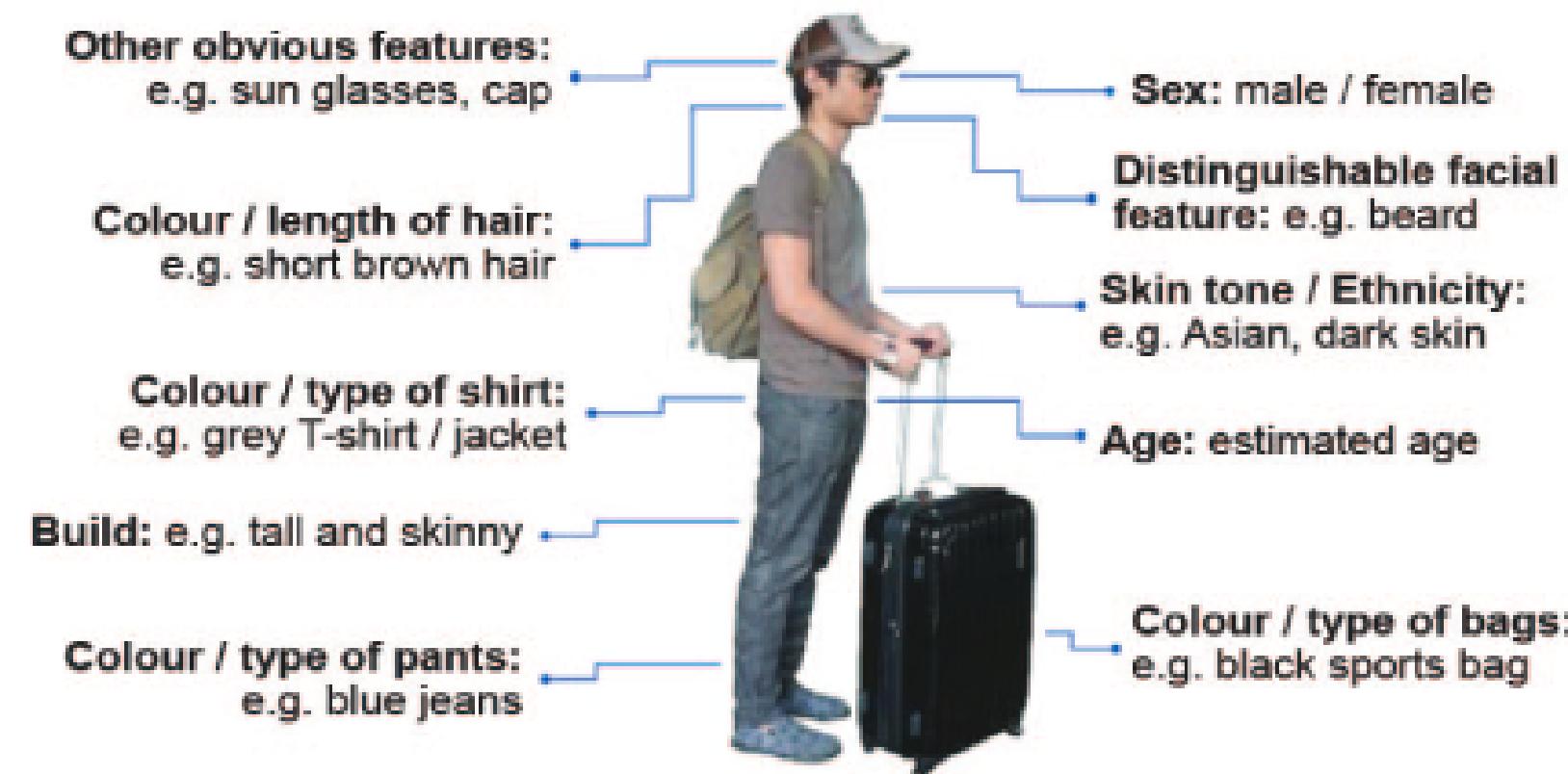


# Problem Statement

The existing surveillance systems is labor-intensive and error-prone manual monitoring. It lack of real-time alerts, and absence of advanced features like object classification. Therefore, there is a pressing need for an intelligent, autonomous object detection surveillance system capable of detecting, classifying, and tracking objects, including suspicious ones, in real-time.

# How authorities describe a suspicious person

## How to describe a suspicious person



Source:

[https://www.lta.gov.sg/content/ltagov/en/getting\\_a\\_round/public\\_transport/a\\_better\\_public\\_transport\\_experience/security.html](https://www.lta.gov.sg/content/ltagov/en/getting_a_round/public_transport/a_better_public_transport_experience/security.html)

## How to describe a suspicious vehicle

**Type:** e.g. car / motorcycle    **Colour:** e.g. black, red    **Vehicle registration number:** e.g. SAA3333A  
**Make / Model:** e.g. Kia Cerato, Honda Civic

# Data Collection

Data are collected from taking photos and images from the internet. The images that were taken are used to customise the weights for the model. These data consists of suspicious objects,

Luggages

Covered Hoodies

Sunglasses

Masks

Caps

Hands in Pocket

Hats

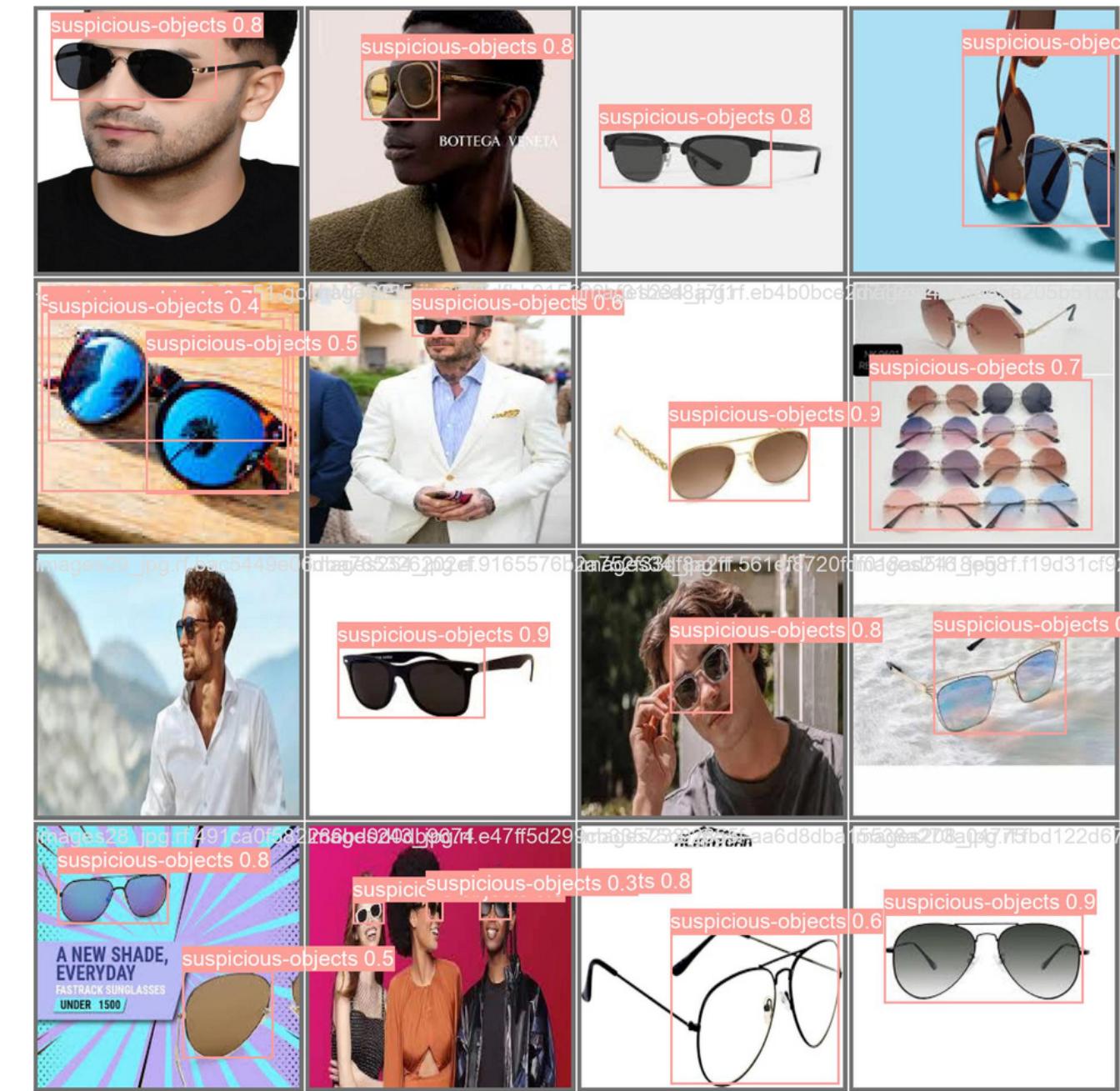
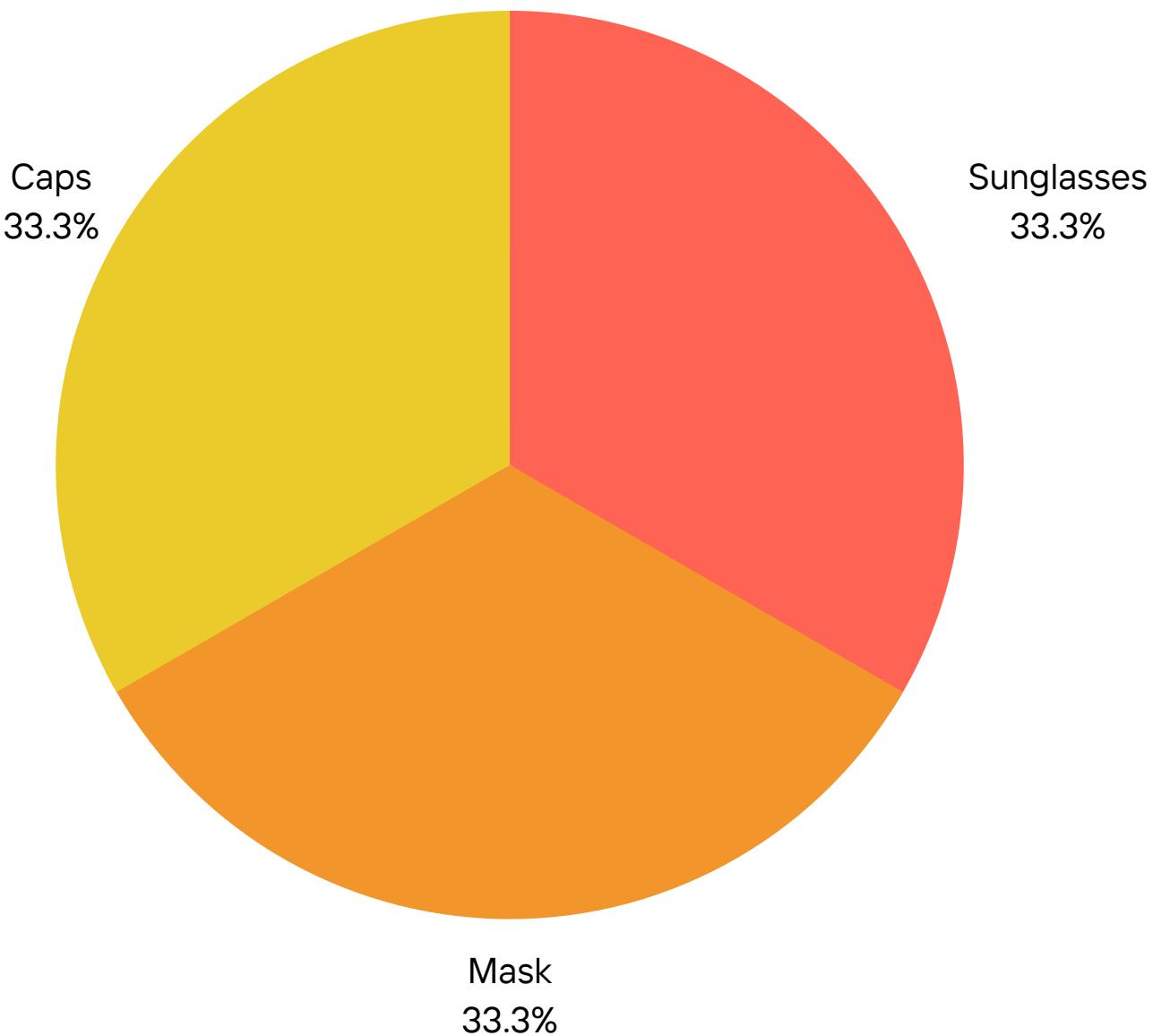
Shades

Black Jackets

# Feature Selection

Feature Selection- \*Top 3 items to disguise

Tags

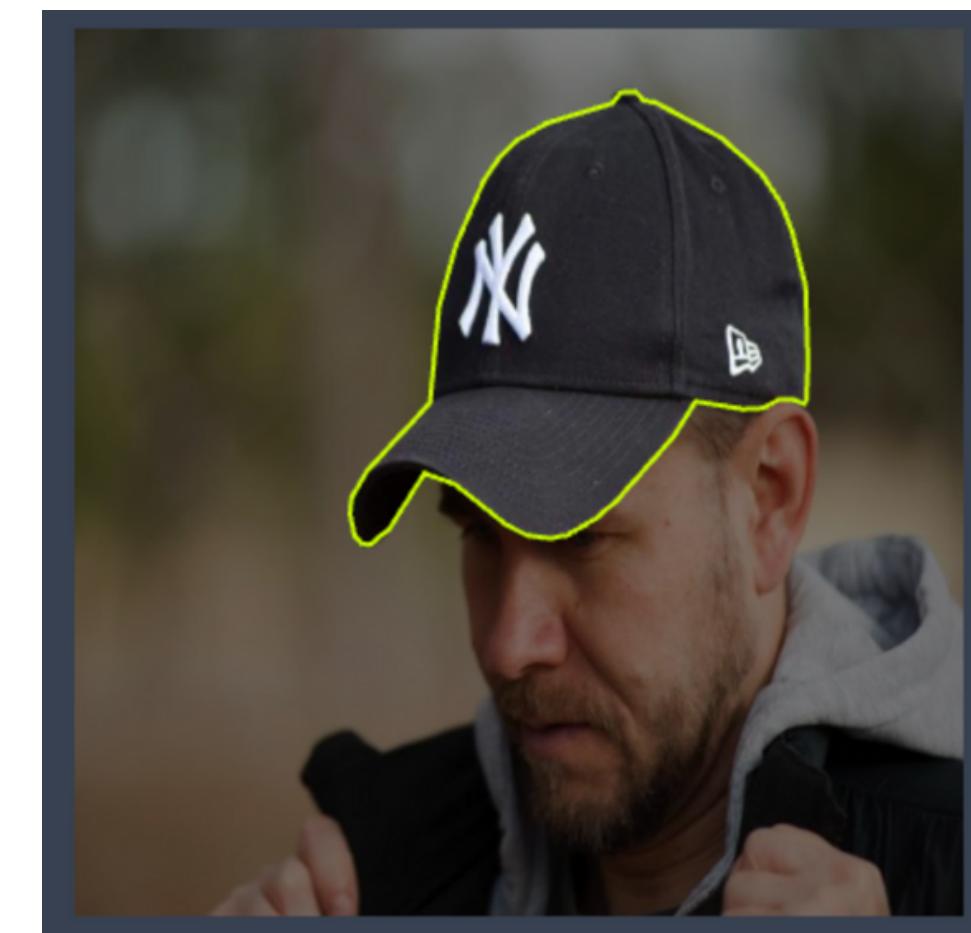
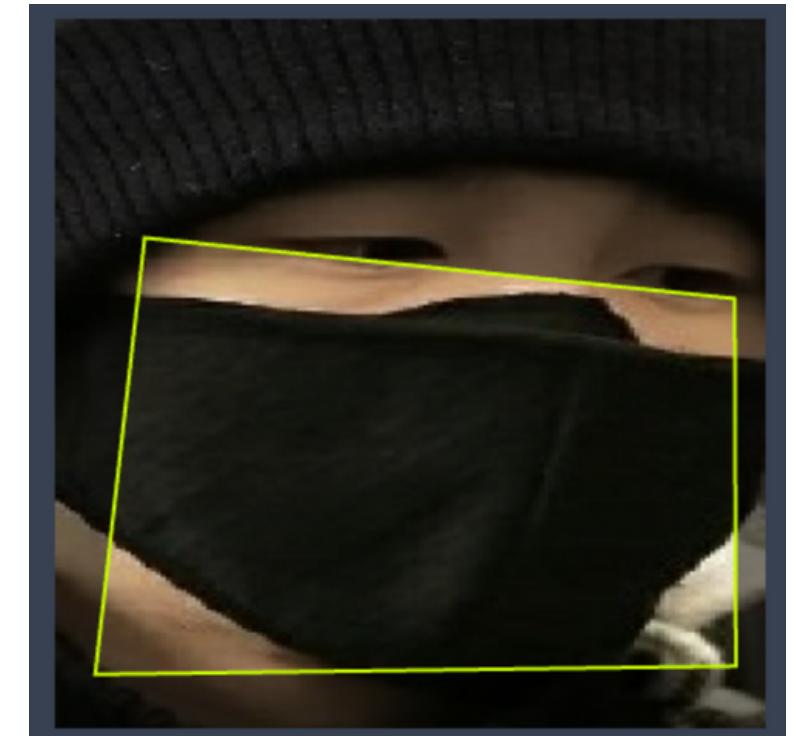
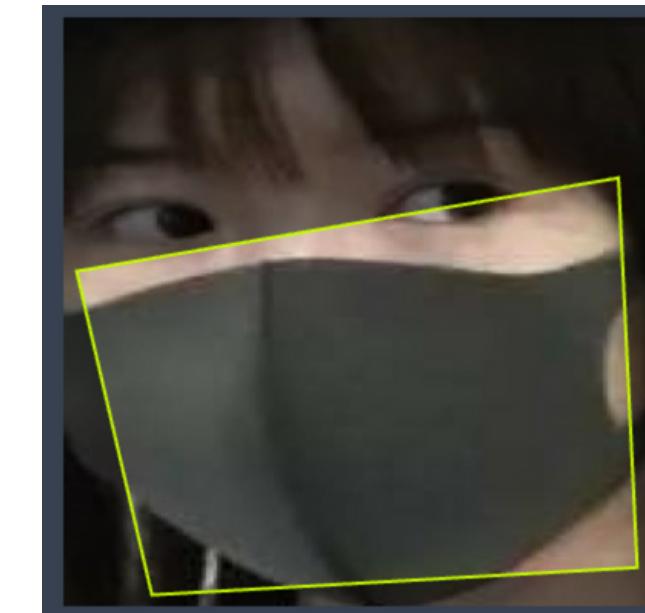
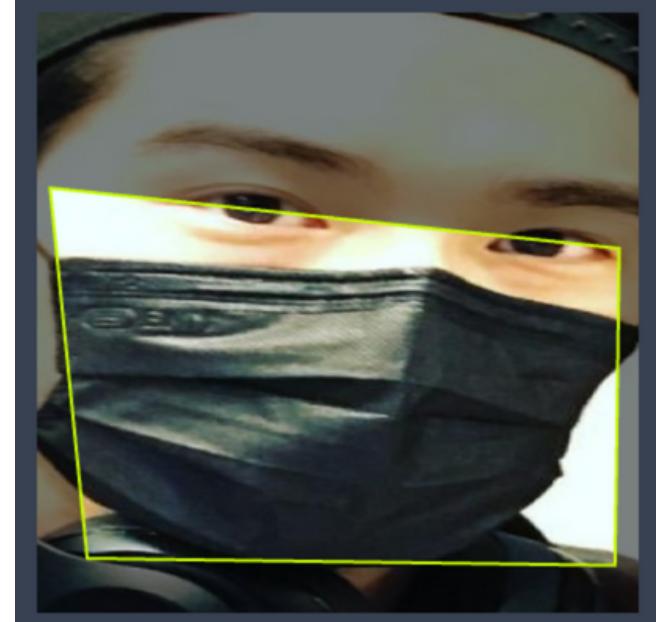


Images

Sunglasses, Caps, Mask

# EDA

Sample Images



# EDA

- **Data Distribution:**

Equal distribution across three classifiers.

- **Object Size Analysis:**

Large objects due to train cabin space.

- **Temporal Patterns:**

More suspicious activities during crowded times.

- **Location Analysis:**

These activities they prepare in tight corners and spaces.

- **Performance on Different Conditions:**

Data augmented for various conditions.

- **Error Analysis:**

Confusion matrix reveals model's performance insights.

# Preprocess and Augmentation

Auto-Orient: Applied

Resize: Stretch to 640x640

There are augmentations to increase the sample size to 5000 from 1500. Below are the augmentations applied to improve the score.

Outputs per training example: 3

Brightness: Between -25% and +25% (Low-light conditions and too bright)

Exposure: Between -25% and +25%

Blur: Up to 2.5px (Rainy)

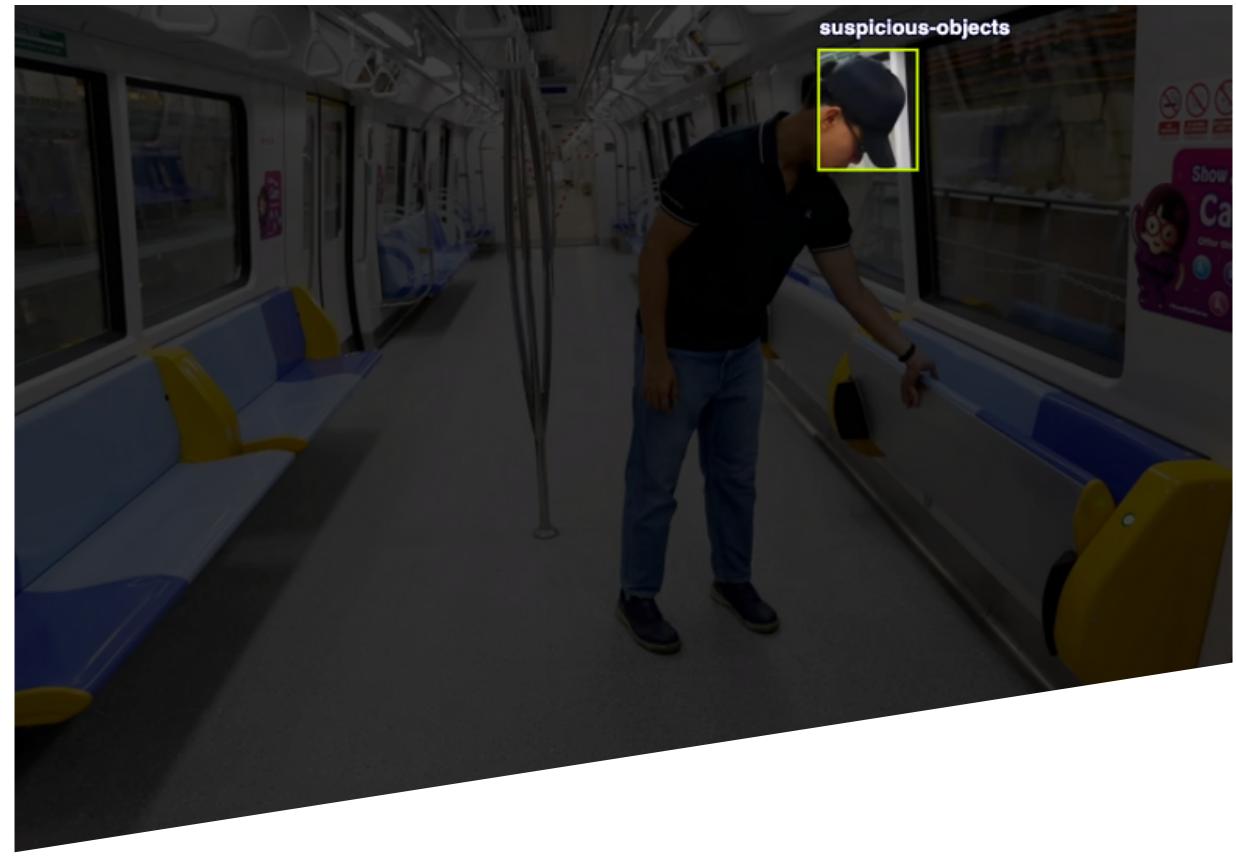
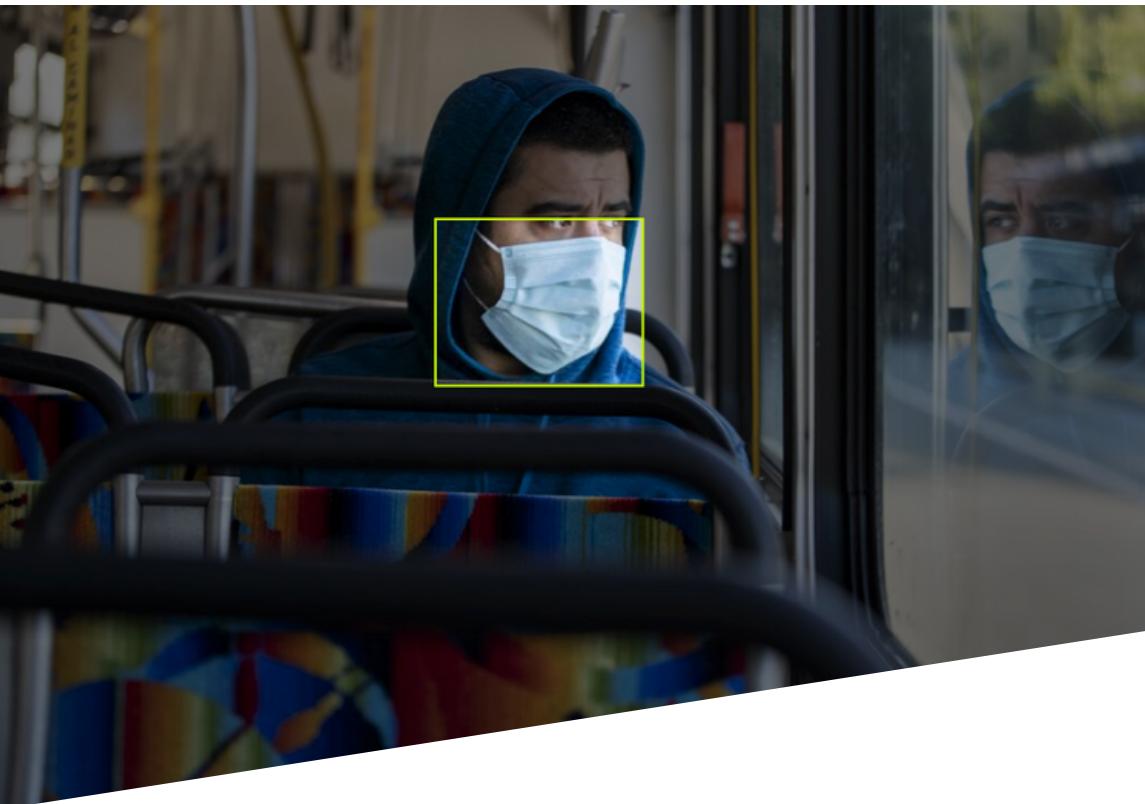
# Model Score

The YOLO v8 model excels in real-time object detection, making it ideal for identifying suspicious items in train cabins. Its speed and accuracy ensure safety, promptly alerting security to potential threats.

YOLO v8	mAP	Precision	Recall
Base Model	72.1%	70.2%	68.8%
Best Model	94.0%	92.7%	90.4%

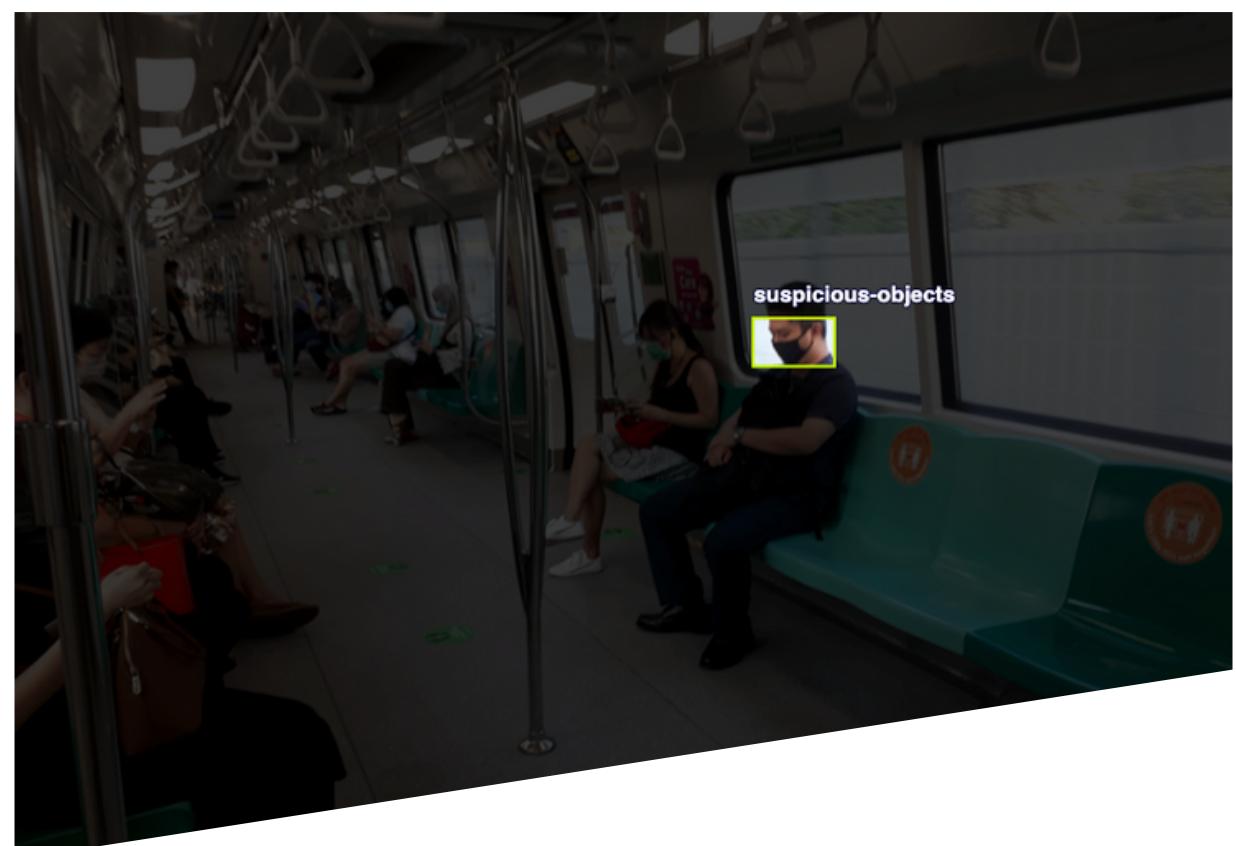


Overall Improvement

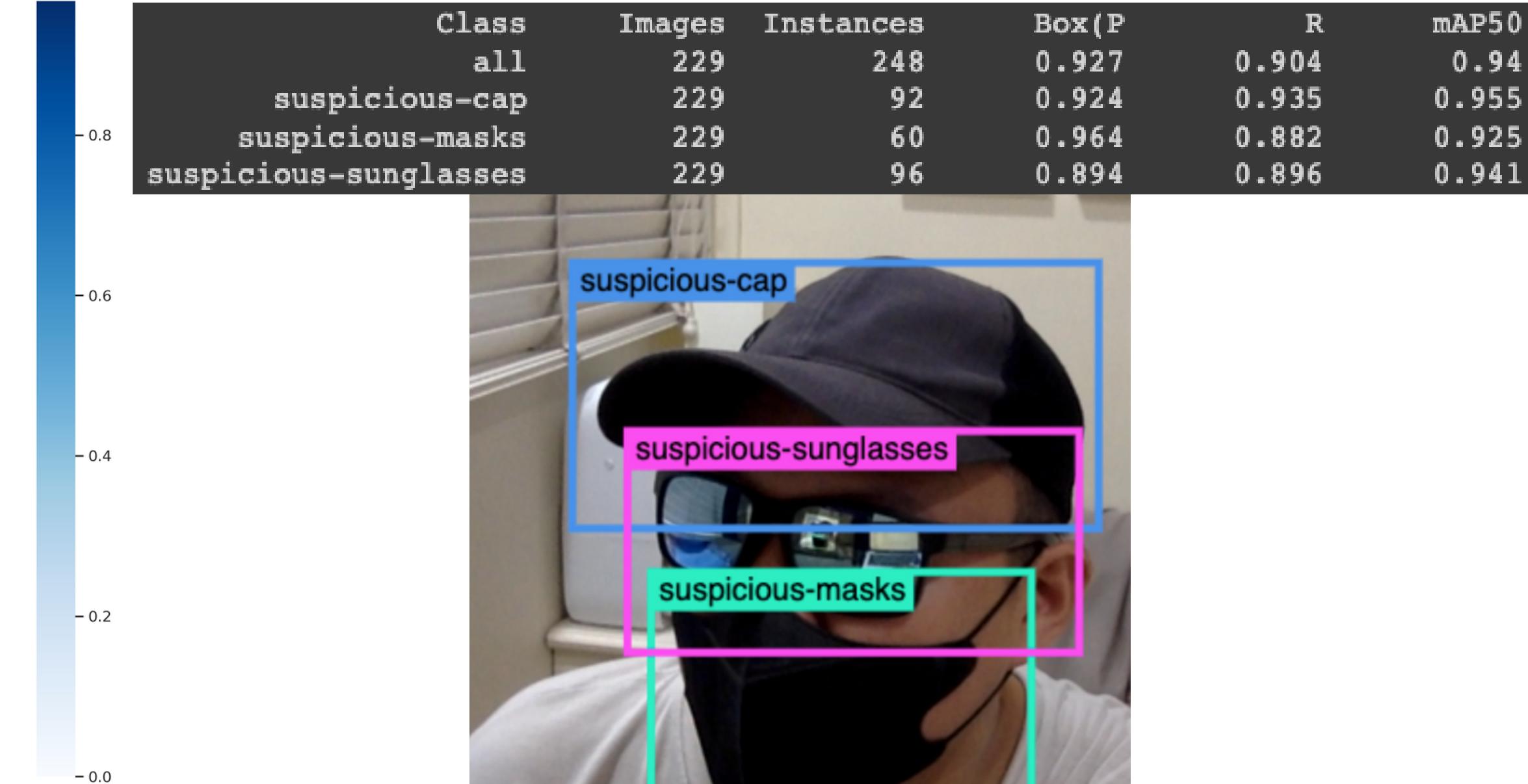
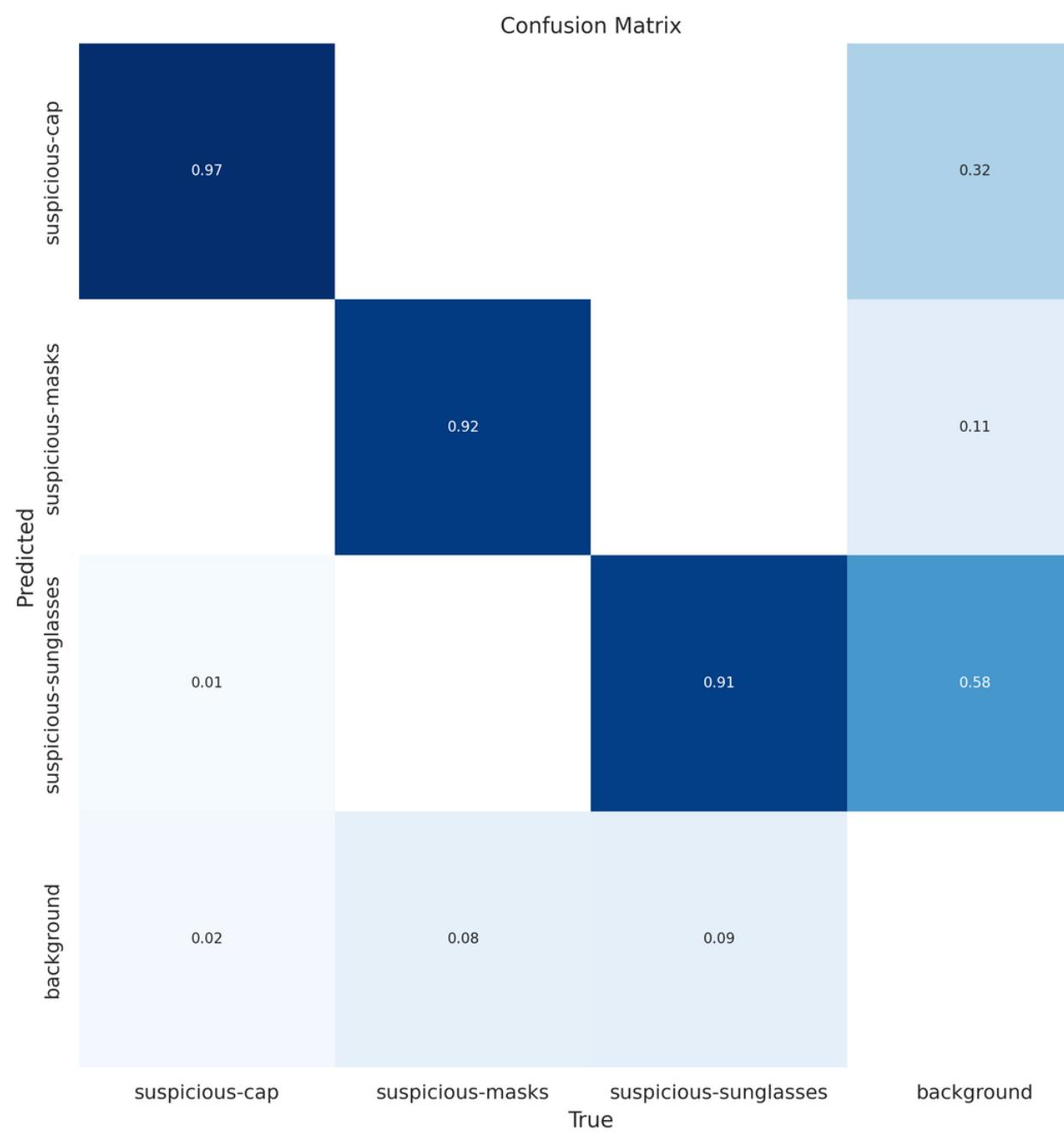
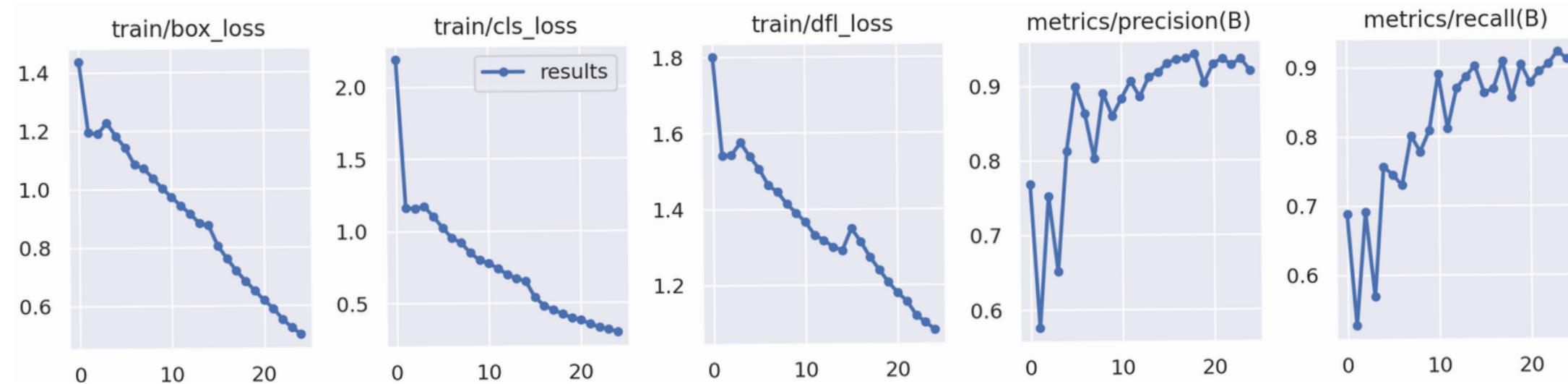


# Performance

Detects sunglasses,  
mask and caps



# Model Evaluation



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## Suspicious Object Detection Model for Train Cabins and Public Spaces

The Suspicious Object Detection Model is an innovative AI solution designed to boost safety in train cabins and public areas. It uses advanced machine learning algorithms to detect potential threats, enabling swift security responses, thereby improving public safety and threat management.



Static Application

Live Application



# Visit my Demo Page

- <https://dmirfan.online>
- Bootstrapped and SSL certified
- Upload an Image
- Provide a URL-linked Image
- Live Webcam



# Deployment Challenges

## Domain-Hosting-File Management (cPanel)

HTML

CSS

Javascript

## Live Webcam

SSL Certificate Acquiring  
Roboflow Limited Credits

## UI/UX

Landing Page  
Static Application

## Suspicious Object Detection Model for Train Cabins and Public Spaces

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Static Application      Live Application

Upload Method Select File

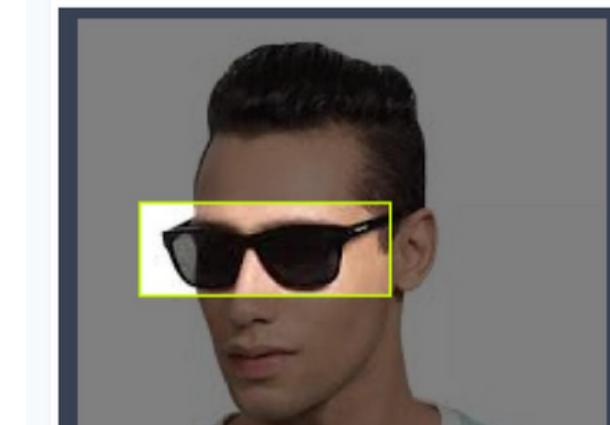
Filter Classes Min Confidence Max Overlap  
Enter class names    40%    30%

Inference Result

Image       JSON

Labels Stroke Width  
 Off     On      1px    2px    5px    10px

Result

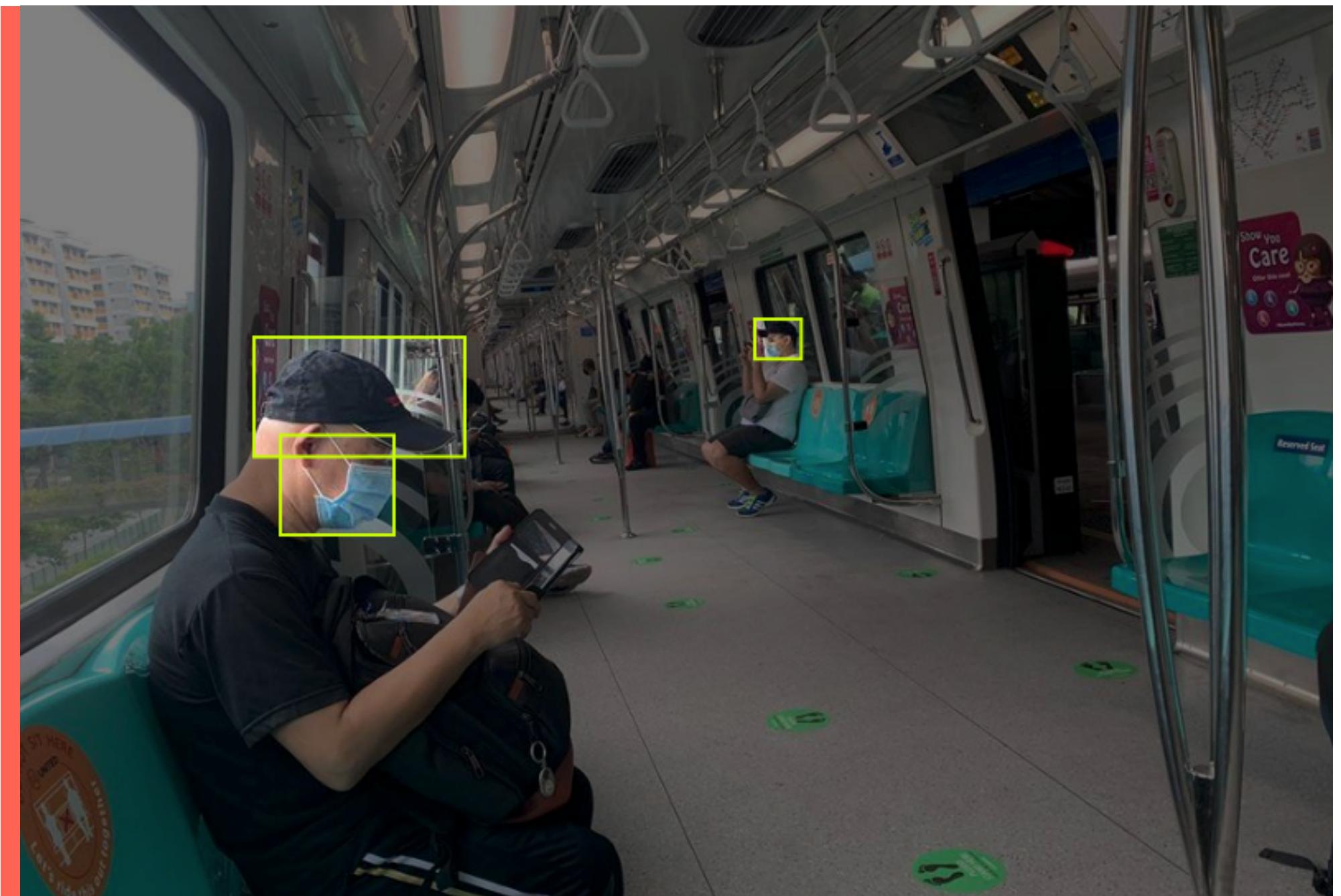


# Recommendations

## Recommendations # 1 Implement in Train Cabins and Platforms

**Why:** These areas are part of the Mass Rapid Transit (MRT) system that sees a significant flow of passengers every day, making them potential targets for security threats.

**How** is it effective: By integrating the suspicious object detection system within these high-traffic areas, it can identify and alert the authorities of any suspicious objects in real-time, thus mitigating potential risks.



# Recommendations

## Recommendations # 2 High-Density Public Spaces

**Why:** High-density public spaces such as shopping centers, and tourist attractions have a large number of people gathering, increasing the potential risk.

**How** is it effective: Due to the sheer number of objects and activities in these areas, manual surveillance can be challenging, making the need for an intelligent detection system crucial. The system can effectively monitor these areas, identify suspicious objects, and alert relevant authorities, thereby enhancing security.



# Recommendations

## Recommendation # 3 Transportation Hubs

**Why:** Transportation hubs, including bus terminals, MRT interchanges, and airports, are not only high traffic areas but also serve as critical infrastructure.

**How is it effective:** Implementing a suspicious object detection system in these areas can enhance overall security and create a safer environment for both travelers and staff. With an extensive coverage and real-time alerts, potential threats can be quickly identified and dealt with, enhancing the effectiveness of the overall security protocol.



# Future Works

Objects-Body Language-Crowded Spaces

Objects	Body Language	Crowded spaces
Increase the number of objects that contribute a suspicious character -Big Bags -Hoodies -Luggages -Helmets	Annotating full body language. - Hands in the pocket. -Always facing downwards	Implement the model into crowded spaces. Suspects like to blend into crowds. -Head counts -Evaluating Facial Expressions

# Questions

Contact details

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