

RECOGNIZING RESTRICTED AREA INTRUSION WITH COMPUTER VISION

Presented By : AIP491_G15
Advisor: Tran Van Ha

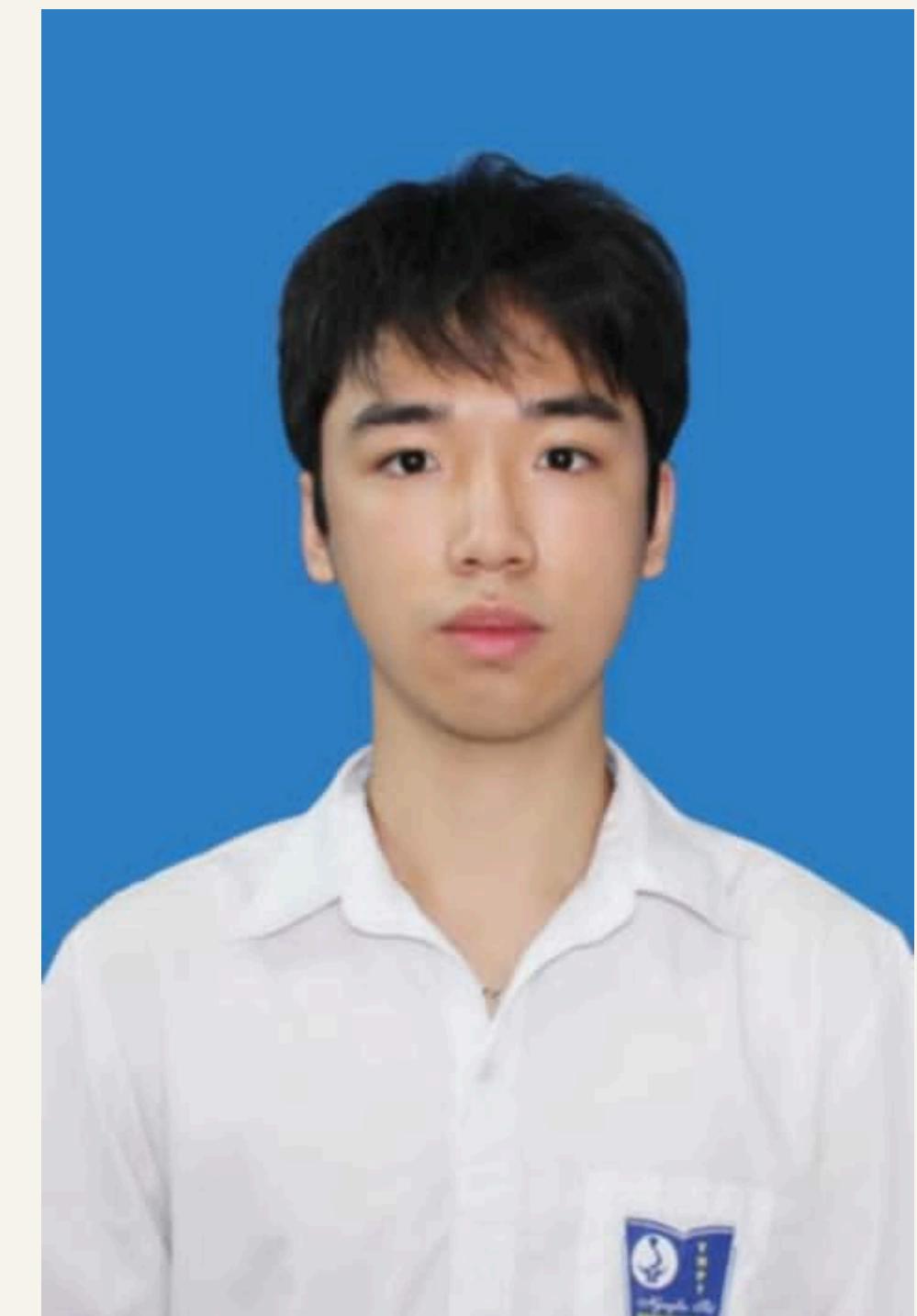
Group members



Bùi Quang Minh - HE170952



Bùi Quang Minh - HE170776
FPT University | 2024



Phạm Tiến Anh - HE170096

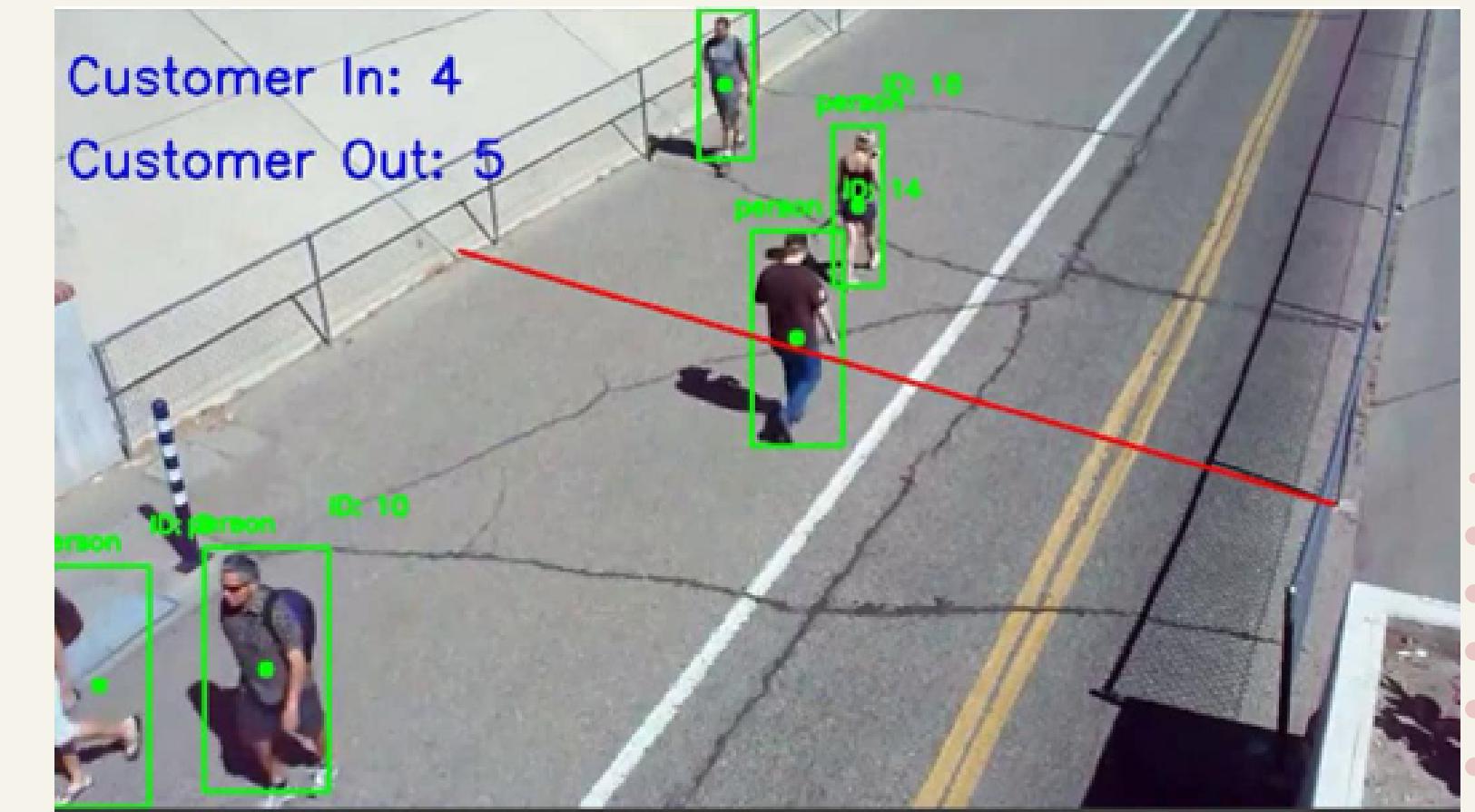
OVERVIEW

- Introduction
- Related Work
- Methodology
- Experiment
- Conclusion

INTRODUCTION

Motivation

- The presence of unauthorized individuals or strangers has become a dramatic problem as the residential areas are growing.
- Effective video surveillance systems is needed.



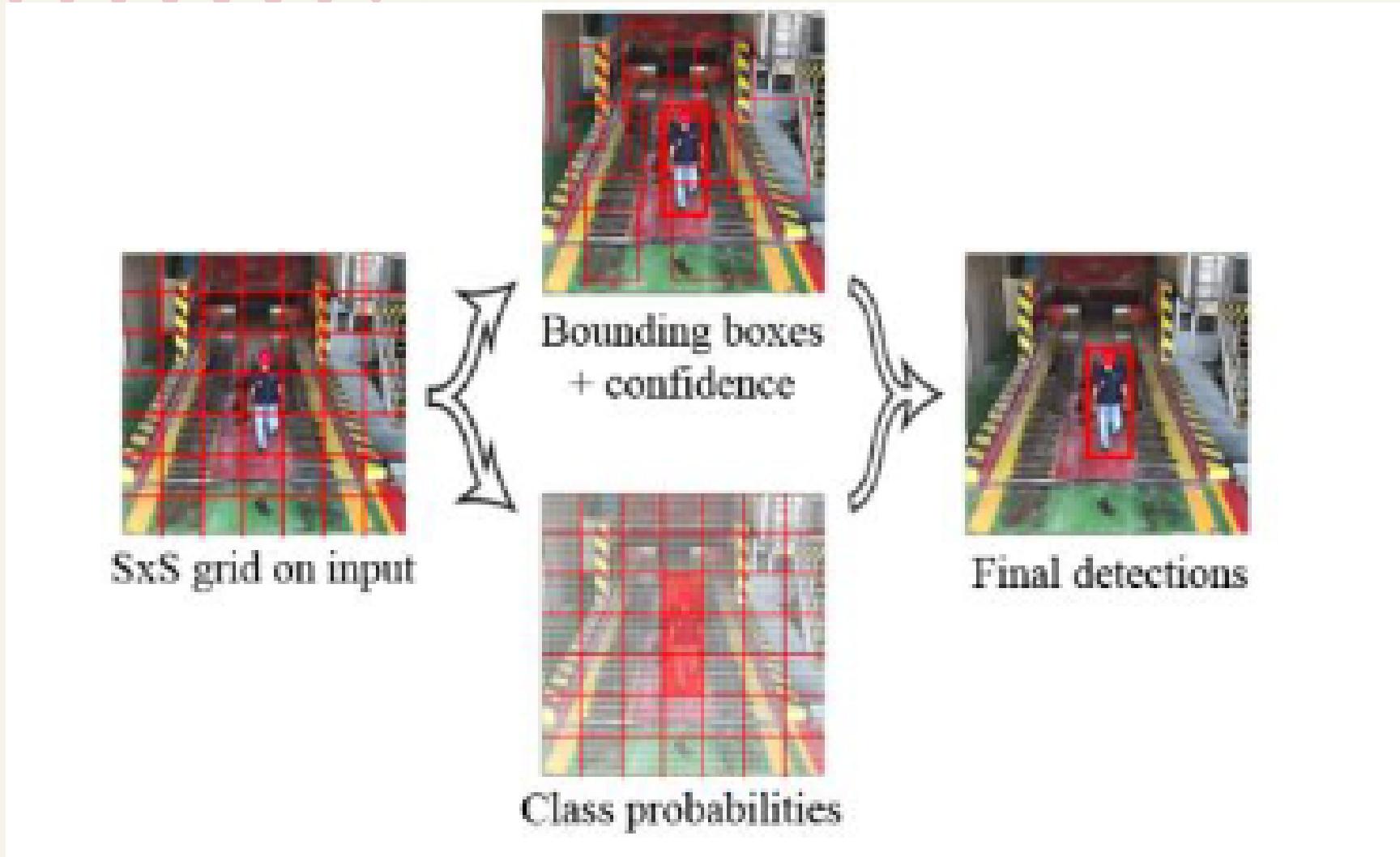
INTRODUCTION

Objective

- Develop a system that can detect people effectively and perform fast tracking in real-time.
- Must have a mechanism to detect potential intruders to secure public surveillance.



RELATED WORK



Human detection in truck dumper area



Human detection in controlled area

METHODOLOGY

● System Overview

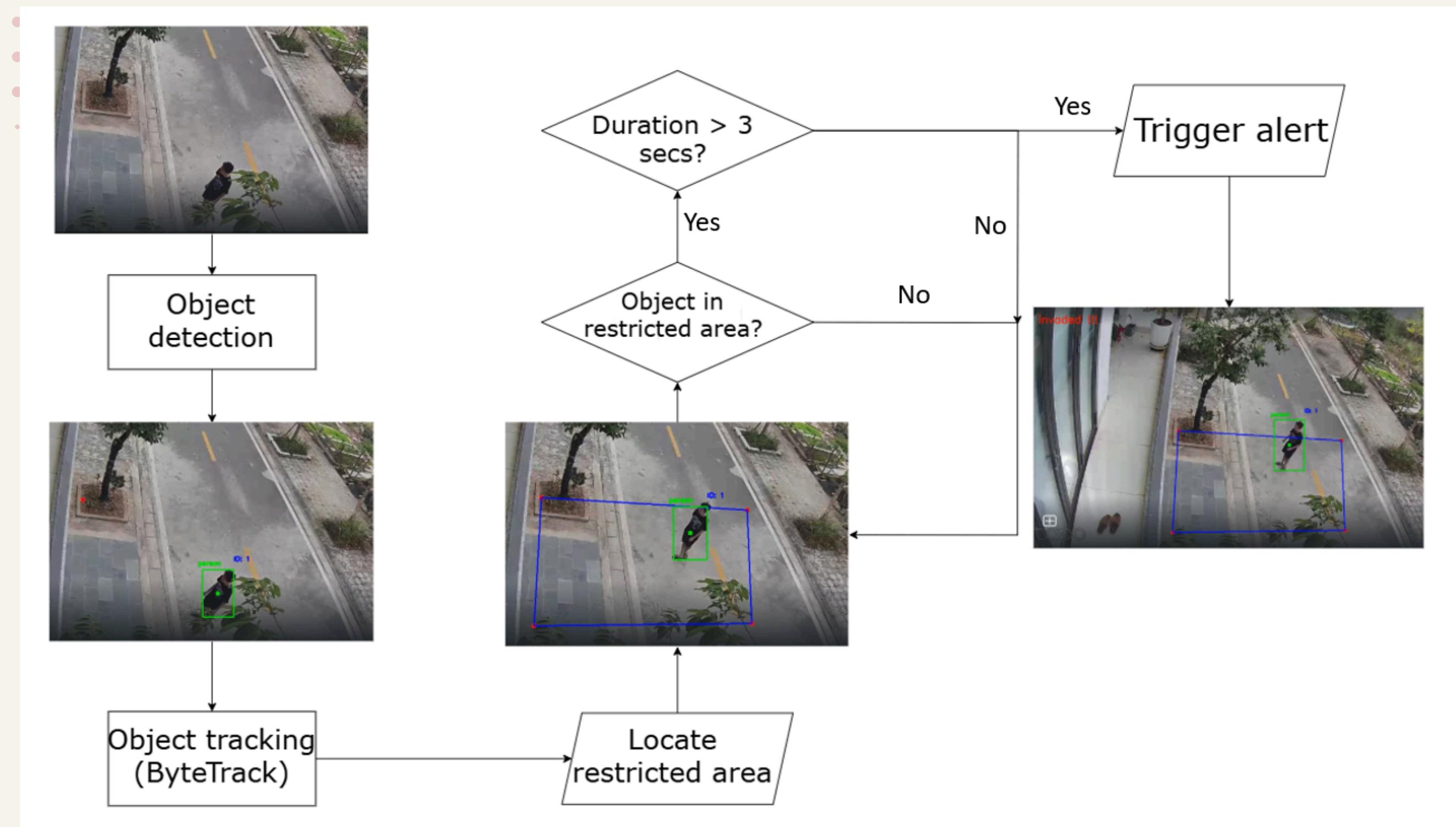
- System Details
- Implementations

● Implement Model

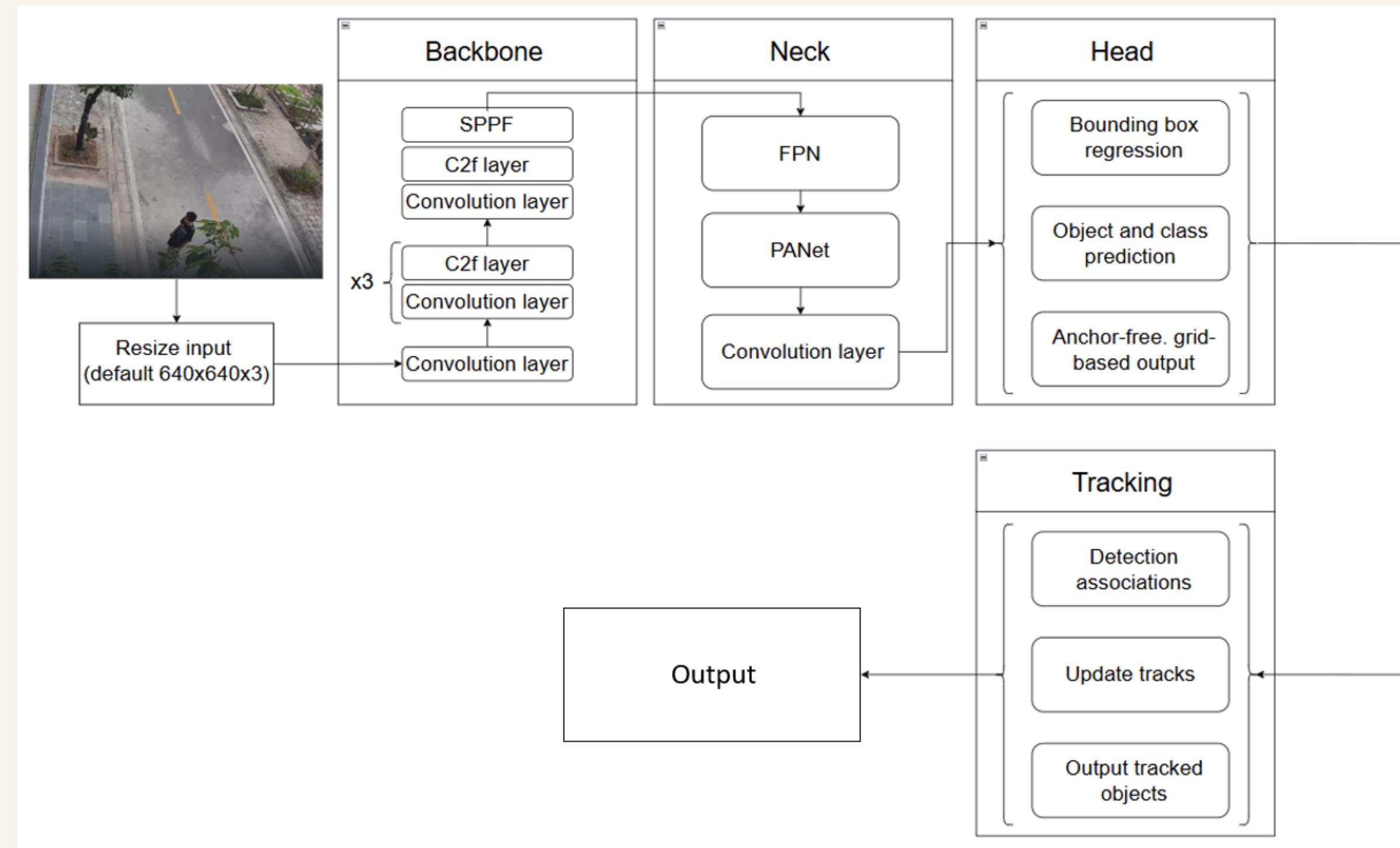
- Object Detect
- Object Tracking

● Data Collection

SYSTEM OVERVIEW



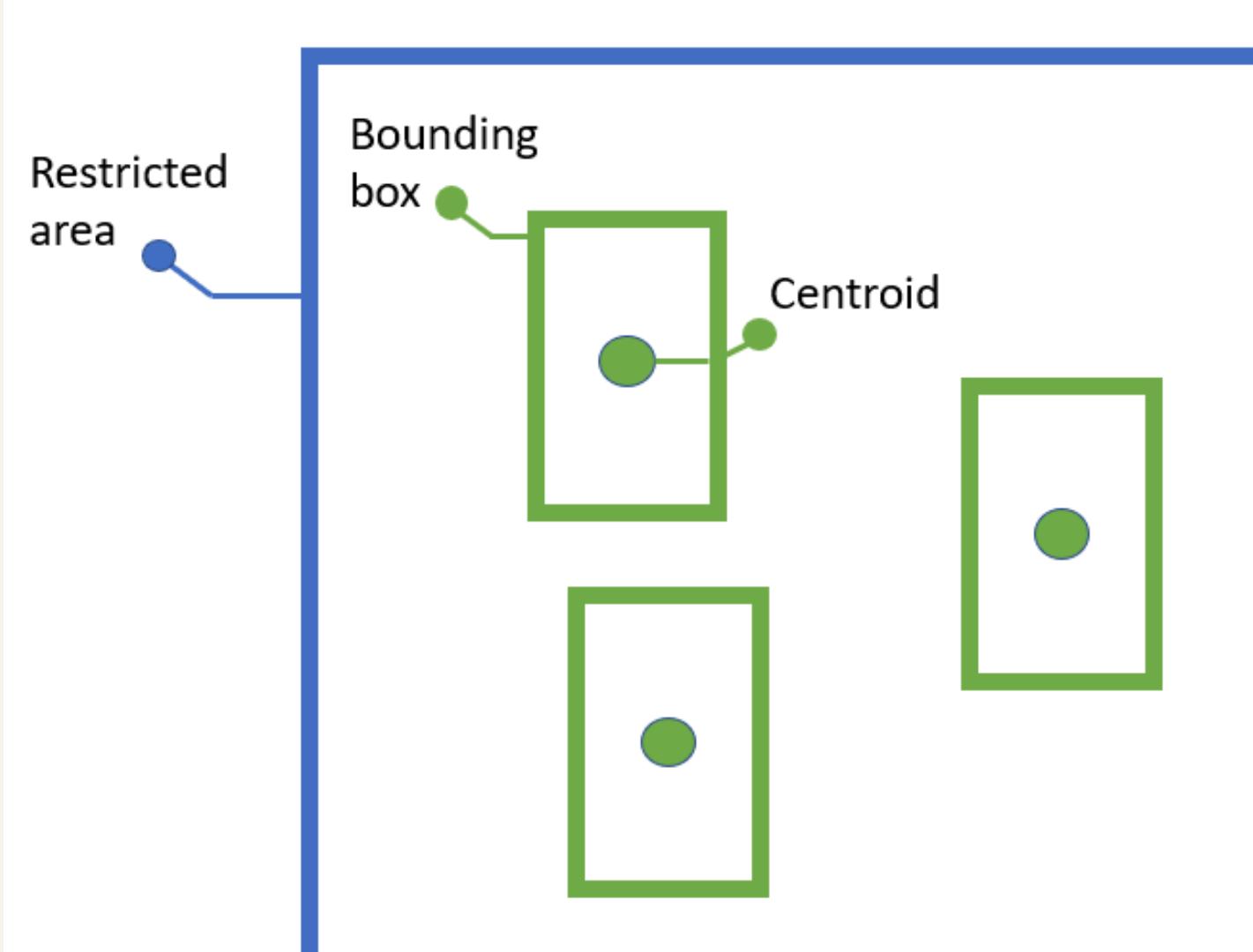
System's pipeline



Model's workflow

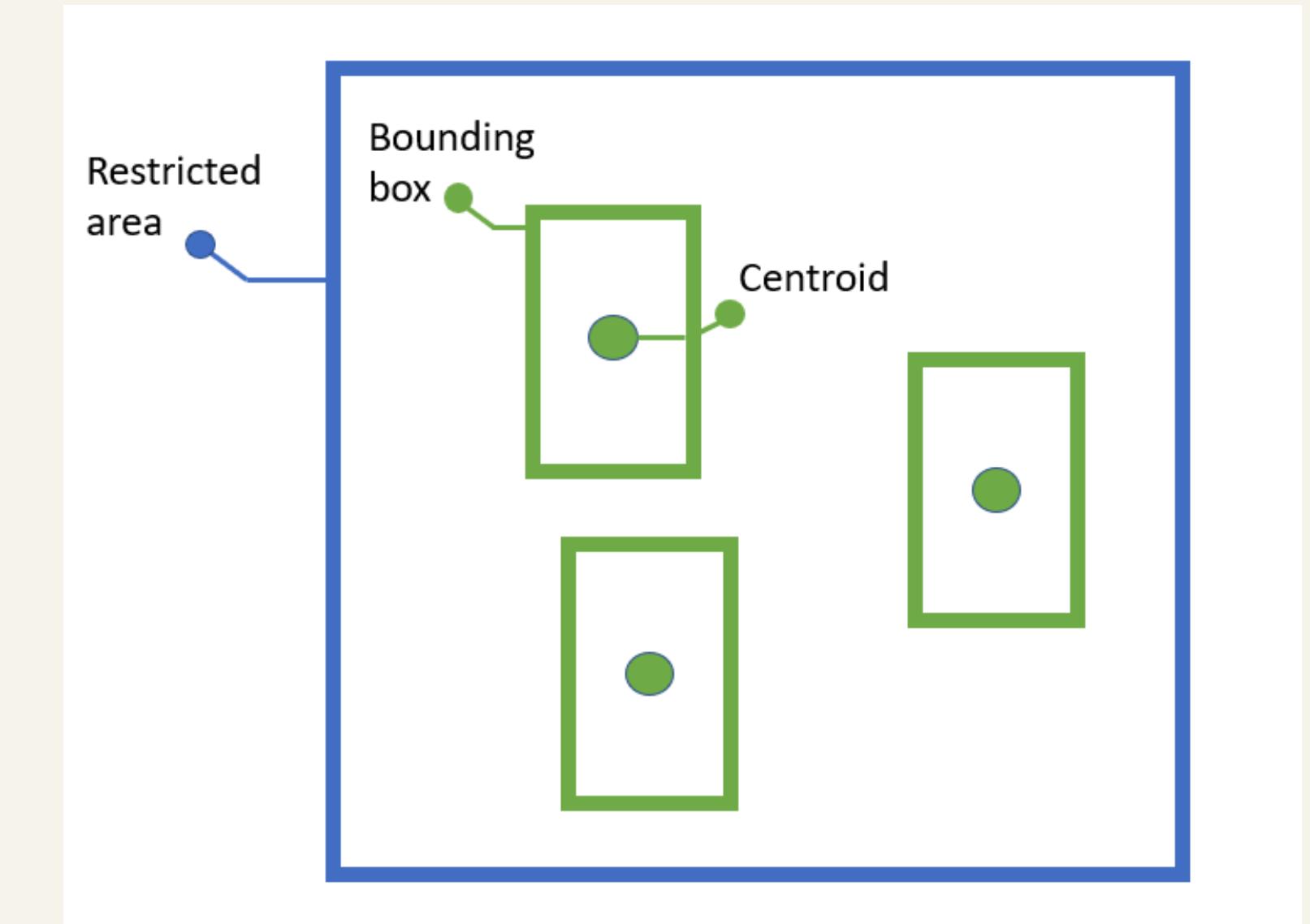
Prohibited zone mechanism

- Sets of coordinates are obtained through user clicks on the screen.
- These coordinates are connected to each other and form a prohibited zone as a blue polygon.
- Centroids of each bounding boxes are calculated based on bounding boxes' coordinates.



Prohibited zone mechanism

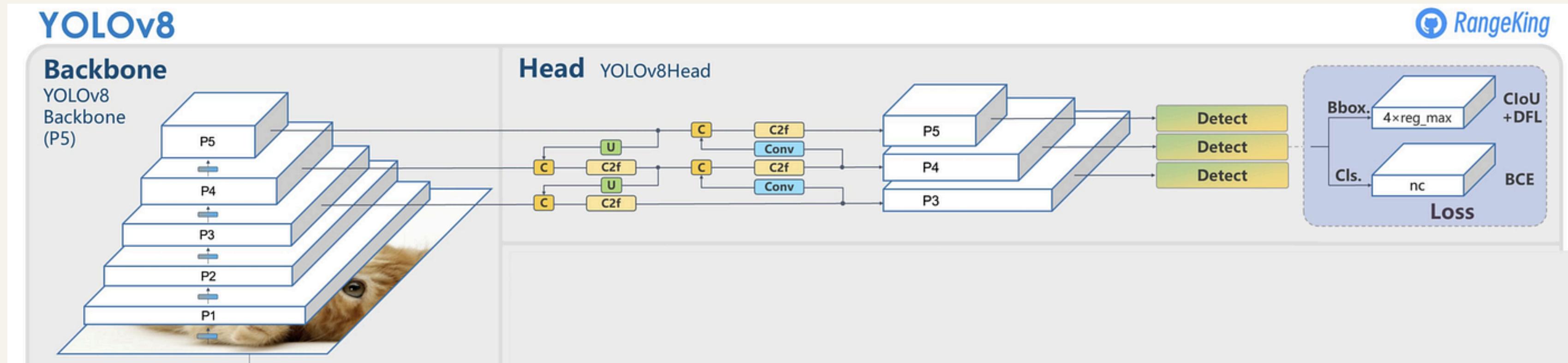
- Using the `contains ()` method from the Shapely library to check if the centroid is in the prohibited zone or not.
- If the centroid stays inside the prohibited zone for longer than 3 seconds, the system triggers an alarm on screen.



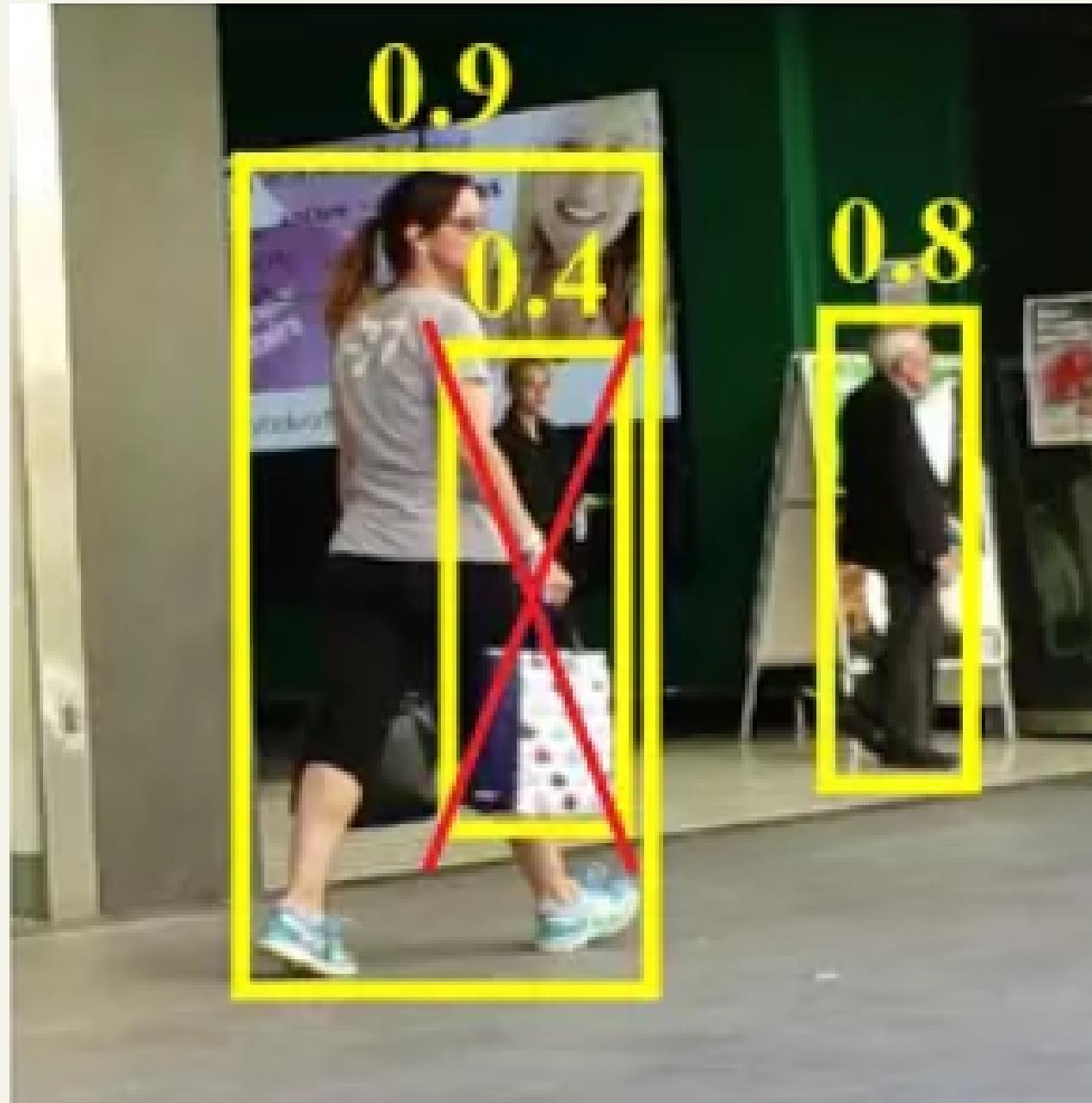


Prohibited zone mechanism's example

IMPLEMENT MODEL



YOLOv8 model

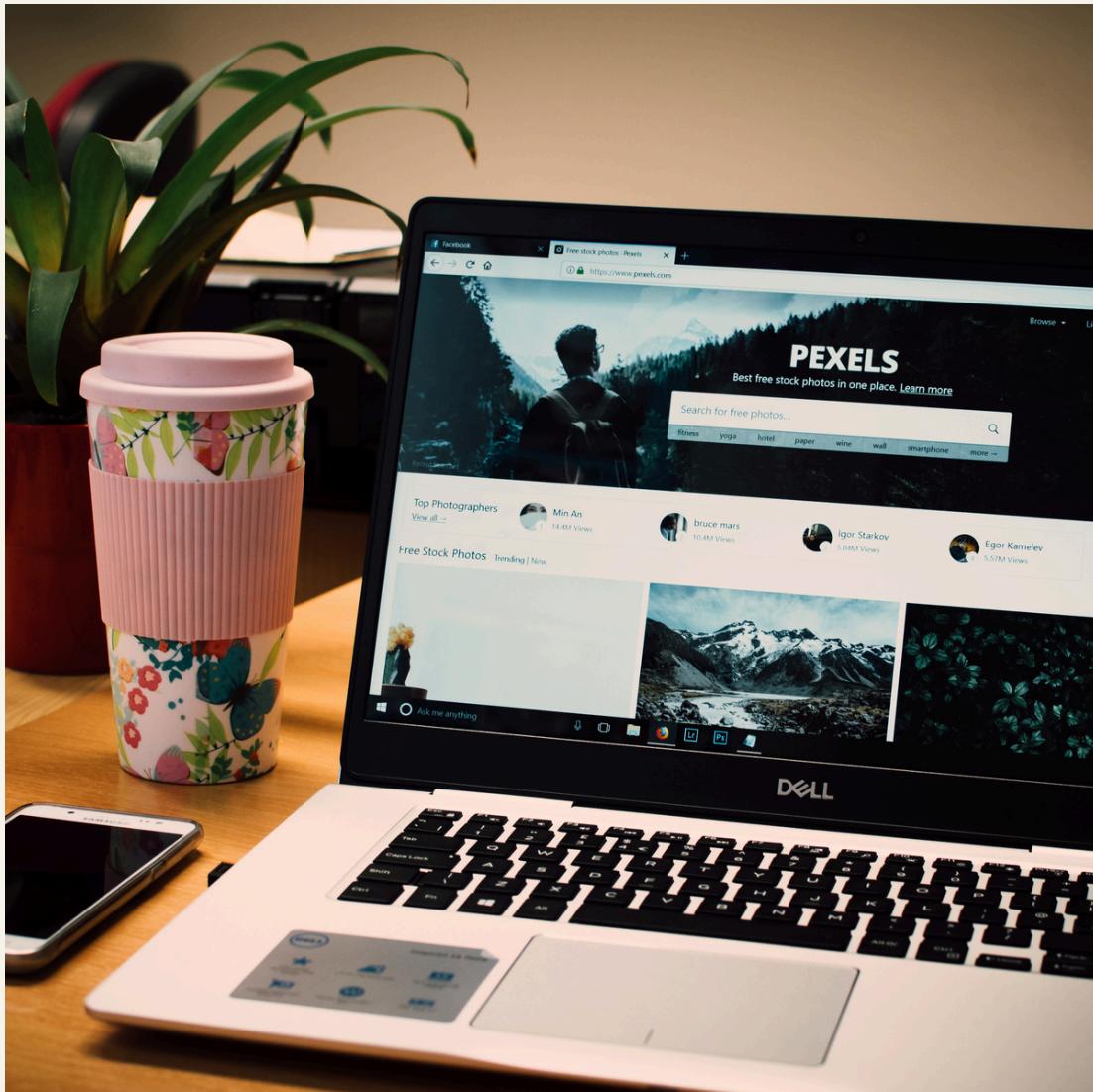


ByteTrack detections

IMPLEMENT MODEL

- ByteTrack is different from SORT tracking although they both use Kalman filter, Hungarian algorithm.
- The main advancement of ByteTrack involves retaining low-confidence detection boxes.

DATA COLLECTION



- There are 18250 images. There are 15550 training images, and 2700 on the validation images, focus on recognizing and tracking people.
- 8000 human images from COCO dataset, 6000 images from surveillance cameras, 4000 human images from public datasets on Roboflow.
- Data augmentation techniques is applied: blur, translation, scale, flip, erasing,crop...

DATA COLLECTION



Dataset images example

TRAINING MODEL



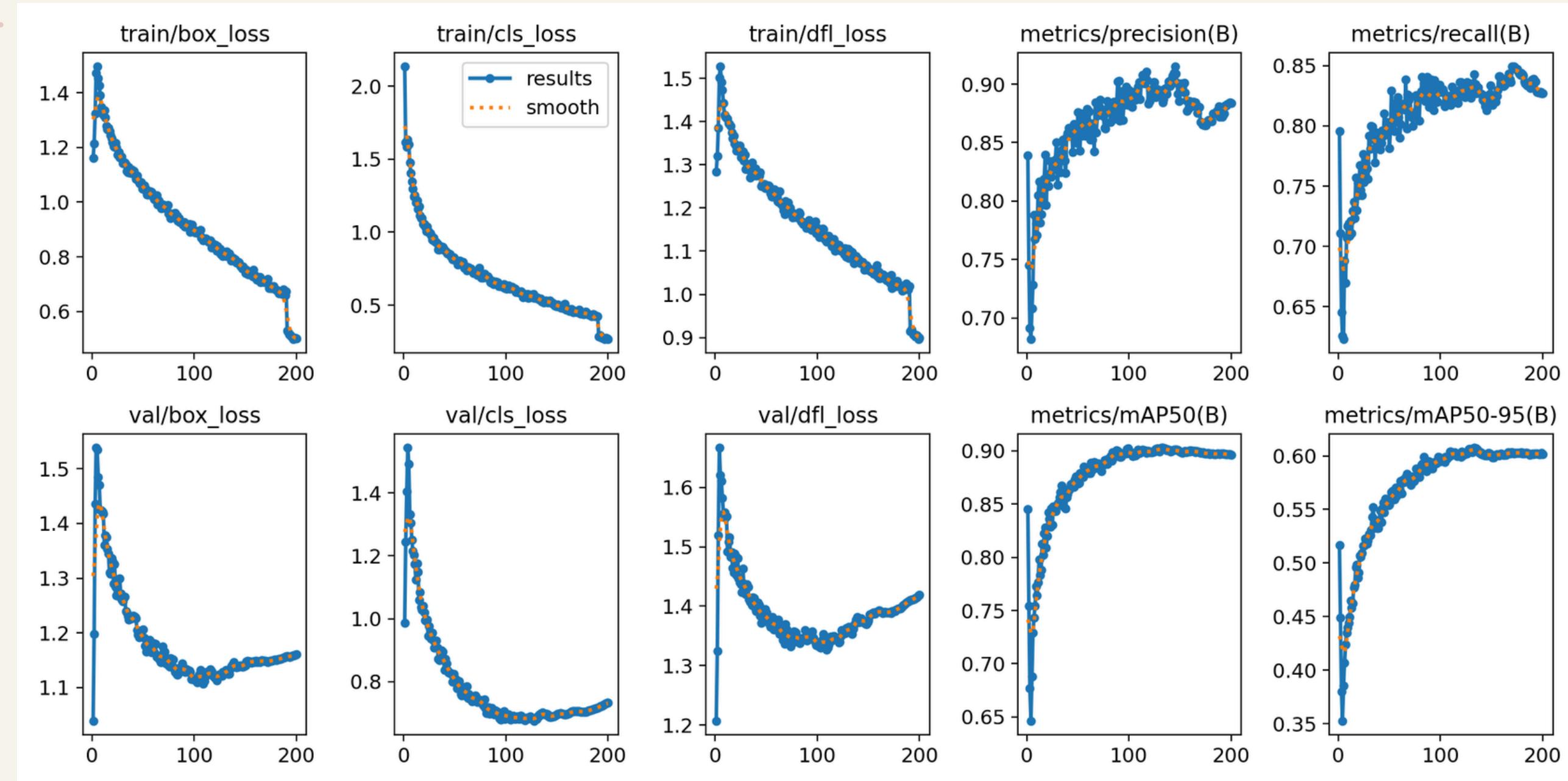
- The model was trained for 200 epochs with a batch size of 3 .The model was trained on RTX2080Ti GPU.
- The model achieved the best result on epoch 145 with a precision of 91.53%, recall at 81.28%, mAP50 at 90.15%, mAP50-95 at 60.12% and the inference time is 17.52 ms.

TRAINING MODEL

Precision(%)	Recall(%)	mAP50(%)	mAP50-95(%)	Inference time(ms)
91.53	81.28	90.15	60.12	17.52

Model's performance after training

TRAINING MODEL



Model's results after training

TRAINING MODEL



Model's detecting results

CONTRIBUTION



- By fine-tuning YOLOv8 and ByteTrack, we developed a system that can effectively monitoring restricted areas.
- Achieved high-precision detection with fast processing speed ,making advanced object detection more accessible for security and surveillance system.
- Can be used in the deployment of robust detection systems in diverse environments such as urban infrastructure, smart homes, and autonomous systems.

LIMITATIONS

- Further evaluation is needed on smaller computers such as Raspberry Pi or real-life surveillance hardware like webcams to further prove its applicability.
- Improve the limitations of the prohibited zone mechanism, as it may not function properly with different camera angles. Additionally, implement a feature that can send alerts to users.

CONCLUSION

- We implement a method for detecting and tracking people, designed to address the limitations of previous approaches and improve detection accuracy in real-world scenarios.
- By fine-tuning YOLOv8 combined with ByteTrack, our system provides effective intrusion alert. The model shows significant results with a precision of 91.53% and an inference time of 17.52 ms, proving its performance in tracking speed and accuracy.

FPT University | 2024

THANK YOU

Presented By: AIP49I_G15