A Practical Weapon Detection System For Enhanced Security Using Artificial Intelligence

CYSF 2025 - ALVEENA ASHIQ - Grade 8 - Westmount Charter School

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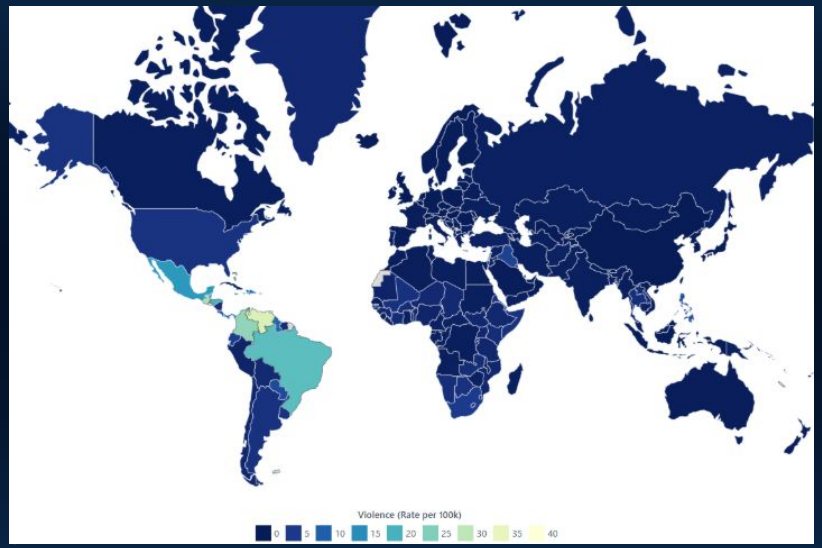
Problem

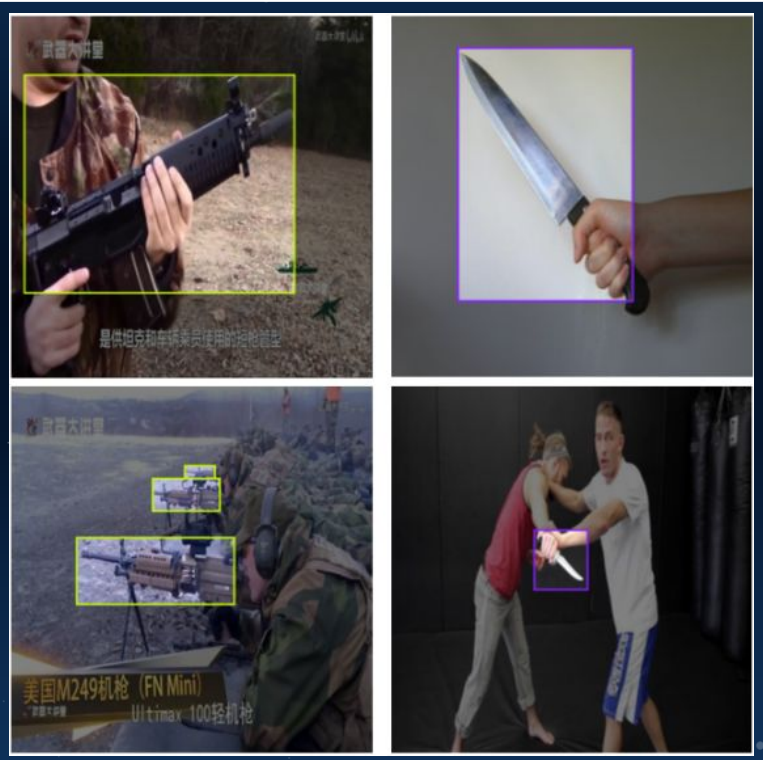
Gun and Weapon Violence



Over 250,000 people died from firearms in 2019, with the majority of deaths being homicides, especially in countries like Brazil and the United States.

02 Method

Object Detection



Some labelled data of guns and knives

Development

A Windows-based workstation

- Demonstrates the suitability of the system for a central monitoring station
- Can be connected to multiple IP security cameras to detect weapons.

Python

- Windows, macOS, Linux, Raspbian, and more.
- NumPy, OpenCV, PyTorch, and others.
- Ideal for rapidly validating a proof of concept or building a prototype.

Raspberry Pi-based camera system

- Equipped with weapon detection analytics
- Cost-effective solution
- does not require a central monitoring station for operation.

YOLOv8 Models

Nano Model

- For developing integrated weapon detection system
- Works well with minimal computational resources of Raspberry Pi
- Provides faster inference but lower accuracy.

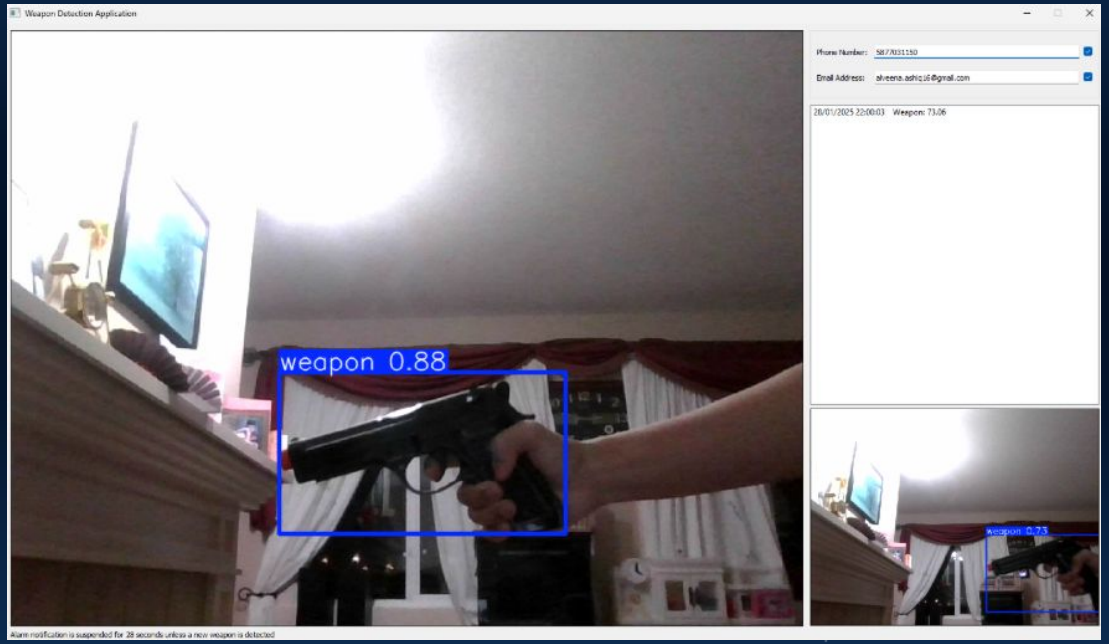
Large Model

- Higher accuracy at the cost of slower inference speed and increased computational demands.
- For the Windows-based workstation application
  - Typically have sufficient computational power to handle a Large model

```
27
28  class VideoThread(QThread):
29      change_pixmap_signal = pyqtSignal(QVariant, arguments=['data'])
30
31      def __init__(self, channel):
32          super().__init__()
33          self.channel = channel
34          self.model = YOLO('../YOLOv8l_WeaponModel.pt')
35
36      def run(self):
37          # capture from web cam1')
38          vidcap = cv2.VideoCapture(self.channel)
39
40          success, image_BGR = vidcap.read()
41
42          while (success):
43              now = datetime.now()
44              success, image_BGR = vidcap.read()
45
46              results = self.model.predict(image_BGR, conf = 0.7)
47
48              # Visualize the results on the frame
49              annotated_frame = results[0].plot()
50
51              aDict = {"image": annotated_frame, "result": results[0], "datetime": now}
52
53              self.change_pixmap_signal.emit(aDict)
54
55          # shut down capture system
56          vidcap.release()
57
```

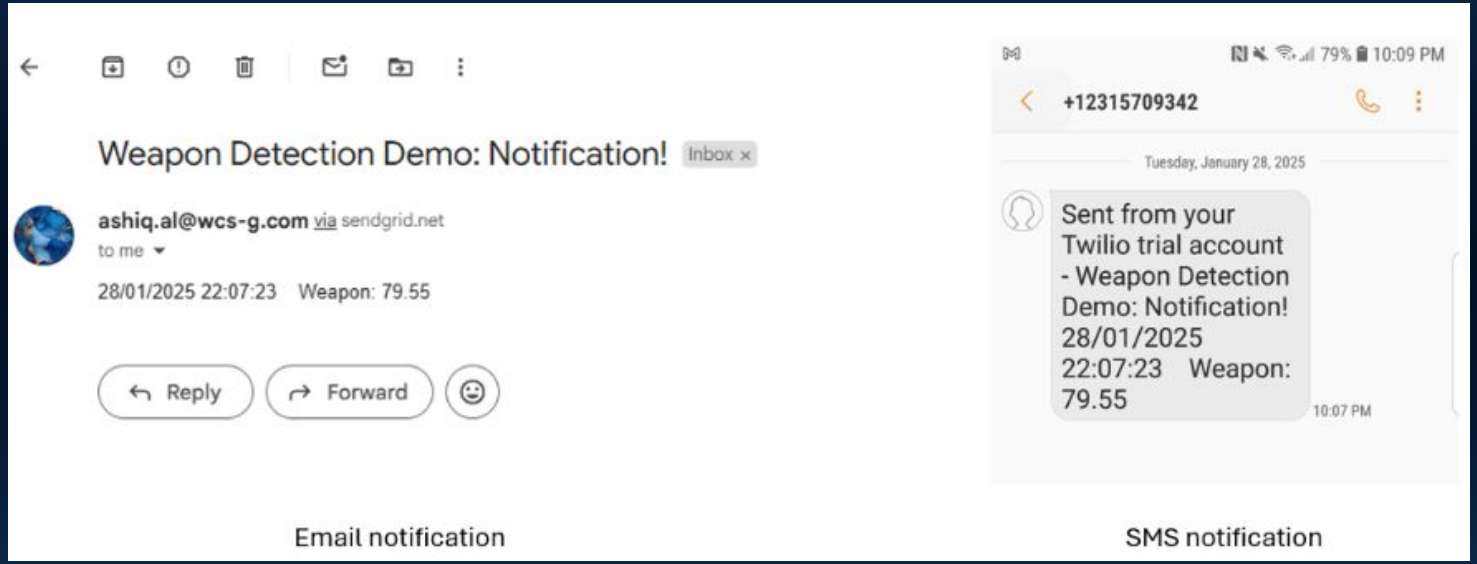
A code snippet from the developed application

Application



Weapon detection application interface

Notification



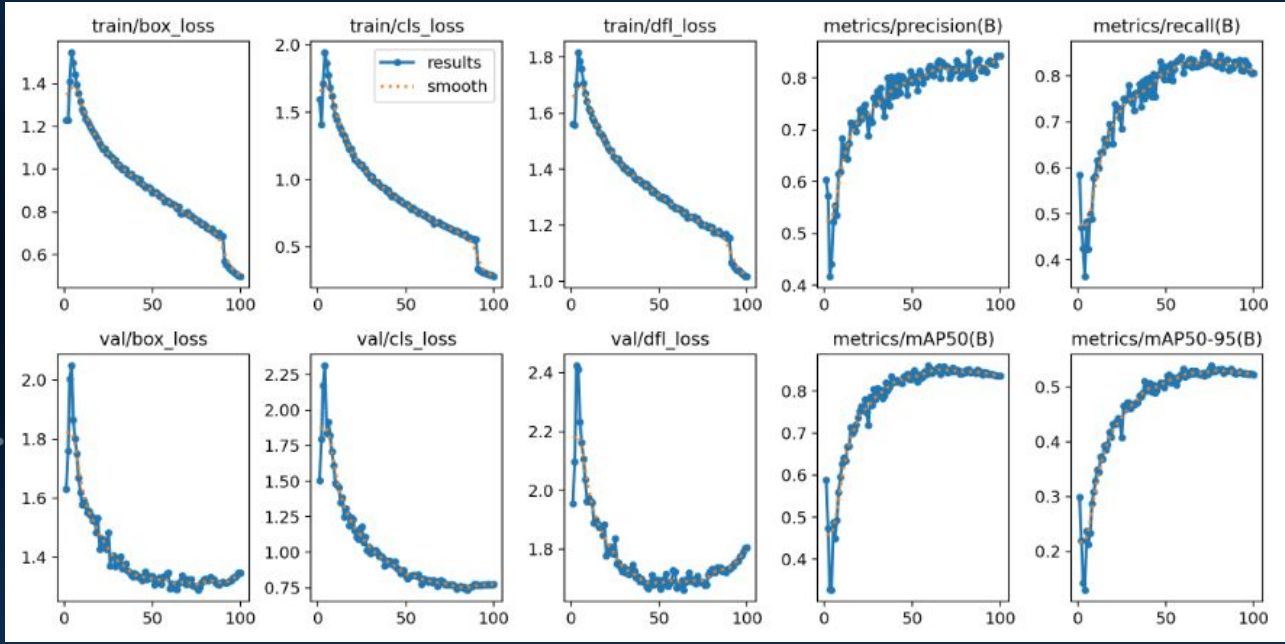
Real-time weapon detection notification via email and SMS

Raspberry PI Camera Prototype

Raspberry PI camera prototype with integrated weapon detection analytics

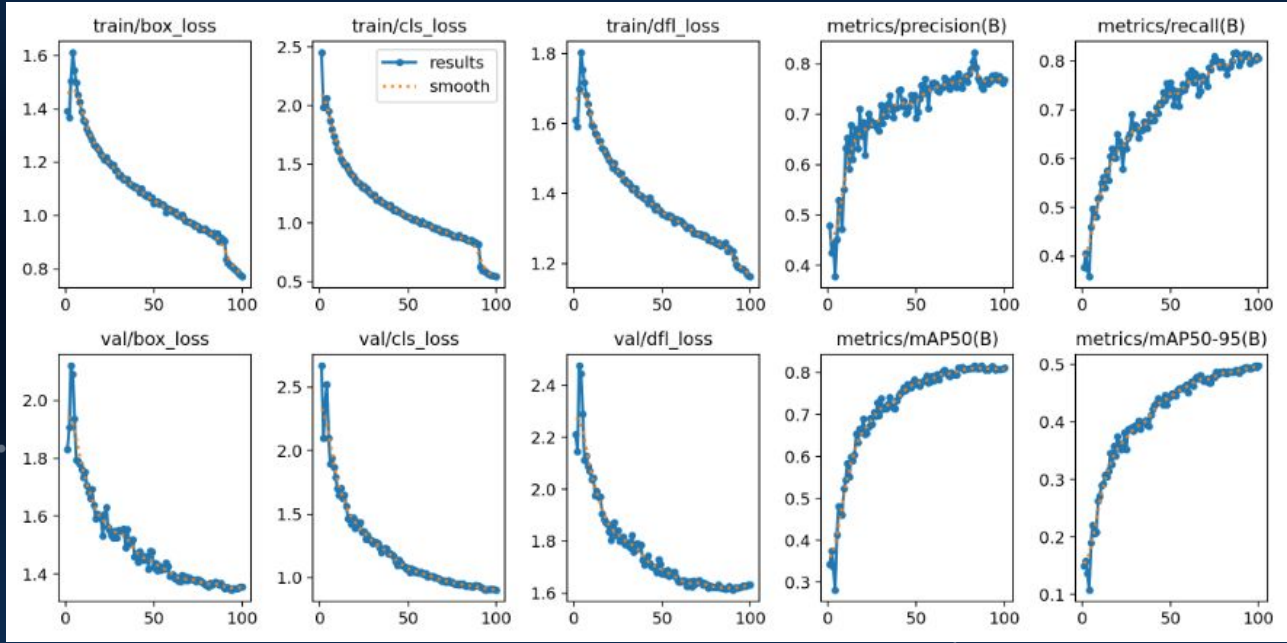
03 Analysis

Performance Analysis



YOLOv8 Large model training results from over 100 epochs using the weapon dataset

Performance Analysis



YOLOv8 Nano model training results from over 100 epochs using the weapon dataset

Performance Analysis

Model	Precision (%)	Recall (%)
YOLOv8l	82.6	82.8
YOLOv8n	76.8	80.4

Precison and recall values of the trained YOLOv8l and YOLOv8n models

04 Conclusion

Two weapon detection systems

A central monitoring station-based application capable of analyzing streaming video from commercial IP cameras

A cost-effective, standalone edge camera device with built-in weapon detection analytics.

Thank you!

For listening to my CYSF presentation