Weapon Detection Using Object Detection And Deep Learning

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***Abstract* — In the course of recent years, the quantity of mass shootings has expanded radically. Weapon brutality on public grounds brought about many injured or dead people which reflects the firearm savagery issue. The inability to quickly address the underlying driver of weapon viciousness is having enduring ramifications for many citizens. Hence there is a need for an automated system, that doesn't require manual intervention, and ensures quick action and minimal harm.**

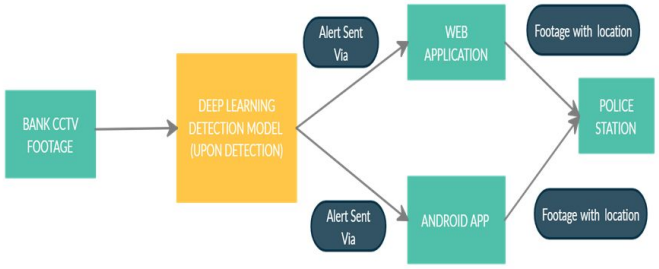
Keywords— weapons, deep learning, object detection, yolov5, dataset, android application, web application.

I. INTRODUCTION

By and large, police reaction time is around 20 minutes. At the point when a shooting happens, in some cases calling 100 isn't possible immediately, rather, an individual ought to be in a sheltered spot for him to have the option to call for help. also, that may take a lot more time. So, the 20 minutes police response time does not include the time it takes to call 100.

The deep learning model performs custom object detection,and is designed to classify and identify weapons, captured from the footage provided. The footage provided to the model is presumed to be real-time surveillance from the CCTV cameras. When the model detects any weapon from the footage, it prepares and sends the live footage clippings to the local police station with the name and location of the place. The police receive it through the web and android applications.It reduces the possibility of public harm, as the police gets notified automatically, without the necessity of manual intervention.

II. SYSTEM DESIGN



The system design explains the overall structure of the model. It starts with live footage from Banks being passed into the model. If there is positive detection, then an alert is immediately sent to both the web application and the android application.
The alert contains the video snippet and the location of the bank. It is sent to the web and android app, which are accessible by the police.The idea is for the local police to receive the alert, and take required action at the earliest, preventing harm.

III. WORKING

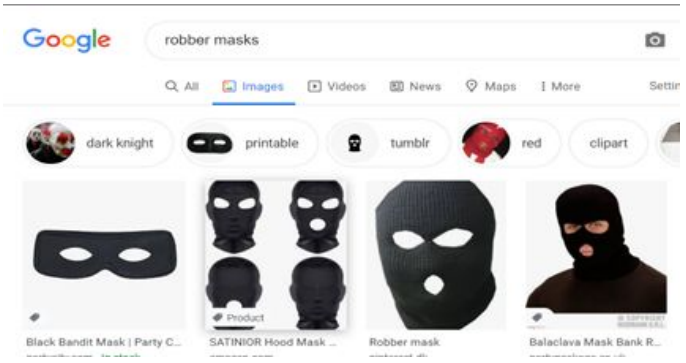
A. Dataset Creation

1) Tech Stack:

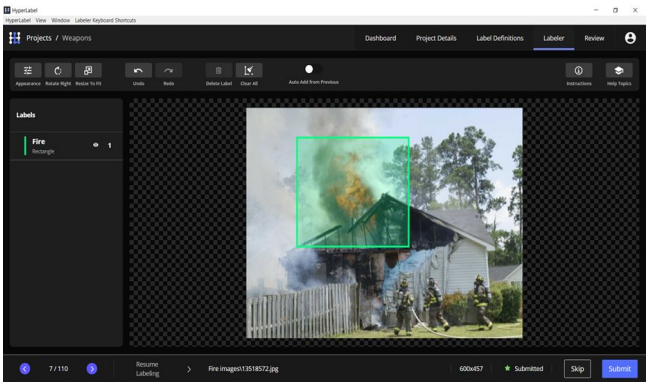
- Hyperlabel
- LabelImg
- OIDV4

2) Working:

The dataset has been carefully curated to meet the needs of this model. Large numbers of images of guns, rifles, fire, knives and robber masks have been taken from websites like Google Images, Shutterstock etc. and hand-annotated as per requirement.



OIDV4 has been used to scrape images off the internet. After gathering the images, Hyperlabel is used to annotate (box) each picture, and labels for each picture are obtained.



B. MODEL

1) Tech Stack :

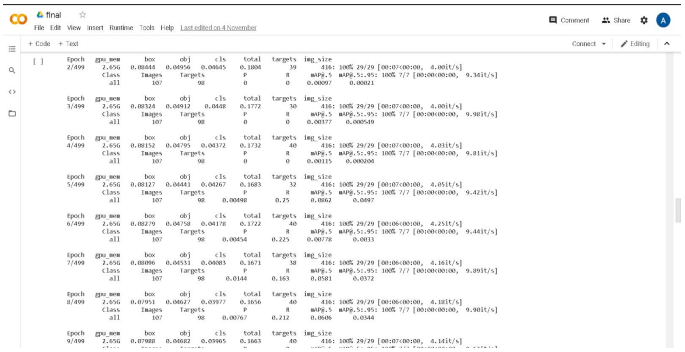
- YOLO V5
- Python
- Python

2) Working:

YOLO “You Only Look Once” is one of the most popular custom image detection algorithms .In this project the latest version Yolov5 by ultralytics is used.the model divides up the image into a grid of 13 by 13 cells: Each of these cells is responsible for predicting 5 bounding boxes. A bounding box describes the rectangle that encloses an object. YOLO also outputs a confidence score that tells us how certain it is that the predicted bounding box actually encloses some object.

3) *Training and Testing:*

The Dataset images are first uploaded to google colab . The dataset is then split into training and testing and uploaded within the git pulled yolov5 folder where each of them is uploaded with its annotated text file with the exact same name and the training is started.



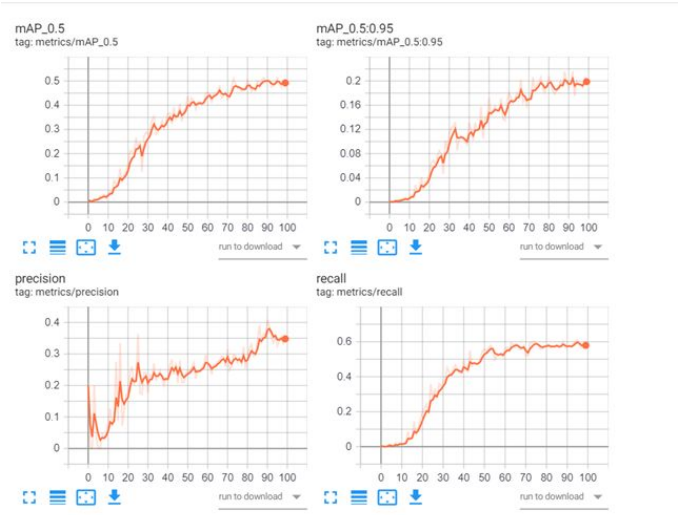
Yolo then uses the generated weights file from the training data and predicts the given video by extracting frames in real time.If the yolo detects a higher weapon threshold for the frame the model,it sends an alert to the server.

4) Result :

The model was then tested on a random video and a few random recognised frames were taken for representation.

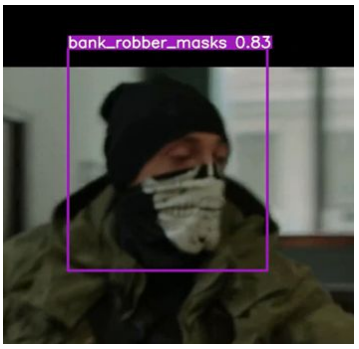
100 EPOCHS :

Statistics :

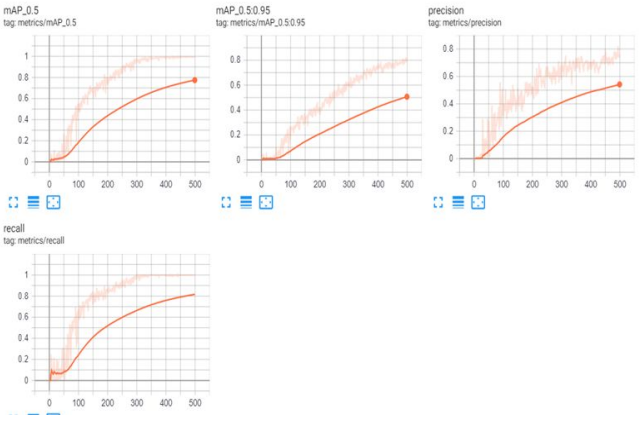


As shown in the statistics and image above not very good accuracy is achieved due to undertraining.

500 EPOCHS :



Statistics :



The accuracy has improved considerably and this is the sweet spot for the number of epochs as anymore would lead to overfitting of the model.

B. Android Application

1) Functionality:

This app is the representation of a software used by the police. It acts as a perfect presentation of how the alerts would be sent to the police from the software run on the client’s side.ON receiving the alert, the police

can take action.

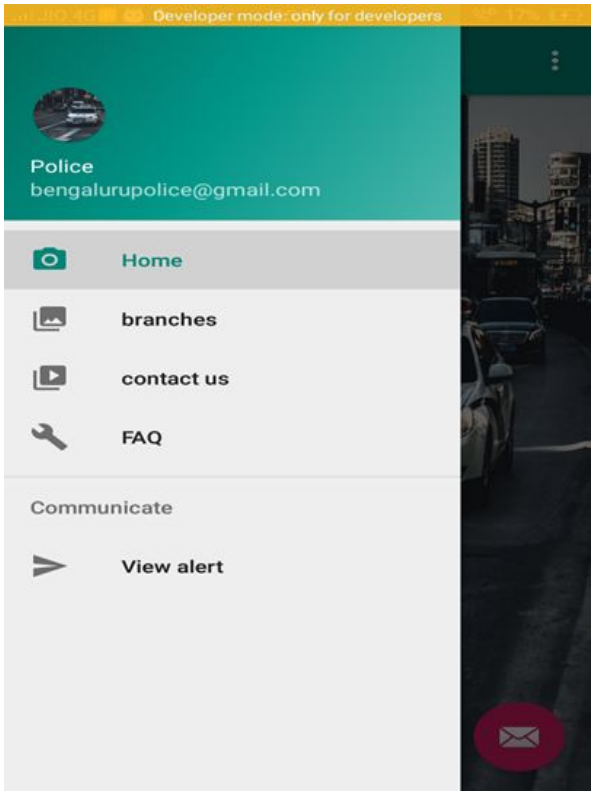
2) *Interface Showcase:*

a) Login Screen:

Fig.2a

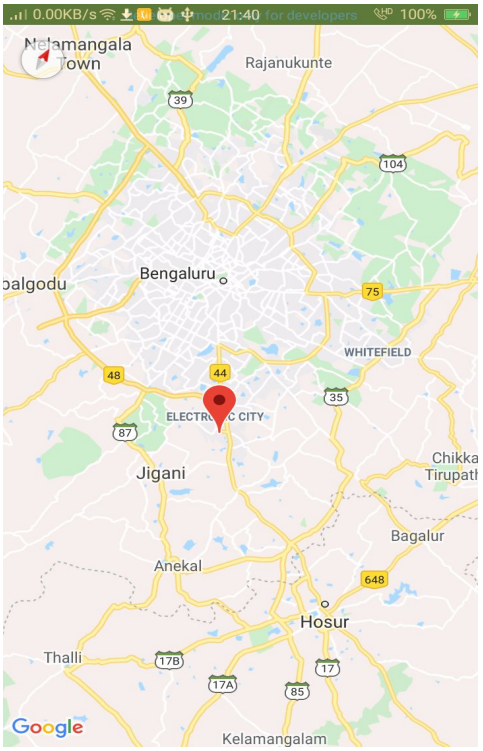
- Users (police) can enter the credentials given to their department and login.

b) Home Page :



- On login, the home page is visible which shows general information.
- The navigation bar shows option such as "branches"(where information about branches and departments is readily available),"Contact us" (where contact information for said branches and departments is available), an "FAQ section" (which is a readily available resource for first time users) and a "send alert" section (that shows the location sent by an incoming alert)

3) Location



C. Web Application

1) Functionality:

This web app is the representation of a software used by the police. It acts as a presentation of how the alerts would be sent to the police from the software run on the client's side.

2) Interface Showcase :

a) Login page:

Fig.3a

- Police officials can enter the credentials of that particular station/department.
- Either field cannot be left empty.
- Cancel button clears the entered information, in case the user wishes to retype their credentials.

b) Home page :

Fig.3b

- Home page contains a navigation bar with - Branches, Location and Logout.

c) Branches:

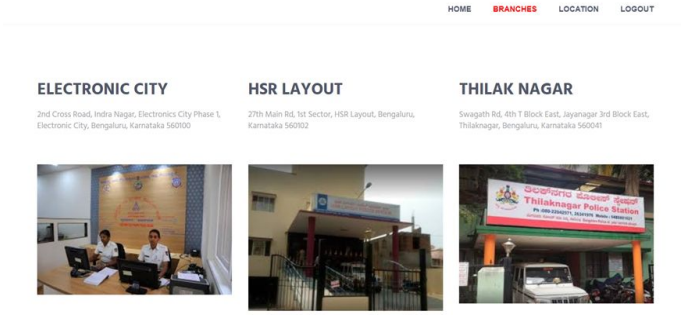
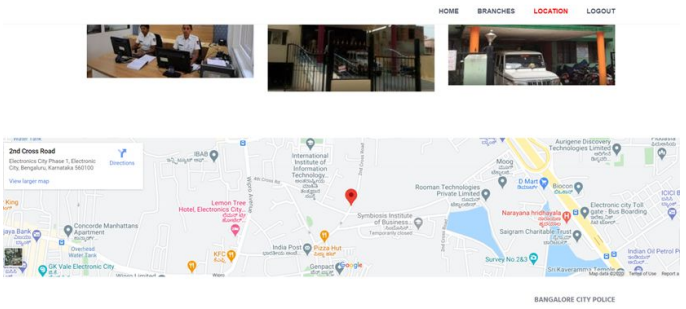


Fig.3c

d) Location :

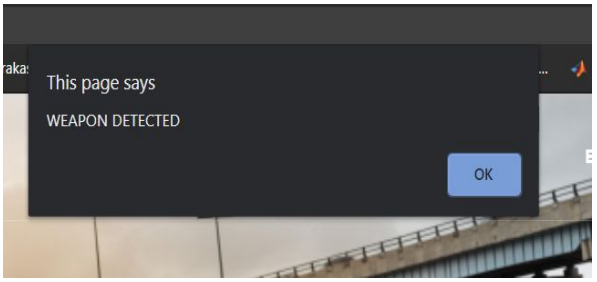


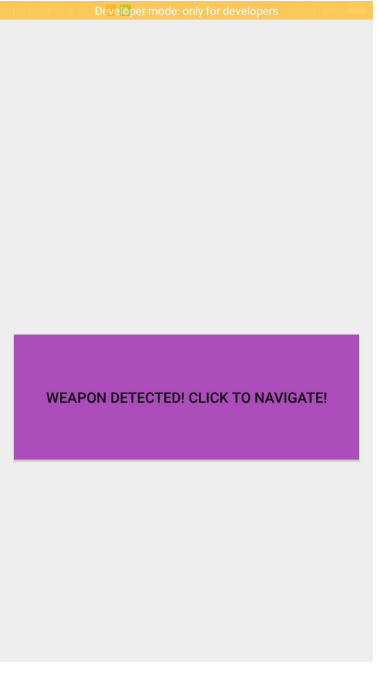
- On clicking Locations from the navigation bar, it displays the location on Google maps of that particular police station branch.

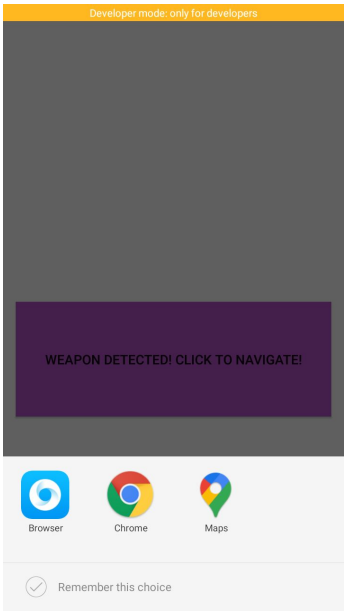
IV. CONNECTION

We connect all the components by use of servers. We set up a real time firebase database in the backend. The deep learning model, upon detection changes certain values in the firebase database, that trigger events in both web and the android application.

Upon detection, an alert is sent to both the applications, and along with that there is a drive link to the video snippet, and the google maps location to the bank or venue where weapons were detected.







V. CHALLENGES OVERCOME

- One of the main difficulties is when there is lack of data and skewed data,unlike conventional machine learning models.Just images of a particular object are not sufficient the data must be correctly annotated for the model to be trained .Such data is rarely available specially for custom object detection.This problem was overcome by scraping images from various websites and manually labelling them with the Hyperlabel and labelimg.

- The skewness of the data led the accuracy of the model to reduce considerably .this happened because some classes such as guns had considerably more collectible images compared to classes like robber masks.This was fixed by using same number of images in all classes despite having only 100 images in each class to stabilise accuracy.

VI. PRODUCT SCOPE

- This project has covered all the technical features required to operate in any bank/school/public places.
- The product comes as a software that can be run by the bank/school/public place.
- Software package is flexible to work in any environment with easy setup and minimal supervision.
- The product requires the use of HD cameras placed in the bank/school/public place.
- Overall, this product has a good scope for the future and has a high need in the current status quo.

VII. FUTURE SCOPE

- This project can be hosted on a cloud platform to improve speed of detection and the alerts.

- Further improvement on the accuracy can be made via acquiring larger datasets and faster computing power.

CONCLUSION

This system was designed with the safety of citizens in mind.The automation of weapon detection ensures that the police are informed irrespective of whether or not the staff is held hostage.This ensures the maximum probable safety for said citizens without the need for any manual intervention.By making use of Deep learning, we can detect weapons such as rifles, knives, pistols and the presence of fire on the occasion of an explosion as well as the presence of a person wearing a robber's mask.The app thus aims to make the time taken by the police to respond reduce drastically.

ACKNOWLEDGEMENT

We would like to express our gratitude to our guide for this project, Prof. Silviya Nancy for mentoring us throughout the course of this project. We also would like to thank the Department of Computer Science at PES University, for giving us this opportunity to work on this project.

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