Original Article

Weapon Detection Alerting System

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Abstract

In today's world, more crimes are happening, so people fear their safety and security. Mostly, gun violence is categorized as the most highly anticipated violence around the world as it is growing rapidly. Closed Circuit Television (CCTV) cameras are used in many areas to monitor activities, but still we need human oversight and involvement. We require a technology that is capable of automatically identifying these criminal activities. This project focuses on providing a secure place using CCTV footage as a source to detect harmful weapons like guns by using deep learning algorithm. Therefore, weapon detection is a primary requirement in the current world and our project presents automatic weapon detection using webcam identifying weapons using Convolutional Neural Networks (CNN). We implemented YOLO "You Only Look Once" V4 object detection model by training it on our customized dataset. The training outcomes show that YOLO V4 outperforms YOLO V3 in speed and accuracy. Applying this model to our surveillance system in smaller areas, we may save a person's life, which may reduce the crime rate. Additionally, our proposed system also alerts the admin by sending email with the captured image of the weapon, if the weapon is detected.

Index terms: YOLO, CNN, SVM, SSMBD, SSD, RCNN, FCOS

I. INTRODUCTION

Weapons which are used to commit violence gives a significant eloquence on many factors like public health, and psychological trauma, which brings mental illness. Daily we see several news related to gun violence, where in many cases the main problem is that people are keeping grudges even for small issues, which leads them to commit crimes. Acquiring a gun has become easier nowadays, here one point is notable that around many students die and leave their happiness due to these shootings which have dramatically increased over the years. This gun violence had made many students wounded and caused death also. Many governments in other countries have made a rule of this very strictly and to follow and which changed many people to good behavior. Applying this type of system and model in our surveillance system, we can save human life and reduce the rate of manslaughter or mass killing. Additionally, many scientists have come across my making many robots and new technology and reducing many deaths rated by these armed one's weapons or unsafe assets to avoid any kind of assault or risk to human life. Although the human visual framework is quick and precise and all across came like many things which are new technology and also able to detect these types of things which make us safe and also to reduce all killings. Nowadays, using the accessibility of huge datasets, advanced machine learning algorithms, and better calculations, we can now effectively prepare PCs and develop an automated computer-based system to distinguish and identify numerous items on a site with high accuracy. Recent developments indicate that machine learning, deep learning, and image processing algorithms have played a vital role in smart surveillance and security systems. Similarly, we have used one of the object detection techniques named YOLO, which uses derived features to recognize all the occurrences of an object category. We used YOLO version 4 to detect objects like weapons with a higher accuracy rate. If the weapon is detected, the admin will be notified through email with the image captured.

II. LITERATURE SURVEY

Wenbo Lan and his team, worked on Pedestrian Detection Based on YOLO Network Model[1]. They have modified the network structure of the YOLO algorithm and created a new structure called YOLO-R to extract information about shallow pedestrian features to include pass-through layers with the original YOLO network. Using the INRIA dataset as test set,

YOLO V2 and yolo-R were evaluated. The result showed that the YoloV3 network model is better than the YoloV2 network model. Obstacle detection technique[2] for interior environments used the light field camera and yolo object detection algorithm to classify items according to the groups and those items were marked in the image. The training images of obstacles were labeled and unnecessary obstructions were removed using the object filter. The efficiency of this algorithm is proved by several scene types, such as pedestrian, charge books, and others.

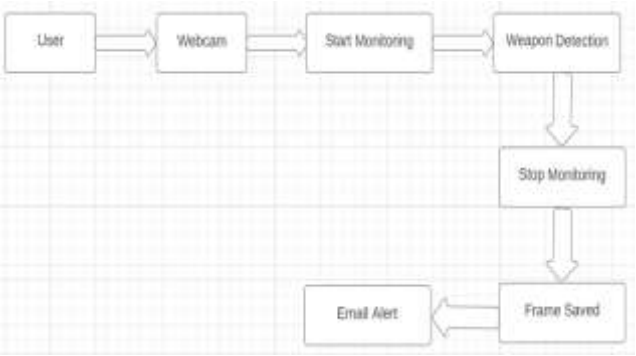
The Author Zhimin Mo and his team, worked on the Identification and Detection of Automotive Door Panel Solder Joints based on YOLO [3]. A technique based on the yolo algorithm that displays location of solder joints and the type in real time to identify more precisely detect the tiny solder connections. Using many levels of prediction, it predicts the location using different size feature maps and integrates the results to get the outcome. This shows that flexibility and real-time of welding of automotive door panels, help to boost the efficiency of the manufacturing line. In End-to-End Object Detection with Transformers [4], they have observed that when recurrent neural networks are employed for object deduction projects, the accuracy is worst and the model runs slower due to the sequential nature of processes. So, they obtained a model that is absolutely faster because these processes are performed in parallel using transformer topologies. Faster CNN-based vehicle detection and counting strategy for fixed camera scenes [5], they developed a surveillance system that uses advanced digital data infrastructure that allows for the monitoring of traffic with the identification of incidents and the prior raising of alarms. The goal of the vehicle detection and classification system was for traffic scene is to direct surveillance operations and reduce the need for human resources to monitor hundreds of cameras during traffic surveillance, which can lower the rate of traffic accidents for drivers, which also increase the success of driverless cars. The YOLO V2 classifier detector was used in this study together with effective vehicle identification and counting technique based on convolution neutral networks (CNNs) and the KLT tracker. Mahdi Hashemzadeh and his team contributed Smoke detection in video using convolutional neural networks [6] and efficient spatio-temporal features aim to detect regions which are containing smoke in an image. The image can be in any format like a frame of a video or a frame of a stream received from a surveillance camera. They have created an accurate smoke detection solution without any false alarms by applying a combination of deep, spatial, and spatio-temporal features. It uses the features that are extracted from the visual and dynamic characteristics of the smoke. This is to separate the real smoke regions from the non-real ones. The proposed method was a combination of motion detection method with a customized lightweight CNN to find the smoke regions and then introduced a set of spatio-temporal features to build an SVM model to filter out the non-smoke or smoke-like objects from the real smoke regions.

Single shot multi-box detector (SSMBD) [7] algorithm used for higher detection precision with real-time speed. However, the single shot multi-box detector (SSMBD) algorithm is not appropriate to detect tiny objects, since it overlooks the context from out of the boxes. Their proposed approach uses a new architecture as a combination of Faster R-CNN with convolutional features and SSMBD with multi-scale contexts in additional layers. Though multi-scale feature extraction may improve accuracy for detecting big object, it does not exhibit a good precision of speed to detect small object. FCOS: Fully Convolutional One-Stage Object Detection[9], they have reformulated object detection in a per-pixel prediction fashion. They show that how they make use of multi-level prediction to improve the recall and resolve the ambiguity resulted from overlapped bounding boxes in training. The two possible issues of the proposed FCOS can be resolved with multi-level prediction with FPN and a large stride. FCN-based FCOS is still able to produce a good BPR, and it can even be better than the BPR of the anchor-based detector Retina Net. FCOS compares the popular anchor-based one stage detectors including Retina Net, YOLO and SSD, however with much less design complexity. FCOS completely avoids all computation and hyper-parameters about anchor-boxes and solves the object detection in a per-pixel prediction fashion, like other dense prediction tasks such as semantic segmentation. Weapon Detection using Artificial Intelligence and Deep Learning for Security Applications has been implemented SSD and quicker RCNN algorithms [8] simulated for pre labeled and self-created image dataset for weapon (gun) detection. SSD formula provides higher speed with 0.736 s/frame. Whilst quicker RCNN provides speed 1.606s/frame, that is poor compared to SSD. SSD provided real time detection to a quicker speed but quicker RCNN provided superior accuracy. Helmet detection [10] was done using SSD to extract feature maps and applied a convolutional filter for detecting objects. Detects bike riders without helmet and saves picture in a folder. The result obtained a precision 98% for all the parameters and this study could help the police control room.

III. PROPOSED WORK

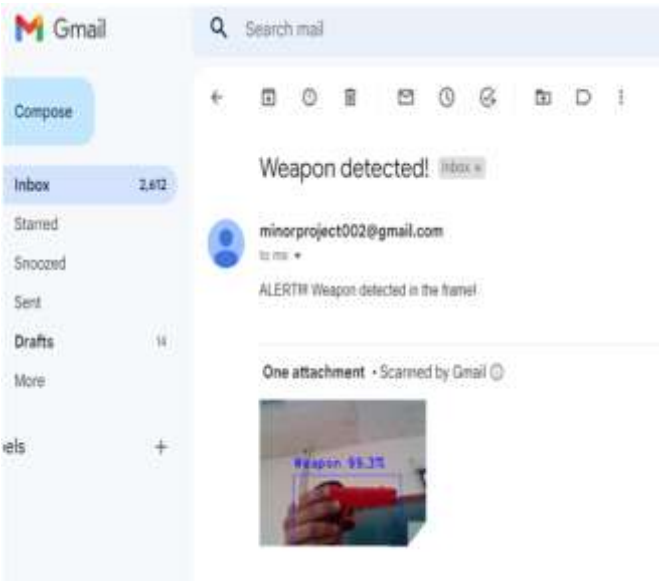
This project helps in detecting weapons like handguns and provides a user-friendly, reliable, and accessible system to reduce crime by monitoring CCTV in real-time. We can even find the person who is containing the weapon. We have built our own custom dataset for weapons of classes by combining the gun pictures to find the accuracy of the dataset by testing and training it. Nowadays, we can see in shopping malls and airports when a person entering into it they will be checking

if anything objects is found like a gun just sounds alarming. So, by knowing this alarm the people who are near him can understand he might be a thief or terrorist and move far away from them. Similarly, we have collected the images of weapons, which are taken in different angles, and trained and tested them in the YOLOV4 algorithm. Developed code for users to take input as webcam, where if a weapon is detected, it automatically saves frame of the weapon detected. An alerting System is developed for emailing the admin, with the captured weapon image.



IV. EXPERIMENTAL RESULTS

In this paper, weapon images are collected, trained and tested based on YOLOV4 object detection algorithm, which resulted in utmost accuracy. In real-time, when the weapon is detected in the frame, the picture is saved in a folder and automatically the alerting mail is sent to the admin.



V. CONCLUSION

A real-time frame-based efficient Weapon detection deep learning model has been developed with a high accuracy value. This can be used by Security officials to perform Surveillance, by implementing in real-time. If the current tool is integrated, an alert can be sent to a nearby police station can be implemented.

The Future enhancements are:

- Real-Time implementation can be done with Mask-RCNN.
- Detecting fake weapons from real ones.
- Detecting handheld guns by Pose and Human Key point Estimation.
- Identifying weapon using metal detector.
- Creating a model API and pushing it to real-time CCTV using a Raspberry PI.
- Trying ZeroEyes technology, using a drone with a camera.

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