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WEAPON DETECTION USING ARTIFICIAL INTELLIGENCE AND DEEP LEARNING FOR SECURITY APPLICATIONS: IMPLEMENTATION

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ABSTRACT:

Due to an increase in crime at packed events and unsettling lonely regions, security is always a top issue in all fields. Computer vision is widely used in abnormal detection and monitoring to solve various issues. Due to the increasing need to defend human safety, security, and property, video surveillance systems that can identify and decipher scene and anomaly occurrences are essential for intelligence monitoring. This project uses the SSD and Faster RCNN convolution neural network (CNN) techniques to create automated gun (or) weapon detection. The suggested implementation employs two different datasets. One dataset contained images that were already labelled, and the other contained images that needed to be manually labelled. Both methods produce high accuracy in the results tabulated, but their practical use may depend on the trade-off between time and precision.

Keywords: Weapon, CNN, RCNN, Faster_ RCNN, SSD, Detection

[1] INTRODUCTION

Weapon or Anamoly detection is the identification of irregular, unexpected, unpredictable, unusual events or items, which is not considered as a normally occurring event or a regular item in a pattern or items present in a dataset and thus different from existing patterns. An anomaly is a pattern that occurs differently from a set of standard patterns. Therefore, anomalies depend on the phenomenon of interest [1][3][4][5].Object detection uses feature extraction and learning algorithms or models to recognize instances of various category of objects [6]. Proposed implementation focuses on accurate gun detection

and classification. Also concerned with accuracy, since a false alarm could result in adverse responses [10] [11] [12].Choosing the right approach required to make a proper trade-off between accuracy and speed. Fig. 1 shows the methodology of weapons detection using deep learning. Frames are extracted from the input video. Frame differencing algorithm is applied and bounding box created before the detection of object [7][8][13][14].

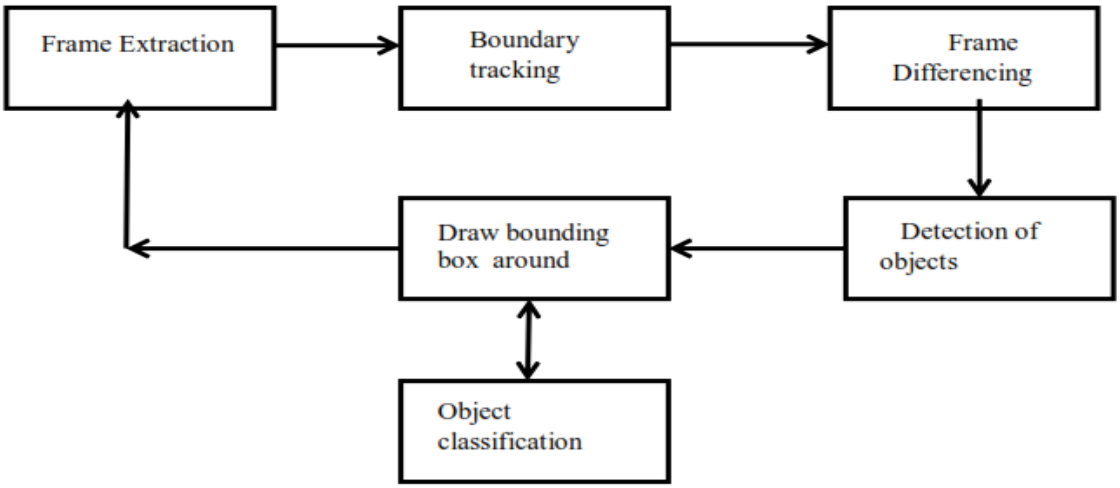


Fig. 1 Methodology

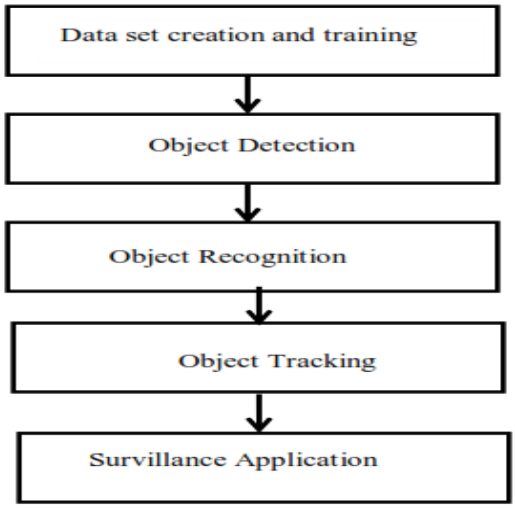


Fig. 2 Object Detection and Tracking

The flow of object detection and tracking as shown in Fig. 2. Dataset is created, trained and fed to object detection algorithm. Based on application suitable detection algorithm (SSD or fast RCNN) chosen for gun detection. The approach addresses a problem of detection using various machine learning models like Region Convolutional Neural Network (RCNN), Single Shot Detection (SSD) [2][9][15][16].

[2] **Literature Survey**

Security is always a main concern in every domain, due to a rise in crime rate in a crowded event or suspicious lonely areas. Harsha Jain et. al [17] discussed Weapon detection using artificial Intelligence and deep learning for security applications. Abnormal detection and monitoring have major applications of computer vision to tackle various problems. Due to growing demand in the protection of safety, security and personal properties, needs and deployment of video surveillance

systems can recognize and interpret the scene and anomaly events play a vital role in intelligence monitoring. This paper implements automatic gun (or) weapon detection using a convolution neural network (CNN) based SSD and Faster RCNN algorithms. Proposed implementation uses two types of datasets. One dataset, which had pre-labelled images and the other one is a set of images, which were labelled manually.

Nowadays, the surveillance of criminal activities requires constant human Monitoring. Most of these activities are happening due to handheld weapons mainly pistol and gun. Object detection algorithms have been used in detecting weapons like knives and handguns. Handgun and knives detection are one of the most challenging tasks due to occlusion, variation in viewpoint and background cluttering that occurs frequently in a scene. This paper reviewed and categorized various algorithms that have been used in the detection of handgun and knives with their strengths and weaknesses. Arif Warsi [18] et. al studied and presented a review of various algorithms used in detecting handguns and knives.

Increasing crimes in public nowadays pose a serious need of active surveillance systems to overcome such happenings. Type of weapon used in the crime determines its seriousness and nature of crime. An active surveillance with weapon classification can help deciding the course of action while identifying the possibilities of any crime happening. Neelam Dwivedi et. al [19] studied and presented a novel approach for weapon classification using Deep Convolutional Neural Networks (DCNN). That is based on the VGG Net architecture. VGG Net is the most recognized CNN architecture which got its place in Image Net competition 2014, organized for image classification problems. Thus, weights of pre-trained VGG16 model are taken as the initial weights of convolution layers for the proposed architecture, where three classes: knife, gun and no-weapon are used to train the classifier. To fine tune the weights of the proposed DCNN, it is trained on the images of these classes downloaded from internet and other captured in the lab achieved for weapon classification

Gyanendra Kumar Verma et. al. [20] Studied and presented an automatic handheld gun detection system using deep learning particularly CNN model. Gun detection is a very challenging problem because of the various subtleties associated with it. One of the most important challenges of gun detection is occlusion of gun that arises frequently. There are two types of occlusions of gun, namely gun to object and gun to site/scene occlusion. Normally, occlusions in gun detection are arises beneath three conditions: self-occlusion, inter-object occlusion or by background site/scene structure. Self- occlusion arises when one portion of the gun is occluded by another. Some authors and researchers are studied and discussed IOT, Artificial Intelligence and Deep Learning Techniques /methods in Security Applications domains [21][22][23][24][25][26].

[3] Existing System

Weapon or Anamoly detection is the identification of irregular, unexpected, unpredictable, unusual events or items, which is not considered as a normally occurring event or a regular item in a pattern or items present in a dataset and thus different from existing patterns. An anomaly is a pattern that occurs differently from a set of standard patterns. Therefore, anomalies depend on the phenomenon of interest [3] [4]. Object detection uses feature extraction and learning algorithms or models to recognize instances of various category of objects.

3.1 DISADVANTAGES OF EXISTING SYSTEM

- All concealed weapons that are hidden in someone's clothing are not visible.
- Sometimes it may give false alarm after finding exactly nothing from searching.
- There are personal weapons found with license. But they are considered harmful and taken into custody.

3.2PROPOSED SYSTEM

Proposed implementation focuses on accurate gun detection and classification. Also concerned with accuracy, since a false alarm could result in adverse responses [11] [12]. Choosing the right approach required to make a proper trade-off between accuracy and speed. Figure 1 shows the methodology of weapons detection using deep learning. Frames are extracted from the input video. Frame differencing algorithm is applied and bounding box created before the detection of object.

3.3 ADVANTAGES OF PROPOSED SYSTEM

- All suicide bombs and weapon capable in harmful explosions are identified.
- There are manual policies of this weapon recognition which will produce a video image
- which can show those concealed weapons, handcuffs, knives and other similar harmful weapons.
- When the weapon is detected we can notice easily by alarm sounds.
- Image sensors are used. Their portability and flexibility is very highly appreciated.

3.4 SYSTEM ARCHITECTURE

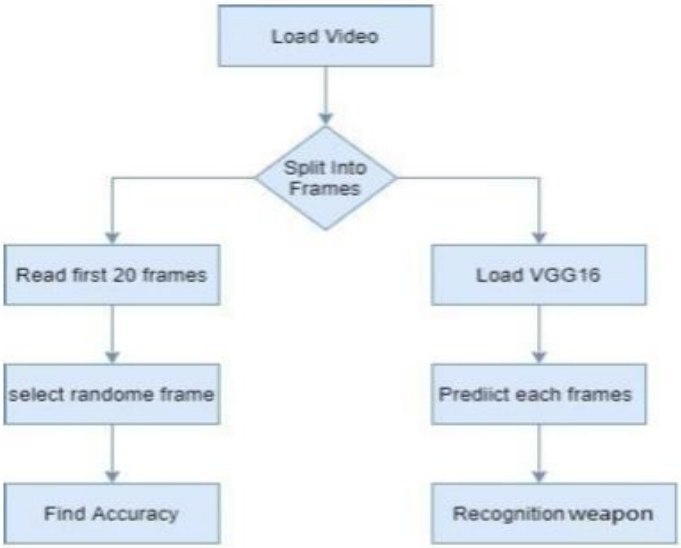


Fig. 3 System Architecture

3.5 SOFTWARE ENVIRONMENT

In this paper we are implemented source code in Python Programming language. Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages.

- Python is Interpreted: Python is processed at runtime by the interpreter. You do not need to compile your program before executing it. This is similar to PERL and PHP.
- Python is Interactive: You can actually sit at a Python prompt and interact with the interpreter directly to write your programs.
- Python is Object-Oriented: Python supports Object-Oriented style or technique of programming that encapsulates code within objects.
- Python is a Beginner's Language: Python is a great language for the beginner-level programmers and supports the development of a wide range of applications from simple text processing to WWW browsers to games.

[5] IMPLEMENTATION

5.1 Modules Description

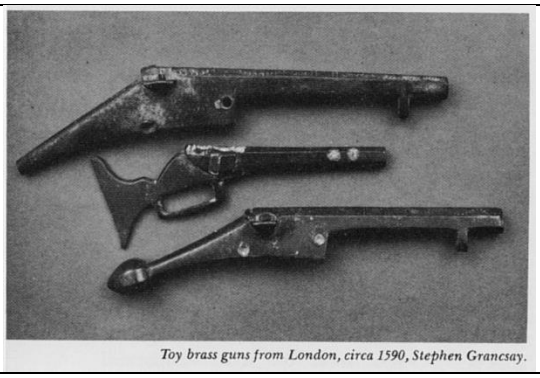
i) User: The User can start the project by running mainrun.py file. User has to give –input (Video file path).The open cv class Video Capture(0) means primary camera of the system, Video Capture(1) means secondary camera of the system. Video Capture (Video file path) means without camera we can load the video file from the disk. Vgg16, Vgg19 has programmatically configured. User can change the model selection in the code and can run in multiple ways.

ii) FASTER R-CNN: Layers of CNN and faster RCNN architecture depicted in respectively. It has two networks RPN to generate region proposals and network for object detection. To generate region proposals it uses selective search approach. Anchors or region boxes are ranked by RPN network. Dataset Creation and Training Images are downloaded in bulk using Fatkun Batch Image Downloader (chrome extension) which can download multiple Google Images at once. Then the downloaded images are labelled. 80% of total images used for training and 20% images for testing. The created ammunition dataset was then trained using Single Shot Detector (SSD) model and made 2669 iterations/steps on the model to ensure that the loss is less than 0.05 in order to increase the accuracy and precision. Figure 4 shows folder with test and train images. Figure 6 shows image with labels.

iii) VGG16: VGG16 is a convolutional neural network model. Deep Convolutional Networks for Large- Scale c Image Recognition. The model achieves 92.7% top-5 test accuracy in ImageNet, which is a dataset of over 14 million images belonging to 1000 classes. It was one of the famous model submitted to ILSVRC-2014. It makes the improvement over AlexNet by replacing large kernel-sized filters (11 and 5 in the first and second convolutional layer, respectively) with multiple 3×3 kernel-sized filters one after another. VGG16 was trained for weeks and was using NVIDIA Titan Black GPU's.

iv) Object Detection and Recognition: To make sure object is detected, changes are made in the label map and tf_record file. Label map is the file which stores the total number of types of objects that will be detected. weapon is added in the label map. It is a popular approach in deep learning where pre-trained models are used as the starting point on computer vision and natural language processing tasks given the vast compute and Object recognition is refers to a collection of related tasks for identifying objects in digital photographs. Region-Based Convolutional Neural Networks are a family of techniques for addressing object localization and recognition tasks, designed for model performance. You Only Look Once, or YOLO, is a second family of techniques for object recognition designed for speed and real-time use.

5.2 SCREEN SHOTS



Toy brass guns from London, circa 1590, Stephen Grancsay.

Fig 4. Sample input devices

To detect a weapon we can search it by name or by opening the web cam and we can also search it through CCTV photage-image or by video surveillance.

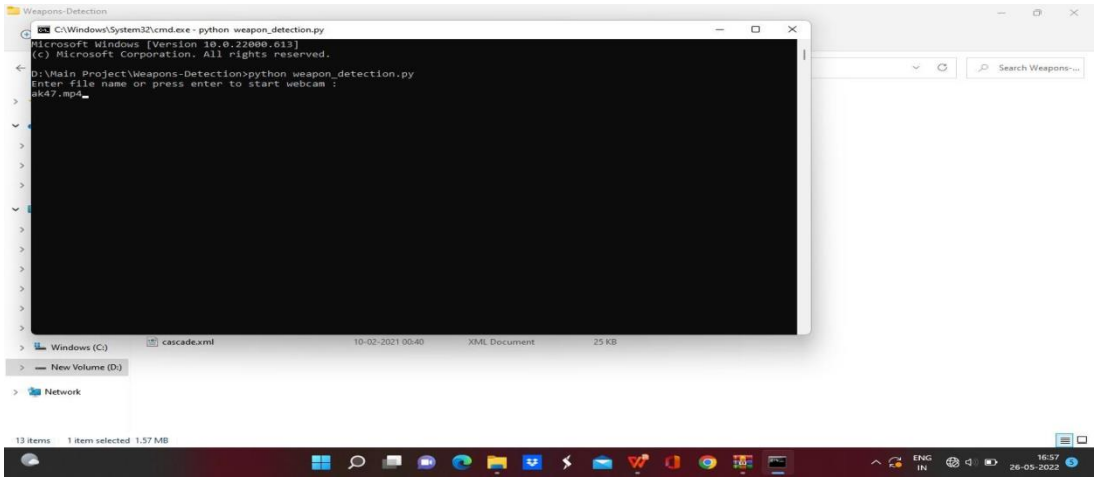


Fig. 5 Sample Input Screen Page

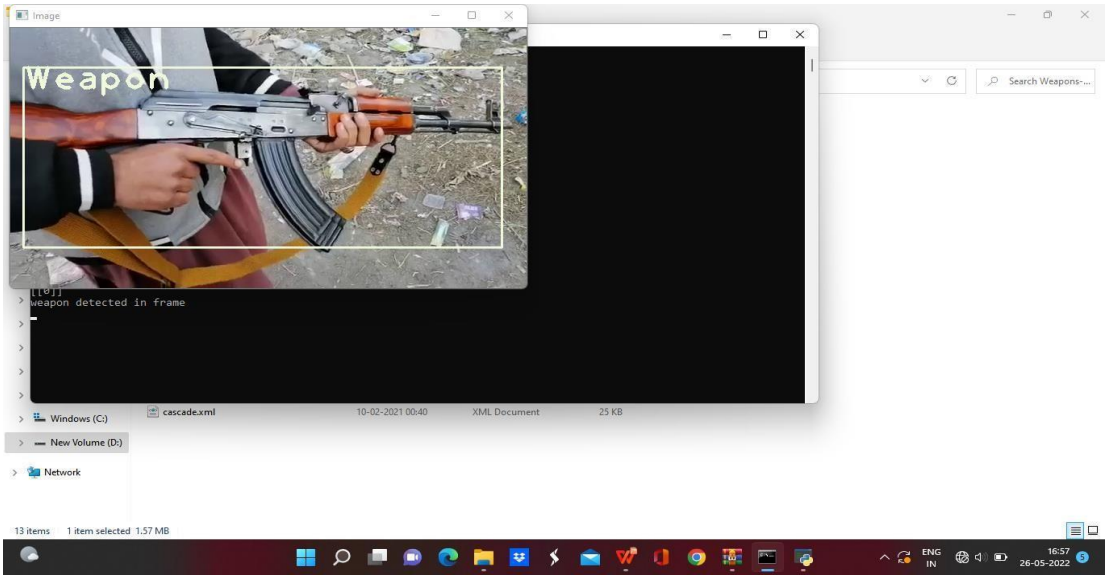


Fig. 6 Weapon Detection Screen Page

When the weapon is detected here we can see a rectangular box and it will give message as Weapon is detected.

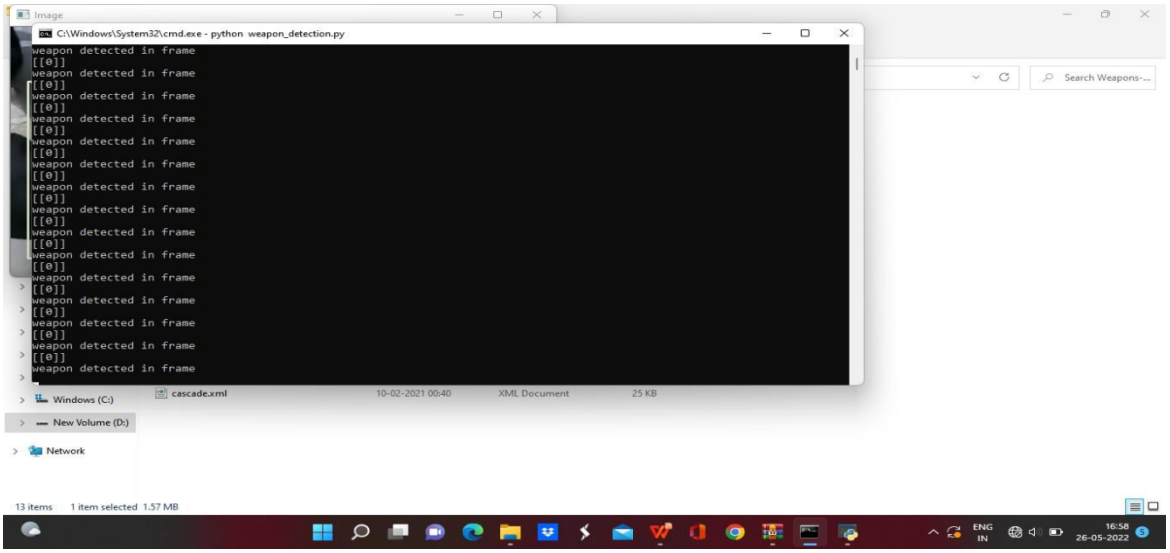


Fig. 7 Output Frame for Detection of Weapon

This is the output format when the weapon is detected in a frame.

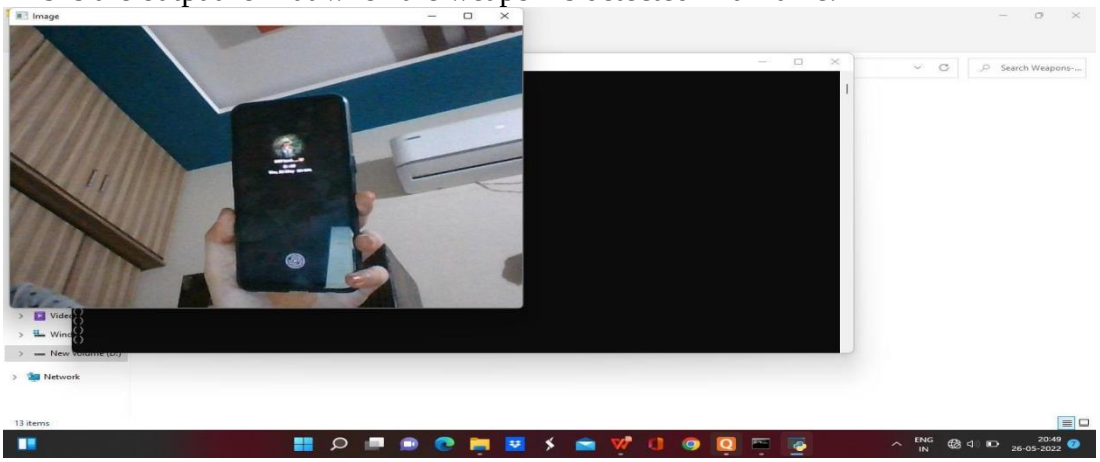


Fig. 8 Negative example for weapon detection

This is the negative example for weapon detection. It means here we can place any object

that it is not a weapon.

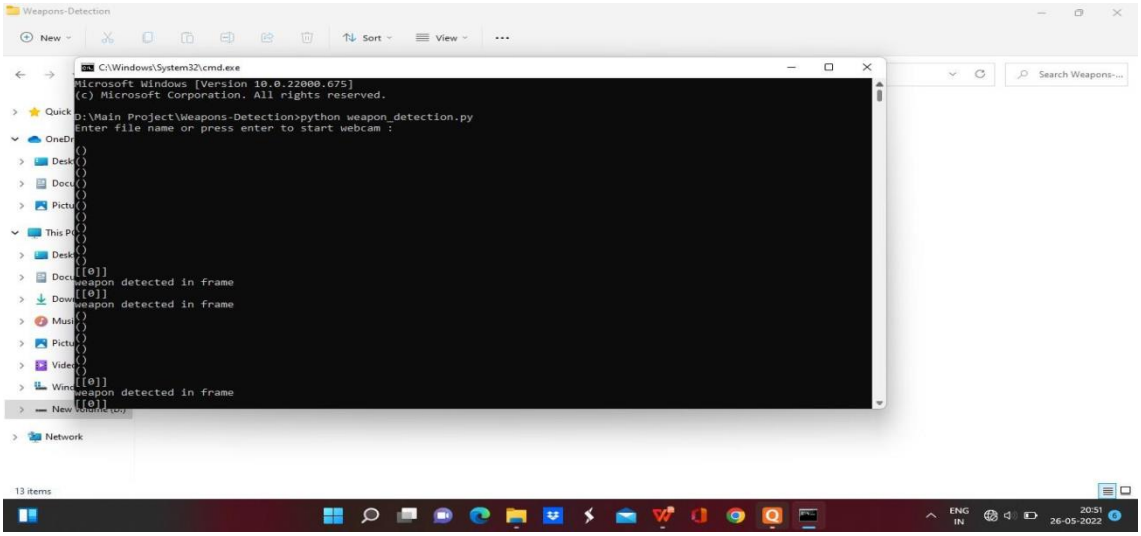


Fig.9 Resultant output

So the resultant output is NULL (()).

[6] CONCLUSION AND FUTURE ENHANCEMENT

6.1 Conclusion: SSD and Faster RCNN algorithms are simulated for pre labelled and self-created image dataset for weapon (gun) detection. Both the algorithms are efficient and give good results but their application in real time is based on a trade off between speed and accuracy. In terms of speed, SSD algorithm gives better speed with 0.736 s/frame. Whereas Faster RCNN gives speed 1.606s/frame, which is poor compared to SSD. With respect to accuracy, Faster RCNN gives better accuracy of 84.6%. Whereas SSD gives an accuracy of 73.8%, which is poor compared to faster RCNN.SSD provided real time detection due to faster speed but Faster RCNN provided superior accuracy. Future enhancement will indeed help in improving the security, law and order situation for the countries who had suffered with a lot with these kind of violent activities. To achieve high precision and recall we constructed a new training database or the real-time scenario, then trained, and evaluated it on the latest deep learning models using two approaches .i.e. sliding window/classification and region proposal/object detection.

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