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Weapon Detection Using Deep learning model and Artificial Intelligence

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Abstract: *Safety and protection are a massive difficulty for today's modern-day world. For a country to be economically robust, it must make sure safe and secure surroundings for traders and tourists. Having stated that, Closed Circuit tv (CCTV) cameras are getting used for surveillance and to display activities i.e., robberies but those cameras nonetheless require human supervision and intervention. We want a system which could automatically stumble on these unlawful activities. Regardless of State-of-the-art deep trendy algorithms, speedy processing hardware, and superior CCTV cameras, weapon detection in actual-time remains an extreme challenge. This paper implements weapon detection using a Faster RCNN algorithm. We have implemented Faster RCNN object detection model by training it on our customized dataset. Our proposed system can also be implemented in high-end surveillance and security robots to detect a weapon or unsafe assets to avoid any kind of assault or risk to human life.*

Keywords: *Object detection, CCTV, weapon detection, Artificial intelligence, deep learning, Faster RCNN.*

I. INTRODUCTION

Object detection techniques are useful for making processing faster and less complex. There are several areas where we will use feature detection, including surveillance, scientific image evaluation, human-laptop interaction, and robotics. We can also use object detection in three-dimensional space. It is very important to hit or track all actions in this 3D space. We can rely on object detection algorithms to not only find items in an image but to do so with speed and accuracy. We need article detection to improve automated systems in workplaces, barrier protection, and cars. Object detection can be beneficial in the case of visitor control. The government can use factor detection strategies to maintain control of paranormal activities in multiple areas to maintain security [1].

The job of this app is basically to do what a human can do with the speed and accuracy of a device. This is particularly

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important in this use case, as it is a lifestyle or loss of life scenario where even the difference in latency makes a difference in saving lives. Once he detects a weapon (slower than AI), a human responsible for monitoring CCTV footage will first go to the surprised nation, no matter how professional he is, then let him know the attacker. Need to contact Govt. This system will also take time as the character has to verbally describe the attacker's clothing, the weapon he is carrying, and the time and location of the incident. While all this is happening, the assailant may have fled the scene. Also, it doesn't help because it's just an eye test that the authorities have to take in the event of an attack, as only the person responsible for monitoring has access to the CCTV and can relay the message. This app aims to get rid of these threats, take a screenshot when a gun is detected on CCTV, and send this message to all security guards without scaring the public or alerting the attacker that you are in danger. There will be disastrous consequences. Since all mandatory security guards can't have 24/7 access to CCTV and display it all the time, it will be easier to send them a screenshot while the attack occurs. This screenshot can also provide all the necessary statistics, such as the face of the attacker, the location, the weapon they carry, and many others. Since a picture is worth a thousand words, it is more reliable than the eye test. This challenge can also help in court. Since court proceedings take years, evidence cannot wait long. For example, if the case requires photographic evidence of an attack years ago, the CCTV garage may not have backed up the footage for years since that's thousands to hundreds of GBs of data. Images but the screenshot can be saved after being recognized as an attack rather than using this app because it is too short[2].

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. Object detection uses feature extraction and learning algorithms or models to recognize instances of various category of objects. Proposed implementation focuses on accurate gun detection and classification. Also concerned with accuracy, since a false alarm could result in adverse responses. Choosing the right approach required to make a proper trade-off

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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].

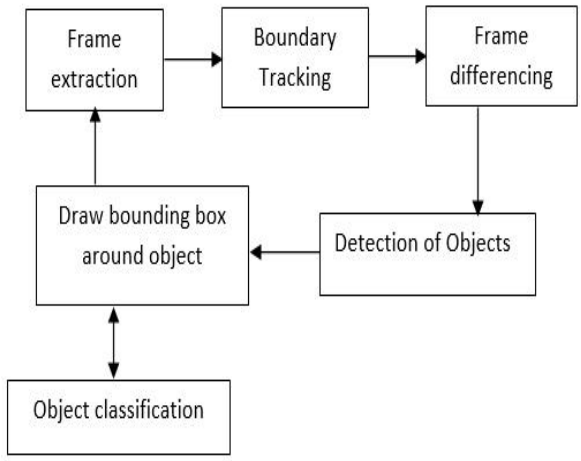

Fig.1 Object detection process

II. LITERATURE SURVEY

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 [4]. Object detection uses feature extraction and learning algorithms or models to recognize instances of various category of object.

Artificial intelligence (AI) and computer vision have enabled us to utilize video feeds in a way that we can detect and classify the objects of our interest in it. Therefore, it has been widely adopted and used in many applications such as autonomous vehicles, security feeds, etc. Many algorithms and architectural works have been done for the aforementioned tasks. In 2020, Murthy, Chinthakindi Balaram et al. [5] provided a detailed and comprehensive discussion and analysis of state-of-the-art techniques and algorithms used in the field of computer vision using deep learning technology, especially for the GPU-based embedded system. They covered many state-of-the-art algorithms that were trained and tested on COCO, PASCAL VOC datasets. The algorithms included RCNN, SPPNet, SSD, RetinaNet, Squeeze Det, and CornerNet; these algorithms were compared and analyzed based on accuracy, speed, and performance for important applications including pedestrian detection, crowd detection, medical imaging, and face detection. Moreover, we also previously implemented a real-time weapon detector model based on YOLOv4 trained with a custom dataset.

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In [6] Conventionally used cement –a primary binder also a necessitate element in producing concrete rates first in the construction industry. Production of conventional cement requires a greater skill and is energy intensive. The usage of waste materials in the production of concrete and reduction in cement content was only the possible alternative in the past decade. Associated risks with the production of Ordinary Portland Cement are well known. A greener aided with a natural friendly claim can be made only with the usage of the waste materials and reduction in evolving respiration gas to the atmosphere. Almost all works are carried out using source material fly ash, with fine aggregate and coarse aggregate.

Erssa Ari et al. [7] The conventional Close circuit television (CCTV) cameras-based surveillance and control systems require human resource supervision. Almost all the criminal activities take place using weapons mostly a handheld gun, revolver, pistol, swords etc. Therefore, automatic weapons detection is a vital requirement now a day. The current research is concerned about the real-time detection of weapons for the surveillance cameras with an implementation of weapon detection using Efficient–Net. Real time datasets, from local surveillance department's test sessions are used for model training and testing. Datasets consist of local environment images and videos from different type and resolution cameras that minimize the idealism. This research also contributes in the making of Efficient-Net that is experimented and results in a positive dimension. The results are also been represented in graphs and in calculations for the representation of results during training and results after training are also shown to represent our research contribution. Efficient-Net algorithm gives better results than existing algorithms.

Akhil Addapa et al. [8] Efficient and accurate object detection has been a important topic in advancement of computer vision systems. With the advent of deep learning techniques, the cure for object detection has increased drastically. The project aims to incorporate state-of-the-art technique for object detection with the goal of achieving high accuracy with a real-time performance. A major challenge in many of the object detection systems is the dependency on other computer vision techniques for helping the deep learning-based approach, which leads to slow and non-optimal performance. In this project, we use a completely deep learning approach to solve the problem of object detection in an end-to-end fashion. The

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network is trained on the most challenging publicly available dataset (PASCAL VOC), on which a object detection challenge is conducted annually.

Deepika B et al. [9] An object needs to be detected. This is done by the use of first and foremost Computer vision Technology YOLO i.e., you Look Only Once. It finds several applications due to its tremendous speed in detecting objects. These object needs to be tracked down, also using YOLO algorithm. YOLO object detection in images means not only to identify what kind of object is included, but also localize it inside the co-ordinates of the "bounding box" containing the Object. YOLO uses deep learning and Convolution Neural Networks (CNN) for object detection. It needs to "see" the image only once and identifies the image. It creates a unique ID for each of initial detections. And then tracking each of the objects as they move around the frames in a video, maintaining the assignment of Unique ID's. This project will be robust to occlusion. It can also be used to detect missing object that has been lost in between frames also

Devaki et al. [10] The object detection is used in almost every real-world application such as autonomous traversal, visual system, face detection and even more. This paper aims at applying object detection technique to assist visually impaired people. It helps visually impaired people to know about the objects around them to enable them to walk free. A prototype has been implemented on a Raspberry PI 3 using OpenCV libraries, and satisfactory performance is achieved. In this paper, detailed review has been carried out on object detection using region conventional neural network (RCNN) based learning systems for a real-world application. This paper explores the various process of detecting objects using various object detections methods and walks through detection including a deep neural network for SSD implemented using Caffe mod.

III. PROPOSED METHODOLOGY

Various fact-based units are received, including negative units and high-quality sets. To improve instrument accuracy, more negatives than high-quality sets are necessary. With this in mind, two examples of a large array of poor record devices (500 data sets) are used compared to a large data unit (250 data sets). This option potentially leads to higher accuracy in detecting preferred weapons, which is why the device is complete. For the evaluation of CCTV video streams, the OpenCV module was converted into a fitted area, which uses a convolutional neural network for processing,

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categorizing, categorizing, and imaging unusual related sports activities. CNN acts as a feature extractor, and the output dense layer contains the features extracted from the image. The extracted features are fed to an SVM to classify the object's interior as a candidate. Affects space. Similar to predicting the presence of an object within the location propositions, the rule set also predicts four values that can offset values to increase bounded area accuracy. For example, given a belief in an area, the rule set should have expected someone to be present, but the person's face should be cut in half within the concept of the place. Consequently, offset values help adjust the bounding field of the location concept. R-CNN set of rules starts off evolved with making many small windows or filters and makes use of the grasping algorithm to broaden the vicinity. Then it locates the equal shades in the regions and merges them collectively. The version maintains to merge all the areas together to enhance the dimensions of the regions. The picture is an illustration of a selective seek algorithm manipulate the spined phrases as you need.

Faster R-CNN

In faster R-CNN instead of performing maximum pooling, we carry out ROI pooling for utilizing a single characteristic map for all the areas. This warps ROIs into one single layer; the ROI pooling layer makes use of max pooling to convert the features. in view that max pooling is likewise operating here, that's why we are able to recall fast R-CNN as an upgrade of the SPPNet. rather than generating layers in a pyramid form, it generates only one layer.The bounding field is further refined with linear regression. faster R-CNN is faster than SPPNet faster R-CNN makes use of a region proposal method to create the sets of regions. faster R-CNN possesses an extra CNN for gaining the local proposal, which we call the regional proposal network. in the training region, the proposal network takes the feature map as input and outputs region proposals. And these proposals go to the ROI pooling layer for similarly manner. Image processing entails manipulating virtual snapshots with a view to extracting extra statistics. we have seen a lot of evolutions in pc hardware in the beyond decade resulting in faster processors and GPUs. That enabled us to resolve new and emerging problems using image processing. Essentially, image processing entails the following fundamental steps: importing image using image acquisition tools, image Pre-processing / Analyzing and manipulating images, Output in which either you can modify an image or make some analysis out of it. We used the

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OpenCV library for all the image pre-processing obligations. OpenCV reads records from a contiguous memory place. we can use OpenCV library for resizing the pics and developing feature vectors out of it, that may be accomplished through converting the image data to NumPy arrays. We used one of the extensions of Deep Neural Nets named CNN (Convolutional Neural community) for training the version.

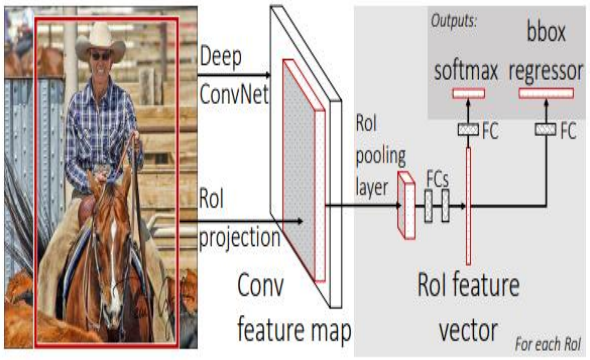

Fig.2 Faster RCNN architecture for object detection

An input image and multiple regions of interest (RoIs) are input into a fully convolutional network. Each RoI is pooled into a fixed-size feature map and then mapped to a feature vector by fully connected layers (FCs). The network has two output vectors per RoI: softmax probabilities and per-class bounding-box regression offsets. The architecture is trained end-to-end with a multi-task loss.

SYSTEM ARCHITECTURE

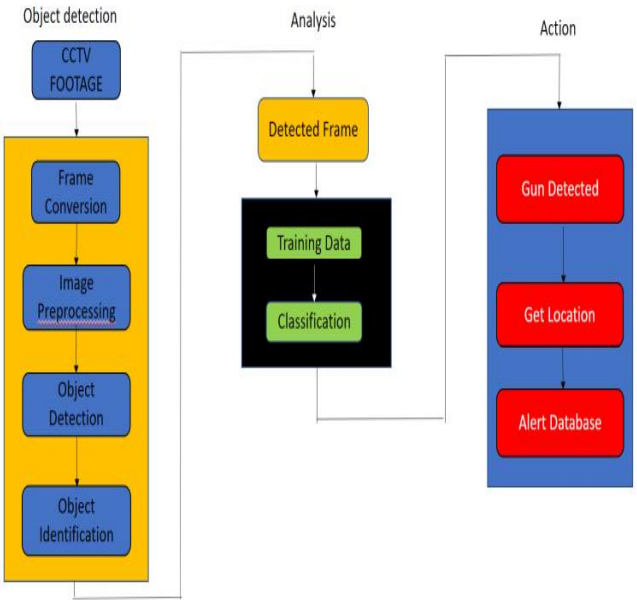

Fig.3 System architecture

IV. RESULTS AND DISCUSSIONS

Dataset Creation and Training

Image classification includes, for example, the class of one object in a picture. However, object localization is to recognize the area of at least one article in a picture and drawing a proliferating box around their degree as shown in Figure 4. Moreover, Figure 5 illustrates the detection of rifle from an animated video.

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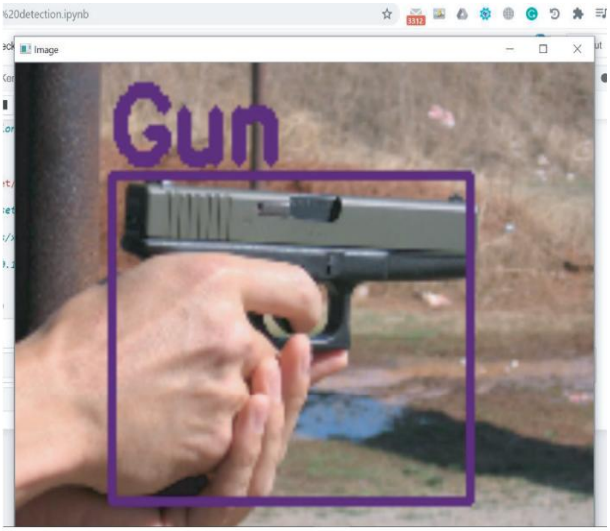

Fig.4 Image along with its label

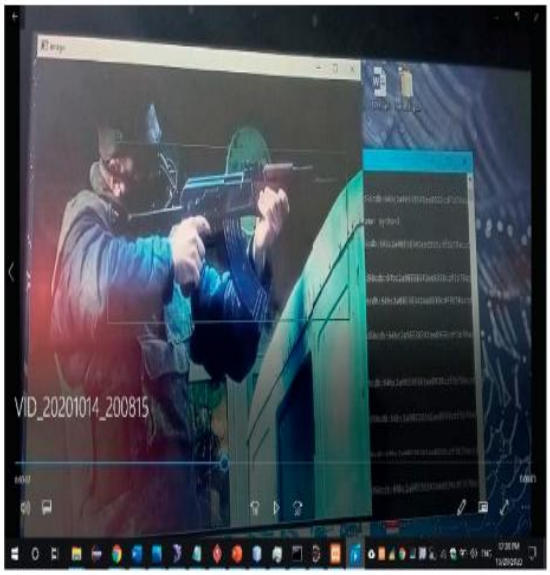

Fig.5 Real-time weapon detected from a video surrounded by bounding box. Weapon category rifle

Sample dataset

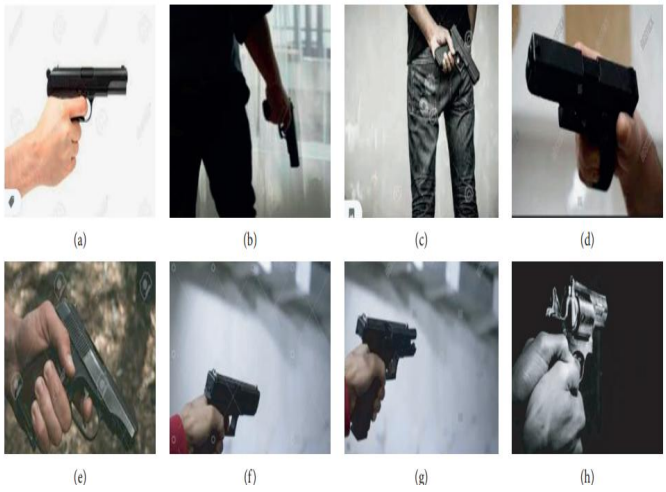

Fig.6 Sample images from collected dataset

V. PERFORMANCE ANALYSIS

TABLE I. Performance Analysis: Faster R-CNN Algorithm

S. No	Models	Dataset used	Accuracy(%)
1	Traditional CNN	IMDB	95
2	SSD	Streaming video	96.6
3	(Yolo) V3	Gun video database	98.89
4	Faster RCNN	Image dataset collected for current research	99.1

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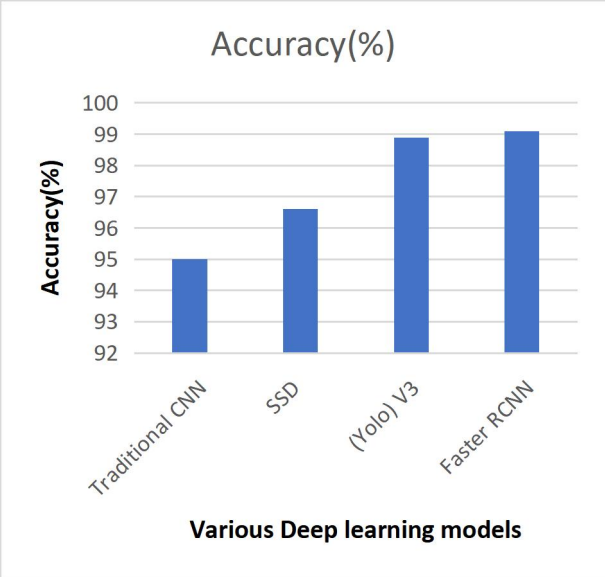

Fig.8 Performance Analysis of deep learning models with proposed algorithm

VI. CONCLUSION

Faster RCNN algorithms is simulated for pre labelled and self-created image dataset for weapon (gun) detection. In this study, the state-of-the-art Faster RCNN object detection model was implemented and trained over our collected dataset for weapon detection. We propose a model that provides a visionary sense to a machine or robot to identify the unsafe weapon and can also alert the human administrator when a gun or a firearm is obvious in the edge. The experimental results show that the trained Faster RCNN has better performance compared to the Traditional CNN model, yolo v3, and SSD is less expensive computationally. Smart surveillance systems would fully replace current infrastructure with the growing availability of low-cost storage, video infrastructure, and better video processing technologies.

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