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Detection and Recognition of Handguns in the Surveillance Videos using Neural Network

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Abstract: ***In this paper a novel method for detecting and recognizing weapons like different types of handguns in different scenarios through webcam video is proposed. There is significant need of prevention of terrorist attack and the earliest detection of such threats is a major concern to ensure human safety. So there is need of deploying these smart surveillance cameras and security systems around the globe. With the high increasing demand for intelligent security surveillance cameras, various researches have been undergoing in a detection system for pre-processing, manipulation and interpretation of video frames and images. The detection process contains analysis of both static and dynamic images to continuous monitor the area for security. Different tracking techniques have been developed with a capability to detect as well as recognize the object in real time scenarios. Tracking of an object and its various associated issues such as extraction of object features, analyzing shape of the object and analyzing object position are the active areas of research. The researchers are continuously proposing new efficient algorithms to enhance the system capability for tracking the suspicious different types of object in motion and extracting the attributes to analyze the object properties if there is a weapon present in the scene or not.***

The proposed hybrid neural network system combines the learning capabilities of neural networks for nonlinear function approximation. The accuracy and efficiency of the system is detected by different objective as well as subjective parameters for evaluation purposes.

Keywords: ***Neural network, gun, image processing, security, object detection, camera.***

I. INTRODUCTION

These days gun like weapons are very concerned in the crimes around the globe. This condition is more severe in those countries where the gun possession is legal. So this violence should be prevented by the early detection of the crime. So there is a need of some type of innovative and an intelligent solution with the means of cameras or surveillance equipments so that an efficient hand gun detection and recognition system should be created.

In the last few years, deep learning as well as convolutional neural networks (CNNs) have achieved excellent outcomes in comparison to all the classical machine learning techniques in different areas of image processing applications [2,6]. Traditional techniques need manual intervention while deep CNNs techniques automatically find increasingly higher grade attributes from data [1, 5]. So the main aim is to develop a good gun detector in videos using CNNs.

The researcher discussed digital image processing methods to find the appearance of some object in complex background [5]. Detection of the object concerns with the condition of illumination, separation of the background from object and the resolution of the object. The technique identified the object in the image in constant static lighting conditions. The various phases to process an image includes: color preprocessing to remove the background image, grayscale filtering to learn the digital images for the detection fine edges and binarization with the help of Circular Hough Transform (CHT) to get the shape of the object. Also it includes counting the number of the object with same shape. Also there may be noise available due to gray scale filtering.

To detect handgun in a scene or in an image so first of all position of the gun must be found with the recognition. So there is a need of object detectors. Convolutional neural network architectures contain different types of other architectures which are unique and have lot of benefits. Object detectors have feature maps of different scales to improve detection accuracy and lowering memory and cost. Object detectors contain different feature maps with different resolutions like Mobilenet-SSD, Faster R-CNN with FPN, RefineDet and M2Det.

II. LITERATURE REVIEW

Sathyajit Loganatha et al. in 2019 [1] worked on the intelligent surveillance systems. Authors focused on solving two scenarios which were detecting potential gun related crimes and detecting abandoned luggage in video footage. Authors presented a deep neural network based prototype which could find handguns in digital images and used different concepts machine learning and computer vision pipeline that detected abandoned luggage at different locations in surveillance footage. The proposed method was

computationally very efficient and indicated that with a very low false alarm rate, it detected maximum of the abandoned items. Authors succeeded to solve shortcomings like having a long-standing individual from the stationary Object Detector. The overall benefit of proposed method was the considerably smaller computational time for each frame taken by algorithm.

R. Kanehisa et al. in 2019 [2] presented the application of the YOLO algorithm to create a firearm detection system. Authors also constructed a dataset relied on the website Internet Movie Firearm Database (IMFDB) for this investigation. Individuals carrying firearms in public places were a strong indicator of dangerous situations. Authors used the convolutional neural network which was found to be an efficient way in the detection and identification of objects in images, having sometimes produced more accurate and consistent results than human candidates. The outcomes obtained, 95.73% of sensitivity, 97.30% of specificity, 96.26% of accuracy and 70% of MAP, demonstrate the technique's efficiency. The technique used stands out for its speed of detection, capable of being executed in real time.

R. Olmos et al. in 2018 [3] focused on the detection of a gun and then improving the performance of object detection. This focused on detecting handguns which were nonmetallic in nature and were in RGB format. The algorithm worked on developing the training data set for obtaining the desired video frames in order to reduce the number of false positives. This could be done by building a data set for both surveillance and control purposes. It reformulated the problem by first training the machine classifier running it on number of video frames during the detection process and then applied region based or pixel based sliding window algorithm on the data set.

The system proposed was unable to detect the pistols in motion and under various lighting conditions. Then the researchers worked on the techniques which can easily detect the weapons concealed under clothing and under different lighting conditions.

M. Grega et al. in 2016 [4] proposed an algorithm that could warn the operator when any weapon was detected in the image. An algorithm was proposed which needed to be precise even in case of poor quality of images, work in real time environment, keep the false alarms as low as possible and act as a sensing system rather than a decision making one. Detection of the knife was done using a modified sliding window method with the help of two descriptors: edge histogram and homogenous texture. Detection of a pistol was performed utilizing canny edge detection, background subtraction algorithm and operations of erosion/dilation. The input of the system was a low resolution image and with a small size of the weapon. It helped to deal with a low quality image.

R. K. Tiwari et al. in 2015 [5] proposed an algorithm which worked on an automatic surveillance framework for the detection of a handgun. The algorithm performed k-means clustering algorithm to eliminate the unrelated objects and Fast Retina Key point (FREAK) and Harris interest point detector were utilized to detect gun in the image. Harris interest point detector focused on change at corners and was invariant to illumination variation, transformation of the geometric features and noise. FREAK was a key point descriptor and was faster as well as accurate. Then the features for the interest points were extracted utilizing key point descriptor and matched with the descriptors of weapon to check for similarity of each segmented object with gun descriptor. System was unable to perform only in case of change of lighting conditions.

III.PROBLEM FORMULATION AND METHODOLOGY

Prevention of terrorist attack and the detection of such threats is a major challenge to ensure public safety. In order to improve the security and ensure the safety of people at places with high commotion, smart surveillance cameras and security systems need to be deployed.

Detecting crime which involves the use of gun is of high priority as the tool is of high threat to a human life. To be able to detect such crimes on time could remove the threats that arise to lives. One of important tasks is to identify guns in the frames of the surveillance footage so that potential threats involving guns could be detected.

After having a comprehensive literature survey, the various research gaps that were identified are as follows:-

1) Guns can have rather complicated structures and may change in shape, size and orientation over subsequent video frames.
2) In a video file, since the object is moving so the appearance of an interested object may vary its projection on a video frame plane.
3) In a video, it is possible to change in intensity, direction and color of ambient light in appearance of interested objects like gun in a video frame plane. ˆ
4) In the acquisitions process of video, it may possible to introduce a certain amount of noise in the image or video signal.
5) In a video file, moving object may be present behind some other object in the current scene.

A. Objectives

This research work will be focused to achieve the following objectives:-

1) To design, study and implement a high-speed gun detection framework.
2) The framework should be fast and reliable
3) The proposed framework depends on the Neural Networks
4) Main focus on improving the speed of rear-view weapon like gun detection, while providing state-of-the-art detection quality.
5) To learn from the design process, identify and solve possible bottlenecks in detection speed and recognize important factors contributing to the overall detection quality

B. Methodology

The following steps will be performed to complete this research work:-

1) Create a neural network that can detect the weapons like gun using different datasets.
2) Train the neural network for low and high illumination and brightness conditions.
3) Feed the live webcam video to this framework using Matlab interface or python interface.
4) Detect the weapon as early as possible and raise the alarm

C. Proposed Algorithm

The proposed algorithm includes specific steps which are as follows:

1) CREATE a neural network with the help of classifier to detect hand guns.
2) Download different datasets of gun and train the classifier.
3) Extract features from the trained images.
4) After training feed the network for detecting guns in live video
5) Perform testing in different lightning conditions.

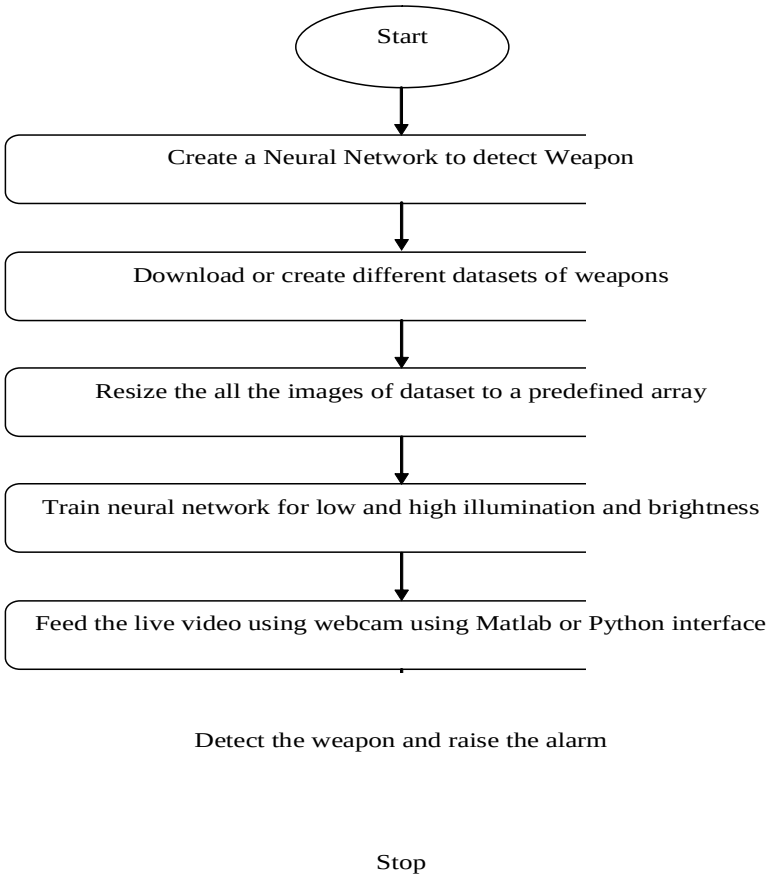

Fig. 1 Flowchart of proposed algorithm

IV. RESULTS

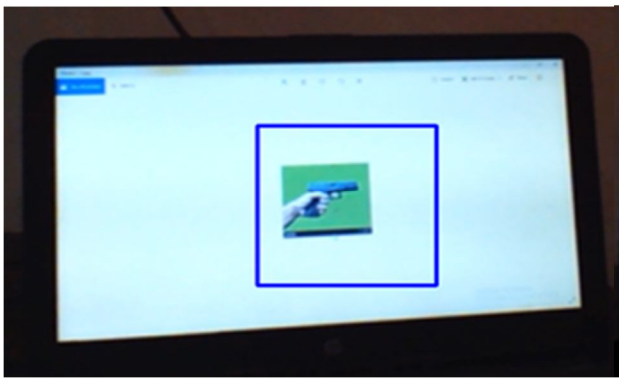

Fig. 2 Hand gun 1 detected by proposed algorithm

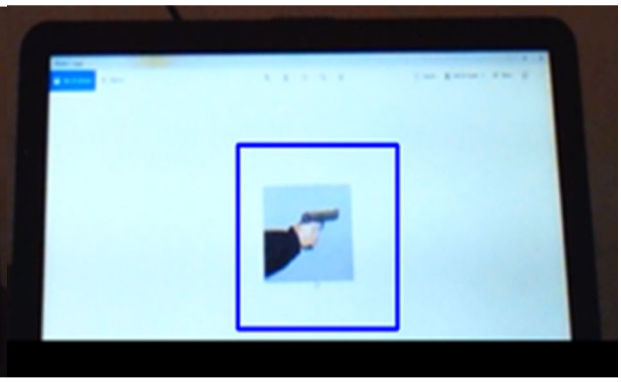

Fig. 3 Hand gun 2 detected by proposed algorithm

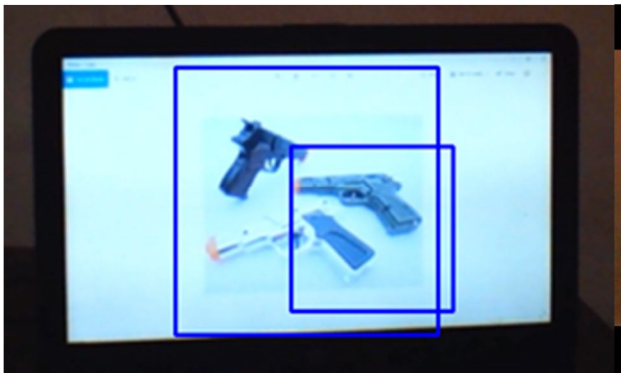

Fig. 4 Hand gun 3 detected by proposed algorithm

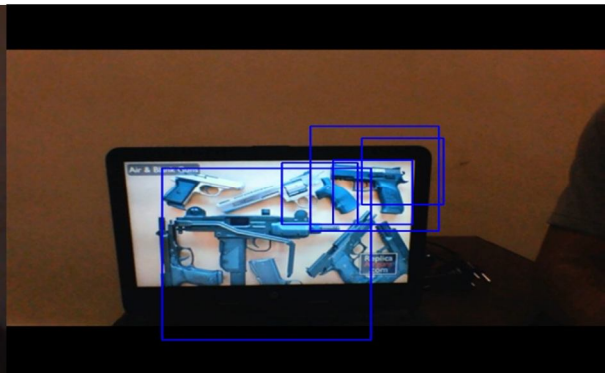

Fig. 5 Hand gun 4 detected by proposed algorithm

Fig. 6 Hand gun 5 detected by proposed algorithm

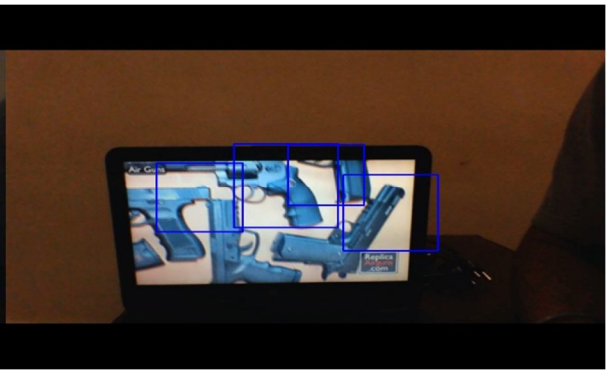

Fig. 7 Hand gun 6 detected by proposed algorithm

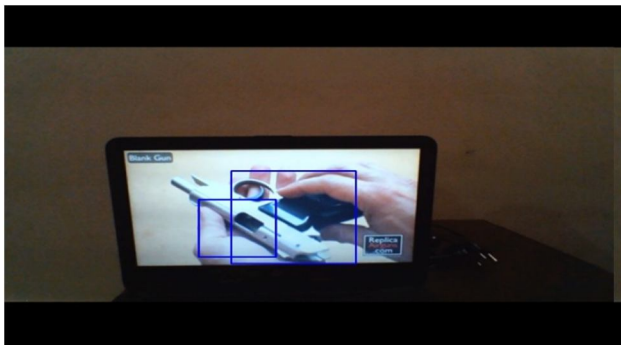

Fig. 8 Hand gun 7 detected by proposed algorithm

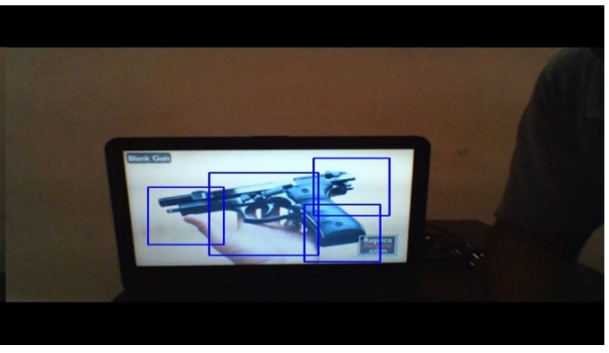

Fig. 9 Hand gun 1 detected by proposed algorithm

TABLEI: RESULT OBTAINED ON THE TEST SET

Database No.	Images or Frames	True Positive	False Positive	True Negative	False Negative	Precision (%)
1	100	76	15	51	0	83.51
2	150	110	10	15	5	91.66

By performing the different test on two different databases the average precision of the proposed system is found to be 87.59which showthe credibility of the proposed system.

V. CONCLUSIONS

From the results it is cleared that proposed algorithm finds the maximum number of handguns in different scenarios. The proposed system even also detects different types and of different length kinds of weapons. The proposes system also detect whether gun is help by hand or resting on table or at some other surface. The true positive obtained on different databases shows the authenticity of the proposed system.

In the future work other weapons like swords or knife can also be detected. Also the intelligent system can also detect whether someone is attacking with the gun or not on the other people.

VI. ACKNOWLEDGMENT

I want to thank my supervisor Mrs. Deepinder Kaur, Assistant professor for providing me thorough knowledge and guiding me throughout this research.

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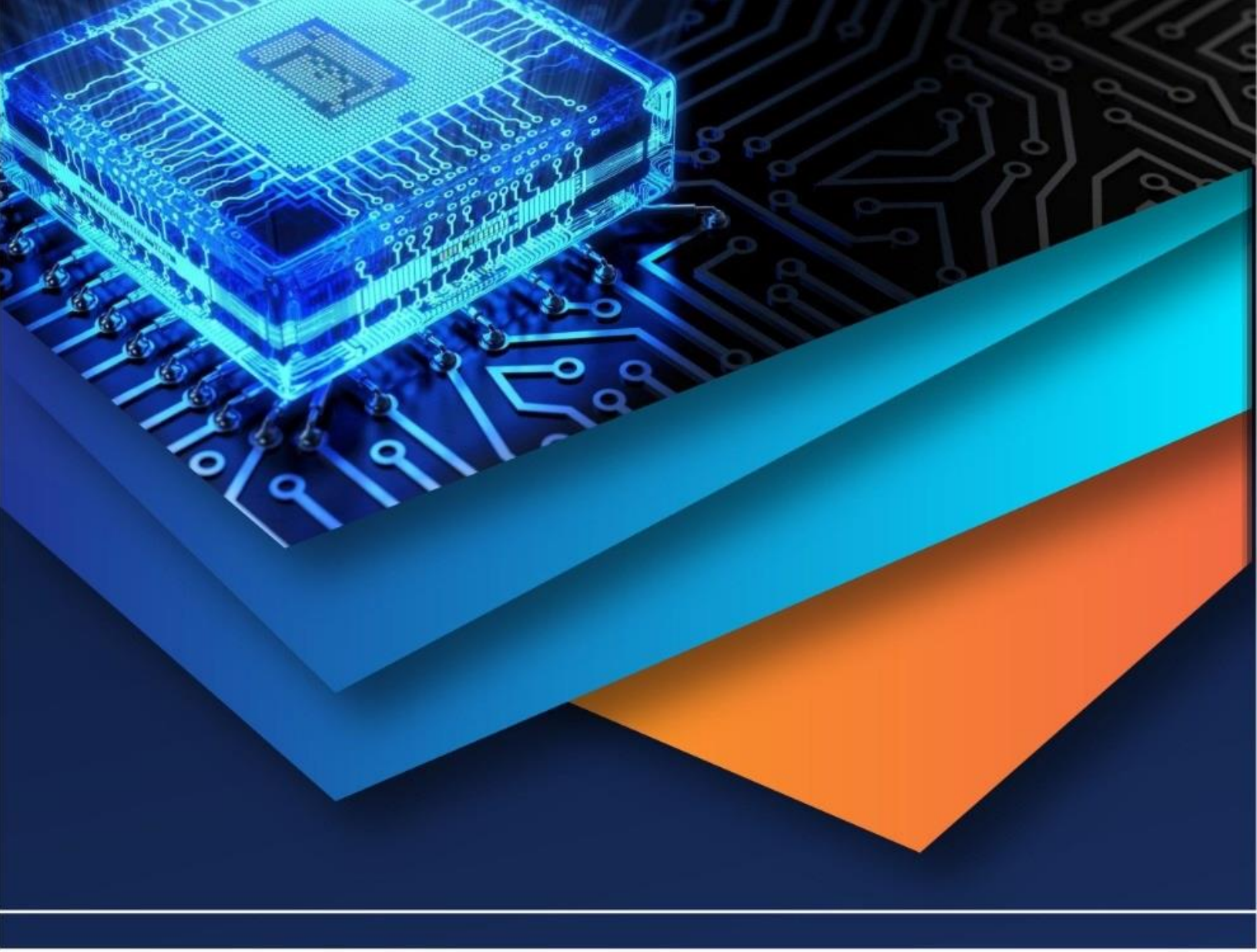

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