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Armaments Detection Using Artificial Intelligence and Deep Learning for Security Application

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Abstract: ***Security is usually a main concern in every domain, thanks to a rise in crime rate in a crowded event or suspicious lonely areas. Abnormal detection and monitoring have major applications of computer vision to tackle various problems. Thanks to growing demand in the protection of safety, security and private properties, needs and deployment of video surveillance systems can recognize and interpret the scene and anomaly events play an important role in intelligence monitoring. This project implements automatic gun (or) weapon detection employing a Convolution Neural Network (CNN) based Single Shot Multibox Detector and Faster R-CNN algorithms. Proposed implementation uses two sorts of datasets. One dataset, which had pre-labeled images and therefore the other one, may be a set of images, which were labeled manually. Results are tabulated, both algorithms achieve good accuracy, but their application in real situations is often based on the trade-off between speed and accuracy. The system is entailed with automatic detection of the handgun/ knife or the other crime objects without manual intervention. This technique operates directly on the raw inputs i.e. security footage of camera in live; thus is proven to exhibit increased accuracy thanks to usage of datasets and instant identification.***

I. PROBLEM STATEMENT

An attempt to design and develop a system which can detect the guns, rifles and other weapons in no time and with less computational resources, so as to provide visionary sense to robots. Proposed implementation uses two sorts of datasets. One dataset, which had pre-labeled images and therefore the other one, may be a set of images, which were labeled manually. Results are tabulated, both algorithms achieve good accuracy, but their applications in real situations are often based on the trade-off between speed and accuracy.

II. PROPOSED SYSTEM

This project implements automatic gun (or) weapon detection employing a convolution neural network (CNN) based SSD and Faster RCNN algorithms. Proposed implementation uses two sorts of datasets. One dataset, which had pre-labeled images and therefore the other one, may be a set of images, which were labeled manually. Results are tabulated, both algorithms achieve good accuracy, but their applications in real situations are often based on the trade-off between speed and accuracy. This technique uses security footage to automatically identify the human behavior using Convolution Neural Nets (CNNs) by forming deep learning model which operates directly on the raw inputs. Dynamically handling illegal activities and instant security actions can be performed. Its increased accuracy is due to usage of datasets and instant identification. Automatic detecting of the handgun in visual surveillance is done by implementing Faster Region-Based CNN (RCNN) by differentiating the amount of false negatives and false positives.

III. INTRODUCTION

Violence committed with weapons causes plenty of effect on public, health, psychological, and economic cost. Number of studies shows that handheld gun or a knife is that the primary weapon used for various crimes like trespassing, robbery, shoplifting, kidnapping and abduction. These crimes are often reduced by identifying the disruptive behavior at early stage and monitoring the suspicious activities carefully so as that law enforcement agencies can further take immediate action. The worldwide price from use of guns could also be as high as 1,000 dead each day. Therefore, we aim to develop a wise surveillance security system detecting weapons specifically guns. Weapon or Anomaly detection is that the identification of irregular, unexpected, unpredictable, unusual events or items, which isn't considered as a normally occurring event or a daily item during a pattern or items present in a dataset and thus differs from existing patterns.

An anomaly could even be a pattern that occurs differently from a set of standard patterns. Therefore, anomalies depend upon the phenomenon of interest. Object detection uses feature extraction and learning algorithms or models to acknowledge instances of various categories of objects. Proposed implementation focuses on accurate weapon detection and classifies it.

We are concerned with accuracy since a false alarm could result in adverse responses. Choosing the right approach required making a proper trade-off between accuracy and speed. Frames are extracted from the input video. Frame differencing algorithm is applied and bounding box is created before the detection of object. The flow of object detection and tracking is as shown in figure 1. 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).

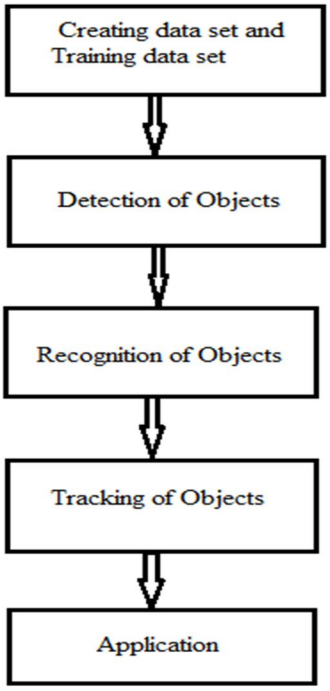

Fig 1: Detection and tracking of Weapon

IV. METHODOLOGY

Figure 2 shows the methodology of weapon detection using artificial intelligence and deep learning. Frames are extracted from the input video and frame differencing algorithm is applied and then a bounding box created before the detection of object.

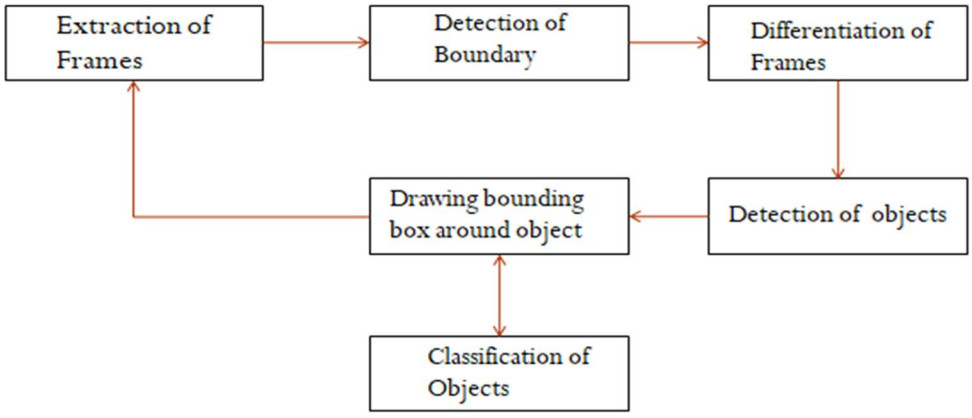

Fig 2: Methodology

The flow of object detection and tracking is as shown in figure 3. Dataset is made, trained and fed to object detection algorithm. supported application suitable detection algorithm (SSD or fast RCNN) chosen for gun detection. The approach addresses an issue of detection using various machine learning models like Region Convolutional Neural Network (RCNN), Single Shot Detection (SSD).

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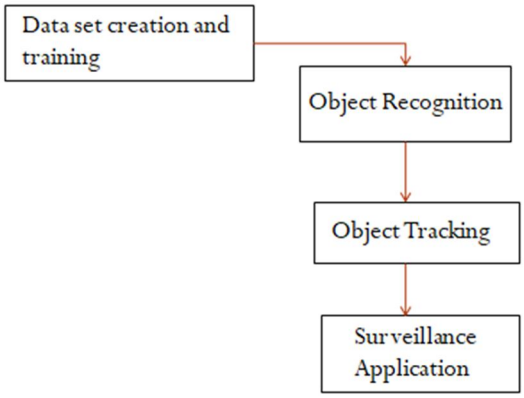

Fig 3: Detection and Tracking

A. Faster R-CNN

Layers of CNN and faster R-CNN architecture is depicted in figure 3 and 4 respectively. Its two network RPN is used to generate region proposals and network for object detection. To generate region proposals it uses selective search approach and the anchors or region boxes are ranked by RPN network.

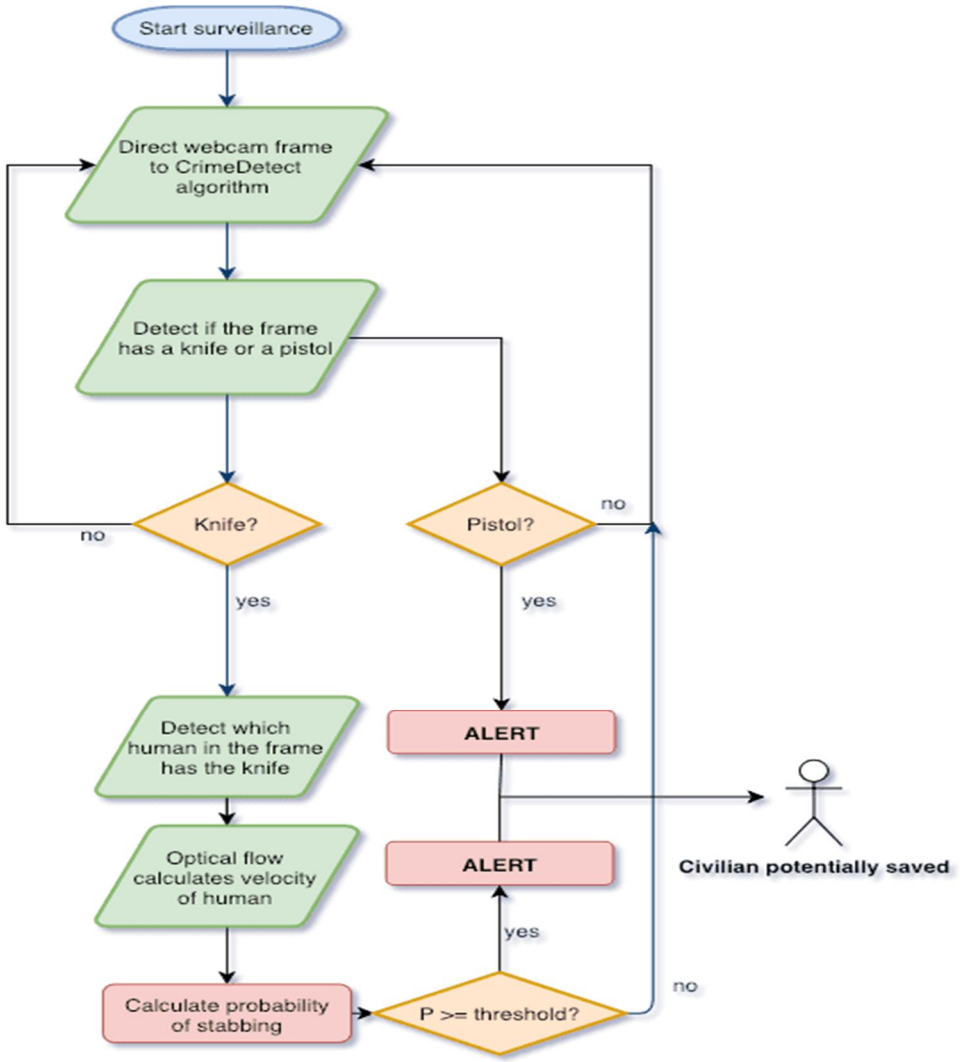

Fig 4: Faster R-CNN

B. SSD (Single Shot Detector)

SSD algorithm reached new milestones in terms of precision and performance detection. SSD accelerates the process by eliminating the need of region proposal network. To beat the drop in accuracy SSD brings a few technology including default boxes and multi-scale features. These improvements allow SSD to match the Faster R-CNN's accuracy using lower resolution images, which further pushes speed higher. Average scoring is around 74% MAP and 59 fps on COCO dataset. Figure 12 shows SSD VGG-16 Architecture

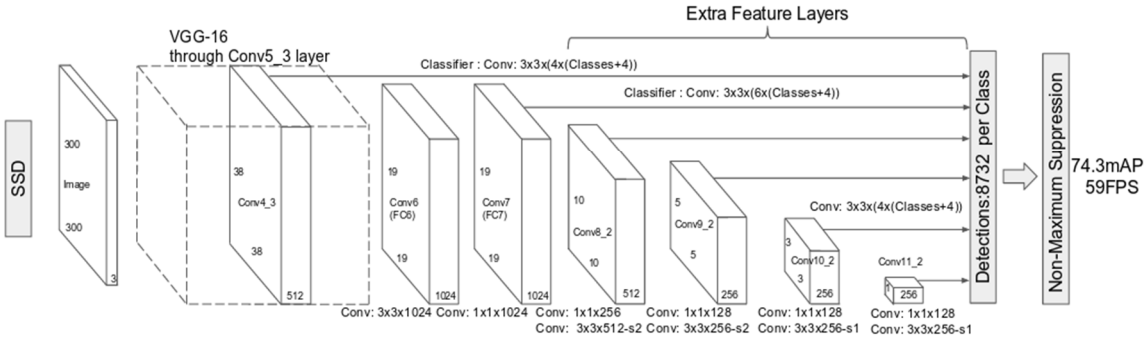

Fig 5: SSD Architecture

V. IMPLEMENTATION

A. Resources or components used for implementation

1) OpenCV 3.4- Open source computer vision library version 3.4.
2) Python 3.5- High level programming language used for various image-processing applications.
3) COCO Dataset- Dataset consisting of common objects with respective labels.
4) Anaconda and Tensorfflow 1.1
5) NVIDIA GeForce 820M GPU-GeForce is a brand of graphics processing units designed by Nvidia.

B. Dataset Specifications

1) Case – I: Video Specifications

a) System Configuration- Intel i5 7th Generation (4 Cores)
b) Clock Speed- 2.5 GHz
c) GPU- NVIDIA GeForce 820M
d) Input Frames per Second- 29.97 fps
e) Output Frames per Second- 0.20 fps
f) Video Format- .mov
g) Video Size- 4.14 MB
h) COCO and self-created image dataset
i) Number of classes trained- 5

2) Case – II: Image specifications

a) System Configuration- Intel i5 7th Generation (4 Cores)
b) Clock Speed- 2.5 GHz
c) GPU- NVIDIA GeForce 820M
d) Input Image Size- 200-300 KB
e) Training Time- ~0.6 seconds(SSD)
f) ~1.7 seconds(RCNN)
g) Image Format - .JPG
h) COCO and self-created image dataset
i) Number of classes trained for- 5

3) Assumptions and Constraints made for Implementation

a) The gun is in line of sight of camera and fully/partially exposed to the camera.

b) There is enough background light to detect the ammunition.

c) GPU with high-end computation power was used to remove lag in the ammunition detection.

d) This is not a completely automated system. Every gun detection warning will be verified by a person in charge.

VI. RESULTS

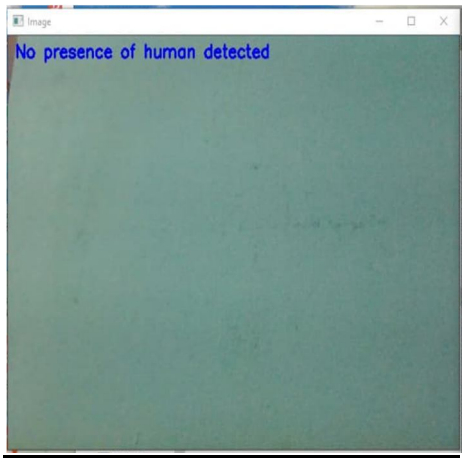

Fig 6: No presence of human detected

Fig: 7: No Suspicious Activity Found

Fig 8: Suspicious Activity Detected

Fig 9: Crime Object Detected

VII. CONCLUSION

SSD and Faster RCNN algorithms are simulated for pre labeled and self-created image dataset for weapon (gun) detection. We propose a model that gives 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 using different types of Object detection algorithms. There's an immediate need to update the current surveillance capabilities to support monitoring the effectiveness of human operators with the growing availability of low-cost storage, video infrastructure, and better video processing technologies.

VIII. FUTURE ENHANCEMENTS

Implementation of this project in real world would be an evaluation in field of security and surveillance. Integration of existing security systems like surveillance cameras with this software will be a game changer in arena of security services. We could possibly save many lives from threats through instantaneous alert systems.

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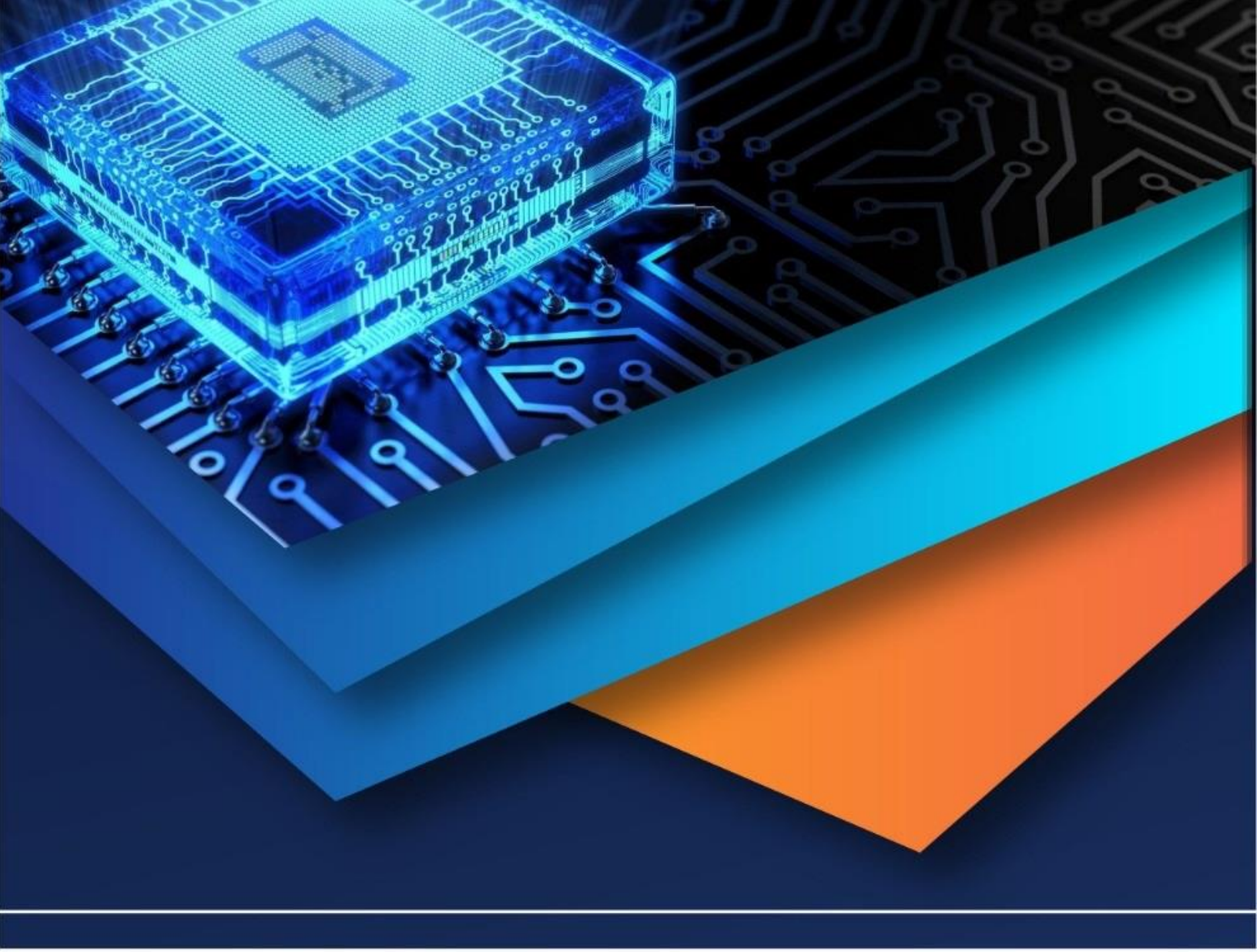

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