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WEAPON DETECTION USING DEEP LEARNING

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ABSTRACT

The problem of increasing gun violence needs immediate action, especially in places like the United States where it is lawful to carry firearms. Unrestricted access to firearms has contributed to a rise in violent crimes, from heists to horrific school shootings. Because of their accessibility, weapons can be easily obtained and abused by people who have bad intents or mental health issues. Using technology, such as security cameras fitted with sophisticated software for weapon detection, such You Only Look Once (YOLO) algorithms done with OpenCV, is one way to tackle this issue. Whether the guns are hidden or on display, authorities can quickly detect and address such threats by putting these surveillance systems in place. YOLO and OpenCV in particular can be used to build and improve weapon detection technologies, which can help law enforcement agencies keep ahead of possible offenders and reinforce safety precautions. But addressing gun violence calls for more than simply technological fixes. The core causes of violence, such as societal concerns and mental health conditions, must be addressed. Early intervention programs and the availability of mental health resources can help reduce the likelihood of violent conduct before it gets out of control. Moreover, a comprehensive plan to lower gun violence must include tightening gun laws, encouraging responsible gun ownership, and developing community involvement. Through the adoption of a comprehensive strategy that integrates technology breakthroughs, communal backing, and proactive actions, communities can strive to establish more secure surroundings and lower the frequency of gun-related aggression.

Keywords: Python, YOLO, Open CV,Voilence

1. INTRODUCTION

In the period of contemporary science and technology, people utilize security cameras in various locations to deter crime. Security personnel must keep an eye on the many video systems that are placed in various locations at the same time. Security personnel typically respond to a crime scene by examining the captured images, analyzing the photos, and gathering the relevant evidence. As a result, setting up a proactive system at the crime site is essential. In this case, quick action can be done to prevent the potential criminal from committing a crime if the program warns the security guards as soon as it detects threatening objects. Therefore, developing a system that can recognize dangerous things is crucial.Image automatic categorization technology has been used to many domains of development due to the rapid advancement of science and technology as well as the growing demand for quality of life among people. We can identify and alert individuals to the possible threats posed by the person in possession of that weapon thanks to weapon detection. Numerous applications use object detection, including machine vision, traffic control systems, medical imaging, item recognition in satellite photos, and more. to raise awareness of picture categorization and to improve the recognition accuracy of images. Determining whether or not a fake exists when a picture is uploaded is the aim of image forgery detection. Therefore, our study aims to provide a method that can recognize image .One current worldwide concern pertaining to human rights is gun violence. The right to life, which is our most fundamental human right, is threatened by gun-related violence. Every day tragedies involving gun violence impact people's lives all throughout the world. Every day, gun violence claims the lives of more than 500 people. The goal of developing OpenCV, an open source, cross-platform, cross-language computer vision library, was to increase the use of computer vision in commercial goods by providing a common foundation for these applications. The library supports hardware accelerators like CUDA and SSE and has over 2500 optimized algorithms

1.1 **Image Recognition:**

Image recognition, in the context of machine vision, is the ability of software to identify objects, places, people, writing and actions in images. Computers can use machine vision technologies in combination with a camera and artificial intelligence software to achieve image recognition. Image recognition is used to perform many machine-based visual tasks, such as labeling the content of images with meta-tags, performing image content search and guiding autonomous robots, self-driving cars and accident-avoidance systems.

While human and animal brains recognize objects with ease, computers have difficulty with the task. Software for image recognition requires deep learning. Performance is best on 4 convolutional neural net processors as the specific task otherwise requires massive amounts of power for its compute-intensive nature. Image recognition algorithms can function by use of comparative 3D models, appearances from different angles using edge detection or by components. Image recognition algorithms are often trained on millions of pre-labeled pictures with guided computer learning. Current and future applications of image recognition include smart photo libraries, targeted advertising, the interactivity of media, accessibility for the visually impaired and enhanced research capabilities.

1.2 Image processing:

Image processing is the process of transforming an image into a digital form and performing certain operations to get some useful information from it. The image processing system usually treats all images as 2D signals when applying certain predetermined signal processing methods.

There are five main types of image processing:

• Visualization - Find objects that are not visible in the image

• Recognition - Distinguish or detect objects in the image

• Sharpening and restoration - Create an enhanced image from the original image

• Pattern recognition - Measure the various patterns around the objects in the image

• Retrieval - Browse and search images from a large database of digital images that are similar

1.3 Image Acquisition:

Image acquisition is the first step in image processing. This step is also known as Image Acquistion

1.4 Image Enhancement:

Image enhancement is the process of bringing out and highlighting certain features of interest in an image that has been obscured. This can involve changing the brightness, contrast, etc.

1.5 Image Restoration :

Image restoration is the process of improving the appearance of an image. However, unlike image enhancement, image restoration is done using certain mathematical or probabilistic models.

1.6 Color Image Processing:

Color image processing includes a number of color modeling techniques in a digital domain. This step has gained prominence due to the significant use of digital images over the internet.

Wavelets and Multiresolution Processing:

Wavelets are used to represent images in various degrees of resolution. The images are subdivided into wavelets or smaller regions for data compression and for pyramidal representation.

1.7 Compression:

Compression is a process used to reduce the storage required to save an image or the bandwidth required to transmit it. This is done particularly when the image is for use on the Internet.

1.8 Morphological Processing:

Morphological processing is a set of processing operations for morphing images based on their shapes.

1.9 Segmentation :

Segmentation is one of the most difficult steps of image processing. It involves partitioning an image into its constituent parts or objects.

1.10 Representation and Description:

After an image is segmented into regions in the segmentation process, each region is represented and described in a form suitable for further computer processing. Representation deals with the image's characteristics and regional properties. Description deals with extracting quantitative information that helps differentiate one class of objects from the other.

1.11 Recognition:

Recognition assigns a label to an object based on its description.

2. LITERATURE SURVEY AND RELATED WORK

Introduction to Literature Survey

Reducing the life-threatening acts and providing high security are challenging at every place. Therefore, a number of researchers have contributed to monitoring various activities and behaviors using object detection. In general, a framework of smart surveillance system is developed on three levels: firstly, to extract low-level information like features engineering and object tracking; secondly, to identify unusual human activities, behavior, or detection of any weapon; and finally, the high level is about decision making like abnormal event detection or any anomaly. The latest anomaly detection techniques can be divided into two groups, which are object-centered techniques and integrated methods. The convolutional neural network (CNN) spatial-temporal system is only applied to spatial-temporal volumes of interest (SVOI), reducing the cost of processing. In surveillance videos of complex scenes, researchers in proposed a tool for detecting and finding anomalous activities. By conducting spatial-temporal convolution layer, this architecture helps one to capture objects from both time domain and frequency domain, thereby extracting both the presence and motion data encoded in continuous frames. To do traditional functions to local noise and improve detection precision, spatial-temporal convolution layers are only implemented within spatial-temporal quantities of changing pixels. Researchers proposed anomaly-introduced learning method for detecting anomalous activities by developing multi-instance learning graph-based model with abnormal and normal bimodal data, highlighting the positive instances by training coarse filter using kernel-SVM classifier and generating improved dictionary learning known as anchor dictionary learning.

Thus, abnormality is measure by selecting the sparse reconstruction cost which yields the comparison with other techniques including utilizing abnormal information and reducing time and cost for SRC.

2.2 Huetal have contributed in "detecting various objects in traffic scenes by presenting a method which detects the objects in three steps".

Initially, it detects the objects, recognizes the objects, and finally tracks the objects in motion by mainly targeting three classes of different objects including cars, cyclists, and traffic signs. Therefore, all the objects are detected using single learning-based detection framework consisting of dense feature extractor and trimodal class detection. Additionally, dense features are extracted and shared with the rest of detectors which heads to be faster in speed that further needs to be evaluated in testing phase. Therefore, intra class variation of objects is proposed for object sub-categorization with competitive performance on several datasets.

2.3 .Gregaetal presented an "algorithm which automatically detects knives and firearms in CCTV image and alerts the security guard or operator" .[2]

Majorly, focusing on limiting false alarms and providing a real-time application where specificity of the algorithm is 94.93% and sensitivity is 81.18% for 9 knife detection. Moreover, specificity for fire alarm system is 96.69% and sensitivity is 35.98% for different objects in the video. Mousavi et al. in carried out video classifier also referred to as the Histogram of Directed Tracklets which identifies irregular conditions in complex scenes.

In comparison to traditional approaches using optical flow which only measure edge features from two subsequent frames, descriptors have been developing over long-range motion projections called tracklets. Spatiotemporal cuboid footage sequences are statistically gathered on the tracklets that move through them.

2.4 .Jietal developed a system for security footage which automatically "identifies the human behavior using convolutional neural nets (CNNs)".[3]

By using deep learning model which operates directly on the raw inputs . Therefore, 3D CNN model for classification requires the regularization of outputs with high-level characteristics to increase efficiency and integrating the observations of a variety of various models.

3. IMPLMENTATION STUDY

knife and gun detection in surveillance systems. They had used HOG as a feature extractor along with back propagation of artificial neural networks for classification purposes. 13 The detection was performed using different scenarios, first weapon only and then using HOG and background subtraction methods for human before the desired object and claimed to have an accuracy The aforementioned work uses the KNN along with non-linearity of ReLu, convolutional neural layer, fully connected layer, and dropout layer of KNN to reach a result for detection with multiple classes and implemented their work using the Tensor flow open-source platform. Their system

achieved a test accuracy for their dataset . Proposed knives and firearm detection in CCTV images. They had applied MPEG-7 and principle component analysis along with the sliding window approach, which made their work slower for real-time scenarios, although they claimed to achieve good accuracy on their test dataset.

3.1 PROPOSED MODEL

The techniques outlined in the article apply to both computer vision (CV) libraries and frameworks. OpenCV (Open Source Computer Vision Library) stands out as one of the most widely used libraries in the field. Initially designed to enhance the integration of computers and artificial intelligence, OpenCV facilitates the rapid deployment of machines as commercial products. The library encompasses numerous steps for image processing and data acquisition, aimed at streamlining machine operations. The methodological approach in the article is divided into three distinct sections for clarity: Data Collection Image Processing Object Recognition The objective of this project is to investigate the implications of deploying weapons and identifying objects captured in camera images. The article discusses utilizing the Haar cascade technique, a machine learning-based method involving the classification of images into positive (good) and negative (bad) categories during training. Positive images typically contain instances of the classes one wishes to identify, while negative images encompass everything else. Consequently, the primary aim is to evaluate the real-world outcomes of the data available online and to ascertain them through OpenCV. Moreover, incorporating YOLOv8, a state-of-the-art object detection model, into the project can significantly enhance accuracy and speed compared to traditional OpenCV methods. By training the YOLOv8 model with a customized dataset, the system can achieve superior performance in object detection tasks, offering both accuracy and efficiency benefits. This integration broadens the capabilities of the system, enabling it to handle a wider range of object recognition tasks with improved precision and speed.

4. METHODOLOGIES & Algorithm

Modules Description:

4.1 Dataset collection

Gather the images: Gather the genuine and suspected fake photographs for comparison. We can submit these photographs from our PC for forgery detection.

4.2 Feature extraction: We then use OpenCV to extract features from the image. This contains elements like texture and edge.

4.3 YOLOv8: YOLO is a deep learning algorithm that is used to increase the speed and accuracy of OpenCV.

Image matching: We trained the model by using our dataset. Then by using OpenCV, it will divide the video into frames. Then YOLO algorithm will compare the objects in the image with the dataset images it will be done by using the trained model.

4.4 Examine the results: The YOLO algorithm and OpenCV detection tools assess whether there is any weapon in the frame or not. If the YOLO algorithm confidence value is more than 60, the object in the frame is most certainly a weapon. Otherwise, it's quite likely there is no weapon.

4.5 Results Visualization: Ultimately, the outcomes of our analysis will be visualized in a separate window which has been created using cv2.In that Window, it has the information that when the weapon is detected then it has bounded rectangle around the weapon specifying its confidence and its name.

4.6 Yolo Algorithm

YOLO (You Only Look Once) is a popular algorithm for object detection in images and videos. It's known for its speed and accuracy in detecting objects within images or video frames.

If you're interested in weapon detection using YOLO, you would typically follow these steps:

1. **Dataset Collection**: You'd need a dataset containing images with weapons and without weapons. This dataset needs to be labeled with bounding boxes around the weapons.
2. **Training**: Using the labeled dataset, you train a YOLO model. The training involves optimizing the model's parameters so that it can accurately detect weapons in images.
3. **YOLO Implementation**: Implement YOLO algorithm using a deep learning framework like TensorFlow or PyTorch. You can either train the model from scratch or use pre-trained models and fine-tune them for your specific task.
4. **Testing and Evaluation**: After training the model, you need to test it on a separate dataset to evaluate its performance. This involves measuring metrics like precision, recall, and accuracy.
5. **Deployment**: Once the model performs satisfactorily, you can deploy it for real-time weapon detection in images or video streams.

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5 RESULTS AND DISCUSSION SCREEN SHOTS

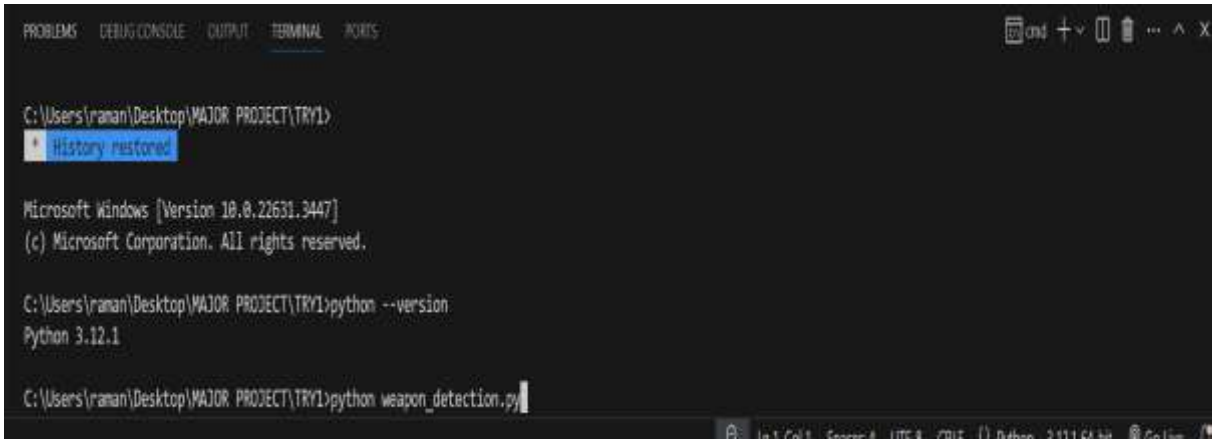

Figure 1 Running the program

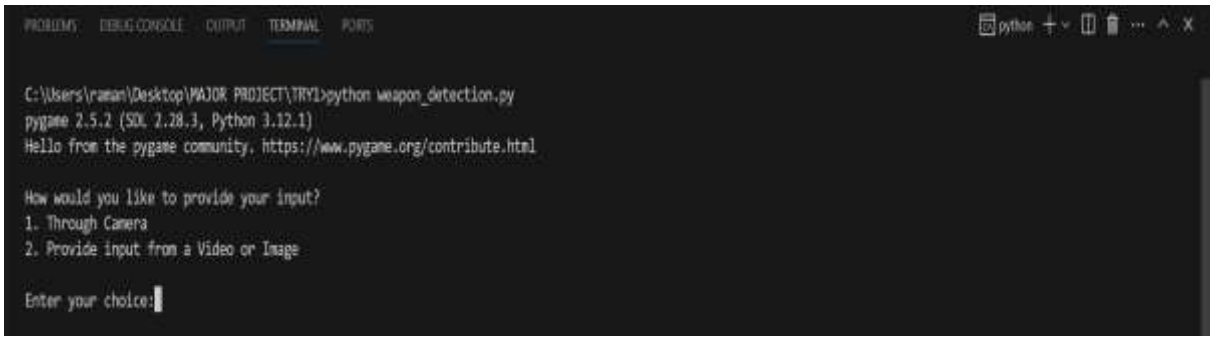

Figure.2 Giving input source

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Figure 3 Weapon detected of class Handgun with 94% confidence and bounded with rectangle box

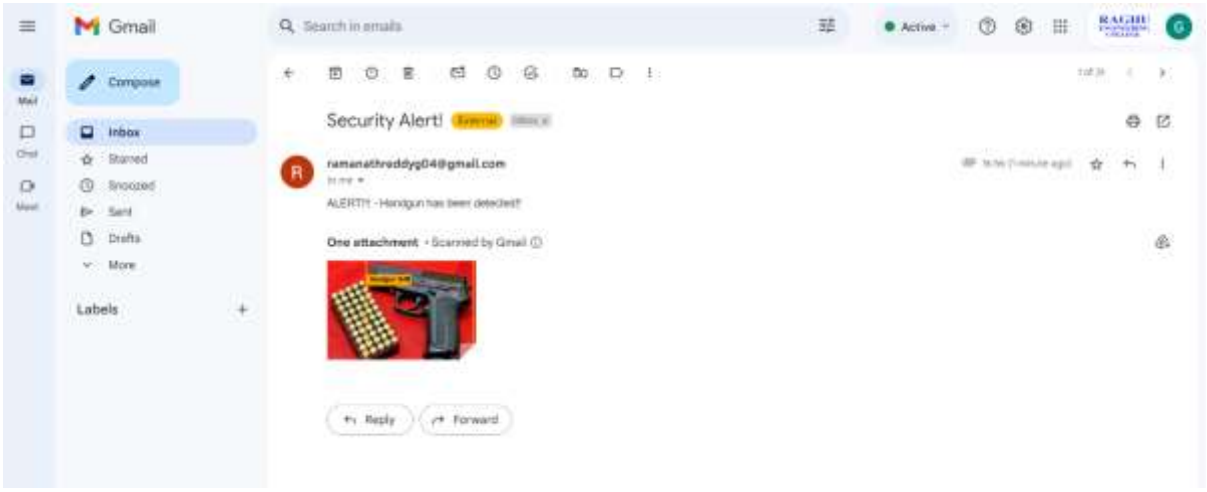

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Figure .4 Mail is sent when the weapon is detected which it contains the class name as well as the screenshot from the video.

Figure 5 Weapon detected of class Longgun with 92% confidence with bounded rectangle

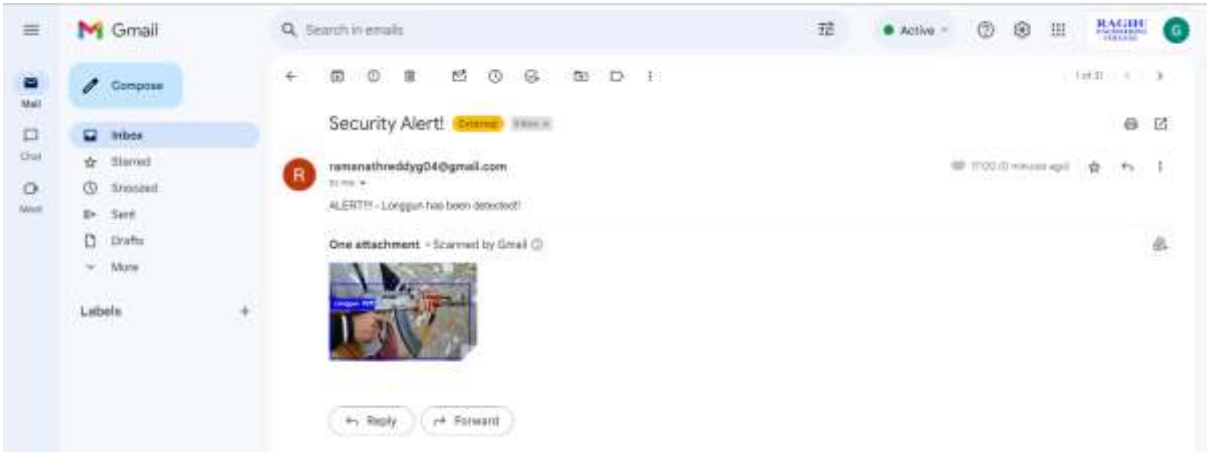

Figure 6 Mail is sent when the weapon is detected in which contains the class name

as well as the screen shot from the video.

Figure 7 No weapon is detected

6. CONCLUSION AND FUTURE SCOPE

6.1 CONCLUSION

Security is a significant issue in the public eye. This archive inspects the security, well-being, and executives of ongoing security gadgets that work with present-day programming to distinguish criminal weapons. The genuine framework is how it is planned particularly for security and security of the board. With regard to observing and control, this movement has presented a better approach to distinguishing weapons. • Weapon detection plays a vital role in safety, security, and surveillance management. In this advanced time of observation and security, the quantity of Closed-Circuit Television (CCTV) conveyed out in the open and private places, has expanded exponentially and this has led to a challenge to humans to spot weapon in so many cameras.

- This paper presents a real-time framework and method that is mainly designed for security and safety management purposes For both monitoring and control purposes, this work has presented a novel automatic weapon detection system in real-time.
- This work will indeed help in improving the security, law, and order situation for the betterment and safety of humanity, especially for the countries who had suffered a lot with these kinds of violent activities.
- This will have a positive impact on the economy by attracting investors and tourists, as security and safety are their primary needs.
- We have focused on detecting the weapon in live CCTV streams and at the same time reduced the false negatives and positives This work will assist with working on the security, and the rule of law of individuals, particularly in nations impacted by viciousness. Decreasing the number of violations, and drawing in travelers, financial backers and people is better.

6.2 FUTURE SCOPE

The future work includes reducing the false positives and negatives even more as there is still a need for improvement. We might also try to increase the number of classes or objects in the future but the priority is to further improve precision and recall. With the addition of modern tech and advancement in AI there will be a possibility of getting more precision based system that can easily detect malicious weapons, even if they are concealed and aren't visible to camera or naked eye.

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