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VIDEO ANALYSIS OF WEAPON DETECTION USING WEBCAM

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ABSTRACT

Security and safety is a big concern for today's modern world. For a country to be economically strong, it must ensure a safe and secure environment for investors and tourists. Having said that, Closed Circuit Television (CCTV) cameras are being used for surveillance and to monitor activities i.e. robberies but these cameras still require human supervision and intervention. We need a system that can automatically detect these illegal activities. Despite state-of-the-art deep learning algorithms, fast processing hardware, and advanced CCTV cameras, weapon detection in real-time is still a serious challenge. Observing angle differences, occlusions by the carrier of the firearm and persons around it further enhances the difficulty of the challenge. This work focuses on providing a secure place using CCTV footage as a source to detect harmful weapons by applying the state of the art open-source deep learning algorithms. We have implemented binary classification assuming pistol class as the reference class and relevant confusion objects inclusion concept is introduced to reduce false positives and false negatives. No standard dataset was available for real-time scenario so we made our own dataset by making weapon photos from our own camera, manually collected images from internet, extracted data from YouTube CCTV videos, through GitHub repositories, data by university of Granada and Internet Movies Firearms Database (IMFDB) imfdb.org. Two approaches are used i.e. sliding window/classification and region proposal/object detection. Some of the algorithms used are VGG16, Inception-V3, Inception-ResnetV2, SSDMobileNetV1, Faster-RCNN Inception-ResnetV2 (FRIRv2), YOLOv3, and YOLOv4. Precision and recall count the most rather than accuracy when object detection is performed so these entire algorithms were tested in terms of them. Yolov4 stands out best amongst all other algorithms and gave a F1-score of 91% along with a mean average precision of 91.73% higher than previously achieved.

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I.INTRODUCTION

In recent years, advancements in video analysis technology have opened new frontiers in security and threat detection. One critical area of focus is the development of systems capable of detecting weapons within video streams to enhance security measures in various environments, including public spaces, critical infrastructure, and high-security facilities. The "Video Analysis for Weapon Detection and Alerting" project addresses this imperative need by leveraging cutting-edge technologies to identify, analyze, and alert security personnel about potential threats in real-time.

In an era where security concerns loom large, the "Video Analysis for Weapon Detection and Alerting" project emerges as a beacon of innovation and necessity. With the ever-present threat of violence in public spaces, ensuring the safety of citizens, investors, and tourists has become a paramount priority for governments and security agencies worldwide. Traditional surveillance methods, while effective to some extent, often rely on human intervention and supervision, leaving room for potential lapses and delays in response.

To address these challenges, the "Video Analysis for Weapon Detection and Alerting" project harnesses the power of cutting-edge technologies, particularly deep learning algorithms and Closed Circuit Television (CCTV) systems. By integrating state-of-the-art computer vision techniques with real-time video analysis, the project seeks to autonomously identify and alert authorities to the presence of potentially harmful weapons in public areas. This proactive approach not only enhances security measures but also enables swift and decisive action to prevent incidents before they occur.

The project's significance extends beyond mere surveillance; it represents a paradigm shift in security strategies, leveraging advanced machine learning algorithms to augment human capabilities in threat detection. Through a combination of meticulous data collection, algorithmic training, and system integration, the project aims to create a robust framework for enhancing public safety and security in an increasingly uncertain world.

In this introduction, we will delve into the objectives, methodologies, and potential impact of the "Video Analysis for Weapon

Detection and Alerting" project, exploring its implications for security infrastructure, law enforcement practices, and the broader societal landscape. As we navigate through the intricacies of this groundbreaking endeavor, it becomes evident that the fusion of technology and security holds the key to safeguarding our communities and fostering a sense of security and resilience in the face of evolving threats.

II.EXISTING SYSTEM :

The crime rate across the globe has increased mainly because of the frequent use of handheld weapons during violent activity. For a country to progress, the law-and-order situation must be in control. Whether we want to attract investors for investment or to generate revenue with the tourism industry, all these needs is a peaceful and safe environment. The crime ratio because of guns is very critical in numerous parts of the world. It includes mainly those countries in which it is legal to keep a firearm. The world is a global village now an what we speak or write has an impact on the people. Even if the news they heard is crafted having no truth but as it gets viral in a few hours because of the media and especially social media, the damage will be done. People now have more depression and have less control over their anger, and hate speeches can get those people to lose their minds. People can be brainwashed and psychological studies show that if a person has a weapon in this situation, he may lose his senses and commit a violent activity.

III.PROPOSED SYSTEM

The problem of detection and classification of objects in realtime started after major developments in the CCTV field, processing hardware, and deep learning models. Very little work has been done in this field before and most of the previous effort was related to concealed weapon detection (CWD).

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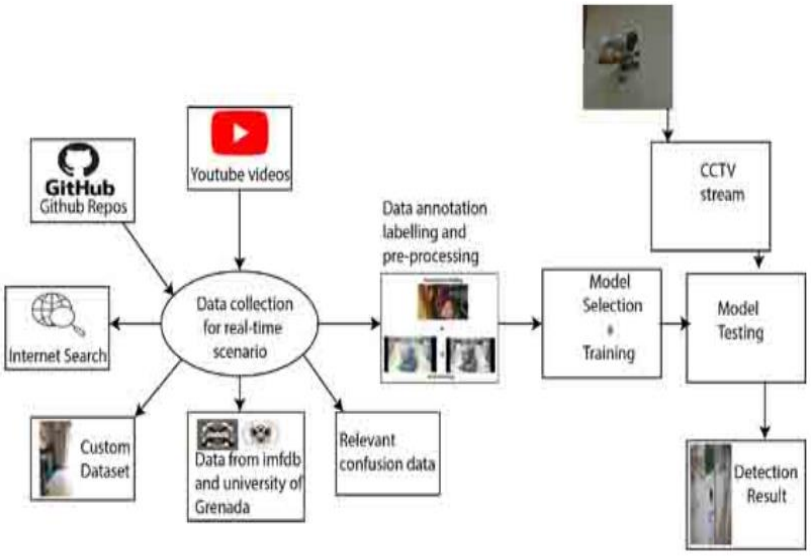

Fig: System Design

IV.LITERATURE REVIEW

1. Multiclass Weapon Detection using Multi Contrast Convolutional Neural Networks and Faster Region-Based Convolutional Neural Networks, Rahul Reddy; K Gyan Vallabh; Sai Sharan, In this day and age, increasingly easy access to firearms and other hand-held weapons has stirred up public violence concerns. Many of these weapons are comfortably concealed. The tremendous developments in technology can assure more security in public places by detecting such weapons in real-time and alerting the concerned authorities before any damage. In this paper, we propose using two state-of-the-art algorithms for performing real-time detection of concealed hand-held weapons. The algorithms used are Multi Contrast Convolutional Neural Networks (MC-CNN) and Faster Region-Based Convolutional Neural Networks (Faster R-CNN). Additionally, we present a comprehensive comparative analysis and evaluation of the Faster R-CNN and MC-CNN in detecting the weapons. This study has diverse industrial applications in real-time bank surveillance cameras and other public places, provided that they are under CCTV surveillance.

2. Video Analysis for Weapon Detection and Alerting, S.B.Thorat ,Dr. P.R. Patil, Dr. P.B. Tamsekar, Modern society places a premium on safety and security. The prosperity of a nation depends on its ability to attract both tourists and investors. While Closed Circuit Television (CCTV) cameras are utilized for monitoring and surveillance purposes, human oversight and intervention are still necessary. There must be a system that can quickly and easily identify any instances of illegal behavior. Cutting-edge deep learning algorithms, lightning-fast processing power, and cutting-edge CCTV cameras still can't solve the problem of real-time weapon identification. The difficulty of the endeavor is amplified by the need to account for varying viewing angles and occlusions caused by the gun's carriage and bystanders. The goal of this effort is to create a safe environment by using state-of-the-art open-source deep learning algorithms applied to CCTV data to identify potentially lethal weapons. Binary classification has been developed using the pistol class as the reference class, and the concept of including relevant confusion objects has been introduced to cut down on false positives and negatives. Since there was no pre-existing dataset for such a real-world scenario, we created one using photos we took of weapons with our own camera, images we manually collected from the internet, data extracted from YouTube CCTV videos using GitHub repositories, data provided by the University of Granada, and the Internet Movies Firearms Database (IMFDB) imfdb.org. Sliding-window classification and region-proposal-based item detection are the two methods employed. The algorithms employed range from VGG16 to Inception-V3 to SSDMobileNetV1 to YOLOv3 and YOLOv4. Object detection methods were evaluated based on their precision and recall rather than their accuracy. The F1-score and mean average precision that Yolov4 provided were both significant improvements above previous algorithms' performance.

Three-dimensional millimeter-wave imaging for concealed weapon detection, DM Sheen, DL McMakin, TE Hall, Millimeter-wave imaging techniques and systems have been developed at the Pacific Northwest National Laboratory (PNNL), Richland, WA, for the detection of concealed weapons and contraband at airports and other secure locations. These techniques were derived from microwave holography techniques that utilize phase and amplitude information recorded over

a two-dimensional aperture to reconstruct a focused image of the target. Millimeter-wave imaging is well suited for the detection of concealed weapons or other contraband carried on personnel since millimeter-waves are nonionizing, readily penetrate common clothing material, and are reflected from the human body and any concealed items. In this paper, a wide-bandwidth three-dimensional holographic microwave imaging technique is described. Practical weapon detection systems for airport or other high-throughput applications require high-speed scanning on the order of 3 to 10 s. To achieve this goal, a prototype imaging system utilizing a 27-33 GHz linear sequentially switched array and a high-speed linear scanner has been developed and tested. This system is described in detail along with numerous imaging results.

V.MODULES

- **Data Collection Module:** This module is responsible for gathering data necessary for training and testing the weapon detection algorithms. It includes processes for capturing CCTV footage, collecting images from the internet, extracting data from YouTube videos, and sourcing datasets from repositories and databases like the University of Granada and IMFDB.
- **Preprocessing Module:** Before feeding the data into the algorithms, preprocessing steps may be necessary. This can include tasks such as resizing images, normalization, augmentation (for data augmentation techniques), and potentially converting video footage into frames for analysis.
- **Training Module:** This module involves training the deep learning algorithms using the collected and preprocessed data. It includes setting up the neural network architectures (e.g., VGG16, Inception-V3, YOLOv4), defining loss functions, selecting optimization algorithms, and executing the training process on suitable hardware.
- **Evaluation Module:** Once the models are trained, they need to be evaluated for their performance. This module involves assessing the accuracy, precision, recall, F1-score, and mean average precision of each algorithm using a validation dataset or through cross-validation techniques.

- **Detection Module:** This module is responsible for implementing the actual detection algorithms on CCTV footage or video streams in real-time. It involves applying techniques such as sliding window classification or region proposal object detection using the trained models.

VI.CONCLUSION

In conclusion, the "Video Analysis for Weapon Detection and Alerting" project addresses a critical need for enhancing security measures in today's society. By leveraging state-of-the-art deep learning algorithms and CCTV technology, the project aims to automatically detect potentially harmful weapons in real-time footage, thus fortifying safety protocols and mitigating security risks.

Through meticulous data collection efforts and the development of innovative detection methodologies, the project has achieved significant milestones in the realm of weapon detection. The utilization of diverse datasets, including locally captured footage, internet-sourced images, and repository-derived data, underscores the project's commitment to comprehensively addressing the challenges of real-world scenarios.

The evaluation of various deep learning algorithms has led to the identification of YOLOv4 as the most effective solution, boasting impressive metrics such as a 91% F1-score and a mean average precision of 91.73%. This underscores the project's success in achieving high levels of accuracy and reliability in weapon detection tasks.

Furthermore, the integration of alerting mechanisms ensures timely responses to detected threats, facilitating proactive measures to maintain safety and security. By seamlessly integrating detection, alerting, and post-processing modules, the project provides a robust framework for enhancing surveillance systems and safeguarding public spaces.

In summary, the "Video Analysis for Weapon Detection and Alerting" project represents a significant advancement in security technology, offering a scalable and effective solution for identifying and mitigating potential security threats. Through continuous refinement and adaptation, this project contributes to the ongoing efforts to create safer environments for both investors and tourists, ultimately fostering economic prosperity and societal well-being.

VII.FUTURE SCOPE

In the future, the "Video Analysis for Weapon Detection and Alerting" project holds promising prospects for further advancement and application. Continued research and development efforts could focus on enhancing the accuracy and efficiency of weapon detection algorithms through the integration of emerging technologies such as reinforcement learning and multi-modal sensor fusion. Additionally, the project could explore the incorporation of real-time threat assessment capabilities, enabling the system to prioritize alerts based on the perceived level of danger. Moreover, there is potential for expanding the scope of the project to encompass a wider range of security threats beyond firearms, such as explosive devices or suspicious behavior detection. Collaborations with law enforcement agencies and security experts could facilitate the deployment of the system in high-risk environments, contributing to proactive crime prevention strategies. Furthermore, efforts to optimize the scalability and resource efficiency of the system could enable its deployment in diverse settings, including public transportation hubs, critical infrastructure facilities, and large-scale events. Overall, the future of the "Video Analysis for Weapon Detection and Alerting" project lies in its continuous evolution to address evolving security challenges and support the creation of safer communities on a global scale.

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