



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 5, May 2025

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International Journal of Innovative Research of Science, Engineering and Technology (IJIRSET)



www.ijirset.com |A Monthly, Peer Reviewed & Refereed Journal| e-ISSN: 2319-8753| p-ISSN: 2347-6710|

Volume 14, Issue 5, May 2025

|DOI: 10.15680/IJIRSET.2025.1405253|

Detecting Firearms in Surveillance Footage

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ABSTRACT: This project focuses on real-time gun detection utilizing a pre-trained YOLO (You Only Look Once) algorithm and a Tkinter-based user interface (UI). The system aims to enhance security by identifying the presence of guns in video feeds in real-time. YOLO's object detection capabilities enable swift and accurate identification of guns, while Tkinter provides an intuitive interface for monitoring and controlling the detection process. The system notifies authorities via email when a gun is detected, ensuring prompt action and improving safety in sensitive environments.

KEYWORDS: Real-time Object Detection, Image Classification, Surveillance Footage Analysis

I. INTRODUCTION

The detection of firearms in surveillance footage is an essential aspect of modern security systems, particularly in environments such as airports, public spaces, and government buildings. With the increasing concerns about public safety, there is a growing need for effective real-time threat detection mechanisms. Traditional methods of detecting firearms rely on manual observation and conventional image processing techniques, which are often slow and prone to human error. However, advancements in artificial intelligence (AI) and deep learning (DL) offer a promising solution to automate and enhance this process. Deep learning, a subset of machine learning, has demonstrated remarkable success in image recognition tasks, particularly in the domain of object detection. Convolutional Neural Networks (CNNs), in particular, have shown to be highly effective in analyzing visual data for the identification of specific objects. By training deep learning models on large datasets of images and videos containing various firearm types, it is possible to build robust systems capable of accurately detecting firearms in real-time surveillance footage. This project aims to leverage the power of deep learning to automate the detection of firearms, making security systems more efficient and timely in identifying potential threats. The application of deep learning in firearm detection offers significant advantages over traditional methods, including faster processing speeds, higher accuracy, and the ability to adapt to new types of firearms or environments. This project will explore various techniques, such as CNNs and other state-of-the-art models like YOLO (You Only Look Once) and Faster R-CNN, to develop a system capable of identifying firearms with minimal false positives and negatives. By the end of this project, we aim to create a system that can be integrated into existing surveillance networks, providing an additional layer of security and contributing to the overall safety of public and private spaces.

II. LITERATURE REVIEW

The detection of firearms in surveillance footage has gained significant attention due to the increasing need for public safety and crime prevention. Traditional approaches for firearm detection rely on manual inspection or simple image processing techniques, which often fall short in complex real-world scenarios. The advancements in deep learning have led to more robust and automated solutions. Convolutional Neural Networks (CNNs) and other deep learning architectures have been effectively applied to object detection tasks, providing superior performance in detecting firearms in video data. Research by Ren et al. (2017) on the Faster R-CNN framework has laid a foundation for this field, allowing for real-time detection with high accuracy. Recent studies have expanded on these initial approaches by exploring different architectures and strategies for improving firearm detection in surveillance systems. For instance, Zhao et al. (2019) proposed a combination of CNN and Recurrent Neural Networks (RNNs) to handle both spatial and temporal information in video data. This hybrid approach allows the model to not only detect firearms but also track their movement over time, making it effective for surveillance over longer periods. Moreover, the use of



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transfer learning and pre-trained models, such as YOLO (You Only Look Once), has accelerated the adoption of deep learning in real-time surveillance systems by reducing the need for large labeled datasets and computational resources.

III. DESIGN AND IMPLEMENTATION

Detecting firearms in surveillance footage using deep learning is a crucial application for enhancing security systems, especially in high-risk areas such as airports, banks, and public spaces. The project starts with data collection, which involves gathering a diverse dataset of images and videos containing firearms, ensuring a variety of backgrounds, lighting conditions, and angles to train the model effectively. Annotating this data with labels identifying firearms is essential for the supervised learning approach. Popular object detection models such as YOLO (You Only Look Once) or Faster R-CNN (Region-based Convolutional Neural Networks) are ideal choices for this task, as they can detect multiple objects in real time and provide accurate bounding boxes around detected firearms. For model training, the deep learning approach uses convolutional neural networks (CNNs) to learn spatial hierarchies of features in the footage. By feeding the annotated dataset into the model, it learns to differentiate between firearms and other objects based on visual features such as shape, colour, and texture. The model undergoes multiple iterations of training and validation to minimize false positives (incorrectly detecting objects as firearms) and false negatives (failing to detect firearms). Data augmentation techniques like rotation, scaling, and flipping are applied to improve the model's robustness to variations in the input footage.



FIGURE: Block Diagram for detecting firearms in surveillance footage

IV. EXPERIMENTAL RESULTS

The goal of this project is to develop a deep learning-based system for detecting firearms in surveillance footage, improving safety and security by identifying potential threats in real-time. The experimental design begins with data collection, where a large dataset of labeled surveillance footage containing both firearm and non-firearm events is curated. This dataset is essential for training a convolutional neural network (CNN), which will learn to recognize key features in images that distinguish firearms from other objects. To enhance the model's accuracy, diverse footage, including different angles, lighting conditions, and environments, is used to ensure the system can generalize well across various scenarios.





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V. CONCLUSION

The real-time gun detection system developed using the YOLO algorithm and Tkinter interface demonstrates a significant advancement in security technology. By employing YOLO's pre-trained model, the system efficiently identifies firearms in video streams with high precision and speed. The integration of Tkinter facilitates a user-friendly interface for managing the detection process, making it accessible and easy to operate. The system's capability to send instant email alerts upon detecting a gun ensures timely intervention, enhancing safety in sensitive environments. Overall, this project showcases the practical application of advanced object detection technologies in real-time security scenarios, offering a robust solution for firearm monitoring and threat prevention.

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