



Violence Detection System

¹Khedekar Sulakshna, ²Meckenzie Wilson, ³Mulla Kadarsahab, ⁴Nanekar Meghraj, ⁵Prof. Chorade Priti

¹²³⁴Student, ⁵Professor

¹²³⁴⁵Department of Computer Engineering,

¹²³⁴⁵Vidya Prasari Sabha's College of Engineering, Lonavala, India

Abstract- With the rapid rise in urbanization and public surveillance infrastructure, ensuring public safety has become a significant challenge. Traditional surveillance methods are limited by manual observation, leading to delayed responses and inefficiencies. This research proposes a Violence Detection System using 3D Convolutional Neural Networks (3D CNNs) and transfer learning techniques. By analyzing spatial and temporal video features, the system detects violent behaviors in real-time. The proposed model achieves robustness against variations in video quality, resolution, and lighting conditions. Comprehensive evaluations demonstrate its effectiveness across diverse datasets, offering a scalable solution for modern surveillance applications.

Keywords- Public Safety, Video Analysis, Real-time Detection, Deep Learning, Violence Detection, Surveillance Systems

I. INTRODUCTION

The increasing presence of surveillance cameras in public spaces is a direct response to growing concerns about safety and security in urban areas. From big city streets to schools, shopping malls, and transportation hubs, these cameras capture a big volume of video data daily. While surveillance systems have significantly contributed to crime deterrence and post-incident investigations, they are still far from perfect in addressing real-time challenges. The reliance on manual monitoring creates issues in response time, as human operators can only analyze a limited number of video feeds simultaneously. Fatigue, distractions, and limited capacity further worsen these challenges, leading to missed incidents or delayed reactions.

The issue is further compounded by the rising rates of violent crimes in public and private spaces. These crimes often occur in seconds, leaving little time for intervention. Traditional surveillance systems, designed to record events for later review, lack the capability to actively detect and alert authorities about violent behavior as it happens. This limitation emphasizes the need for intelligent, automated solutions capable of identifying threats in real-time and enabling quicker responses to mitigate potential harm.

In this research, we present a **Violence Detection System** that integrates 3D CNNs with pre-trained action recognition models. The system is designed to process real-time video streams, detect violent actions, and issue immediate alerts to relevant authorities. It addresses common challenges such as low-quality video, lighting variations, and crowded environments by employing robust preprocessing and model training techniques. The proposed solution has been tested on publicly available datasets as well as custom datasets, demonstrating superior accuracy, speed, and scalability.

II. LITERATURE SURVEY

Mollah, M. Al-Hossain, and R. D. Sharma [1] provide a thorough review of action recognition and violence detection techniques used in video surveillance. They discuss the evolution from traditional methods to new machine learning approaches, particularly utilizing the capabilities of deep learning models. Their analysis highlights the effectiveness of these advanced techniques in improving detection accuracy and the ability to process video data in real-time. The authors also address the challenges faced in implementing these systems, including the need for large datasets and computational resources, ultimately reducing the potential for deep learning to enhance public safety through more reliable surveillance systems.

B. Varadarajan, M. M. S. U. K. K., and L. L. Johny [2] focus specifically on the application of deep learning in violence detection within video surveillance systems. They highlight the advantages of using convolutional neural networks (CNNs) for recognizing violent actions due to their ability to learn hierarchical features from raw video data. Their study proposes a combined model that integrates multiple deep learning approaches to improve detection accuracy. By analyzing various datasets, the authors demonstrate that their proposed system significantly outperforms traditional methods, paving the way for more effective and automated violence detection solutions in real-world scenarios.

F. Liu, Y. Zhang, J. Huang, and H. Xie [3] tackle the critical challenge of real-time violence detection using deep learning techniques. Their research presents a practical implementation that balances high accuracy with the processing speed required for immediate response in surveillance settings. They develop a deep learning framework that employs CNNs to analyze video frames, identifying violent actions efficiently. The authors emphasize the importance of optimizing their model to reduce latency, making it suitable for applications where quick decision-making is essential, such as public safety and security monitoring.

S. S. Jain, P. Agrawal, and P. B. Deshmukh [4] investigate violence detection in videos using convolutional neural networks (CNNs), focusing on the effectiveness of feature extraction from video frames. Their study presents a detailed framework that demonstrates how CNNs can capture essential patterns and characteristics of violent actions. By employing extensive experimentation on various datasets, the authors illustrate the potential of CNNs to enhance detection capabilities, reducing false positives and improving overall accuracy. Their findings support the notion that deep learning approaches are well-suited for practical applications in surveillance.

R. R. Srinivasan, A. S. Bhagat, and S. Thaker [5] introduce a novel approach to detecting violent actions using 3D convolutional neural networks (3D CNNs). This method captures both spatial and temporal features in video data, which is crucial for accurately identifying dynamic behaviours. The authors argue that traditional 2D CNNs often miss important motion-related information, leading to less effective detection. Through extensive testing, they demonstrate that 3D CNNs significantly outperform their 2D counterparts in recognizing violent actions, thus contributing to more robust surveillance systems capable of analyzing complex interactions in real time.

H. Zhang, Q. Chen, X. Guo, and X. Liu [6] explore violence detection in surveillance videos using a multi-feature fusion approach. They emphasize the importance of combining various types of features—such as motion, colour, and texture—to enhance the model's ability to detect violent actions accurately. By integrating these diverse features, the authors show that their method improves the overall performance of violence detection systems. Their study highlights the need for sophisticated techniques that utilize a broader range of information, reinforcing the notion that a multifaceted approach can lead to more reliable outcomes in real-world surveillance applications.

S. K. Lee and C. S. Yeo [7] focus on action recognition in real-time surveillance systems through deep learning techniques. Their research discusses various architectures and models that can be employed to improve the accuracy and speed of action recognition tasks. By proposing a framework that leverages these deep learning architectures, the authors demonstrate how to enhance the responsiveness of surveillance systems, making them more effective in detecting actions as they occur. Their findings suggest that incorporating advanced

deep learning strategies can significantly contribute to the development of smarter surveillance solutions, ultimately improving public safety outcomes.

III. PROBLEM STATEMENT

In today's world, violence in public spaces, schools, workplaces, and online media has become a growing concern. Traditional surveillance systems rely heavily on human operators to monitor live video feeds, making them prone to fatigue, oversight, and inefficiency. Existing automated systems for violence detection often fall short due to limitations in processing video from diverse environments, handling low-quality footage, and detecting nuanced violent behavior in crowded or complex scenarios. Moreover, real-time detection remains a significant challenge, especially in scenarios requiring immediate intervention.

IV. MOTIVATION

The increasing events of violence in public and private places, coupled with rising security concerns, increases the need for reliable automated detection systems. Manual monitoring is labor-intensive, prone to human error, and limited in scalability, particularly in environments with multiple surveillance cameras. Advancements in deep learning have opened new avenues for solving this issue by enabling systems to process video data more accurately and in real-time.

Key motivators include:

1. **Public Safety:** Real-time violence detection can prevent crimes, mitigate harm, and enhance public trust in security systems.
2. **Technological Potential:** Emerging technologies such as 3D CNNs and pre-trained models offer the capability to model complex human behaviours and dynamic scenarios, making them ideal for violence detection tasks.
3. **Scalability:** A robust automated system can monitor multiple video feeds simultaneously, ensuring comprehensive coverage without additional human resources.
4. **Ethical and Social Impacts:** Detecting violence in online media and movies can create safer, non-triggering content for vulnerable audiences, enhancing inclusivity and safety in digital platforms.

V. OBJECTIVES

The main goals of this project is to-

- Create a system that can detect violence in video footage automatically.
- Use advanced technologies like 3D CNNs to improve accuracy.
- Ensure the system works in real-time and sends alerts instantly.
- Design it to handle low-quality and low-light video footage effectively.

VI. PROPOSED SYSTEM

Proposed system is a CNN based model which detects violence in real time via video feed. Key components include Data collection , Pre – Processing, Feature extraction , Violence Detection and Alerting System.

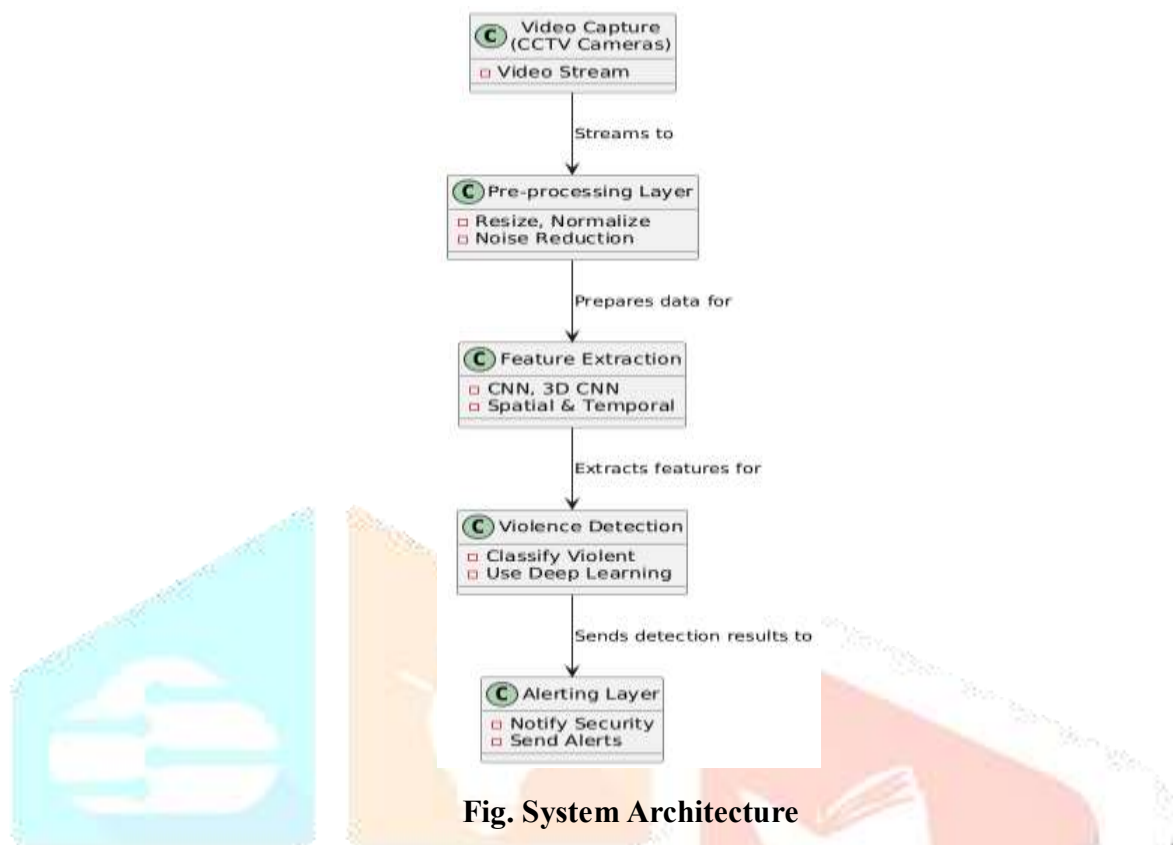


Fig. System Architecture

- **Modules -**

- 1) **Data Collection (CCTV Cameras):** Captures video streams, which are passed along the system for further processing.
- 2) **Pre-processing Layer:** Includes steps like resizing, normalizing, and noise reduction to prepare the video data for feature extraction.
- 3) **Feature Extraction:** Uses Convolutional Neural Networks (CNNs) and 3D CNNs to extract spatial and temporal features from the video stream.
- 4) **Violence Detection:** Classifies the extracted features as violent or non-violent using deep learning models.
- 5) **Alerting Layer:** Notifies security personnel and sends alerts based on the detection results.

- **Dataset -**

Proposed system will be using **Violence Detection Dataset (VDD)** and **RWF-2000 Dataset** for developing and training model to detect violence .

- **Model Architecture -**

A. **Input Layer:** Accepts pre-processed video frames.

B. Convolutional Layers

Multiple layers that apply filters to extract features like edges, textures, and patterns.

Pooling Layers:

Max pooling or average pooling layers reduce the dimensionality of the feature maps while retaining the most important information, optimizing computational efficiency.

Fully Connected Layers:

These layers take the flattened output from the pooling layers and learn to classify the features into different categories of actions (violent or non-violent).

C. Output Layer:

A softmax layer that provides a probability distribution across the classes, indicating the likelihood of each action type.

• System Workflow –

1. **Video Input:** Model is fed video stream live from a CCTV.
2. **Preprocessing:** The preprocessing layer applies preprocessing to standardize the video.
3. **Prediction:** The CNN processes the video, and gives predictions that include whether there is violence in the video.
4. **Result :** Display the result by determining violence and alert the user/admin via alerting module.

VII. CONCLUSION

Proposed violence detection system based on convolutional neural networks (CNNs) offers a powerful tool for enhancing safety in various environments. By using CNNs, the system can automatically identify important visual features from video footage, allowing it to recognize violent actions effectively. With a well-structured dataset and video processing, the system can provide accurate results in real time, helping to detect potentially dangerous situations quickly. As concerns about public safety grow, such technology can play a crucial role in monitoring areas and ensuring timely responses to incidents.

Looking ahead, there are several possible upgrades to improve the system further. Expanding the dataset to include a wider variety of scenarios and environments could enhance the model's robustness and reduce false positives. By incorporating multi-modal data analysis, such as combining video footage with audio clues, could improve detection accuracy. Additionally, by leveraging advanced techniques like transfer learning or ensemble methods might enhance performance by utilizing pre-trained models on similar tasks. Implementing real-time analytics and alerts could provide immediate notifications to authorities, allowing for quicker interventions. Overall, these upgrades have the potential to significantly enhance the effectiveness and reliability of violence detection systems, contributing to safer communities.

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