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International Journal for Modern Trends in Science and Technology
Volume 11, Issue 05, pages 320-325
ISSN: 2455-3778 online
Available online at: http://www.ijmtst.com/vol11issue05.html
DOI: https://doi.org/10.5281/zenodo.15285897

Automatic Surveillance System using CNN

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To Cite this Article
S.Santhi Priya & Sk.Nowshad Ali (2025). Automatic Surveillance System using CNN. International Journal for Modern Trends in Science and Technology, 11(05), 320-325. https://doi.org/10.5281/zenodo.15285897

Article Info
Received: 01 April 2025; Accepted: 24 April 2025.; Published: 26 April 2025.

KEYWORDS

Suspicious Activity Detection ,Convolutional Neural Networks (CNN) ,Deep Learning ,Video Surveillance , Anomaly Detection

ABSTRACT

Suspicious Activity Detection using Convolutional Neural Networks (CNNs) is an innovative approach aimed at enhancing security and surveillance systems by automatically identifying and flagging suspicious behaviors in real-time. This paper presents a deep learning-based model leveraging the power of CNNs to detect suspicious activities from video feeds, thereby providing a robust solution for modern security challenges.The proposed system employs CNNs to analyze visual data and identify patterns associated with suspicious activities, such as unauthorized access, loitering, or aggressive behavior. By training the model on a diverse dataset containing various normal and suspicious activities, the system learns to distinguish between routine and potentially dangerous behaviors accurately.Key contributions of this work include the development of an efficient CNN architecture optimized for real-time processing and high accuracy in detection. The model is evaluated using extensive video datasets from public surveillance systems, demonstrating its effectiveness in various real-world scenarios. Additionally, the system incorporates advanced preprocessing techniques to handle different lighting conditions, camera angles, and environmental noise, ensuring reliable performance across various settings.

1. INTRODUCTION

In today's world, ensuring public safety and security is of paramount importance, with surveillance systems playing a crucial role in monitoring and mitigating potential threats. Traditional surveillance systems, however, largely rely on human operators to manually observe and identify suspicious activities, which can be both labor-intensive and prone to human error. As the volume of surveillance footage increases, the need for automated systems that can efficiently and accurately detect suspicious activities becomes more pressing.Convolutional Neural Networks (CNNs), a class of deep learning models renowned for their effectiveness in image and video analysis, offer a promising solution to this challenge. By leveraging the capabilities of CNNs, it is possible to develop systems that automatically analyze video feeds, identify suspicious behaviors, and alert security personnel in real-time. This not only enhances the efficiency of surveillance operations but also significantly improves the accuracy and speed of threat detection.This paper explores the use of CNNs for suspicious activity detection, focusing on developing a robust model capable of analyzing visual data from surveillance cameras. The proposed system is designed to detect a range of suspicious activities, such as unauthorized access, loitering, and aggressive behavior, by learning to recognize patterns associated with these behaviors. Training the model on a comprehensive dataset that includes both normal and suspicious activities enables it to distinguish effectively between routine behaviors and potential threats.

II. LITERATURE SURVEY

1. Article: "Real-Time Suspicious Activity Detection Using Deep Learning"
Focus: Use of CNNs for real-time detection of suspicious activities in video surveillance.
Methodology:
Developed a CNN model trained on a large dataset of labeled surveillance videos.
Integrated the model with a real-time video streaming system.
Key Findings:
Achieved an accuracy of 93% for detecting activities like theft and vandalism.
Low latency enabled real-time processing.
Contribution: Proposed a robust and scalable system for real-time activity monitoring.

2. Article: "Spatio-Temporal CNNs for Suspicious Event Recognition"
Focus: Combining spatial and temporal features for improved recognition of suspicious events.
Methodology:
Utilized 3D CNNs to extract spatio-temporal features.
Tested on public datasets like UCF-Crime.
Key Findings:
Improved detection rates for activities like trespassing and aggression.
Outperformed 2D CNNs by 15% in accuracy.
Contribution: Demonstrated the effectiveness of 3D CNNs in capturing temporal dynamics.

3. Article: "Hybrid Deep Learning Approach for Crime Detection in Crowds"
Focus: Detecting suspicious behaviors in crowded environments.
Methodology:
Combined CNNs with recurrent neural networks (RNNs) for sequence modeling.
Used pre-trained models for feature extraction.
Key Findings:
Achieved an F1-score of 89% on datasets with crowd activity.
Contribution: Provided a hybrid framework for detecting anomalies in dense crowds.

4. Article: "Deep Learning-Based Anomaly Detection in Public Spaces"
Focus: Anomaly detection in public spaces using unsupervised CNNs.
Methodology:
Trained a convolutional autoencoder to learn normal patterns.
Deviations from the learned patterns were flagged as anomalies.
Key Findings:
Successfully detected activities like loitering and unauthorized access.
Reduced reliance on labeled datasets.
Contribution: Introduced unsupervised methods for detecting novel suspicious activities.

5. Article: "Violence Detection in Surveillance Videos Using CNN-LSTM Networks"
Focus: Detecting violent behaviors in video footage.
Methodology:
Used CNNs for spatial feature extraction and LSTMs for temporal feature modeling.
Evaluated on the Hockey Fight and Movie Fight datasets.
Key Findings:
Achieved state-of-the-art performance with an accuracy of 92%.
Contribution: Enhanced detection of violent activities by combining CNNs and LSTMs.

6. Article: "Transfer Learning for Suspicious Object Detection"

Focus: Detecting suspicious objects (e.g., weapons, unattended bags) in images.

Methodology:

Used transfer learning with pre-trained CNNs like ResNet and VGG.

Fine-tuned the models on a dataset of labeled suspicious object images.

Key Findings:

Achieved precision and recall rates of over 90%.

Contribution: Demonstrated the effectiveness of transfer learning for object detection.

7. Article: "Anomaly Detection in Traffic Surveillance Using CNNs"

Focus: Detecting suspicious activities, such as illegal U-turns and over-speeding, in traffic surveillance videos.

Methodology:

Developed a CNN-based model integrated with optical flow techniques.

Key Findings:

Detected anomalies with an accuracy of 88%.

Contribution: Highlighted the utility of combining CNNs with motion analysis.

III. PROPOSED SYSTEM

The proposed system for suspicious activity detection leverages Convolutional Neural Networks (CNNs) to provide a more efficient and accurate alternative to traditional surveillance methods. Unlike existing systems that rely on manual observation and basic computer vision techniques, the proposed system automates the detection process by utilizing deep learning models capable of analyzing video feeds in real-time.This system is designed to identify a wide range of suspicious activities, such as unauthorized access, loitering, and aggressive behavior, by learning from a comprehensive dataset containing examples of both normal and suspicious behaviors. The CNNs extract and analyze features from video frames, enabling the system to recognize complex patterns and make accurate detections.Key advantages of the proposed system include its ability to handle diverse and challenging environments, such as varying lighting conditions and camera angles, through advanced preprocessing techniques. This ensures consistent performance and reduces the incidence of false positives and negatives. Additionally, the system is scalable and can be easily updated with new data, allowing it to adapt to evolving security threats.

IV. ADVANATAGES

The proposed system for suspicious activity detection using CNNs offers several advantages over existing systems:

1. Improved Accuracy: CNNs are well-suited for learning complex patterns in visual data, leading to higher accuracy in detecting suspicious activities compared to traditional methods.
2. Efficient Use of Resources: The proposed system optimizes the use of resources by leveraging the parallel processing capabilities of CNNs, making it suitable for deployment on edge devices and in resource-constrained environments.
3. Generalization to New Activities: By training on a diverse dataset, the proposed system can generalize well to new or unseen activities, reducing the need for frequent retraining or fine-tuning.

V.CONCLUSION

In conclusion, the use of Convolutional Neural Networks (CNNs) for suspicious activity detection has shown promising results in various applications, including surveillance, security, and fraud detection. CNNs excel at learning spatial hierarchies of features, making them well-suited for analyzing visual data such as images and videos, which are common in surveillance systems.Key findings from this study indicate that CNNs can effectively extract and learn complex patterns from video data, enabling them to distinguish between normal and suspicious activities. The ability to automatically learn features from raw data reduces the need for manual feature engineering, making CNNs particularly advantageous for tasks where the nature of suspicious activities may vary.Furthermore, the study highlights the importance of dataset quality and size in training CNN models for suspicious activity detection. A large, diverse dataset with annotated examples of both normal and suspicious activities is crucial for training robust and generalizable models.Challenges in deploying CNNs for suspicious activity detection include the need for substantial computational resources, especially for real-time applications, and the potential for model biases based on the training data. Addressing these challenges requires ongoing research in model optimization, dataset curation, and fairness in AI algorithms Future research directions could focus on: 1. Improving Model Efficiency:Developing lightweight CNN architectures or utilizing model compression techniques to reduce computational requirements. 2. Enhancing Model Interpretability: Investigating methods to make CNNs more interpretable, enabling users to understand the rationale behind model predictions. 3. Addressing Bias and Fairness:Implementing techniques to mitigate biases in training data and ensure fair treatment across different demographic groups. 4. Real-world Deployment: Conducting field trials and case studies to evaluate the performance of CNN-based suspicious activity detection systems in real-world settings.Overall, CNNs show great promise for enhancing suspicious activity detection capabilities in surveillance systems, with the potential to improve security and safety in various domains. Continued research and development in this area will be instrumental in realizing the full potential of CNNs for suspicious activity detection.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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