IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 10, May 2025
Impact Factor: 7.67

Suspicious Activity Detection System

Pratiksha D. Kale[1], Vishal D. Bhand[2], Saujanya S. Mirge[3], Aditya J. Nagure[4]
Assistant Professor, Computer Engineering[1]
Students, Computer Engineering[2-4]
NBN Sinhgad Technical Institutes Campus, Pune, India

Abstract: *The Suspicious Activity Detection System is designed to enhance the intelligence and effectiveness of modern surveillance systems. This project introduces an automated method for identifying unusual human behavior in real-time video streams using deep learning. Its main goal is to boost safety and enable quick responses by detecting suspicious actions without needing constant human supervision. The system uses OpenCV to capture and process frames from a live video feed. These frames are then analyzed by a Convolutional Neural Network (CNN) model trained to recognize the difference between standard and potentially suspicious activities based on visual patterns observed in surveillance footage. When the system detects an unusual action, it saves the corresponding video frame locally and instantly sends an email alert to the appropriate authority. This prompt notification helps ensure timely intervention in critical situations. The entire system is built using Python, with key libraries such as Keras for deep learning, OpenCV for image processing, and SMTPLIB for sending email notifications. The model was trained using relevant surveillance datasets and tested on both internal and external video sources to evaluate its performance. Results showed that the system performs reliably across different environments. By combining artificial intelligence with real-time surveillance, this solution addresses the growing need for automated security in places like public spaces, workplaces, ATMs, and other high-risk areas. It not only expands the reach of surveillance but also reduces the chances of human oversight, making it easier to respond swiftly and accurately to possible threats.*

Keywords: Suspicious Activity Detection, Convolutional Neural Networks (CNN), Deep Learning, Real-time Surveillance

I. INTRODUCTION

In today's world, where public safety and real-time awareness are more important than ever, the need for smart, automated surveillance systems has seen rapid growth. Traditional methods that rely on human monitoring can be inconsistent, often hindered by fatigue or missed cues, making them less reliable in high-stakes situations. To overcome these challenges, this project introduces an advanced Suspicious Activity Detection System powered by deep learning and computer vision. Unlike basic surveillance tools, this system is capable of recognizing a wide range of abnormal and potentially dangerous situations. Beyond detecting unusual human behavior, it can also identify broader threats such as aggressive crowd behavior, panic situations, natural disasters like earthquakes, and other scene-based anomalies. The heart of the system is a Convolutional Neural Network (CNN) trained on a diverse and carefully selected dataset that covers various real- world threat scenarios. This enables the system to accurately interpret different types of suspicious activity as they unfold in real time. For swift response, it also features an automated alert system that sends immediate email notifications to assigned security personnel whenever suspicious behavior is detected in the video feed. By validating the system on both test environments and real surveillance footage, its reliability and adaptability to different situations have been demonstrated. This solution is especially effective in public areas, transport stations, and other sensitive locations where quick reaction is crucial. Overall, this system marks a major step forward in the evolution of surveillance technologies, offering a proactive approach to threat detection and contributing significantly to enhanced public safety.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 10, May 2025
Impact Factor: 7.67

II. LITERATURE REVIEW

2.1 Suspicious Human Activity Recognition From Surveillance Videos Using Deep Learning - Monji Zaidi, Gabriel Sampedro, Ahmad Almadhor, Shtwai Alsubai, Abdullah Hejaili, Michal Gergus, Sidra Abbas

This study introduces a deep learning-based approach aimed at improving the accuracy and efficiency of Suspicious Human Activity Recognition (SHAR) systems. By training their models on carefully selected datasets and testing on both unseen data and real-world YouTube videos, the authors demonstrated strong generalization capabilities. Their work highlights how deep learning can significantly enhance the reliability of real-time surveillance applications, pushing SHAR systems closer to practical deployment.

2.2 Abnormal Activity Detection and Classification of Bus Passengers With In-Vehicle Image Sensing- Huei-Yung Lin, Chun-Han Tseng

Focusing on passenger safety in autonomous buses, this research tackles the common challenge of occlusion in human activity recognition. The authors implemented an overhead vision system that captures top-view images to better recognize passenger behavior. A specialized neural network processes both spatial and temporal features from these views. They also developed a custom dataset, BUS-HAR, to reflect real-world passenger scenarios. Experimental results confirmed that their method outperforms existing techniques, making it effective for detecting abnormal or dangerous behavior inside autonomous public transport.

2.3 A Review of Abnormal Behavior Detection in Activities of Daily Living - Nian chi Tay, Tee Connie, Thian Song Ong, Andrew Beng jin Teoh, Pin Shen The

This paper emphasizes the growing importance of Abnormal Behavior Detection (ABD) in daily living, particularly for the elderly in smart home environments. It presents a comparative review of ABD systems using both sensor-based and vision-based data, along with traditional and deep learning methods. A key issue identified is the scarcity of diverse datasets for training robust models. The study provides valuable insights for future research and supports the development of more intelligent and responsive Ambient Assisted Living (AAL) technologies.

2.4 Abnormal Crowd Behavior Detection Using Motion Information Images and Convolutional Neural Networks - Cem Direkoglu

This work presents a novel technique for detecting abnormal crowd behavior, such as panic or sudden movement, using Motion Information Images (MIIs). These MIIs are created from optical flow data to capture the direction and intensity of motion across video frames. A CNN model is then trained on these images to classify crowd behavior as normal or abnormal. The approach shows promising results on benchmark datasets like UMN and PETS2009, demonstrating its effectiveness in complex crowd scenarios.

2.5 Suspicious Behavior Recognition Based on Face Features - Mossaad Ben Ayed, Sabeur Elkosantini, Shaya Alshaya, Mohamed Abid

In a unique take on surveillance, this study explores the detection of suspicious behavior by analyzing emotional cues—particularly fear—through facial expressions and heart rate estimation. Using a combination of image processing techniques, including bandpass filtering and Eulerian/Lagrangian transformations, the system estimates heart rate from video footage. Implemented on a Raspberry Pi 3 for real-time performance, the method achieved accurate results on the CK dataset. This approach offers a lightweight and innovative solution for emotion-based behavior recognition in intelligent surveillance systems.

III. METHODOLOGY

The Suspicious Activity Detection System is designed to recognize a broad spectrum of potentially dangerous or abnormal activities—ranging from suspicious human actions and unattended objects to natural disasters and crowd-related violence—by applying deep learning techniques to video surveillance data. The development of this system follows a structured methodology comprising several key stages:

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 10, May 2025
Impact Factor: 7.67

Data Collection: To train the system effectively, a diverse dataset was compiled that reflects both normal and suspicious scenarios. This dataset includes:

• CCTV footage from various environments

• Publicly available surveillance video datasets

• Real-world clips from YouTube showing incidents such as theft, vandalism, fire outbreaks, abandoned bags, earthquakes, and aggressive crowd behavior

• This mix of controlled and naturalistic video sources ensures the model is exposed to a wide variety of environments and activity types.

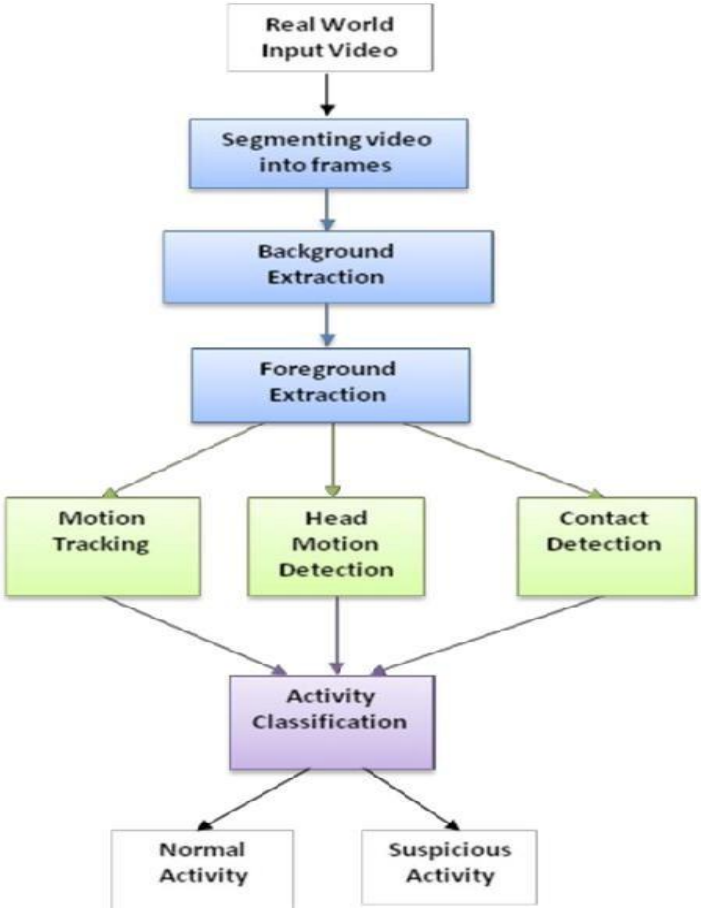

Fig.1. Activity Detection

Data Preprocessing: Collected videos were first broken down into individual frames. These frames underwent several preprocessing steps:

• Resizing and normalization to maintain consistency across all inputs

• Data augmentation techniques such as rotation, zooming, and flipping were applied to increase dataset variability and improve model generalization.

• Labeling was carried out to categorize each frame or video segment into specific activity classes, including suspicious human behavior, bomb threats, natural calamities, or crowd violence.

Feature Extraction using Deep Learning: Two types of deep learning models were employed to extract meaningful features from the video sequences:

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 10, May 2025
Impact Factor: 7.67

• Time Distributed CNN (TD-CNN): This model extracts spatial features from individual frames while maintaining temporal order across sequences
• Conv3D Networks: These models analyze both spatial and temporal dimensions simultaneously, making them ideal for capturing motion and activity patterns across frames
• Together, these models help the system learn complex patterns that are indicative of various suspicious activities.
• Suspicious Activity Classification: Once trained, the models are capable of analyzing both real-time video feeds and pre-recorded footage to classify events into different suspicious activity categories. A high-confidence threshold is applied to ensure that only activities with strong predictive certainty trigger alerts, helping reduce false positives.
Alert Mechanism and Reporting: When a suspicious activity is detected, the system responds with the following actions:
• On-screen alerts to notify operators monitoring the system
• Email notifications are sent instantly to designated authorities using the SMTP protocol, allowing for prompt intervention.
• This multi-level alert mechanism ensures that potentially harmful incidents can be quickly recognized and addressed, enhancing the overall effectiveness of security operations.

IV. CONCLUSION

The development of the Suspicious Activity Detection System represents a meaningful step forward in the realm of intelligent surveillance and public safety. By harnessing the capabilities of deep learning—particularly through Time-Distributed CNN and Conv3D architectures—the system can effectively recognize a broad spectrum of suspicious activities. These range from abnormal human behavior to environmental anomalies such as abandoned items, bomb threats, natural disasters like earthquakes, and incidents involving aggressive crowd behavior. Thorough testing on both benchmark datasets and real-world video footage has demonstrated the system's strong performance, showcasing high accuracy and reliable generalization across varied scenarios. Its practical value is further enhanced by a built-in alert system, which automatically sends email notifications to designated authorities upon detecting a potential threat. This makes it highly suitable for real-time deployment in sensitive and high-risk areas such as airports, train stations, government facilities, and public events. The results highlight how deep learning-based surveillance can significantly improve situational awareness and enable quicker response times to emerging threats. Looking ahead, this work sets the stage for further advancements such as integrating multi-camera views, predicting anomalies before they occur, and deploying cloud-based analytics for scalable real-time monitoring. These future directions will play a vital role in shaping smarter, more efficient, and more responsive surveillance systems.

V. ACKNOWLEDGEMENT

We would like to sincerely thank everyone who supported and encouraged us during the journey of developing our project, "Suspicious Activity Detection System." We are especially grateful to our Principal, Dr. Shivprasad P. Patil, for giving us the opportunity to work on this project and for creating a learning environment that fosters innovation and research.Our heartfelt thanks go to our Head of Department, Dr. Shailesh P. Bendale, whose constant encouragement, insightful suggestions, and support kept us motivated throughout the course of this work.We would also like to express our deep appreciation to our guide, Prof. Pratiksha D. Kale, for her invaluable mentorship. Her guidance, patience, and constructive feedback played a crucial role in shaping our ideas and helping us navigate challenges during the development of this system.

REFERENCES

[1] M. Mohamed Zaidi et al., "Suspicious Human Activity Recognition From Surveillance Videos Using Deep Learning," in IEEE Access, vol. 12, pp. 105497-105510, 2024, doi: 10.1109/ACCESS.2024.3436653.
[2] H. -Y. Lin and C. -H. Tseng, "Abnormal Activity Detection and Classification of Bus Passengers With In-Vehicle Image Sensing," in IEEE Access, vol. 12, pp. 23057-23065, 2024, doi: 10.1109/ACCESS.2024.3365138.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 10, May 2025
Impact Factor: 7.67

[3] N. C. Tay, T. Connie, T. S. Ong, A. B. J. Teoh, and P. S. Teh, "A Review of Abnormal Behavior Detection in Activities of Daily Living," in IEEE Access, vol. 11, pp. 5069-5088, 2023, doi: 10.1109/ACCESS.2023.3234974.
[4] C. Direkoglu, "Abnormal Crowd Behavior Detection Using Motion Information Images and Convolutional Neural Networks," in IEEE Access, vol. 8, pp. 80408-80416, 2020, doi: 10.1109/ACCESS.2020.2990355.
[5] M. Ben Ayed, S. Elkosantini, S. A. Alshaya and M. Abid, "Suspicious Behavior Recognition Based on Face Features," in IEEE Access, vol. 7, pp. 149952-149958, 2019, doi: 10.1109/ACCESS.2019.2947338