International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 10 | Oct - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Theft Detection in CCTV – A Review

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Abstract- Closed-Circuit Television (CCTV) surveillance is common in public places in many countries. The availability of CCTV footage has resulted in significant changes in policing and legal systems. While locating a person of interest is important for public safety, it is also a task of high visual complexity that necessitates sustained attention, good identity detection and recognition skills, and other cognitive resources. Also, because there is limited time and resources to take corrective action, the scale of wrongdoing is growing exponentially. It has become critical to reduce the amount of time required to identify the offender. The primary goal of our project is to expedite the process of identifying an offender from CCTV footage or other sources. The purpose of the project is to alleviate menial tasks, improve the efficiency of the identification process, and streamline the process. Metadata is used to boost the performance of identification systems. Since According to several police officers, when a crime occurs, whether it is a theft or a murder, investigators obtain CCTV footage from nearby cameras and analyse the chronology of the incident in order to identify and trace the accused persons. As a group, our aim is to create an algorithm based project employing a variety of other components to accomplish our objective to reduce the tedious work of manually watching and spending the countless hours identifying a person from the acquired footage. We'll make sure that we complete this project by the set date and break it down into more simpler modules to make it more viable as it will be a learning curve for us as we'll be exposed to unhackneyed concepts for us and expand our learning horizon.

Keywords -: - Security, CCTV, Theft, Robbery

1. INTRODUCTION

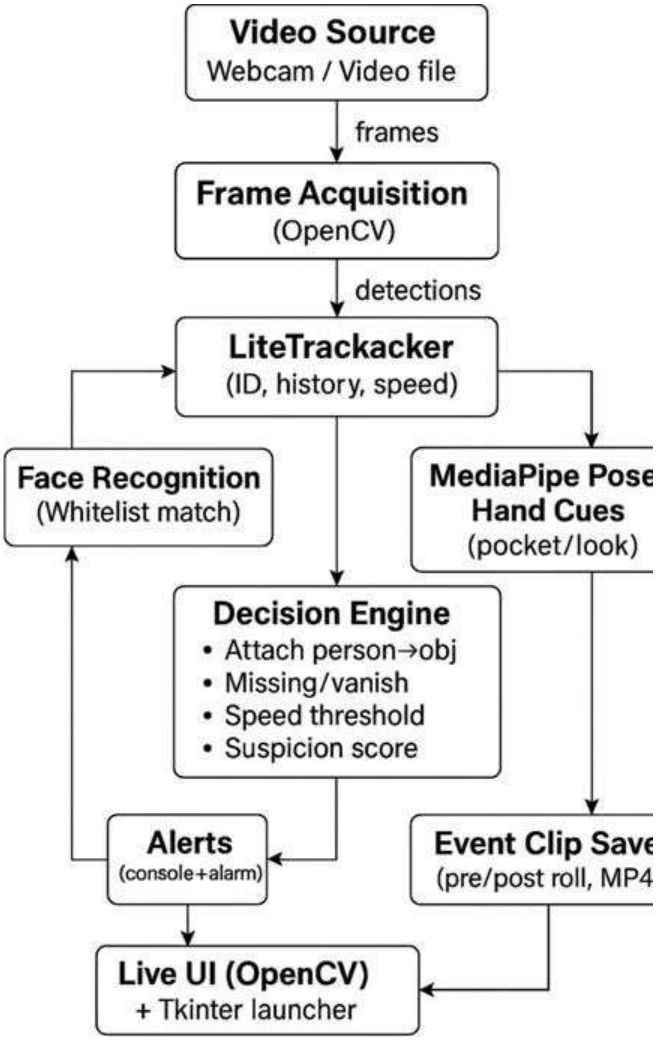
The project seeks to revolutionize the process of person identification within CCTV footage by harnessing the power of Artificial Intelligence, image processing, and machine learning. With a focus on streamlining manual tasks, reducing time constraints, and enhancing efficiency, this endeavor aims to expedite the identification of individuals, especially in law enforcement scenarios, ultimately contributing to improved public safety and investigative processes.

2. ABOUT PROJECT

In our project we have develop a Real-Time theft detecting system that uses basic Computer Vision and Deep Learning. The goal is to detect when a person performs the suspicious act. We have use a YOLO (You Only Look Once) model to detect and track both the person and the item of interest in real-time. By integrating an Action Recognition model to analyse the sequence of frames, the system would classify the tracked person's action as 'concealment,' and when confirmed, it would save the incident clip and then send to security dashboard. Although challenges such as occlusion, lighting conditions, and detect suspicious activity continuous improvements in deep learning models and hardware acceleration promise more accurate and reliable results. In the future, combining theft detection with predictive analytics, cloud integration, and multi-camera coordination can further strengthen automated surveillance systems.

Overall, this project demonstrates that intelligent theft detection systems are a crucial step toward safer, smarter, and more secure environments.

3. SYSTEM BLOCK DIAGRAM



4. LITERATURE SURVEY

A literature survey was carried out to find various papers published in international journals such as IEEE, Springer, MDPI etc. related to tracing missing people using facial recognition to get the best algorithm for the same.

Surbhi Singla and Raman Chadha [1], they proposed an intelligent system which will detect the crimes from the real time CCTV Feed and classify them and provides an alert system to the nearest police stations and ambulances etc. So, that system will help in reducing the crime rate in any country. This paper reviews all prior research in this area, including approaches for object recognition and finding priority frames, techniques and algorithms like Yolo used to detect crimes , various datasets used and algorithms used to analyse crime data and train the dataset .It covers the various recent trends in researches in this field and analysing the challenges faced and various research gaps and this paper also discuss how we can overcome these gaps in research so as to develop a better intelligence surveillance system in ML field.

Suryanti Awang Mohd Qhairel Rafiqi Rokei and Junaida Sulaiman [2], the paper introduces a security system known as Suspicious Activity Trigger System (SATS) that able to automatically trigger an alarm or an alert message whenever suspicious activity is detected from the CCTV video image. The algorithm will detect an object which is a person in the video and classify it as a suspicious activity or not. If the activity is classified as the suspicious activity, the system will automatically display a trigger message to alert SATS user. The user can therefore take whatever appropriate measure to prevent being a victim. Therefore, YOLOv6 can be implemented in the security system to prevent crimes in residency areas.

T sings and S. K. Das [3], In this paper, highlight that older surveillance methods (like background subtraction) were unreliable, producing too many false alarms due to things like shadows or light changes. The previous generation of accurate Deep Learning model was too slow for real-time monitoring, and there was no practical, integrated system for smart cities. Their literature review justifies a new approach that uses the YOLO algorithm for fast, accurate object detection and combines it with a custom algorithm and SORT tracking on a compact hardware platform to achieve a rapid, reliable, and contextual decision about whether an object has actually intruded into a defined restricted zone.

Saldanha, Naik, Parashtekar [4], In this paper, authors establish that traditional CCTV surveillance, which relies on manual human monitoring, is highly inefficient and often fails to prevent crimes as it's mainly for post- event analysis. They note that while machine learning offers an alternative, earlier models were too slow or inaccurate. Their review justifies adopting the YOLO (You Only Look Once) algorithm because it provides the speed necessary for realtime object detection of suspicious activities, thereby allowing the proposed system to reduce reliance on human vigilance and enhance overall security through automated, instant alerts, even distinguishing

between Daytime monitoring for weapons and Nighttime detection for anonymous intruders.

Murat Koca [5], Real-Time Hand Gesture Detection and Classification Using Convolutional Neural Networks. In their work, Murat Koca. introduced a movement detector and a classifier using CNNs to identify observed motions. The researchers suggested the Levenshtein distance for evaluation, which comprehensively analyses both misclassifications and the presence/absence of detections. This offline technique for RGB images achieved an accuracy of 0.973 and a precision of 0.803. Although effective, this method was outperformed in accuracy and precision by the proposed algorithm.

N. Omkar Sainath and Malla Reddy [6], YOLO- V7 to Overcome Theft Activities:, the authors developed a YOLOv7-based framework designed to detect suspicious theft-related activities in real- time surveillance footage. The system leverages YOLOv7's object detection capabilities to monitor and identify unusual human behaviors that may indicate theft. While the framework demonstrates potential in addressing security concerns, the paper notes that performance metrics such as accuracy and FPS, along with large-scale real- world testing, are not yet fully detailed, leaving room for further research and validation.

Yang Zhou, Xianghua Xu, and Ran Wang [7], EI-YOLO: Efficiently Improved YOLO on Detection of Prohibited Items During Security Inspections. the authors introduced an improved YOLO-based model known as EI-YOLO, which aims to provide faster and more accurate detection of prohibited items during security inspections. The model enhances detection efficiency in real-time scenarios where quick response is essential for safety. Although the method shows promising results, it still requires adaptation for theft detection in CCTV surveillance and further validation in real-world environments to ensure practical usability.

Chandrasekaran [8], The existing research on automated security primarily focuses on deep learning models like YOLO for real-time object and activity detection, with studies covering robbery prediction, general theft activity, and criminal behavior analysis. For instance, developed a real-time robbery prediction system using YOLO V7, demonstrating improved accuracy in high-risk areas. Similarly, Ganagavalli and Santhi (2024) proposed a YOLO-based system focused on analysing human behavioral patterns to mitigate crimes. Other works have integrated models to detect complex anomalies, like those by Malekar (2021) and Sakiba et al. (2023), who combined convolutional LSTMs and YOLOv7 to leverage both spatial and temporal data for identifying sequential criminal patterns. Despite these advancements, a significant gap remains, as current automated systems still face issues with high false positives, lack of adaptability to varied environmental conditions (like poor lighting or occlusions), and inadequate verification mechanisms, which hinders their real-world reliability.

Jeong-Hun Kim, Young-ho Park [9] The study presents an automatic shoplifting detection model using surveillance videos. By applying ROI-based optical-flow analysis instead of whole-frame features, the method effectively captures subtle, short-term behaviors like hiding items in bags or pockets. The proposed approach reduces unnecessary background noise, improves accuracy, and addresses workforce shortages in CCTV monitoring. Future work involves validating the system through extensive experiments and expanding its scalability to other abnormal behavior detection tasks**.**

Mohammed Sherooq Ali, Sreeju A, Shifa Reem, Jasna, Neethu Mathew [10] This research presents an AI-based automatic theft detection system for smart homes using CCTV footage. The system employs face recognition techniques, including HOG features and Haar cascade, to detect and identify individuals in real-time. It compares captured faces with a criminal database and notifies the owner and police if a threat is detected, enhancing security with minimal human intervention.

5. CONCLUSION

The reviewed papers collectively emphasize the growing reliance on deep learning, particularly YOLO variants (YOLOv2–YOLOv7 and EI-YOLO), for real-time crime and anomaly detection in CCTV surveillance. While CNNs,

LSTMs, and hybrid models have enhanced accuracy, speed, and contextual decision- making, challenges such as false positives, adaptability to varied environments, and large-scale real-world validation remain. Overall, these studies highlight the potential of intelligent surveillance systems to move beyond manual monitoring towards proactive, automated, and reliable crime prevention solutions.

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