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SMART THEFT MONITORING USING MACHINE LEARNING

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Abstract - The rising incidents of theft in retail and public spaces demand robust monitoring solutions that leverage advanced technology. This project explores a machine learning-based system for Theft Monitoring using Behavioral Analysis and Suspicious Activity detection. By integrating Real-Time Processing capabilities, the system can analyze live video feeds to identify potentially suspicious behaviors through Pose Estimation and You Only Look Ones (YOLO) for feature extraction and classification. Additionally, Twilio (SMS Gateway) enables instant alerts to security personnel, ensuring prompt incident response. The proposed solution aims to enhance security through automated, intelligent surveillance that minimizes human error and response delays.

Index Terms – Theft Monitoring, Behavioral Analysis, Surveillance camera, Suspicious camera, yolov5, Twilio.

Introduction

Theft in retail environments is a regular issue that leads to huge financial losses daily traditional ways of thief prevention such as security guards and static camera monitoring has limitations in terms of efficiency scalability and real-time intervention to represent these challenges smart theft monitoring systems utilizing machine learning are becoming rapidly popular these systems can automatically detect abnormal activities by analyzing video footage audio signals and transactional data which allows for real-time identification and alerting of store staff. A theft detecting process is a security solution managed to monitor and respond to unauthorized activities protecting assets and ensuring safety using advanced technologies including high visual cameras motion detectors and ai it enables real-time detecting and alerts for abnormal activities main feature includes face detection remote access and automated responses like alarms or

alerting to authorities. widely approached in homes and shops and banks these system makes security reduce theft-related losses and provide safety by integrating effective tools this system offers a reliable scalable and less cost-effective way to safeguarding property and valuables.

Theft is a significant issue in various sectors, leading to financial losses and security concerns. Traditional surveillance methods often rely on human oversight, which can be prone to errors and inefficiencies. A theft detection system aims to identify suspicious activities and theft events in real time using advanced technologies. The system must minimize false positives to ensure reliable and actionable alerts. It should be scalable to accommodate environments ranging from small retail stores to large warehouses. Integration with existing security infrastructure, such as cameras and alarms, is essential for effective deployment. The solution should prioritize user-friendly interfaces for monitoring and incident review. Data privacy and ethical compliance are crucial to avoid infringing on individual rights. The system should be cost-effective to allow widespread adoption. Ultimately, it strives to provide an automated, efficient, and robust theft prevention mechanism.

The objective of the smart theft monitoring system project using ml is to develop an automatic intelligent answer that identifies and prevents theft in retail environments the project makes a leverage machine learning algorithms to analyses in the data from video audio sensor and transactional sources in real time enabling the detection of suspicious behaviors and this will lead to huge losses Specific objectives include:
1. Real-Time Detection: Identifies theft activities in real-time by analyzing various video feeds, including video surveillance, audio cues, and transaction logs.
2. Behavioral Analysis: Recognize patterns in customer movement and actions, differentiating normal behaviors from potentially suspicious ones through anomaly detection.

Theft causes significant financial losses especially in retail and commercial settings traditional surveillance methods are inconsistent and leads to human error creating a need for automated solutions a theft monitoring system enhances security by providing real-time detection and alerts enabling swift action it promotes customer and employee safety by determining criminal activities businesses can leverage such systems to protect their assets and maintain a strong reputation advancement in artificial intelligence and information technology enable smarter more reliable monitoring tools these systems reduce operational costs by minimizing losses and the need for constant manual oversight they also provide data insights to predict and prevent future incidents ethical and compliant monitoring fosters accountability and trust ultimately a theft monitoring system creates a safer more secure environment for everyone involved.

LITERATURE SURVEY

In a paper by Sourav Bhattacharya and Ritvik Chakraborty (February 2022), titled "Shop Smart Lock System Using ML" the authors propose a solution aimed at enhancing security in various settings such as jewelry shops, banks, apartment complexes, offices, and vehicles. The system integrates smart locks with the surveillance to address challenges like theft and robbery.

Abhay Kumar Ray and Ashish Bagwari (June 2021) discuss the importance of communication security in IoT-based smart stores. Their paper emphasizes the need to safe guard sensitive data during device communication and storage to ensure privacy.

PROPOSED SYSTEM

Smart Theft monitoring using machine learning aims to detect the thief's by using below proposed system features:

1. Data Collection and Preprocessing

- Sources: Collect data from CCTV, motion sensors, RFID tags, and possibly other Internet of Things (IoT) devices in-store.
- Preprocessing: Perform preprocessing to filter noise and reduce false positives by focusing on areas with high theft risk (e.g., high-value aisles, exit points).

2. Machine Learning Algorithms for Detection

- Object Detection and Tracking: Use advanced models like YOLO or Faster R-CNN to recognize people, objects, and interactions in the store.
- Behaviour Analysis: Classify typical shopper behaviours (browsing, purchasing) against suspicious activities (lingering, item concealment) using CNNs or recurrent neural networks (RNNs) for action recognition.

3. SMS Gateway Integration:

- Trigger Alerts: Set up conditions that define

suspicious activities, such as prolonged presence in high-value aisles or items removed from shelves without checkout.

- Automated SMS Alerts: When these conditions are met, the system triggers an SMS message via an SMS gateway (e.g., Twilio, Nexmo) to the security team or management.
  Integrating an SMS gateway provides instant and remote notification capabilities, which improves the system's responsiveness and allows for a more flexible and effective theft prevention strategy.

SYSTEM ARCHITECTURE

This system design consists of various layer as:

1. Data Collection Module

Purpose: To gather raw data from various sources.

2. Data Preprocessing Module

Purpose: To clean, preprocess, and transform the data into a format suitable for ML models.

3. Machine Learning Model Training Module

Purpose: To train models that can detect theft or suspicious activity based on historical data.

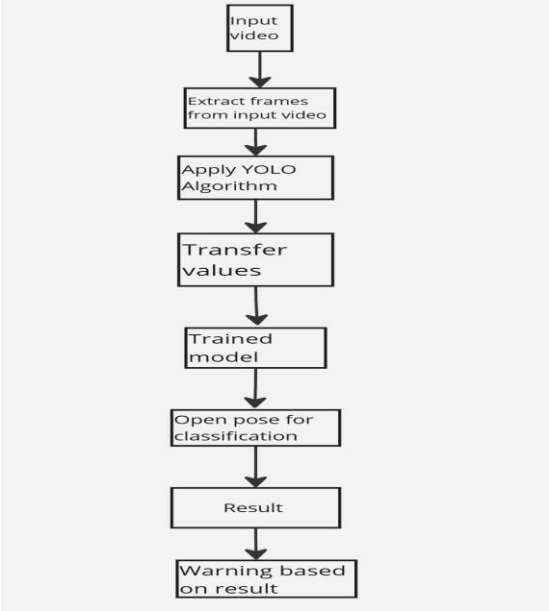
4. Real-Time Detection Module

Purpose: To detect theft or suspicious activity in real-time using the trained ML models.

5. Alerting and Notification Module

Purpose: To notify relevant stakeholders (security personnel, store managers, etc.) when suspicious activities are detected.

Fig 1: System architecture



USECASE DIAGRAM:

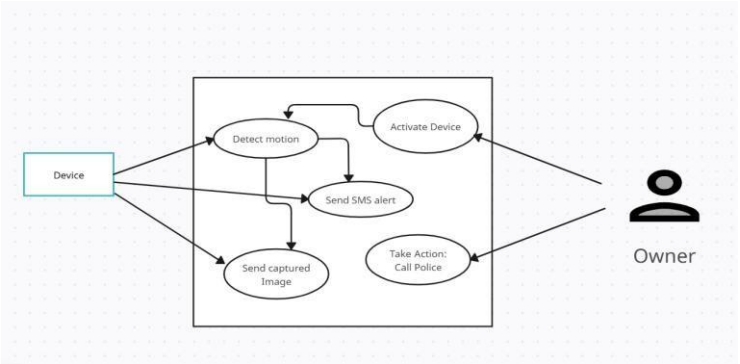


Fig 2: Use case diagram

IMPLEMENTATION

Implementing a smart thief monitoring using machine learning involves integrating video detection with automated alerting.

Objective:

The goal is to develop a system that monitors a specific area or assets, detects suspicious activities (e.g., unauthorized human presence or object removal), and sends immediate alert via SMS to the concerned authority.

Components:

Yolov5: Yolov5 is a fast and accurate deep learning model for object detection. It detects objects in video feeds or images and draws bounding boxes around them.

SMS Gateway Integration: The purpose is upon detecting suspicious activity, The system sends an SMS alert to the secured personnel or owner.

System workflow:

- **Video feed:** Capture live or file video from a camera using OpenCV.
- **Object detection:** use yolov5 to detect objects in each frame
- **Condition monitoring:** Evaluate the detection results for thief conditions
- **Alert Trigger:** if a condition is meet, compose an alert message.
- **SMS sending:** send the SMS using gateway API.

Deployment:

Deploy the system on the local device like a computer or an edge device for real time monitoring.

The implementation of a smart theft monitoring system using YOLOv5 and machine learning provides an efficient and automated solution for real-time security. The system is designed to monitor specific areas or assets, detect

suspicious activities such as unauthorized access or object removal, and send immediate SMS alerts to designated personnel. YOLOv5, a powerful deep learning model, processes video streams to detect and identify objects, drawing bounding boxes and labels around them. Video feeds are captured using OpenCV, enabling compatibility with various camera systems. The detection results are then evaluated against predefined conditions, such as the presence of unauthorized individuals or the removal of critical items. When such conditions are met, the system generates an alert message and sends it via an SMS gateway API, ensuring swift notification to concerned authorities. Deployment options include local computers, edge devices like NVIDIA Jetson Nano, or cloud platforms, providing flexibility for real-time operations across different environments. This system eliminates the need for continuous human monitoring, enhances security response times, and serves as a reliable tool for theft prevention.

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Trained model dataset:

Fig 4: Trained dataset

RESULT:

From the above implementation of Theft monitoring using YOLOv5 and Twilio combines advanced object detection with real-time alerts. YOLOv5, trained on a custom dataset, identifies suspicious activities or unauthorized movements in video feeds. Frames from live cameras are processed to detect theft-prone items or intrusions. When predefined conditions are met, the system triggers an alert via Twilio's SMS gateway. Twilio sends real-time notifications to predefined numbers, ensuring immediate action. The system is deployable on local machines or cloud platforms, supporting scalability and low latency. Proper dataset preparation and fine-tuning thresholds minimize false alerts, making it effective for surveillance in retail, warehouses, or high-security zones.

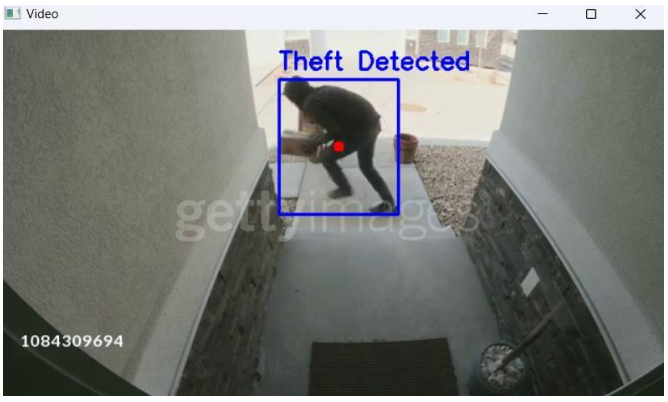

Fig 3: Detection of Theif

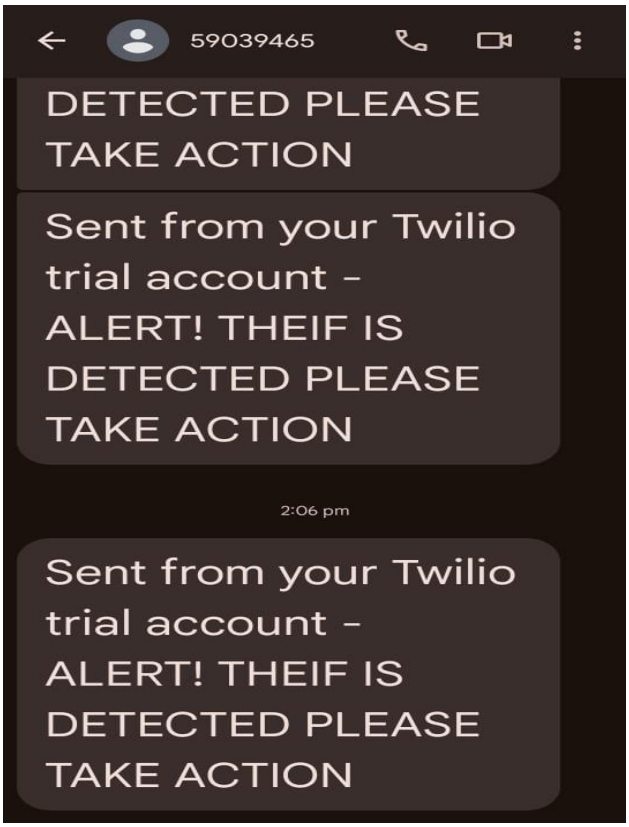

Fig 5: SMS Alerting

CONCLUSION:

The smart theft monitoring system using machine learning represents a significant advancement in security technology. By leveraging the power of machine learning algorithms, the system can efficiently detect unusual patterns, identify potential theft activities, and send real-time alerts to prevent losses.

Such systems offer several advantages, including higher accuracy in anomaly detection, adaptability to various environments, and reduced dependency on manual surveillance. The integration of advanced technologies such as computer vision, object tracking, and behaviour alarms and providing timely responses to threats.

In conclusion, the deployment of a machine-learning-based theft monitoring system contributes to safer environments for both individuals and businesses, paving the way for more reliable, proactive, and intelligent security solutions. Theft monitoring using the YOLO (You Only Look Once) algorithm offers efficient, real-time object detection for security applications. Its speed and accuracy make it ideal for identifying suspicious activities in environments like stores and warehouses. YOLO integrates seamlessly with surveillance systems, reducing human effort and enabling proactive theft prevention. Challenges such as occlusion, complex scenarios, and the need for high-quality training data can impact performance, but advancements in YOLO versions addresses these issues. By combining YOLO with behavioral analysis and, theft detection can be further improved, making it a powerful tool for modern security solutions.

FUTURE SCOPE:

The future scope of a smart theft monitoring system using machine learning is vast, with potential advancements in anomaly detection, predictive analytics, and integration with IoT devices for a more interconnected and efficient security network. Enhanced features such as real-time facial recognition, behavioural analysis, and multimodal data integration can significantly improve accuracy and responsiveness. Scalability to smart city applications and the adoption of privacy-preserving AI will ensure widespread acceptance and compliance with data protection laws. With the integration of cloud computing and edge processing, the system can deliver faster, more reliable results, while customizable solutions will cater to industry-specific needs. These advancements promise to revolutionize security, offering a proactive and intelligent approach to theft prevention.

The future scope of a smart theft monitoring system using machine learning is immense, driven by advancements in AI and interconnected technologies. Future systems can leverage deep learning for advanced anomaly detection and integrate predictive analytics to anticipate theft before it occurs. The inclusion of IoT devices, such as smart sensors and drones, can create a highly interconnected security network. Innovations like multimodal data fusion (e.g., combining audio, video, and motion data) and real-time behavioral analysis will enhance detection precision. Furthermore, edge computing will enable faster processing directly at the source, reducing latency, while cloud integration ensures scalability for larger applications, such as smart cities. Privacy-preserving AI and adherence to global data protection laws will facilitate broader adoption. Customizable solutions tailored to specific industries, such as retail, logistics, and public spaces, will expand its use cases, making theft monitoring more efficient and universally applicable.

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