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Detection of Criminal Activities through CCTV By Analyzing Live Footage For Mob Formation, Body Language of Suspect

Mr. Pratik More, Mr. Yash Rokade, Mr. Vishal Gore, Mr. Sahil Ramzan, Mr. Sunil Dattir

U.G. Student, Department of Computer Engineering, MVP's KBT College of Engineering, Nashik, India

U.G. Student, Department of Computer Engineering, MVP's KBT College of Engineering, Nashik, India

U.G. Student, Department of Computer Engineering, MVP's KBT College of Engineering, Nashik, India

U.G. Student, Department of Computer Engineering, MVP's KBT College of Engineering, Nashik, India

Assistant Professor, Department of Computer Engineering, MVP's KBT College of Engineering, Nashik, India

ABSTRACT: With the increasing need for enhanced security measures, the utilization of Closed Circuit Television (CCTV) systems has become important in safeguarding public and private spaces. The system employs advanced algorithms to analyze video streams from CCTV cameras, with a primary focus on identifying and alerting authorities to potentially criminal activities. Through the utilization of Machine Learning and Deep Learning technologies, including Convolutional Neural Networks (CNNs), this system provides automated surveillance and alert capabilities. Key components of this system include robust real-time video processing, monitoring and control interface, and an alerting mechanism that integrates seamlessly with email services. When an abnormal activity is detected, the system generates immediate alerts, sending notifications to designated security personnel, law enforcement agencies, and property owners via mail. This instant notification feature enables rapid response, reducing the likelihood of criminal incidents escalating and improving overall safety in the monitored area.

KEYWORDS: Machine Learning, Weapon detection, theft prevention, CNN, YOLO Algorithm

I. INTRODUCTION

In recent times, the surge in criminal activities, especially during nighttime, has raised significant concerns in India, with robberies being a major issue for law enforcement. Although CCTV cameras are widespread, their effectiveness in deterring and addressing crimes is limited. To address this, the concept of a "Criminal Activities Detection System" has emerged, utilizing machine learning algorithms to enhance CCTV capabilities [1]. This system continuously monitors live video footage for suspicious human activities, promptly alerting the host via mobile phone upon detection and providing a link to the live feed for real-time assessment. The machine learning algorithms are trained on diverse live video data to recognize patterns associated with criminal behavior, ensuring accurate identification and classification [5]. This proactive approach leverages technology to enhance security measures, offering early warnings and aiding in crime prevention and mitigation.

II. PROBLEM STATEMENT

In recent years, the proliferation of Closed-Circuit Television (CCTV) cameras has significantly enhanced public safety and security measures. However, it is difficult for law enforcement organizations to efficiently monitor and identify criminal activity in real-time due to the massive volume of surveillance material recorded. To address this challenge, there is a growing need for intelligent systems capable of analyzing live CCTV footage to detect suspicious behaviors and criminal activities.

III. RELATED WORK

Paper 1: "Detecting Criminal Activities From CCTV by using Object Detection and machine learning algorithms"
Summary: 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, algorithms used to analyze the crime data and train the dataset. It covers the various recent trends in researches in this field and analyzing 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 machine learning field [1].

Paper 2: “Design for visitor authentication based on face recognition technology using CCTV”

Summary: The research paper proposes a system that can identify visitors by applying AI technology to CCTV and provide services according to the situation. The system was developed using a Jetson Nano and YOLO, which is an object detection deep learning model that can recognize visitors in realtime. The proposed system collects facial data from CCTV, identifies the visitor using deep learning and compares it with the stored user data. The accuracy and detection speed of the system was evaluated and analysed and found to be 86.3% accurate with an average detection speed of 6.5 FPS. The future scope includes considering other biometric data for user authentication, integrating the system with smartphones for remote access, and improving the system’s accuracy. The drawback is that the system may have limitations in recognizing faces in low-light conditions or obstructed views [2].

Paper 3: “Detection of GUN Violence in Surveillance Video using Open CV”

Summary: The research paper delves into the detection of gun violence in surveillance videos, employing a combination of OpenCV, Cascade Classifier, and Deep Learning Networks. The authors conducted an extensive analysis of positive and negative samples to train the model, assembling a dataset comprising gun images sourced from Google Images. Utilizing object discovery models based on deep learning approaches, they implemented a smart surveillance security system capable of detecting handguns through a fusion of vision styles and deep learning techniques. A cascade classifier model was trained for real-time object detection. Despite achieving promising results, further work is essential to optimize the classification algorithm’s performance in terms of both accuracy and speed. The authors recommend exploring available classifiers and enhancing their efficiency [3]. However, the paper acknowledges drawbacks, including the high computational cost associated with processing large datasets, sensitivity to noisy and incomplete data, and the necessity for optimization to achieve real-time processing speeds, indicating areas for future research and development.

Paper 4: “Group Tracking for Video Monitoring Systems: A Spatio-Temporal Query Processing Approach”

Summary: The research paper presents an innovative spatio-temporal query processing approach for tracking human groups in video monitoring systems. It efficiently tracks groups in real-world datasets and proposes using query results to improve learning-based methods’ speed and accuracy. Future work may explore addressing perspective projection and temporal consistencies. Challenges include the need for manual ground truth labeling, extended training times relative to video duration, and limitations in applying learning-based techniques for rapid group discovery in video monitoring systems [4].

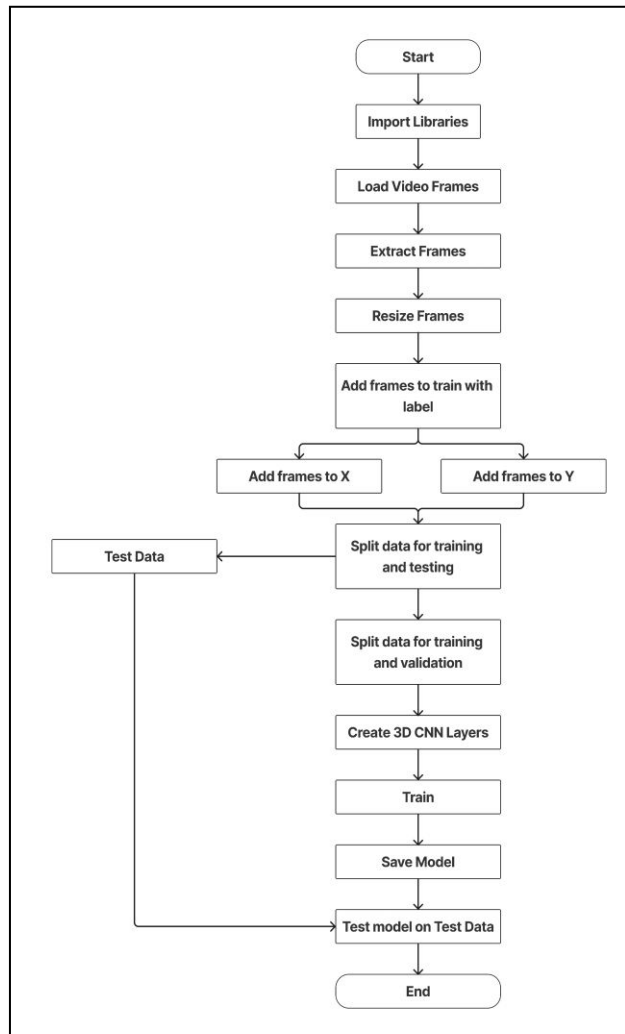
Paper 5: “Human Action Recognition using Machine Learning in Uncontrolled Environment”

Summary: The research paper “Human Action Recognition using Machine Learning in Uncontrolled Environment” introduces an efficient model for human action recognition (HAR) in uncontrolled settings through machine learning. It involves removing redundant frames, extracting segments of interest (SoIs), and mining feature descriptors like Geodesic Distance (GD), 3D Cartesian-plane Features (3D-CF), Joints MOCAP (JMOCAP), and n-way Point Trajectory Generation (nPTG). A neuro-fuzzy classifier handles the classification task, achieving 82.55% and 91.99% accuracy on HMDB-51 and Hollywood2 datasets, respectively [4]. The study emphasizes the challenges of HAR in uncontrolled environments and how the proposed model addresses them. Future research aims to enhance accuracy by considering contextual information while minimizing computational time. Limitations include the model’s potential struggle with complex activities and scenes, along with performance reliance on input

IV. SYSTEM ANALYSIS & DESIGN

Propose System: The proposed project aims to enhance the detection of criminal activities through live CCTV footage analysis, focusing on mob formation and suspect body language. Upgrades to the existing CCTV infrastructure will include replacing outdated cameras with high-resolution models, strategic positioning, and regular maintenance for optimal performance. Cutting-edge video analytics algorithms, incorporating machine learning and AI, will improve accuracy in identifying suspicious behavior. Efforts will prioritize optimizing realtime processing, leveraging powerful hardware, cloud solutions, and data compression techniques to reduce latency. Privacy concerns will be addressed through the integration of privacy-preserving technologies like anonymization and data encryption.

Flowchart:



RNN vs CNN:

Convolutional Neural Networks (CNNs) excel in image and video processing tasks, focusing on spatial features like edges, shapes, and patterns for tasks such as classification, detection, and segmentation. They handle large input data efficiently but have limitations in input sizes and capturing temporal effects. Recurrent Neural Networks (RNNs) are preferred for sequential data tasks like natural language processing and speech recognition, despite the vanishing gradient problem. In our scenario, we opted for CNNs due to their suitability for fixed-size image classification tasks, efficient feature extraction, and integration into real-time pipelines. While RNNs excel in sequential data processing, CNNs outperform them in spatial feature extraction for image tasks, making them the ideal choice in our case.

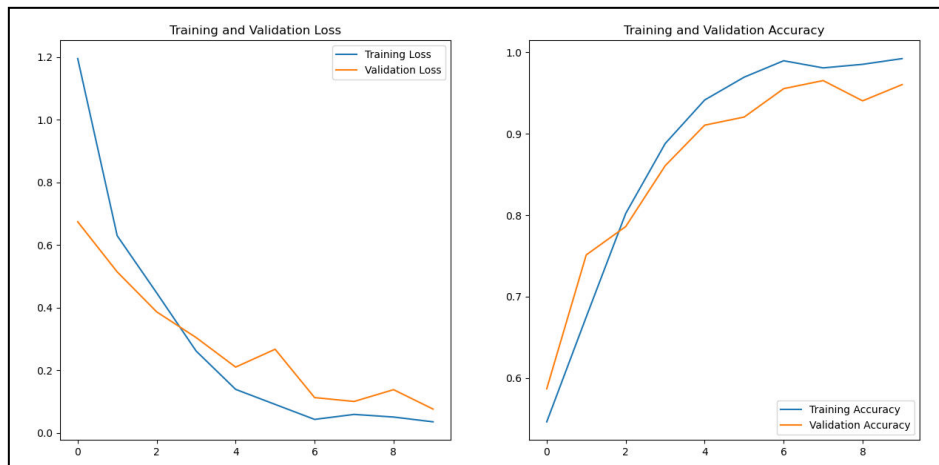
Algorithm:

- **Real-time Surveillance:**
 - **CCTV Monitoring:** A web camera captures a live video feed of individuals in a specific area.
 - **Image Processing:** Each frame of the video feed is processed using a CNN model that has been trained to recognize weapons, such as knives or guns. The CNN extracts features and patterns from the frames.
 - **Criminal Activity Detection:** The CNN identifies and classifies objects in each frame. If it detects a person with a knife or gun, fighting, it triggers an alert.

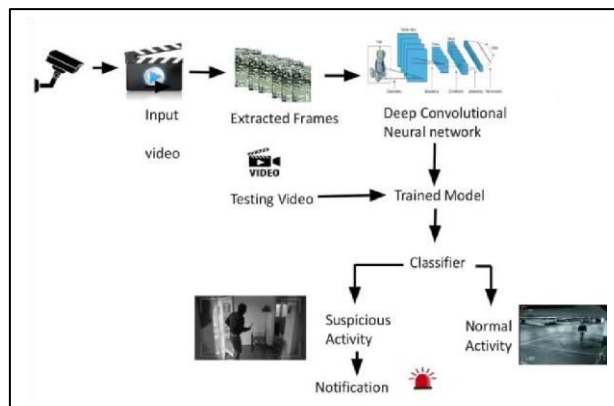


- **Real-time Alerting:** When criminal activity is detected, the system displays an immediate notification on the screen or sends alerts to security personnel, law enforcement, or the relevant authorities, enabling them to respond promptly to the potential threat.
- **Crowd Monitoring:**
 - **Video Footage Processing:** Users can start camera or upload video recordings of crowded environments or events, such as public gatherings, transportation hubs, or busy streets.
 - **Frame Splitting:** Each frame of the video is divided into a grid, and YOLO operates on this grid. YOLO's unique approach allows it to simultaneously identify objects in each grid cell.
 - **Object Detection:** YOLO identifies and classifies objects within the frames, which, in this context, includes detecting people and other objects in the crowded scene.
 - **Suspicious Activity Identification:** YOLO's object detection capabilities are extended to identify potential criminal activities. For example, it can detect altercations, fights, or the presence of weapons among the crowd.

Model Training:



System Architecture:



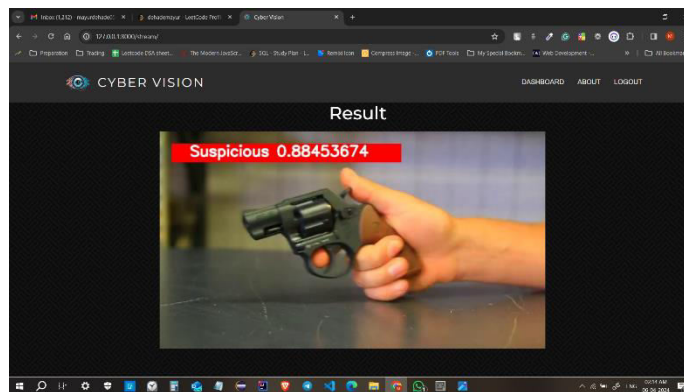


Library Used:

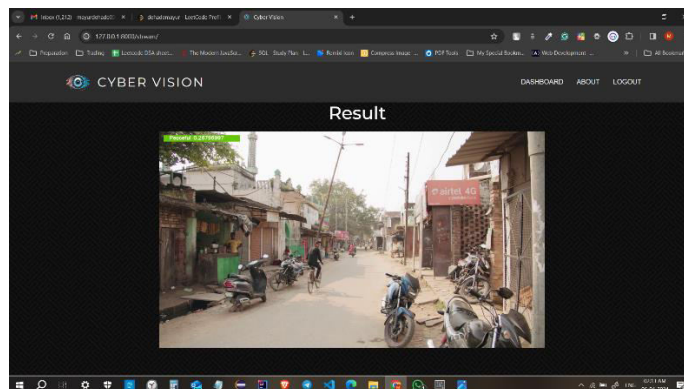
- OpenCV: OpenCV stands for "Open Source Computer Vision library" and is a popular library for image and video processing. It provides many functions for tasks like image filtering, feature detection, object recognition, and video tracking. OpenCV is widely used in computer vision, robotics, and other machine learning applications where image processing and analysis are required.
- TensorFlow: TensorFlow is an opensource library originally developed by Google that provides support for building and training machine learning models. It supports deep learning, neural networks, and other types of models, and provides abstractions for building and training models in Python. TensorFlow is widely used in research, industry, and academia for machine learning and data analysis applications.
- Pandas: Pandas is a library that provides data manipulation and analysis tools, particularly for tabular and time-series data. It offers data structures for efficiently storing and querying large datasets in Python and provides functions for data cleaning, merging, and aggregation. Pandas is widely used in finance and scientific research for data analysis and visualization.

V. EXPERIMENTAL RESULTS

Figures shows the results of criminal activity detection from a video and live camera.



(a) Criminal Activity



(b) Normal Activity

VI. CONCLUSION

The system Crime Identification System presented in this project embodies a robust and technologically advanced solution aimed at enhancing public safety and security. By combining real-time surveillance, deep learning techniques like CNN, and crowd monitoring through the YOLO algorithm, the system demonstrates a holistic approach to crime



prevention and detection. While the project sets out ambitious goals, including high accuracy, scalability, data privacy, and ethical considerations, it is vital to recognize the significance of potential risks, such as false alarms, data security, and legal compliance. To ensure the system's success, proactive risk management, adherence to privacy and ethical guidelines, and a strong focus on public trust and transparency are essential.

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