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Smart Eye Using Deep learning

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ABSTRACT: The most critical considerations right now are safety and security. The purpose of this presentation is to evaluate recent advances in computer vision and image processing to address security issues. Additionally, it discusses the initiatives taken by the development teams to combine some of these ground-breaking concepts into a single prototype system. Understanding scene information, object tracking, and categorization are all part of how computer vision expands the image processing paradigm. The development of computer vision technology frequently takes into account extremely specific applications, and the aim of a more thorough understanding of computer vision systems exists, at least initially, outside of existing technology. In this post, our major focus is on the smart CCTV features, such as the tracking feature, noise detection, face detection, rectangle motion detection, visitor recording, and visiting room detection. This can be accomplished by fusing Python computer vision algorithms with the camera.

KEYWORDS: Computer vision, Object Tracking's, Face Identification, Open CV, Tkinter, Noise, Motion.

I. INTRODUCTION

In today's world, ensuring security has become a crucial aspect, focusing not just on incident investigation but also on preventing potentially catastrophic incidents. While digital video surveillance systems have become more affordable and provide the infrastructure to capture, store, and share video footage, the task of threat detection still heavily relies on human intervention. Monitoring individuals through surveillance video is a complex and significant responsibility. However, with advancements in technology, surveillance systems can now operate 24/7 and allow for the retrieval of stored footage when necessary.

While these systems can aid in crime prevention and help authorities identify and solve crimes, they often fall short in terms of detecting and identifying individuals involved. We leverage the power of open-source computer vision software, such as OpenCV, which provides a robust library of image processing tools, enabling real-time image analysis. By integrating intelligent surveillance into our system, we have developed a solution that not only records events but also identifies and verifies individuals.

To address these limitations, our project focuses on implementing a0 comprehensive system that combines facial recognition with additional capabilities using Artificial Intelligence (AI) and Computer Vision. We leverage the power of open-source computer vision software, such as OpenCV, which provides a robust library of image processing tools, enabling real-time image analysis. By integrating intelligent surveillance into our system, we have developed a solution that not only records events but also identifies and verifies individuals.

II. LITERATURE SURVEY

Here we have selected few key literatures after exhaustive literature survey and listed as below:

Sandeep Singh et al [1], propose a cost-effective security camera using OpenCV for night vision, achieving 83% accuracy in face and person detection. The camera can be controlled by custom AI assistants, providing a low-cost system for individuals in the titled paper- "Smart Surveillance".

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B. Varma Teja Reddy et al [2], Proposal of Smart CCTV Surveillance system with intrusion detection, live streaming; face recognition authentication, IP technology, and smart image analysis in the titled paper-"smart cctv camera monitoring system using iot".

Hritika Pandit Patil et al [3], Modernism prioritizes welfare and security, with computer vision systems providing advanced features like monitor, face identification, noise detection, visitor detection, and video recording for smart surveillance. In the titled paper- "smart surveillance system".

M. Naveen et al [4], "Intelligent Surveillance System with CNN Algorithm & Machine learning". This paper focuses on detecting humans using complex machine learning processes to optimize data storage and reduce storage requirements. Unique features, such as upright body, neck, and distance ratio, are used for identification.

Prasanna Rajendra et al [5], describes a smart surveillance system using IP webcams and face recognition, improving security by using efficient algorithms like Local Binary Patterns Histogram (LPBH), facial landmark, and motion detection. The system achieves 85%-95% accuracy in face recognition.

Dr. Sanjay M. Malode et al [6], proposes a "Smart Security Camera using Machine Learning" project aims to create an economical security system using a device's built-in camera. The system can upload pictures and videos, send notifications via SMS, and support cloud services. It provides accurate data for monitoring and minimizes human power reliance.

Anna Irin Anil et al [7], describes vigil, a real-time distributed wireless surveillance system using embedded surveillance technology for image detection and traffic monitoring. It leverages edge computing for real-time tracking and surveillance in enterprise campuses, retail stores, and smart cities.

III. PROBLEM STATEMENT

The existing closed-circuit television (CCTV) systems employed for security and surveillance purposes suffer from significant limitations when it comes to accurately detecting and identifying objects and actions. These systems heavily rely on manual monitoring, which is both time-consuming and susceptible to human error, thus hindering real-time response to incidents. Consequently, there is a pressing need for an advanced Smart CCTV System that harnesses the power of deep learning techniques to enhance object identification, tracking, and activity recognition, ultimately bolstering security and surveillance capabilities.

The proposed Smart CCTV System aims to overcome the shortcomings of traditional CCTV systems by leveraging the potential of deep learning algorithms. By incorporating cutting-edge advancements in computer vision and machine learning, this system will revolutionize object detection, enabling precise and reliable identification of various objects and actions in real-time. Through the application of deep learning models, the system will continuously learn and adapt to new patterns and scenarios, thereby significantly reducing false alarms and improving the overall accuracy of surveillance operations.

IV. DESIGN AND IMPLEMENTATION

The current scope of traditional CCTV systems is limited to basic video recording without any advanced features. In order to enhance the capabilities of surveillance systems, we propose the development of a Smart CCTV System empowered by deep learning techniques. This system aims to revolutionize traditional CCTV functionalities by introducing advanced features such as object monitoring, face identification, in and out detection, noise detection, normal recording, and selected area noise detection.

In the following figure 1 shows the flowchart of different features which can be performed by using this project:

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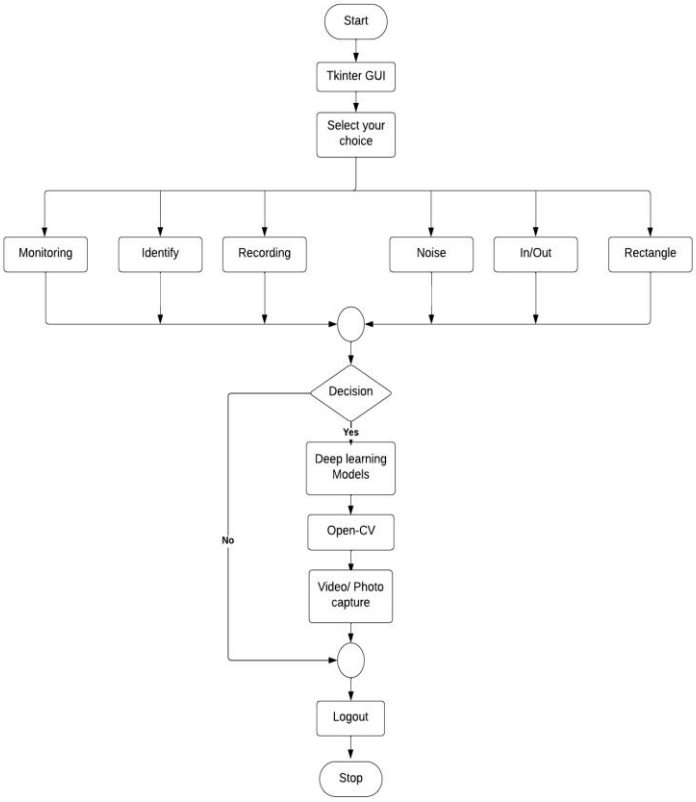
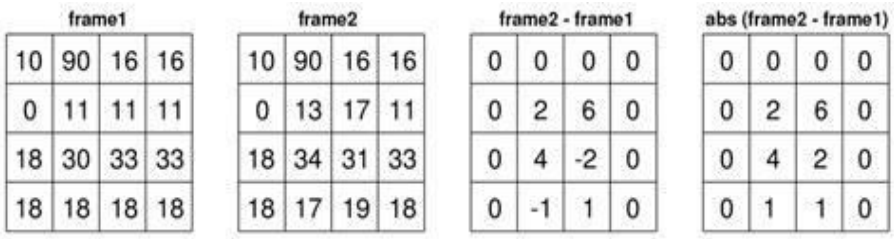


Fig 1: Flowchart of the system

1. **Monitoring**: It constantly monitors the frames and detects which object or thing from the frame has been taken away be the thief. This uses **Structural Similarity** to find the differences in the two frames. The two frames are captured first when noise was not happened and second when noise stopped happening in the frame.Structural Similarity Image Measurement (SSIM) is an image quality assessment algorithm with the advantages of simplicity, high efficiency and better consistence. Its evaluation of performance is better than PNSR (peak signal-to-noise ratio) and MSE (mean-square error).
2. **Noises**: The majority of cctvs have this feature, which is used to detect noise in the frames; nonetheless, in this lesson, we'll examine how it operates. Simply put, every frame is continuously analysed and noise-checked. The following frames check for noise. Simply put, we calculate the absolute difference between two frames. In this way, the difference between two images is analysed, and contours (the motion's limits) are determined.



frame1

10	90	16	16
0	11	11	11
18	30	33	33
18	18	18	18

frame2

10	90	16	16
0	13	17	11
18	34	31	33
18	17	19	18

frame2 - frame1

0	0	0	0
0	2	6	0
0	4	-2	0
0	-1	1	0

abs (frame2 - frame1)

0	0	0	0
0	2	6	0
0	4	2	0
0	1	1	0

Fig 2: Noises Sample

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As you would know all images are just integers/ float values of pixels which tell the brightness of pixel and similarly every pixel has those values of brightness. So we just do simply absolute difference because negative will make no sense at all.

3. **Visitors in room detection:** This is the feature which can detect if someone has entered in the room or gone out. So it works using following steps:
   - It first detect for noises in the frame.
   - Then if any motion is detected it finds out from which side that happens either left or right.
   - And in the last if the motion is detected from left and ended to right then it will detect it as entered and capture the frame Or vise-versa.

   So there is not complex mathematics going on around in this specific feature. So basically to know from which side does the motion happened we first detect for motion and later on we draw rectangle over noise and last step is we check the co-ordinates if those points lie on left side then it is classified as left motion.

4. **Drawing rectangle and detecting motion:** The model analyzes the visual information within that area and determines if there is any motion present. If the model detects motion within the rectangle, it can perform a specific action, such as sending a notification to the user or activating additional security measures. This helps to identify and respond to potential threats or unusual activities within the monitored area.

5. **Recording:** In this normal recording will be done with noticing each and every aspect of the room. This function offers same functionality as the traditional CCTV offers. We used this so that owner will get the basic functions also with extra one. These modules will be created using OpenCV under the domain of Computer Vision.

6. **Face identification:** Develop a face identification system using the LBPH algorithm to accurately recognize individuals based on facial features. The system should be capable of capturing facial images, extracting local binary patterns from the images, and creating a histogram representation of these patterns. It should then utilize machine learning techniques to train a classifier that can distinguish between different individuals. The objective is to create a robust and efficient face identification system that can be applied in various applications, such as access control, surveillance, and personalized services.

V. RESULTS AND DISCUSSION

To improve video surveillance and analysis, the Smart CCTV system employs deep learning algorithms. These algorithms enable real-time object detection, recognition, and behaviour analysis, providing valuable information for security and monitoring purposes. The system also detects abnormal activities and suspicious behaviour, allowing for immediate alerts and notifications. The incorporation of deep learning algorithms has significantly improved the intelligence and adaptability of the CCTV system. The system's potential to improve overall security measures is highlighted, as it automates monitoring processes, provides real-time insights, and aids in the identification of patterns, trends, and potential threats. Overall, the Smart CCTV system shows promising potential for revolutionising video surveillance and strengthening security measures.

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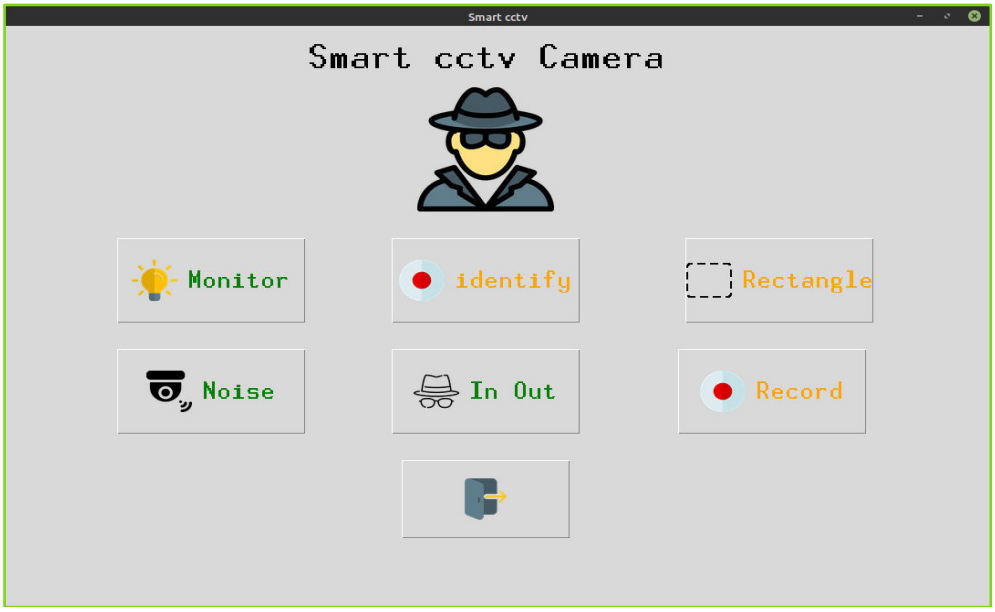

Fig 1: Tkinter GUI of Smart CCTV

In the above figure 3 show the results of Tkinter GUI which supports multiple buttons with labelling of multiple features likes monitoring, identification, rectangle, noise, in/out, recording and logout options.

VI. CONCLUSION AND FUTURE WORKS

The Smart CCTV system utilizes deep learning algorithms to enhance video analysis and surveillance. By detecting and recognizing objects in real-time video streams, the system enables real-time monitoring and alert generation. This enables proactive responses to potential threats or incidents. The integration of deep learning algorithms improves the system's intelligence and adaptability. Future development and expansion opportunities include incorporating additional deep learning algorithms like facial recognition or license plate recognition, noise detection and other features to create a comprehensive security ecosystem. Overall, the Smart CCTV system provides an advanced and intelligent solution for video surveillance, enabling efficient monitoring, threat detection, and proactive security measures.

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