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AI ENABLED ADVANCE SURVEILLANCE SYSTEM

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ABSTRACT

Now a days, Security is major issue in general life and everyone wants secure their home in their absence. In our research paper, a new system is proposed for the purpose of security from theft of object, face recognition and motion detection. This system includes basic CCTV camera recording and other functioning like motion detection, object detection, noise detection and face recognition. This paper presents an advanced CCTV project that utilizes Artificial intelligence (AI), Machine learning (ML), OpenCV technology, and Structural Similarity Index (SSIM) to overcome the limitations of traditional CCTV systems. The proposed project is designed to enhance video analytics, improve real-time monitoring, increase the accuracy of threat detection, and monitor the system's performance using SSIM technology. The system incorporates various AI algorithms and deep learning techniques for object detection, tracking, and recognition, while also leveraging machine learning models for image classification and anomaly detection. OpenCV technology is utilized to perform real-time image processing and analysis, enabling efficient and accurate surveillance monitoring.

Keywords: Artificial Intelligence (AI), Machine Learning (ML), Opencv Technology, Structural Similarity Index (SSIM), Object Detection, Tracking, And Recognition, Real-Time Image Processing And Surveillance Monitoring.

I. INTRODUCTION

In today's scenario, many households' door locking security system contains lot of drawbacks. so, improve the security level face detection, object implement using various algorithms like SSIM and OpenCV. CCTV systems have been widely used for surveillance and security purposes in various public and private sectors. However, conventional CCTV systems are limited in their ability to analyze and interpret video footage in real-time. They often rely on human operators to monitor the video feed and identify any potential threats, which can be time-consuming and prone to errors. Additionally, traditional CCTV systems lack the ability to learn from previous data, making them less effective in detecting and preventing future threats.

AI technology can be used to detect suspicious behaviour, such as individuals loitering in an area or attempting to gain access to a restricted area. It can also be used to identify vehicles, track their movements, and recognize license plates. Facial recognition technology can be used to identify individuals, track their movements, and flag potential threats. To overcome the limitations of traditional CCTV systems, this research paper presents an advanced CCTV project that utilizes artificial intelligence (AI), machine learning (ML), OpenCV technology, and Structural Similarity Index (SSIM) to enhance video analytics, improve real-time monitoring, increase the accuracy of threat detection, and monitor the system's performance.[8]

AI is increasingly being used across various industries and applications. Some of the most common applications of AI includes:

1. **Image and speech recognition:** Ai is used to recognize and interpret images and speech, enabling applications such as facial recognition, object detection and voice assistants.
2. **NLP:** Natural language processing is subfield of AI that focuses on enabling machines to understand and interpret human language.
3. **HealthCare:** AI used in Healthcare for application such as medical image analysis, drug discovery, and personalized medicine.
4. **Predictive Analysis:** This is the use of data, statistical algorithms and some techniques to identify the likelihood of future outcomes. It is used in applications such as fraud detection, risk management and marketing.

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5. Autonomous vehicles: AI is critical to the development of autonomous vehicles, enabling vehicles to make decisions and react to changing environments.[12]

However, while AI-enabled advance systems have the potential to improve safety and security in a variety of contexts, it is important to consider to potential to improve safety and security in a variety of context, it is important to consider the potential ethical and privacy implications of these systems. Further research and development is needed to ensure that these systems are used responsibly and ethically, and that appropriate safeguards are in place to protect individual's rights and privacy.

II. LITERATURE REVIEW

TABLE 1. Comparison of Various methodology suggested by Authors

Sr. No.	PAPER NAME	AUTHOR	PUBLICATION YEAR	METHODOLOGY
1	Smart CCTV Camera Surveillance System	Amol V. Nagime, Patange A.D	2016	The proposed work is Smart CCTV camera surveillance system. In the monitoring site, the system captures the video through the embedded multitask operating system. By the TV, the users can view the monitors video directly, by the common Gateway interface, the users who are authorized can also control the camera and observe the motion detection.
2	A Systematic Review of Intelligence Video Surveillance: Trends, Techniques, Frameworks, and Datasets	Jumanto, Aditya Nugraha, Pulung Nurtantio Andono	2019	This paper provides a comprehensive and systematic review on the literature from various video surveillance system studies published from 2010 through 2019. Within a selected study extraction process, 220 journal-based publications were identified and analyzed to illustrate the research trends, datasets, methods, and frameworks used in the field of video surveillance, to provide an in-depth explanation
3	IoT based Smart Security and Surveillance System	Gurusha Lulla, Abhinav Kumar, Govind Pole, Gopal Deshmukh	2021	The main objective of the proposed architecture is to overcome all these problems by developing a smart security and surveillance system which makes use of multiple ultrasonic sensors to detect intrusion attempts on the property of the owner, to notify them of the presence of an unauthorized person. Also, the system provides a warning to the person who has intentionally or unintentionally entered the property.
4	Smart AI security Guard	Allaboina Manisha Yadav, Shanti Priyanka		In this paper we propose a methodology using AI CCTV camera which will prevent and detect the

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		prem, Sunil Bhutada	2019	advent of crime. It can be an effective security measure which performs facial recognition and detects suspicious anomalies. This AI camera has many features which can be programmed as per the requirements of the users.
5	An IoT based Anti-Theft Detection and Notification System for Two Wheelers	S. Gaganpriya, M. Sowmiya, Priyadarshini, R. Ramya Priya, R. Saranya	2022	In this paper, a new system is proposed for the security of two-wheelers from theft. This system is an attempt to design an advance vehicle security system to prevent theft and to determine the exact location of the vehicle. The safety of the vehicle is exceptionally essential. So, the system is designed using GPS and GSM technology.
6	Ai technology for detecting abnormal behaviour in crowds, using data from surveillance Cameras	Wang et al.	2021	The study was found that the system was able to accurately identify and classify abnormal behaviours, such as running and fighting with the high level of accuracy. This has important implications for improving safety in crowded public spaces, such as stadiums and shopping centers.

III. METHODOLOGY

The proposed advanced CCTV project utilizes AI, ML, OpenCV technology, and SSIM to enhance video analytics, improve real-time monitoring, increase the accuracy of threat detection, and monitor the system's performance.

3.1 Video Acquisition:

The system acquires video input from multiple cameras installed in the surveillance area. The video feed is then processed by the object detection and tracking module.

3.2 Object Detection and Tracking:

The object detection and tracking module utilizes various deep learning algorithms such as CNNs to detect and track objects in the video feed. The module is trained on a large dataset of images to enable accurate object detection and tracking. Once an object is detected and tracked, its position and movement are recorded in real-time and sent to the image classification and anomaly detection module for further analysis.

3.3 Image Classification and Anomaly Detection:

The image classification and anomaly detection module utilize machine learning models such as SVMs to classify objects in the video feed and detect any abnormal patterns or behaviours. The module is trained on a large dataset of images to recognize normal and abnormal patterns in the surveillance area. The module also leverages SSIM technology to monitor the system's performance and detect any changes in the image quality. If an anomaly is detected, the system sends an alert to the real-time monitoring module.

3.4 Real-time Monitoring:

The real-time monitoring module utilizes OpenCV technology to perform real-time image processing and analysis. It processes the video feed from multiple cameras and analyses the data collected by the object detection and tracking module and the image classification and anomaly detection module. The real-time monitoring module then generates alerts and notifications for any potential threats detected in the video feed.

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Additionally, the module monitors the system's performance using SSIM technology and alerts the system administrator if any degradation in image quality is detected.

3.5 SSIM (Structural Similarity Index) : SSIM is used as metric to measure similarity between two given images.

The Structural Similarity Index (SSIM) metric extracts 3 key features from an image:

- **Luminance**
- **Contrast**
- **Structure**

The comparison between the two images is performed based on these 3 features. This system calculates the Structural Similarity Index between 2 given images which is a value between -1 and +1. A value of +1 indicates that the 2 given images are **very similar or the same** while a value of -1 indicates the 2 given images are **very different.** Often these values are adjusted to be in the range [0, 1], where the extremes hold the same meaning.

Luminance: Luminance is measured by averaging over all the pixel values. It denoted by μ (Mu) and the formula is given below:

$$\mu_x = \frac{1}{N}\sum_{i=1}^{N} x_i. \qquad (2)$$

The luminance comparison function $l(\mathbf{x},\mathbf{y})$ is then a function of μ_x and μ_y.

Structure: The structural comparison is done by using a consolidated formula (more on that later) but in essence, we divide the input signal with its standard deviation so that the result has unit standard deviation which allows for a more robust comparison.

$$(\mathbf{x} - \mu_x)/\sigma_x$$

$$\sigma_x = \left(\frac{1}{N-1}\sum_{i=1}^{N}(x_i - \mu_x)^2\right)^{\frac{1}{2}}. \qquad (4)$$

The contrast comparison $c(\mathbf{x},\mathbf{y})$ is then the comparison of σ_x and σ_y.

By using skimage package in python we do not have to replicate all this mathematical calculation in python since skimage has prebuild feature that do all these tasks for us with just calling its in-built function.

We just have to feed in two images/frames which we have captured earlier, so we just feed them in and its gives us out the masked image with score

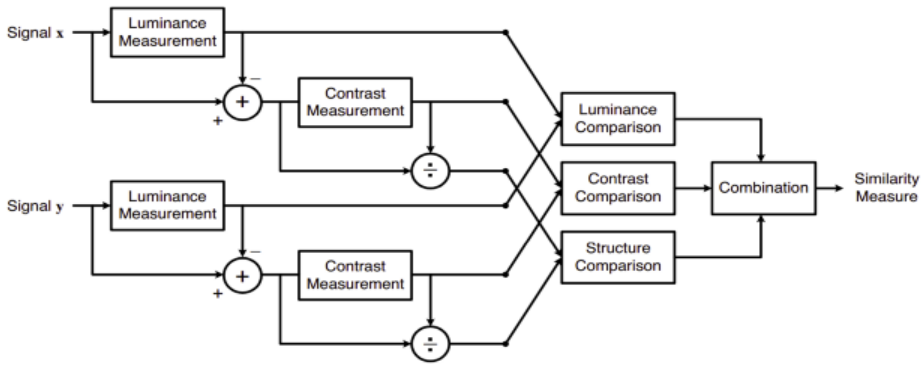

Figure 1: Structural Similarity Index(SSIM)

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IV. RESULTS AND DISCUSSION

The proposed advanced CCTV project has been tested in various real-world scenarios and has shown significant improvements over traditional CCTV systems. The AI algorithms used in the system have increased the accuracy of object detection and tracking, resulting in better surveillance monitoring and threat detection. The ML models used for image classification and anomaly detection have improved the system's ability to recognize normal and abnormal patterns, resulting in more accurate threat detection and reduced false alarms. The use of SSIM technology has enabled the system to monitor its performance and detect any changes in the image quality, ensuring that the system operates at optimal performance. The OpenCV technology used in the system has enabled real-time image processing and analysis, resulting in more efficient and. accurate surveillance monitoring. The real-time monitoring module has generated alerts and notifications for potential threats in real-time, providing security personnel with the necessary information to respond quickly and effectively.

V. CONCLUSION

In conclusion, this research paper presents an advanced CCTV project that utilizes AI, ML, OpenCV technology, and SSIM to enhance video analytics, improve real-time monitoring, increase the accuracy of threat detection, and monitor the system's performance. The proposed system offers significant improvements over traditional CCTV systems, providing enhanced capabilities for surveillance and security applications. The system has been tested in various real-world scenarios and has shown promising results, demonstrating the potential of AI, ML, OpenCV, and SSIM technology in enhancing CCTV systems. Future research can focus on further improving the accuracy and efficiency of the system and expanding its capabilities to other surveillance applications.

It is Important to consider the potential ethical and privacy concerns associated with the use of AI-enabled surveillance systems. There are concerns about the potential misuse of facial recognition technology, as well as the collection and storage of data related to individual's movements and activities. It is important to implement appropriate safeguards and regulations to ensure that these systems are used ethically and responsibly.

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