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Smart Intruder Detection System

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***Abstract:** In recent years, . This creates a dangerous environment in which people live in fear. In today's environment, the issue of home security is a cause of concern. The conventional systems used for intruder detection are very costly, and there is also a possibility of false alarms. The problem of false alarms is eliminated by using OpenCV and a mobile phone to develop a system that can effectively detect an intruder by eliminating the movements of objects that are also moving. When an intruder is detected, the system sends an alert to the user through an email, and the video is also stored in the local storage.*
***Keywords:** OpenCV, Python, IP camera, Background Subtraction, Email alert.*

I. INTRODUCTION

Security and surveillance systems have great importance in safeguarding residences, offices, industrial sectors, as well as restricted zones. Traditional security installations are based primarily on closed-circuit television cameras and manual updating, which require constant human supervision and can produce errors. Moreover, traditional alarm systems that function on motion detection often produce false alarms because of light change, motion of objects, and animals in the surroundings. The primary issue addressed in this paper is the unavailability of an intelligent system that detects the entry of an unwanted human presence

This is an important area since there is an escalating trend regarding both security threat and unauthorized access, and monitoring manually is neither efficient nor effective for continuous surveillance. An intelligent intruder detection system can dramatically improve safety by reducing human dependency, minimizing false alarms, and providing prompt responses to security breaches. These systems are highly important in smart homes, office spaces, and warehouses, as well as in highly secured regions.

In order to counter such a problem, this research work proposes a Smart Intruder Detection System The proposed system analyzes live video streams captured from surveillance cameras and uses a human detection model on relevant frames of the captured video streams for precise intruder detection. Pre-processed image techniques have been employed for improved detection accuracy, and the classification model differentiates human objects from nonthreatening objects.

The anticipated result of the proposed system includes enhanced accuracy of intruder detection, minimized false alarms, and real-time monitoring. The proposed method has been anticipated to provide a cost-effective and reliable automated security solution.

II. LITERATURE REVIEW

[1]CCTV Intelligent Surveillance on Intruder Detection (2021)The proposed research focused on the development of an intelligent surveillance system using CCTV footage to detect intruders. The proposed research utilized simple image processing techniques to detect motion and the presence of humans. The proposed system is expected to offer improved detection accuracy compared to the traditional CCTV surveillance system. [2]Smart Intruder Detection System (2021)The research work proposed a smart intruder detection system using image processing and simple classification techniques. [3]The proposed system attempts to automatically identify intruders from surveillance videosIntruder Detection System using Image Processing(2022)The proposed system employed OpenCV algorithms for motion detection based on user-developed software. The proposed system mainly focused on the detection of moving objects from video inputs and alerting.[4]Real-Time Farm Surveillance Using IoT and YOLOv8 (2025)Although this paper is primarily focusing on the detection of animal intruders in farms, it also uses the latest YOLOv8 algorithm with the help of IoT technology.

A. Limitations of Existing Technology

1) High False Alarm Rate: Conventional methods of motion and image processing are prone to false alarms triggered by movements that are not related to humans, such as animals, shadows, lighting changes, and the presence of objects such as curtains and trees.

2) Dependence on Manual Monitoring: For CCTV systems, constant human monitoring is required, and it is time-consuming, prone to human error, and not suitable for long-term surveillance

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3) Sensitivity to Environmental Conditions : Variations in lighting, camera viewpoint, and background complexity influence the results for conventional and simple image processing techniques. Weather also has a substantial effect

4) Scalability and Cost Issues: Many advanced systems are expensive to implement and maintain, limiting their adoption in small-scale environments such as homes and small offices.

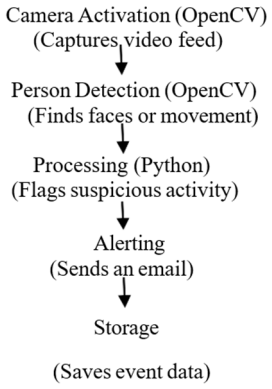
III. PROBLEM STATEMENT

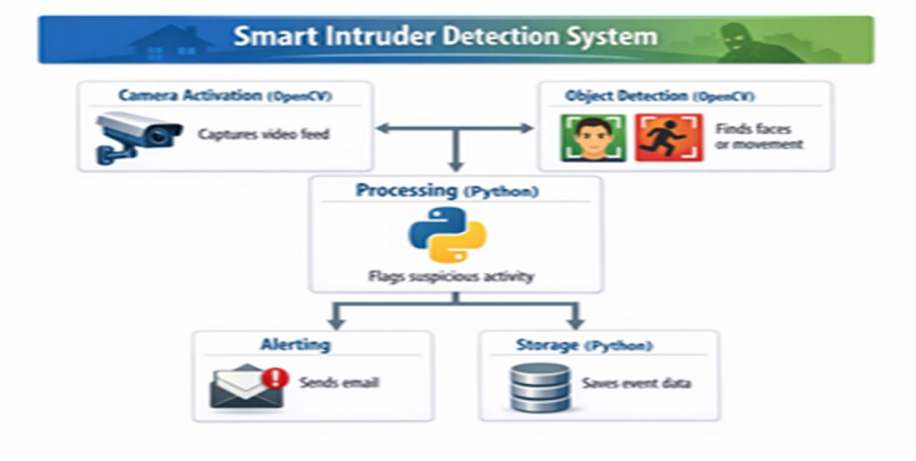
Due to the increasing number of security threats such as trespassing, theft, and unauthorized access to restricted areas, there is a need for intelligent and automated surveillance systems. Traditional security systems such as manual surveillance of CCTV cameras are inefficient, time-consuming, and extremely dependent on human attention, which may lead to a lag in responses and events.

The current surveillance systems are primarily focused on continuous video recording without real-time processing, making it difficult to detect intrusions and normal activity as well as abnormal activity instantly. Additionally, the current systems do not possess the capability to provide instant notifications or valid evidence, which is required for instant decision-making and subsequent investigations

IV. METHODOLOGY

A Smart Intruder Detection System works through a series of interconnected modules that ensure real-time monitoring, detection, and response. The process begins with Camera Activation using OpenCV, where the system captures a continuous video feed from a connected camera. This feed is then passed to the Person Detection module, also powered by OpenCV, which analyzes frames to identify faces or detect suspicious movement. Once detection occurs, the data is sent to the Processing unit in Python, where the system applies predefined rules and logic to flag unusual or suspicious activity. If an intrusion is confirmed, the Alerting mechanism is triggered, automatically sending an email notification to the concerned user or authority to ensure immediate action. Simultaneously, the system's Storage module saves event data, including video frames and metadata, for future review and evidence. Together, these components create a robust, automated security framework that combines computer vision, intelligent processing, and communication to safeguard environments effective.





V. DATASET DESCRIPTION

A. *Dataset Name*

The effectiveness of the proposed Smart Intruder Detection System is highly dependent on the nature of the training and test data used to train the model. This article makes use of both available and custom video data to train the system. This is to ensure that the system is effective in real life

B. *Number of images/videos*

Total video clips: 20–30 surveillance video samples.Image format:
RGB frames extracted from videos

C. *Labels/Classes*

Intruder – Frames containing human presence
Non-Intruder – Frames without human presence (background, objects, shadows)

D. *Train–Test Split*

The dataset is divided as follows:
Training set: 70% of total images Testing set: 30% of total images

VI. EXPERIMENTAL RESULT/ANALYSIS

To evaluate the effectiveness of the intruder detection system, the following metrics are used:

1) Accuracy: Overall correctness of the model
2) Precision: Correctly detected intruders among all detected intruders
3) Recall: Correctly detected intruders among all actual intruders
4) F1-Score: Harmonic mean of precision and recall



(1)



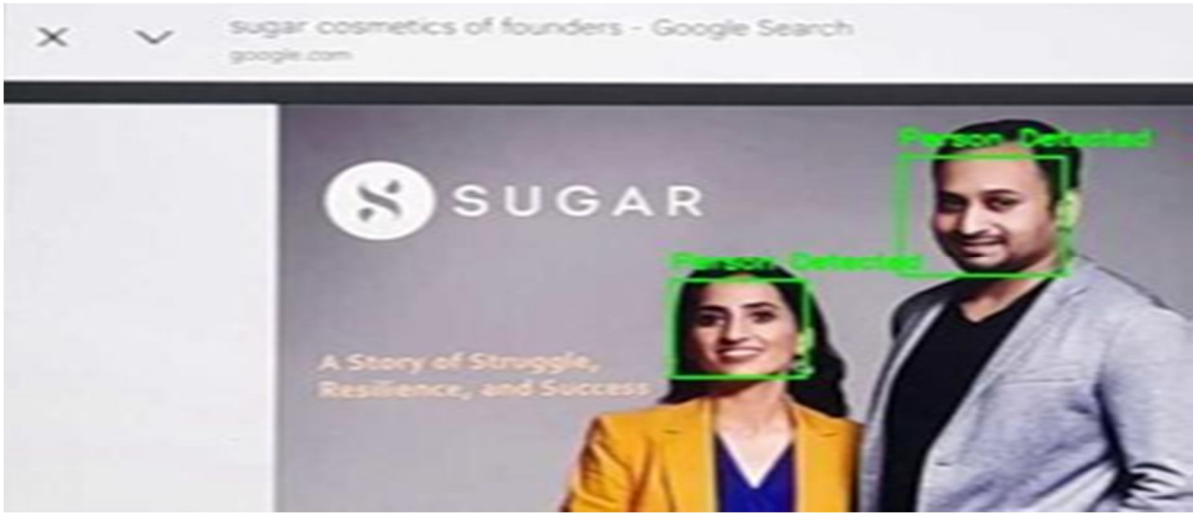
(2)


IP Webcam Pro
No video watermarks
Upgrade to hide
IPv4: http://192.168.0.102:8080
IPv4: https://192.168.0.102:8080
IPv6: http://[2401:4900:ad6c:81ba:7a1d:8c45:fa75:28d7]:8080
Video connections: 0, Audio: 0

(3)


Motion
Motion
Motion

(a)

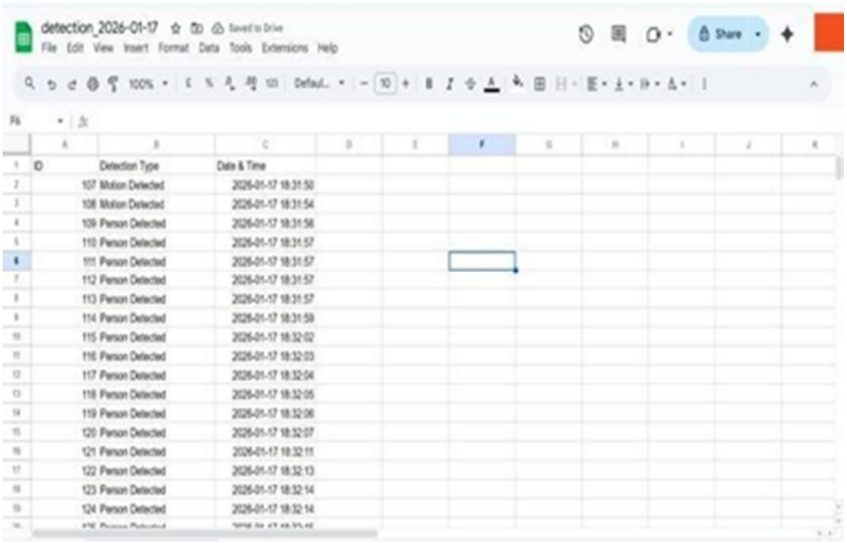

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SUGAR
A Story of Struggle, Resilience, and Success

(b)

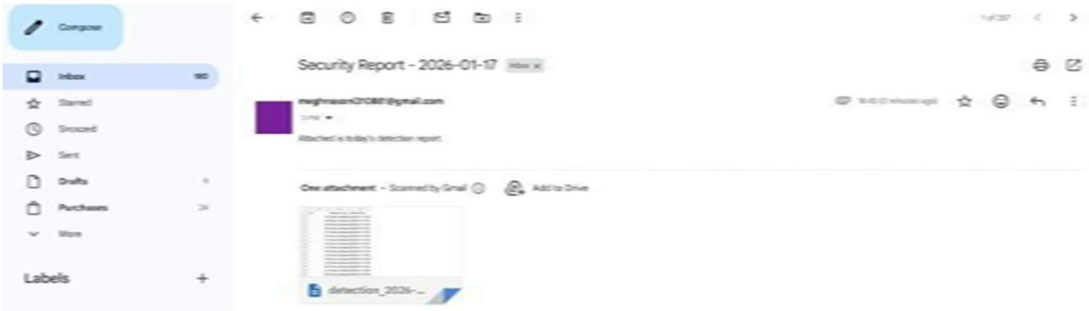
Security Detection Logs

ID	Detection Type	Date & Time
133	Person Detected	2026-01-17 18:41:08
132	Motion Detected	2026-01-17 18:41:07
131	Person Detected	2026-01-17 18:39:17
130	Person Detected	2026-01-17 18:39:17
129	Person Detected	2026-01-17 18:39:16
128	Motion Detected	2026-01-17 18:39:16
127	Person Detected	2026-01-17 18:32:28
126	Person Detected	2026-01-17 18:32:28
125	Person Detected	2026-01-17 18:32:15
124	Person Detected	2026-01-17 18:32:14
123	Person Detected	2026-01-17 18:32:14
122	Person Detected	2026-01-17 18:32:13
121	Person Detected	2026-01-17 18:32:11
120	Person Detected	2026-01-17 18:32:07
119	Person Detected	2026-01-17 18:32:06
118	Person Detected	2026-01-17 18:32:05

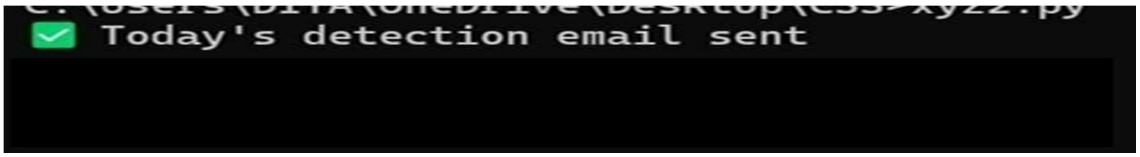
(4)



(5)



(6)



(7)



(8)



(9)

VII. FUTURE SCOPE

Though it has been made clear that the proposed Smart Intruder Detection System works efficiently and reliably, there is vast potential for further improvement and extension. Future improvement can be made on enhancing intelligence, scalability, and usability. In the future, the system can be upgraded by incorporating face recognition to recognize the authorized and unauthorized persons accurately. This would aid in distinguishing between the familiar user and an intruder. It is possible to extend the system to accommodate multi-cam inputs for area coverage in campuses and industrial areas. Connectivity with the Cloud and Internet of Things (IoT) can also be discussed for the remote monitoring and alerts offered through mobile applications or webportals.

VIII. CONCLUSION

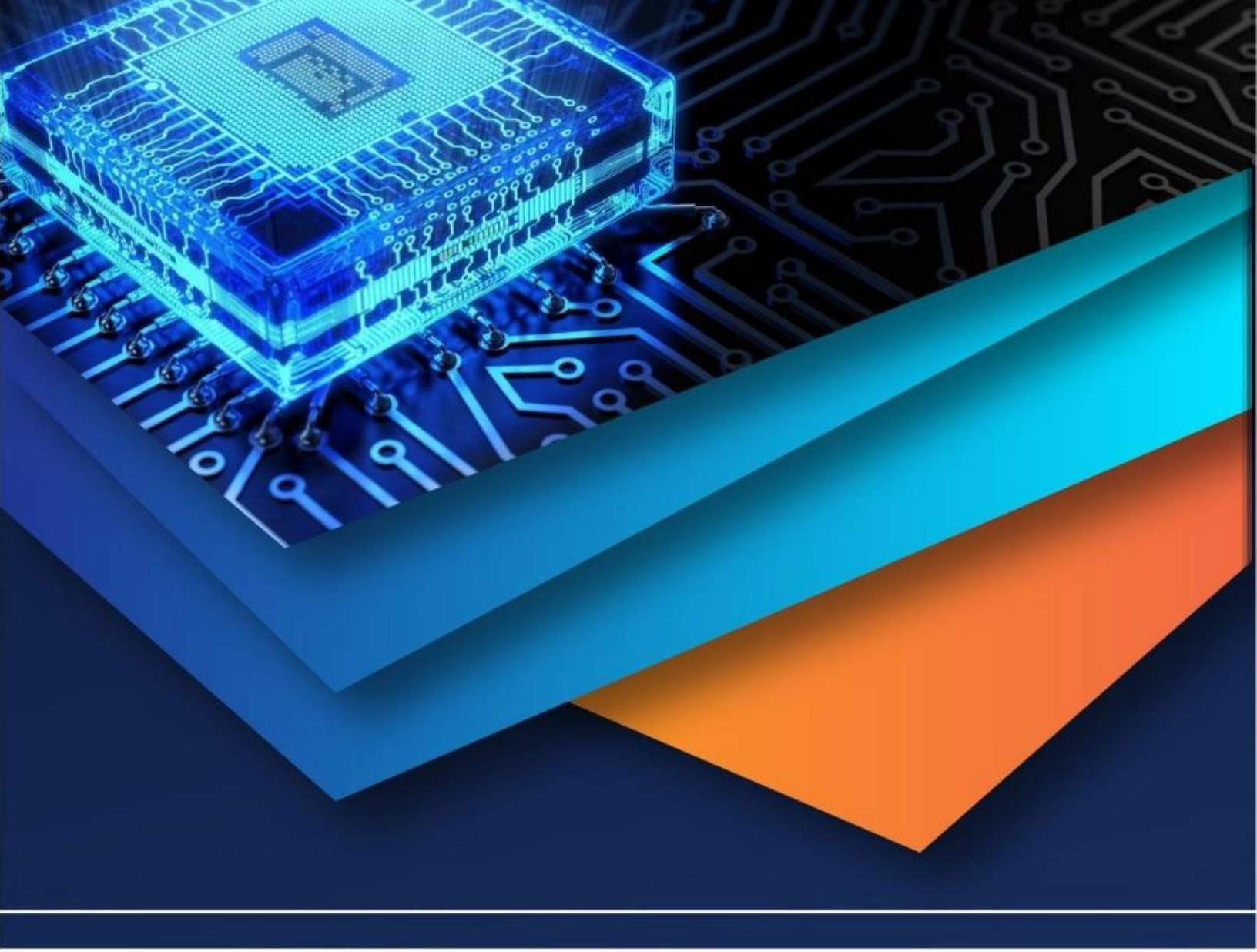
This paper presented a smart intruder detection system that was intended to enhance further the accuracy and dependability of most modern surveillance systems. The proposed system utilizes computer vision and deep learning in detecting human intruders automatically from real-time video streams to reduce reliance on manual monitoring and minimize false alarms generated by traditional motion-based systems. The major outputs of this work are enhanced detection accuracy, reduced false alarm rate, and capability of generating alerts in real time.

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The proposed system is cost- effective and scalable for smart homes, offices, and restricted areas, hence a practical approach for intelligent security and surveillance applications. We have implemented an automatic text detection technique from an image for Inpainting. Our algorithm successfully detects the text region from the image which consists of mixed text-picture-graphic regions. We have applied our algorithm on many images and found that it successfully detect the text region.

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