iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** XI **Month of publication:** November 2023

DOI: https://doi.org/10.22214/ijraset.2023.56752

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue XI Nov 2023- Available at www.ijraset.com

Smart CCTV Surveillance System with Visitor Management System, Face Detection, Fire Alarm, Parking Assistant for Residential Areas

Yash Mahajan[1], Sandesh Shejwal[2], Indrayani Takawale[3], Shivram Marwadi[4], Mrs. Swati Rajput[5]
Department of Computer Engineering, Dr. D. Y. Patil Institute of Engineering, Management and Research, Maharashtra, India

Abstract: ***The "Smart CCTV Surveillance System" stands as a revolutionary solution at the nexus of security, cutting-edge technology, and user-centric design. Anchored by features such as real-time facial recognition, trustworthiness recognition, and comprehensive threat detection, the system redefines the paradigm of surveillance and access control. Beyond addressing the critical challenges of unauthorized access and security threats, this project introduces a robust fire alarm feature. By integrating sophisticated algorithms for real-time fire detection, the system ensures swift response to potential emergencies. Alongside this, the project streamlines visitor management through automation, optimizing registration, check-in, and check-out processes. The addition of parking assistance enhances the overall user experience, guiding visitors to available parking spaces and mitigating congestion. In essence, the "Smart CCTV Surveillance System" not only establishes an impregnable security infrastructure but also envisions a future where technology seamlessly collaborates with human needs, fostering environments that are not just secure but also smarter and more user-friendly.***

Keywords: Smart CCTV, OpenCV, visitor management, fire alarm, threat detection, parking assistance, trustworthiness detection

I. INTRODUCTION

In the ever-evolving landscape of security technologies, the Smart CCTV Surveillance System stands as a beacon of innovation, promising to reshape the contours of surveillance, access control, and emergency response. In this era of heightened security concerns, the integration of advanced features such as real-time facial recognition, trustworthiness recognition, and dynamic threat detection becomes not just a necessity but a pivotal stride towards fortifying the resilience of security infrastructure. The overarching objective of this research is to comprehensively delve into the intricacies and implications of this cutting-edge system.

At the heart of the "Smart CCTV Surveillance System" lies the capability of real-time facial recognition. This feature, powered by sophisticated machine learning algorithms, enables the system to instantly identify and categorize individuals, differentiating between authorized personnel, visitors, and potential threats. Concurrently, trustworthiness recognition takes this paradigm a step further, assigning trust levels to recognized individuals, ensuring nuanced access control based on established trust metrics.

A distinctive feature that sets this system apart is its robust visitor management. Automated processes for registration, check-in, and check-out streamline the often hectic task of managing visitors. The system maintains a comprehensive database with timestamps, providing not only a meticulous record but also facilitating swift responses in case of emergencies. This feature is very useful for the premises that lack security personnel for keeping a track of visitors.

Beyond access control and visitor management, the "Smart CCTV Surveillance System" introduces a formidable fire alarm feature. Incorporating advanced algorithms for real-time fire detection, the system ensures rapid response to potential emergencies, mitigating risks and damages. This not only fortifies the security infrastructure but introduces a layer of proactive emergency preparedness.

Additionally, the research showcases its user-centric design through the integration of parking assistance. This feature, often overlooked in traditional security systems, guides visitors to available parking spaces, reducing congestion and enhancing the overall visitor experience.

This research aims to unravel the intricacies of the "Smart CCTV Surveillance System," contributing to the broader discourse on the intersection of technology, security, and user-centric design. Through a comprehensive analysis of its components, capabilities, and real-world implications, this research seeks to provide insights that extend beyond mere technological advancement, offering a blueprint for the creation of environments that are not just secure but also smarter and more intuitively attuned to human needs.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue XI Nov 2023- Available at www.ijraset.com

II. LITERATURE REVIEW

The paper authored by V. Babanne, N. S. Mahajan, R. L. Sharma, and P. P. Gargate [1] contribute to the literature on modern city security. They emphasize the importance of smart cameras with intelligent video analysis for monitoring and alerting to abnormal activities. The implementation focuses on early fire detection, smart parking, and crowd estimation, addressing drawbacks of post-investigation techniques. The work, grounded in machine learning, promises better performance and event detection, enhancing video surveillance systems with proactive alert generation.

Another paper, authored by S. U. Ahmed, H. Khalid, M. Affan, T. A. Khan, and M. Ahmad [2], introduces an intelligent facial recognition system for applications like person tracking and home security. The study makes use of pan-tilt servos for tracking and motion detection together with automated facial recognition. Unusual activity is tracked, synced with cloud storage, and sends out warnings to mobile devices. When there is no internet, an offline database file is made, and faces that are not recognised cause an audio alert to sound. Additionally, the system has relays for voice communication and light activation in addition to speech recognition. Notably, it uses the Raspberry Pi 3B+ microprocessor to offer affordable security solutions.

The paper by authors Radhika. K. M, Shankar. M. Bakkannavar, Arjun. M. S, and Samarth Bhaskar Bhat [3] address the critical need for efficient face detection in CCTV footage. Their research provides a comprehensive review of existing techniques, analyzing challenges like lighting variations and occlusions. Focusing on traditional methods such as Viola-Jones, the study offers valuable insights for researchers and practitioners. By evaluating different approaches, the research contributes to the design of robust face detection systems, aiming to enhance the reliability of surveillance and security applications.

Study made by authors Y. Tao, Z. Zongyang, Z. Jun, C. Xinghua, and Z. Fuqiang [4] address the threat of "black flights" with unauthorized UAVs. They propose a lightweight feature-enhanced CNN for real-time low-altitude object detection, overcoming the limitations of existing algorithms. The method achieves a remarkable detection speed of 147 FPS and an mAP of 90.97% on a flying objects dataset. The evaluation based on MS COCO indicates its versatility in general object detection. This work presents a promising solution to enhance public safety through efficient and precise object detection in complex environments.

A probabilistic syntactic technique is described in the article [5] by authors Ivanov Yuri and Bobick Aaron for identifying and detecting prolonged activities and interactions in surveillance recordings. The system, which consists of an event generator, adaptive tracker, and parser, is able to recognise in a parking lot events such as pick-up and drop-off that include interactions between a person and a car. Three major contributions are the creation of an effective incremental parsing algorithm, the extension of the parsing method for multi-agent interactions within a single parser, and the introduction of a consistency-based pruning mechanism. With this approach, precise surveillance video analysis has advanced.

III. METHODOLOGY

A. Face Detection using OpenCV

The implementation of face detection is accomplished through the utilization of OpenCV, an open-source computer vision library that provides a rich set of tools for image and video processing.

1) *Image Acquisition:* The process initiates with the acquisition of video frames from the CCTV cameras. These frames are continuously fed into the system, forming a real-time video stream.
2) *Pre-processing:* Prior to face detection, pre-processing techniques are applied to enhance the quality of the frames. This may involve tasks such as resizing, normalization, or histogram equalization to ensure consistent and optimal conditions for face detection.
3) *Face detection Algorithm:* OpenCV provides pre-trained deep learning models for face detection, such as Haar cascades or more modern models based on deep neural networks (DNN). The selection of the specific model depends on factors like accuracy requirements and computational efficiency.
4) *Integration with OpenCV:* The chosen face detection model is integrated into the system using OpenCV's programming interfaces. This involves loading the pre-trained model and configuring parameters such as the confidence threshold for face detection.
5) *Real-time Detection:* As the video frames are continuously processed, the face detection algorithm operates in real-time, identifying faces within each frame. The algorithm marks the detected faces with bounding boxes.
6) *Face Recognition and Categorization:* The detected faces are subsequently passed to the face recognition module, where machine learning models identify and categorize individuals based on the facial metadata present in the admin database. This thereby enables to distinguish between authorized personnel and visitors.

7) *Continuous Monitoring and Adaptation:* The process continues in a loop ensuring real-time adaptability to changes in the environment. The system continually monitors the video stream and characterises the people into trustworthy and visitors respectively.

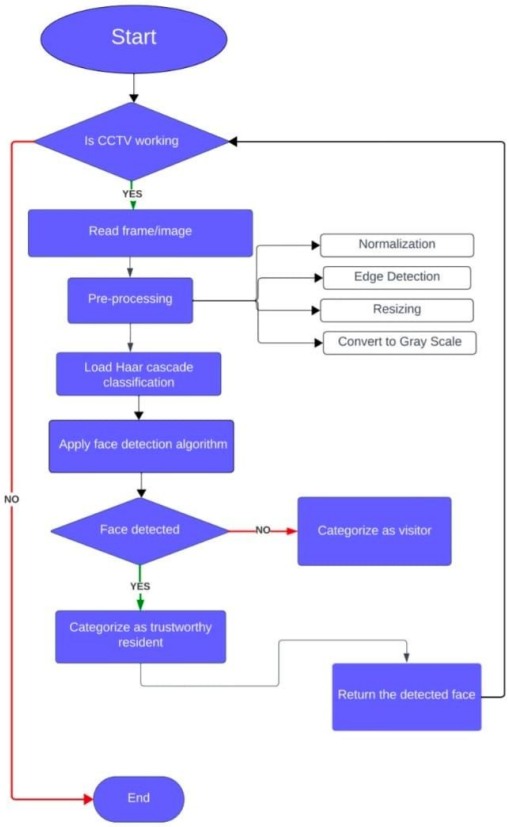


Fig 3.1 Face Detection using OpenCV Flowchart

B. Visitor Management System Database

1) *Visitor Registration Data:* When a visitor enters the premises, the information of the visitor will be stored in the database, including their captured image from the CCTV camera, check-in and check-out timestamps, and facial metadata.
2) *Facial Metadata:* The database holds facial metadata for both registered personnel and visitors. For trusted individuals, this metadata includes facial features that facilitate rapid recognition, enabling the system to distinguish between authorized personnel and visitors. This information is crucial for real-time facial recognition during check-in, check-out, and continuous monitoring.
3) *Timestamp Integration:* The database is seamlessly updated with the timestamps created during check-in, check-out, and other noteworthy events. By linking each timestamp input to the respective visitor, a chronological log of their activity on the property is created. If there is a criminal intervention on the property, these visitor timestamps will be highly useful.
4) *User Authentication:* Access to the database is secured through robust authentication mechanisms. Only authorized personnel with the appropriate credentials can access and manage the database, ensuring the confidentiality and integrity of the stored data.
5) *Alerts and Notifications:* The integration of facial metadata allows the system to generate alerts and notifications based on the identity of individuals. Notifications will be rolled out whenever any visitor enters the premises thereby enabling the residents of the property to get updates.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue XI Nov 2023- Available at www.ijraset.com

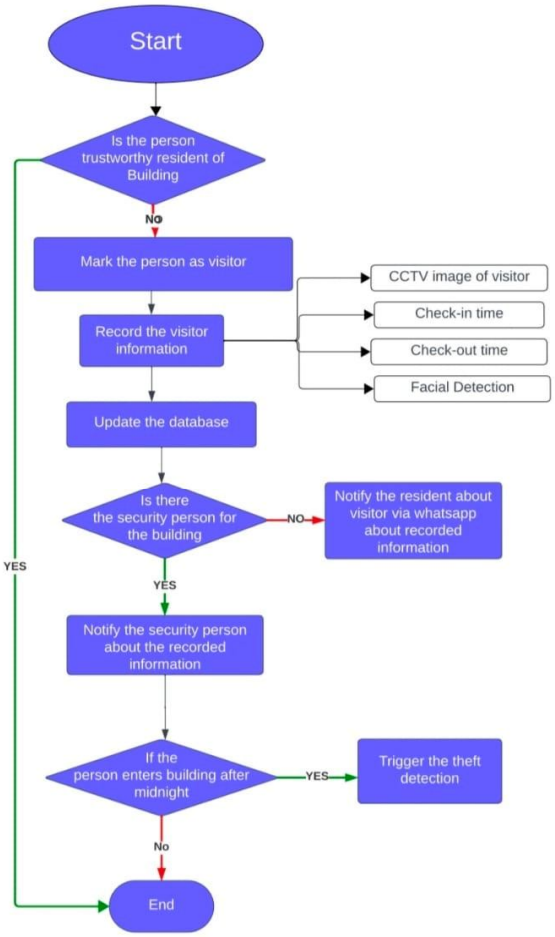


Fig 3.2 Visitor Management System Working Flowchart

C. Implementation of Advanced Features: Theft Detection, Fire Alarm, and Parking Assistance via Web Application

Advanced capabilities beyond traditional surveillance can be achieved with the implementation of advanced features — Theft Detection, Fire Alarm, and Parking Assistance. The integration of these features is facilitated through a user-friendly web application, providing administrators with centralized control and real-time insights.

1) *Theft Detection:* When the system detects potential theft, alerts are generated in real-time. These alerts can be configured to trigger notifications to security personnel or the residents of the premises, providing an immediate response to mitigate security threats. In order to guarantee a drop in theft and other crimes on campus, the system also sounds an alarm if an intruder enters after midnight.
2) *Fire Alarm:* The fire alarm feature employs computer vision algorithms capable of recognizing patterns indicative of fire or smoke. These algorithms continuously analyse video streams from CCTV cameras for any signs of a fire emergency.
3) *Parking Assistance:* The parking assistance feature utilizes image processing techniques to recognize available parking spaces within the monitored area. This involves analyzing video frames to identify unoccupied parking spots. The information about available parking spaces is relayed to the web application, where administrators or residents can access a visual representation of parking availability in real-time. Visitors, too, can use the application to find convenient parking spaces.
4) *Web Application Interface:* The web application provides a user-friendly dashboard where administrators can monitor the status of all integrated features. This includes real-time video feeds, alerts, and the current status of theft detection, fire alarm, and parking availability.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue XI Nov 2023- Available at www.ijraset.com

IV. TESTING AND RESULTS

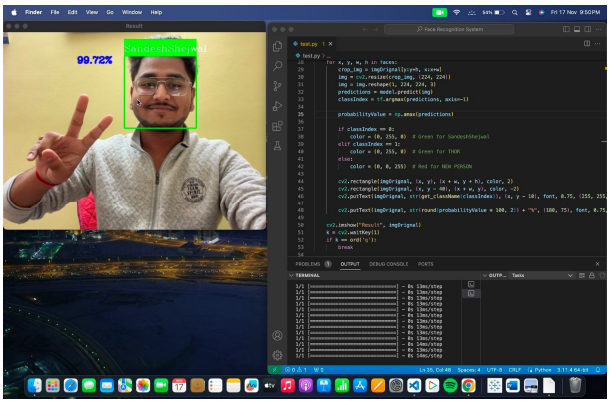


Fig 4.1 Screenshot of Face Recognition output where name of trusted person and the accuracy is mentioned.

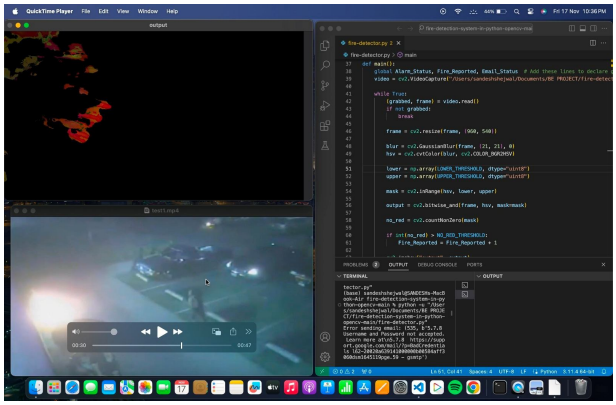


Fig 4.2 Screenshot of Fire Alarm when fire is detected

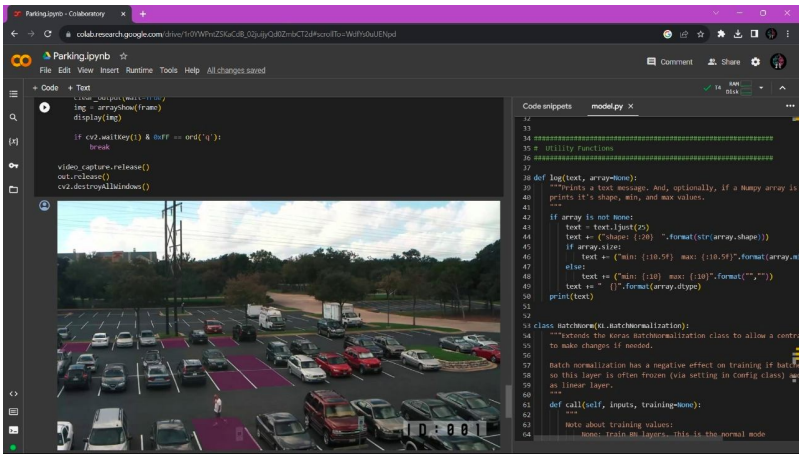


Fig 4.3 Screenshot of Parking Assistant highlighting the vacant spaces in parking

V. CONCLUSIONS

The Smart CCTV Surveillance System provides a complete security solution with its cutting-edge capabilities, which include real-time face recognition, trustworthiness recognition, fire alarm, theft detection, parking assistance, and simplified visitor administration. The Visitor Management System becomes essential in buildings without security staff because it offers automatic, effective, and careful management over visitor activities. The system becomes an independent safety net when proactive features like fire alarms and theft detection are combined with sophisticated access control. The parking assistance feature further improves the experience of visitors. In conclusion, this system is more than simply a technological wonder; it is a uniquely designed solution to the security issues of today, making areas safe, effective, and easily navigable, particularly in settings without a dedicated security staff.

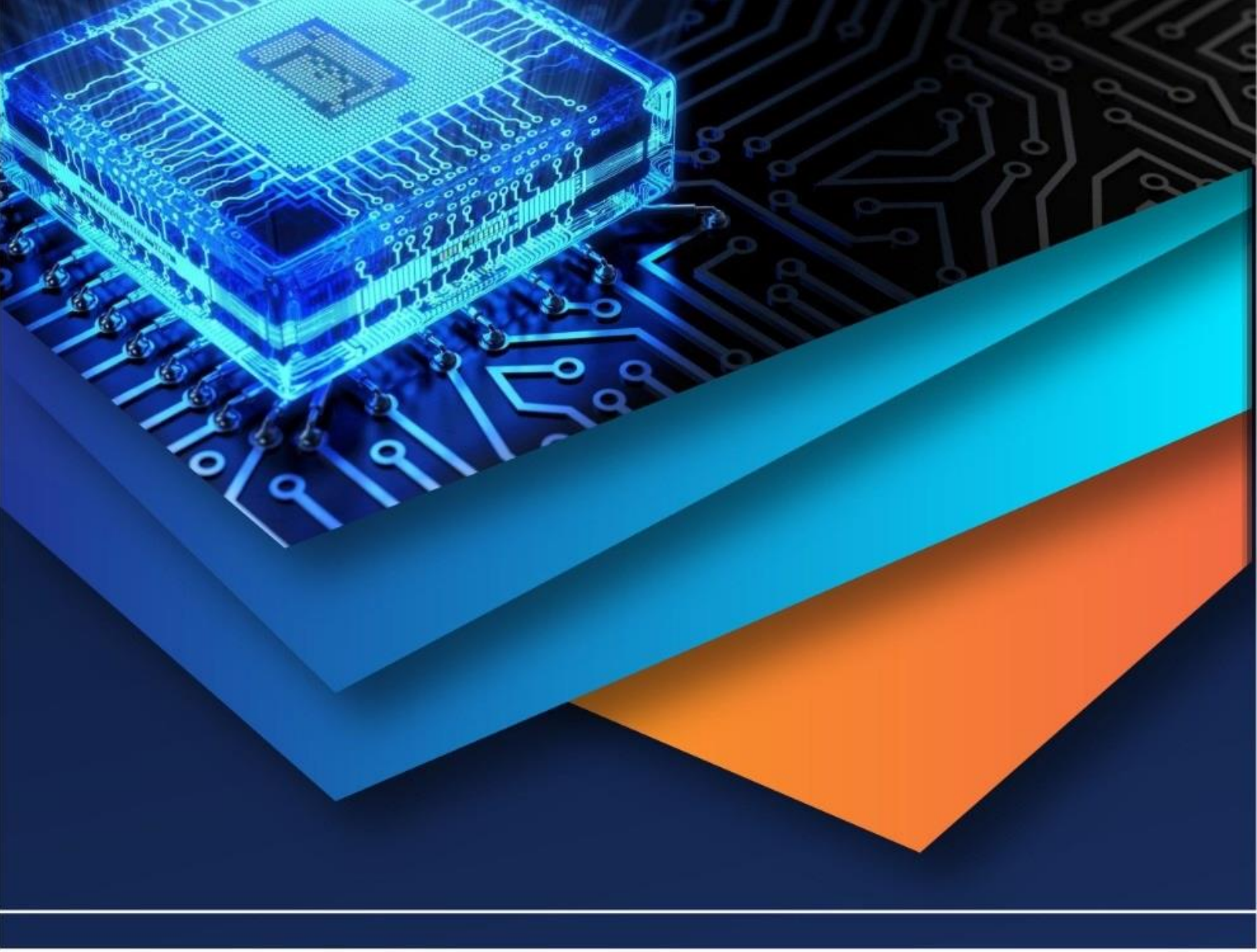
VI. ACKNOWLEDGMENT

We extend our sincere gratitude to Mrs. Swati Rajput, whose invaluable guidance and mentorship played a pivotal role in the successful completion of this project. Her expertise, encouragement, and unwavering support were instrumental in shaping our ideas into a robust and innovative system. We would like to express our appreciation to our college for providing the conducive environment and resources that enabled us to embark on this project. The support from the faculty and the conducive learning atmosphere have been crucial in our academic journey. Our heartfelt thanks go to the open-source community and the developers behind the tools and libraries that powered this project. Their collaborative spirit and commitment to shared knowledge have been a constant source of inspiration.

The availability of these resources played a significant role in the realization of our project goals. Lastly, we extend our deepest gratitude to our family members for their unwavering support and understanding throughout the duration of this project. Their encouragement and patience were the pillars that sustained us during challenging moments. This project would not have been possible without the collective support and encouragement from these individuals and institutions. We are sincerely thankful for their contributions to our academic and professional growth.

REFERENCES

[1] V. Babanne, N. S. Mahajan, R. L. Sharma and P. P. Gargate, Machine learning based Smart Surveillance System, 2019 Third International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), Palladam, India, 2019
[2] S. U. Ahmed, H. Khalid, M. Affan, T. A. Khan and M. Ahmad, Smart Surveillance and Tracking System, 2020 IEEE 23rd International Multitopic Conference (INMIC), Bahawalpur, Pakistan, 2020
[3] Radhika. K. M, Shankar. M. Bakkannavar , Arjun. M. S, Samarth Bhaskar Bhat, Face Detection from CCTV Footage using OpenCV and Haar Cascade, https://www.ijraset.com/best-journal/face-detection-from-cctv-footage-using-opencv-and-haar-cascade
[4] Y. Tao, Z. Zongyang, Z. Jun, C. Xinghua and Z. Fuqiang, Low-altitude small-sized object detection using lightweight feature-enhanced convolutional neural network, in Journal of Systems Engineering and Electronics, vol. 32, no. 4, pp. 841-853, Aug. 2021
[5] Ivanov Yuri and Bobick Aaron, Recognition of multi-agent interaction in video surveillance, Proceedings of the IEEE International Conference on Computer Vision. 1. 169 - 176 vol.1. 10.1109/ICCV.1999.791214.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY