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# SMARTEYE360 - Real Time Smart CCTV Surveillance System

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***Abstract:*** In an age marked by rapid technological advancement, seamlessly integrating new technologies with existing infrastructure is crucial. One notable effort in this direction focuses on enhancing data access, optimization, and organization by merging traditional technology with cutting-edge concepts. This start-up specializes in big data analytics and edge computing, aiming to shape a brighter future. Security concerns, particularly in areas with abandoned properties due to demanding responsibilities, are paramount. To address this, CCTV cameras are widely deployed to safeguard homes during owners' absence. Additionally, in smart cities, surveillance cameras play a vital role in collecting evidence for crime prevention and investigation. This project introduces a novel surveillance approach that combines conventional video monitoring with advanced motion-based sensing technology. Unlike typical systems that merely record footage, the proposed system utilizes sensor cameras to identify and analyze visible object motion, facilitating proactive responses to potential security threats. Its ability to capture only moving frames through motion detection represents a significant breakthrough, optimizing system resources. By integrating prior background intensity inference into frame analysis, the system enhances its ability to detect and respond to physical movements accurately. This research and development initiative not only advances security systems but also showcases the successful fusion of traditional and modern technology to tackle contemporary challenges. The suggested motion-based surveillance system presents a viable alternative for efficient and resourceful security monitoring in both residential and urban environments.

***Index Terms*** - Surveillance Systems, Motion-Based Surveillance, Security Threats, Smart Cities, Optimization, Edge Computing.

## I. INTRODUCTION

In today's ever-evolving landscape, security and surveillance have become paramount concerns for both individuals and organizations alike. Among the forefront technologies driving this domain forward are Closed Circuit Television (CCTV) surveillance systems, offering a broad array of applications with diverse functionalities. However, traditional CCTV systems often fall short in providing comprehensive security due to their limited capacity to interpret events captured in footage. To address this limitation, advancements such as adaptive background subtraction and human presence detection are being integrated into surveillance technologies, enabling real-time monitoring and enhanced situational awareness. One of the key challenges in surveillance technology lies in effectively detecting and tracking human traits amidst dynamic backgrounds and potential environmental disturbances. By incorporating adaptive background subtraction techniques, the system can discern between background elements and objects of interest, such as human movement, with greater accuracy. This ensures that the surveillance system remains focused on relevant events while minimizing false alarms caused by extraneous factors. Moreover, this paper proposes a holistic approach to security enhancement by leveraging a range of cutting-edge technologies. From personalized identification and crime detection to energy conservation and smart city infrastructure support, the project aims to integrate various features seamlessly into existing infrastructure and technological frameworks. By prioritizing ease of access, data optimization, and organization, alongside advancements in big data analytics and edge computing,

the proposed system endeavours to provide comprehensive protection against evolving threats. In essence, this introduction highlights the imperative for innovation in surveillance technology to meet the escalating demands of modern security challenges. By bridging the gap between traditional surveillance methods and emerging technological advancements, the proposed system represents a significant step towards ensuring robust security measures in today's dynamic environments.

## II. REVIEW OF LITERATURE STUDY

The following section is a literature survey of the previous research papers and research which gives detailed information about the previous system along with its advantages and disadvantages. A survey was done on the existing literature and products to find out their shortcomings and research gaps in their systems. This survey consisted of more than 15 literature papers where the most relevant ones are listed below.

Maliha Khan, Sudeshna Chakraborty, Rani Astya and Shaveta Khepra [1] Face detection and picture or video recognition is a popular subject of research on biometrics. Face recognition in a real-time setting has an exciting area and a rapidly growing challenge. Framework for the use of face recognition application authentication. This proposes the PCA (Principal Component Analysis) facial recognition system. The key component analysis (PCA) is a statistical method under the broad heading of factor analysis. The aim of the PCA is to reduce the large amount of data storage to the size of the feature space that is required to represent the data economically. The wide 1-D pixel vector made of the 2-D face picture in compact main elements of the space function is designed for facial recognition by the PCA. This is called a projection of self-space. The proper space is determined with the identification of the covariance matrix's own vectors, which are centered on a collection of fingerprint images. This system has a camera-based real-time face recognition system and set an algorithm by developing programming on OpenCV, Haar Cascade, Eigenface, Fisher Face, LBPH, and Python.

Shrikant Jagannath Patro, Prof. Nisha V M [2] Video analytics is growing field in the machine learning and deep learning domain. This paper proposed the model that is capable of performing video analytics at large scale and faster pace and generated the appropriate inference on time. It includes the detail of the algorithm for the automation in video analytics personalized cameras, security and Surveillance system using deep learning. This includes much optimized algorithm for identification of the faces. The second module is consisting of object identification using deep learning and libraries that are capable of identifying 3 million objects i.e. COCOAPI. Video Summarization is a technique introduced to increase the speed of investigation. The Module produced much optimized summary of video.

Yonghui Lu, Langwen Zhang and Wei Xie [3] In practical applications, the number of categories in object detection is always single. In this paper, an efficient YOLO-compact network designed for single category real-time object detection is proposed. This paper first explored a series of methods for converting a large and deep network to a compact and efficient network, through a series of ablation experiments. Then these methods were assembled to YOLOv3 network, which obtains the YOLO-compact's infrastructure. A network structure design approach that separates the down sampling layer from all network modules was proposed, which facilitates the modular design of the network. The residual bottleneck block has been improved, by removing the last 1x1 convolution layer and using 3x3 depth wise separable convolution. Since pedestrian is the most representative object in practical applications, this paper uses the result on person category in VOC2007 test set to represent the network performance. The model size of YOLO-compact is only 9MB, which is 3.7 times smaller than tiny-yolov3, 6.7 times smaller than tiny-yolov2, and 26 times smaller than YOLOv3. The AP result of YOLO-compact is 86.85%, which is 37% higher than tiny-yolov3, 32% higher than tiny-yolov2, and even 2.7% higher than the YOLOv3.

Faqih Hamami, Iqbal Ahmad Dahlan, Setya Widyawan Prakosa, and Khamal Fauzan Somantri [4] Todays many devices generate data everywhere and anytime. Data grow massively and becomes complex thing that needs to be handled. Unstructured data is one type of big data that is difficult to process and consists of unstable attributes. In traffic management, CCTVs are installed to monitor the specific location in the highway. CCTV generates unstructured data in image and video format. These data are difficult to process due to the complexity of the data. This research proposes to implement big data analytics to process real-time unstructured data from CCTV into knowledge displayed in web dashboard. We implement the YOLO framework with YoloV4 Architecture and COCO dataset for traffic flow counting and detecting illegal parking which is categorized as

abnormal situation. Data also can be visualized in real time to facilitate local authority to understand the highway situation.

Phillip Lougher, Doug Shepherd and David Pegler [5] Digital audio and video are difficult to store and replay due to their real-time nature, high bandwidth, and large size. To investigate the techniques required to support audio and video, a specialized continuous media storage server, in operation since December 1991, was built at Lancaster. This server and the techniques used in its design are briefly described. The current work at Lancaster in distributed continuous media storage servers is then outlined. This work is developing a scalable multimedia storage server architecture that supports wide area multimedia storage; storage server scalability that allows the incremental addition of new nodes; high bandwidth through the use of load balancing, including node striping and file replication; and store-and-forward caching for slower and faster than real-time links. The architecture will allow tens of simultaneous users for classroom teaching and video-on-demand applications.

F. Matusek and R. Reda [6] The trade-off between privacy and security was recently a subject of intensive discussion. Giving up privacy does not necessarily result in greater security, and greater security does not necessarily require a loss of privacy. In this work, three different novel approaches are presented to store personal data obtained from intelligent video surveillance systems in an efficient and secure way. The storage process of this data poses a number of challenges e.g. storage optimization, query performance, security management, access control and performance management. Each of the proposed technique is evaluated and analyzed with respect to the above-mentioned challenges. Field test results showed that each of the techniques can be successfully applied to hide/conceal privacy related data with a maximum storage as well as retrieval performance.

Yonghua Xiong, Zhihao Cheng, Keyuan Jiang and Chengda Lu, Min Wu [7], The data centers of cloud video surveillance (CVS) systems based on Hadoop have a couple of common problems such as large energy consumption, low power utilization, etc. Addressing the issue of reducing energy consumption while guaranteeing quality of service, we propose an energy-aware workload balancing method for efficient data storage management in cloud video data centers. A dynamic adjusting algorithm is designed to control the running status of nodes in the data centers according to the access frequency of video data blocks for the purpose of reducing the energy consumption; in order to eliminate the potential influence on the service quality posed by the changes of running status of nodes, the workload balancing between nodes in ring network topology is executed; a nonlinear programming model is established to obtain the minimum number of data blocks transferred during the workload balancing. Experimental results in the GridSim simulation environment show that the proposed method can achieve more energy saving and better performance than the original Hadoop.

GeethaBala P, Jayashree Padmanabhan, and Rajkumar S [8], Smart and innovative trends towards digital India led to data explosion, while many cloud and network applications require smart data management. Storing big data generated in volumes by smart devices and social networks is a challenge, though enhanced storage facilities and storage devices keep coming as each facility requires some overheads or other in maintaining, retrieving and transmitting data. Next generation computing involves vast data handling requirements for which effective storage representations are needed. In this paper an optimal data representation technique based on probability-based encoding is proposed, which can be used for efficient storage and communication of large data. The technique has been tested on various data types and the effectiveness on storage and time are analyzed and presented.

Iulia-Antonia BÎRLOG, Dumitru-Marius BORCAN, George-Manuel COVRIG [9], This paper is meant to describe the interaction between the main components of an IoT system. As the Internet of Things is gaining increasing attention, the overall purpose of the study is to analyze the procedure of transforming signals into processable data. To offer a better under-standing of the complexity this modern concept involves, the research guides the readers to-wards its wide applicability, depicting the main technologies included in both hardware and software components. While these elements are connected and integrated together, a detailed decomposition of the factors involved needs to be illustrated in order to fully demonstrate the significant potential of this technology.

Jielin Jiang, Zheng Li, Yuan Tian and Najla Al-Nabhan [10] Cloud computing is widely used for its powerful and accessible computing and storage capacity. However, with the development trend of Internet of things (IoTs), the distance between cloud and terminal devices can no longer meet the new requirements of low latency and real-time interaction of IoTs. Fog has been proposed as a complement to the cloud which moves servers to the edge of the network, making it possible to process service requests of terminal devices locally. Despite the fact that fog computing solves many obstacles for the development of IoT, there are still many problems to be solved for its immature technology. In this paper, the concepts and characteristics of cloud and fog computing are introduced, followed by the comparison and collaboration between them. We summarize main challenges IoT faces in new application requirements (e.g., low latency, network bandwidth constraints, resource constraints of devices, stability of service, and security) and analyse fog based solutions.

M. Nagakannan, C. Johnson Inbaraj, K. Mukesh Kannan, S. Ramkumar [11] We deals with a review on applications used in IOT in this paper since in today's era IOT is one of the fast growing field the concept IOT is mainly used for connecting various devices with internet by using IOT. For connecting and using IOT into devices we make applications. In this paper we are going to see what the applications that are used by IOT are. Since it is inessential to say that current advertising around the IOT is enormous. In this era everyday a company announces a new IOT based product under different field. The main mission in the paper is providing an outlook about IOT techniques and its Applications.

Mohammed Al Ja'afreh, Hikmat Adhami, Alaa Eddin Alchalabi, Mohamed Hoda, Abdulmotaleb El Saddik [12] Due to the outbreak of Covid-19 pandemic, activities in most sectors- be it business, education or even healthcare- are taking place in an online rather than in an inline style, and as a result, Internet traffic has increased drastically. Recent studies have highlighted that internet traffic has grown by 70% to 300% since March 2020. According to a recent CNN news article, popular content providers such as Netflix and YouTube are slowing down in NorthAmerica and Europe to keep the internet from breaking. With that being addressed, the existing network deployment and solutions, even with the fifth generation mobile communication (5G) partial deployment, are currently under a huge burden. This work intends to review the integration of two of the most innovative network research areas, Software-defined Networks (SDN) and the Internet of Things (IoT). The IoT aims to interface questions over the Internet while the SDN offers orchestration for network management by decoupling the control plane and the data plane. In this article, we present the state of the art of Software-defined networking and the Internet of Things discussing the integrated architectures, challenges, and designs. Also, we discuss two proposals targeting the QoS Key Performance Indicators (KPIs) in IoT via SDN mobile edge computing along with a few directions of possible research that could fill in gaps in these domains.

Jin Su Kim, Min-Gu Kim, Sung bum pan [13] Although computer-based intelligent video surveillance systems have been researched to alert users to unusual events when they occur, real-world applications of these systems are uncommon. Small-device-based intelligent video surveillance systems have been researched as a potential solution to this problem. In order to detect intruders using information learning, detect fire using color and motion data, and detect loitering and falls using human body motion, this article recommends implementing an intelligent video surveillance system based on embedded modules. 88.51% for intruder detection, 92.63% for fire detection, 80% for loitering detection, and 93.54% for fall detection were the performance metrics of the implemented algorithm. The comparison between the algorithm processing time before and after optimization revealed a 50.53% reduction.

Dhanshri Mali, R. T. Patil, Nagaraj Dharwadkar, Chaitanya R. Devale, Omprakash Tembhurne [14] The previous attendance method was RFID based. Users must carry RFID tags in order to use it. The user places cards on a reader to register their attendance, and this operates by scanning the tag. Because someone not permitted can use an authorized RFID to mark attendance, this could lead to a fraud issue. Out of all the identifying techniques currently in use, the face recognition technology found in CCTV cameras is the safest and most effective. Face recognition is applicable in research labs, banks, hospitals, schools, and colleges, among other places. By using face recognition, the challenge of taking attendance can be avoided. Taking attendance is made simple and safe with the help of this technology. This system uses facial recognition to continuously record attendance while comparing faces in the database.

Sharon C D'souza, Sandeep Benny, Shaham Abdulla C P, Sahad Abdulla C P, Albin John [15] Welfare and security are significant factors in modern society. To protect their possessions, individuals install security systems in both their homes and businesses. Everything that happens in a standard surveillance setup is captured on camera. The suggested system is a Python GUI application created in the rapidly expanding field of computer vision and using the most recent programming language. We have focused our analysis primarily on the aspects of smart surveillance that are now under observation. The high-tech expansion of computer vision currently does not include the purpose of learning more about computer vision systems. features, noise reduction, video recording, in-room visitor detection, facial recognition, and noise detection.

## III. METHODOLOGY

The methodology for implementing the SmartEye360 Attendance System integrates both frontend and backend processes to create a robust solution addressing identified challenges and objectives. Leveraging OpenCV and Haar Cascade classifiers, the system utilizes advanced computer vision techniques for real-time attendance tracking, motion and person detection, and face recognition.

**Frontend Implementation:**

1. **User Interface Design:** Design an intuitive interface allowing seamless interaction with the system, incorporating features such as live video display, attendance records, and notification settings.

2. **Live Video Feed Integration:** Integrate functionality to capture live video feeds from surveillance cameras directly into the UI, ensuring smooth streaming and real-time display.

3. **Pre-processing Integration:** Implement pre-processing techniques in the frontend to enhance captured frame quality, including noise reduction and image clarity improvement algorithms.

4. **Real-Time Display:** Enable real-time display of motion detection, face detection, and person detection results on the UI, providing immediate visual feedback to users.

**Backend Implementation:**

1. **System Initialization:** Develop backend processes to initialize the system, establishing connections with surveillance cameras for live video feed capture.

2. **Motion Detection:** Utilize OpenCV libraries to implement backend algorithms for motion detection in captured video frames, processing the feed in real-time.

3. **Face Detection and Person Detection:** Integrate Haar Cascade classifiers in the backend for face and person detection, utilizing trained models to identify faces and individuals within frames.

4. **Attendance Recording:** Develop backend functionalities to record attendance data for recognized individuals, storing time and date information in a database for analysis and reporting.

5. **Notification and Reporting:** Implement backend processes to generate real-time notifications confirming attendance and alerting authorities if needed. Optionally, integrate email notifications for higher authorities.

6. **Iterative Improvement:** Continuously test and refine backend algorithms and processes to enhance accuracy, efficiency, and reliability, incorporating user feedback for ongoing improvement.

By seamlessly integrating frontend and backend components and leveraging OpenCV and Haar Cascade classifiers, the SmartEye360 Attendance System offers an intuitive interface for real-time monitoring of attendance, motion detection, and person identification. This approach ensures ease of use while employing advanced computer vision techniques for enhanced security and management across various environments.

## IV. DESIGN DETAILS:

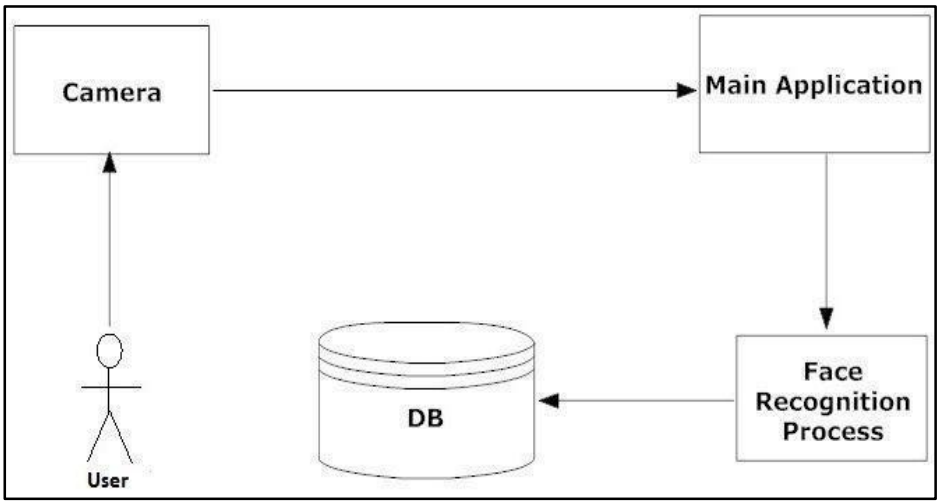


Fig 4.1: Block Diagram

The above figure 4.1 represents the block diagram of the project. It contains different blocks which are present in our project and how the blocks are connected to each other.

## V. IMPLEMENTATION RESULTS:

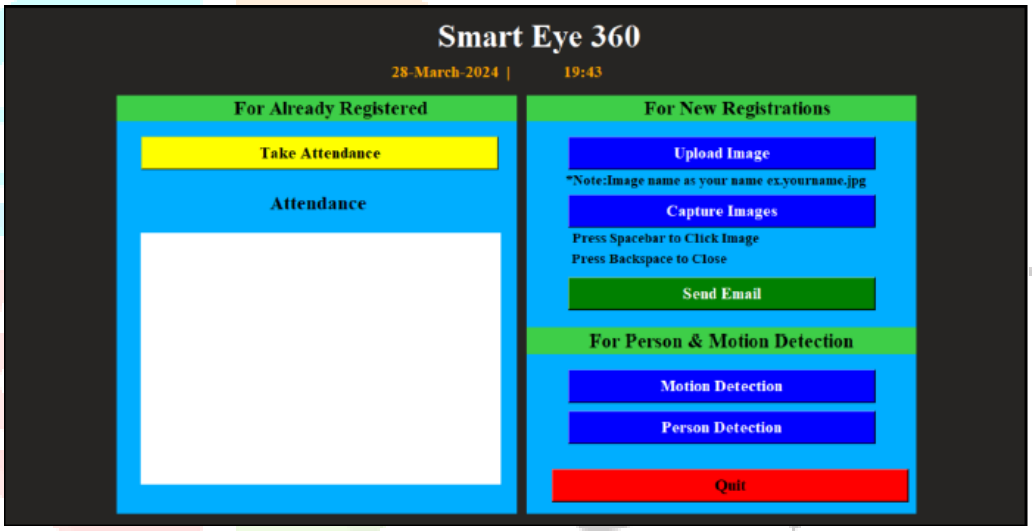


Fig 5.1: Smart Eye 360 Desktop Application Layout

Figure 5.1 Smart Eye 360 Desktop Application Layout integrates motion, person, and face detection for advanced surveillance. Users benefit from seamless data management, enhancing security and decision-making.

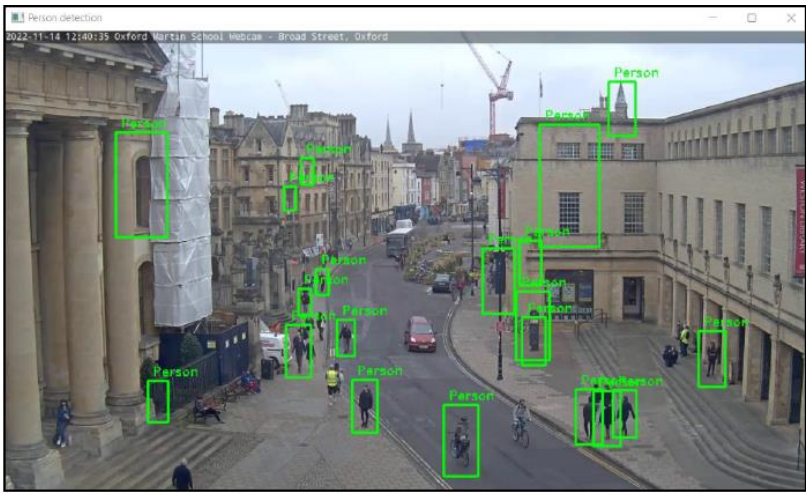


Fig 5.2: Person Detection

Figure 5.2 illustrates the process of person detection using advanced algorithms. The diagram showcases how the system accurately identifies individuals within a given scene.

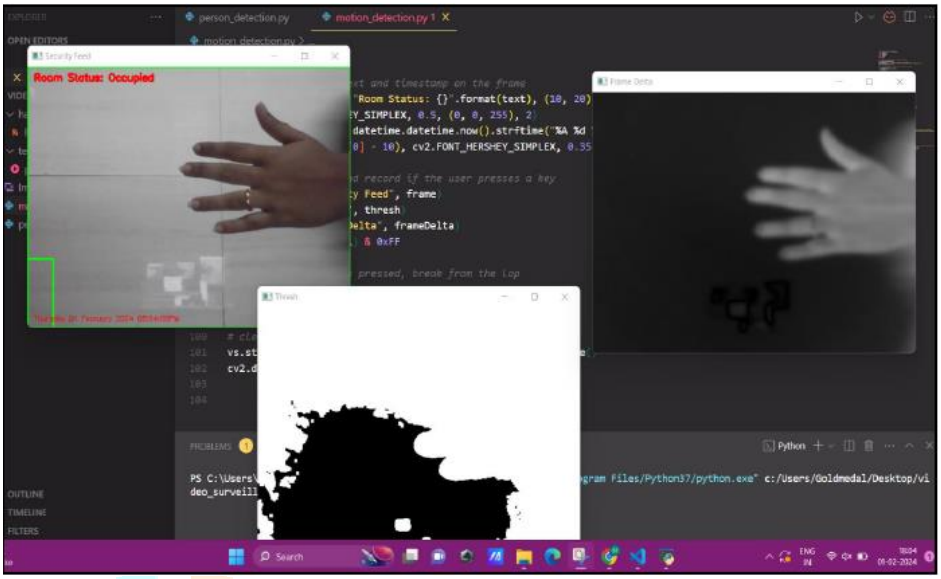


Fig 5.3 Motion Detection

Figure 5.3 displays the motion detection mechanism, illustrating how the system identifies and tracks movements in real-time. The diagram highlights the algorithm's ability to detect dynamic changes within the monitored environment.

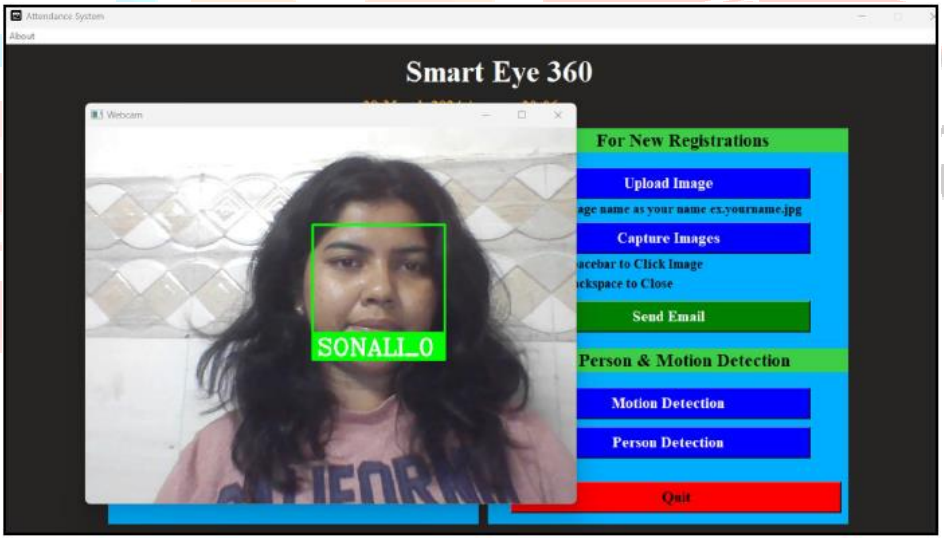


Fig 5.4: Face Detection

Figure 5.4 illustrates the process of face detection using advanced algorithms, showcasing the accurate identification of facial features within an image. This diagram highlights the robust capabilities of the system in recognizing and analyzing faces for various applications.

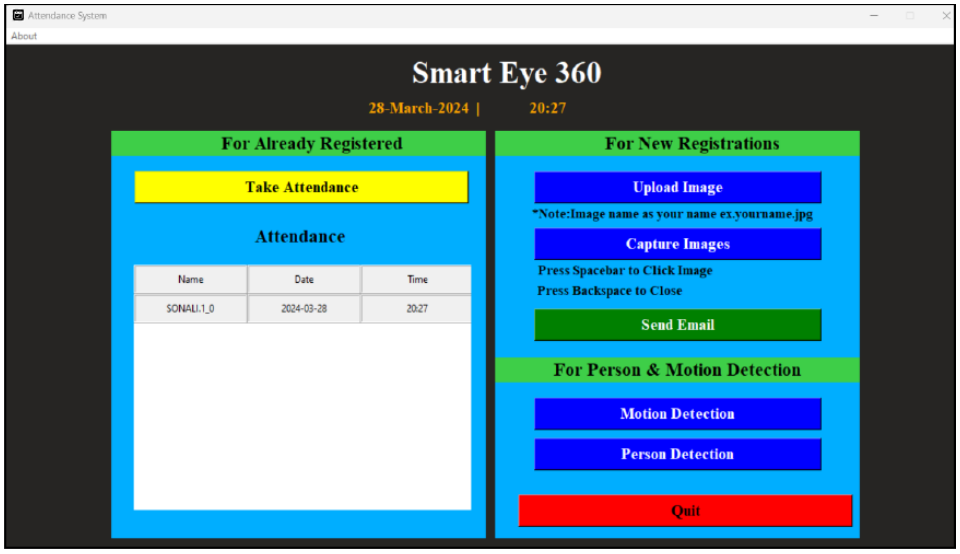


Fig 5.5: Attendance System

Figure 5.5 illustrates the Attendance System, showcasing its interface and functionality for tracking and managing attendance records efficiently. The diagram highlights the integration of facial recognition technology, offering a seamless and automated solution for attendance management.

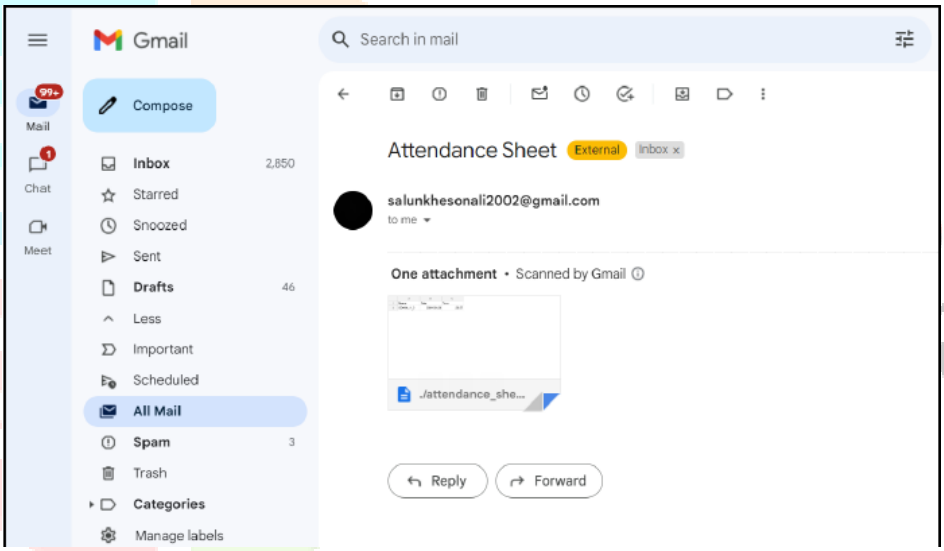


Fig 5.6: Send Email

Figure 5.6 depicts the interface for sending emails, showcasing the user-friendly design and efficient functionality. This image illustrates the seamless process of composing and sending emails within the application.

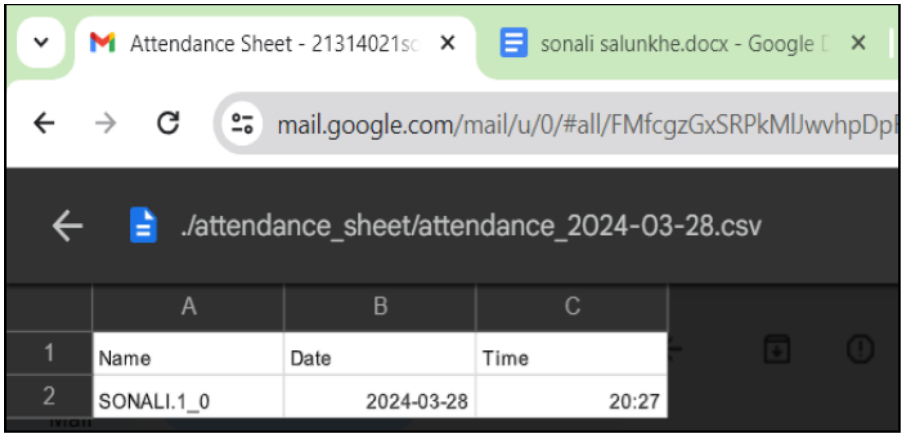


Fig 5.7: Excel Sheet

Figure 5.7 depicts an Excel sheet interface, showcasing data manipulation and organization capabilities. The image highlights the utility of Excel for managing and analyzing information efficiently.

## VI. CONCLUSION:

In conclusion, the introduction of the SMARTEYE360 system as a Smart CCTV Surveillance System heralds a transformative era in urban security, transcending the conventional boundaries of video surveillance. This project represents not just an upgrade, but a paradigm shifts towards a safer, more efficient, and interconnected urban landscape. The benefits it promises are manifold, resonating far beyond mere surveillance enhancement. SMARTEYE360 embodies the pinnacle of modern security technology, seamlessly integrating advanced features such as deep learning algorithms, energy-efficient IoT devices, and robust authentication mechanisms. Its implementation marks a significant step towards the realization of smarter, more resilient cities, where security is not just a function, but a foundational element of urban life. In essence, SMARTEYE360 is not just a system; it is a testament to the transformative power of innovation, shaping the cities of tomorrow into interconnected, intelligent ecosystems where safety, efficiency, and sustainability converge.

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