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Virtual Logger: A Cognitive Framework for Proxy-Proof Attendance Automation and Intelligent Presence Logging

M. Pallavi[1], B. Bhanusri[2], K. Tarangini[3], K. Girish Kumar[4], S. Bashira[5]
[1]*Assistant Professor of CSE Dept, Gayatri Vidya Parishad College of Engineering, Visakhapatnam, Andhra Pradesh*
[2, 3, 4, 5]*UG Students, Department of CSD, Gayatri Vidya Parishad College of Engineering, Visakhapatnam, Andhra Pradesh*

Abstract: ***Attendance management is an essential activity in educational and other environments. Conventional attendance management systems using manual attendance sheets, RFID cards, or even biometric methods like fingerprints face problems of accuracy, proxy attendance, hygiene issues, and higher maintenance costs. To overcome these problems, this paper proposes an intelligent attendance management system using virtual loggers with face recognition technology. In this paper, we propose an attendance management system using face recognition technology with the help of YOLOv8 face detection and FaceNet face recognition. The system is implemented using a Flask-based web server with a React-based web interface. SQLite is used to store attendance data. One of the major advantages of this system is that it includes an automated parent notification system. Parents would be immediately notified of their child's attendance or absence. In this paper, we have also compared the accuracy of our system with other conventional attendance management systems. From the results, it is clear that our system is more accurate and scalable compared to other attendance management systems. It is also immune to proxy attendance. Hence, this system is very efficient and reliable.***

Keywords: Face Recognition, Attendance Management System, YOLOv8, FaceNet, Deep Learning, Computer Vision, Real-Time Monitoring, Proxy Prevention, Parent Notification System, Web-Based Application.

I. INTRODUCTION

Monitoring attendance is an important aspect in educational institutions and organizations, as it has a significant impact on academic and work discipline. Traditional methods of monitoring attendance using registers, RFID cards, and fingerprint-based biometric devices are popular due to their simplicity. Despite this popularity, there are many disadvantages to traditional methods of monitoring attendance. For example, traditional methods are often susceptible to proxy attendance, require physical contact, and are costly to maintain. Furthermore, they do not allow for real-time monitoring and instant reporting. In addition, issues regarding hygiene and security have become more important in modern times. Advances in computer vision and deep learning have made it possible to develop new methods of monitoring attendance using facial recognition-based automated systems. Although face-based methods are more efficient and provide a better user experience compared to traditional methods, they are often unable to perform well under practical conditions, considering issues such as varying illumination, occlusions, and camera angles. Furthermore, there is a lack of effective communication between schools and parents regarding students' attendance.

To mitigate these issues, this paper introduces Virtual Logger, an intelligent attendance management system utilizing real-time facial recognition using YOLOv8 and FaceNet. The system is built using a Flask-based backend, React-based live monitoring and analytics, and SQLite- based secure data storage. The novelty of this system is the parent notification system, which sends notifications instantly to parents regarding students' attendance status. The proposed system is built using deep learning and full-stack web development, ensuring a robust and proxy- proof system for modern education and business scenarios.

II. LITERATURE SURVEY

In the work titled "A GPS-based Face Attendance Register System using Android Applications stored in the Cloud" [1], the authors proposed a mobile-based attendance system in which students are required to mark their attendance by clicking a selfie and using GPS-based verification. The data is recorded and stored in a cloud environment. Such a system is beneficial in that it reduces human intervention and makes learning easier and convenient in a distributed environment. Nevertheless, there are many risks and vulnerabilities in this proposed work, such as GPS spoofing, fake selfies, and manipulation of identities.

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In addition, this work is completely based on internet connectivity and user compliance. Moreover, there is no provision for live classroom monitoring and verification.

The study *"Face Recognition Based Smart and Robust Attendance Monitoring using Deep CNN"* [2] presents an automated attendance system that employs Histogram of Oriented Gradients (HOG) for face detection and deep Convolutional Neural Network (CNN) embeddings for face recognition. Experimental results showed improved recognition accuracy compared to traditional biometric systems and effective reduction of proxy attendance. Nevertheless, the system experienced performance degradation under varying illumination conditions, partial face occlusion, and increased camera distance. In addition, the approach faces scalability challenges in large classrooms and does not support real-time analytics or integrated notification services.

In "Smart Fingerprint Biometric and RFID Time-Based Attendance Management System" [3], the authors proposed a contact-based attendance management system that utilized a fingerprint-based biometric and an RFID card-based attendance management system. Such a system is being widely used in many institutions due to its simplicity, accuracy, and low setup costs. Nevertheless, it is not a suitable solution in terms of hygiene, as it involves a lot of physical contact. Moreover, it is also not a suitable solution in terms of proxy attendance, as multiple students can use a single RFID card. In addition, there is a lack of security in attendance data and a lack of real-time reporting, remote access, and parent/guardian notification. In summary, all the existing attendance management systems fail to provide a unified solution that can provide a real-time attendance management system, high accuracy in a changing environment, scalability, and transparency in communication. Such a problem statement is being addressed in this paper with the proposed Virtual Logger.

Literature Survey On Virtual Logger

Platform / System	Description	Limitations	How Virtual Logger improves
Biometric Attendance Systems[3]	It is a touch-based attendance tracking system using fingerprint scanners or RFID cards, widely used for its simplicity and low cost.	Requires physical contact, raising hygiene issues; can be manipulated using shared IDs; lacks remote monitoring and real-time reporting.	Virtual Logger uses contactless facial recognition with YOLOv8 and FaceNet for real-time, hygienic, and automated attendance tracking.
Face Recognition Based Smart and Robust Attendance Monitoring using Deep CNN[2]	The paper presents a Deep CNN and SVM-based smart attendance system that detects and recognizes student faces using HOG and CNN embeddings to automate attendance and prevent proxies.	The system's accuracy drops with increased camera distance and faces challenges under varying lighting, occlusion, and large-scale real-time conditions.	Virtual Logger uses YOLOv8 and FaceNet for accurate detectionz, duplicate prevention, and offers a full-stack React web dashboard for live monitoring.
A GPS-based Face Attendance Register System using Android Applications stored in the Cloud[1]	These apps use GPS and selfies to record attendance via mobile phones.	Prone to GPS spoofing and fake selfies, dependent on user compliance and network, and lacks live monitoring or automated alerts.	Virtual Logger uses real-time facial recognition from live video, includes instant parent notifications, and enables live tracking via web dashboard.

Table .1. Literature survey

III. PROPOSED SYSTEM

This paper introduces Virtual Logger, which is a real-time, touchless attendance management system based on deep learning algorithms and face recognition. The proposed system can automatically record attendance using live video feeds and can prevent proxy attendance using accurate face detection and recognition. The system can utilize YOLOv8 for face detection, FaceNet for face recognition, and a web-based approach to provide high accuracy, scalability, and transparency. The system can also provide an automated parent notification system to ensure high accountability.

A. System Overview

The system can utilize live video feeds from a webcam or IP camera installed in the classroom or workplace. The video can be processed frame by frame using YOLOv8, which can provide accurate face detection in real-time. The detected face can be passed to FaceNet, which can provide unique face embeddings for accurate face recognition and identity verification. The system can verify this data with the records available in the database and provide accurate attendance status. The verified data can be recorded into an SQLite database using a Flask- based backend, and administrators can view real-time data using a React-based UI. The system can also provide an automated parent notification system.

B. Face Detection and Representation

Face detection is performed using YOLOv8, which efficiently identifies and localizes faces in real time, even under varying lighting conditions and partial occlusions. Once detected, facial regions are preprocessed and passed to the FaceNet model. FaceNet encodes each face into a 512-dimensional embedding vector, capturing discriminative facial features. These embeddings provide a compact and robust representation for accurate identity matching while minimizing computational overhead.

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C. Identity Matching and Decision Process

The generated facial embeddings are compared with stored embeddings in the database using a similarity threshold. If a match is found, the system marks the individual as present and prevents duplicate entries for the same session. If no valid match is detected, access is denied and attendance is not recorded. This decision- making process ensures proxy-proof attendance and prevents unauthorized access.

D. Data Management and Notification Module

Attendance records, including identity, timestamp, and status, are securely stored in an SQLite database managed by the Flask backend. The React-based admin dashboard provides real-time visualization, analytics, and attendance reports. A dedicated parent notification module automatically sends alerts regarding student attendance or absence, improving communication, transparency, and accountability between institutions and parents.

E. Advantages of the Proposed System

1) Contactless and hygienic attendance tracking
2) High accuracy through YOLOv8 and FaceNet integration
3) Real-time attendance logging and monitoring
4) Proxy-proof and duplicate-resistant system
5) Automated parent notification for enhanced transparency
6) Scalable and lightweight architecture suitable for real-world deployment.

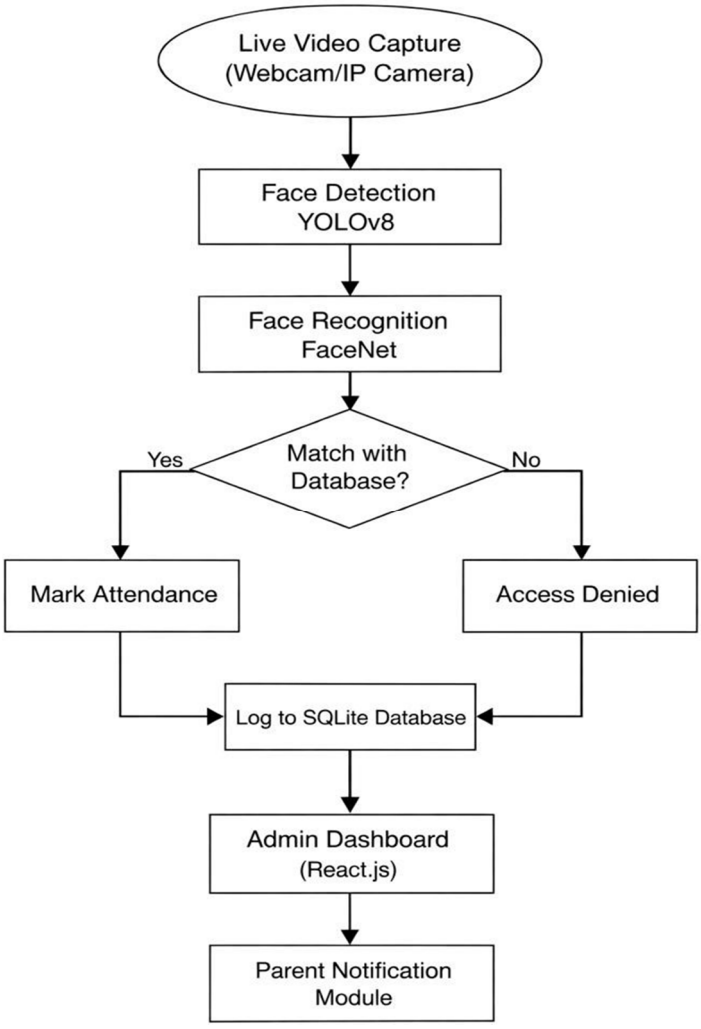


Fig. 1. Virtual logger architecture

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IV. METHODOLOGY

The proposed Virtual Logger system follows a modular architecture that integrates face detection, face recognition, backend processing, database management, and notification services. The overall methodology ensures accurate, real-time, and proxy-proof attendance recording.

A. System Architecture Overview

The system is designed as a client–server architecture consisting of a camera module, a deep learning processing unit, a backend server, and a web-based frontend interface. Live video frames are captured through a webcam or IP camera and forwarded to the backend server for processing. Detected and recognized faces are matched with stored records, and attendance is marked automatically in the database.

The frontend dashboard provides real-time visualization and analytics, while the notification module sends attendance updates to parents.

B. Face Detection Using YOLOv8

YOLOv8 (You Only Look Once, Version 8) is employed for real-time face detection due to its high accuracy and low latency. The model processes each video frame and identifies face regions using bounding boxes. YOLOv8's single-stage detection architecture enables efficient handling of multiple faces simultaneously, even under varying lighting conditions and partial occlusions. Only the detected face regions are forwarded to the recognition module, reducing computational overhead and improving system performance.

C. Face Recognition Using FaceNet

For identity verification, the system utilizes FaceNet, a deep convolutional neural network that generates unique 512-dimensional facial embeddings for each detected face. These embeddings represent discriminative facial features and are compared with stored embeddings using a distance metric such as Euclidean distance. If the similarity score falls below a predefined threshold, the identity is confirmed, and duplicate entries are avoided. This approach ensures high recognition accuracy and prevents proxy attendance.

D. Backend Processing with Flask API

A Flask-based RESTful API acts as the core backend of the system. It manages video frame processing, model inference, face matching, and attendance logic.

The backend also handles secure communication between the deep learning models, database, frontend interface, and notification services. Flask's lightweight and scalable nature makes it suitable for real-time applications.

E. Attendance Database Management

Attendance records, user details, facial embeddings, and timestamps are stored in an SQLite database. The database is structured to prevent duplicate attendance entries for the same individual within a predefined session. Secure storage and controlled access ensure data integrity and privacy.

F. Frontend Visualization Using React

The user interface is developed using React.js, providing a responsive and interactive dashboard. The frontend displays live camera feeds, recognized identities, attendance status, and analytics in real time. This enables administrators to monitor attendance efficiently and make informed decisions.

G. Parent Notification Module

A key feature of Virtual Logger is the automated parent notification module. Once attendance is recorded, the system triggers instant notifications to parents via predefined communication channels. This feature enhances transparency, improves accountability, and ensures timely awareness of student attendance status.

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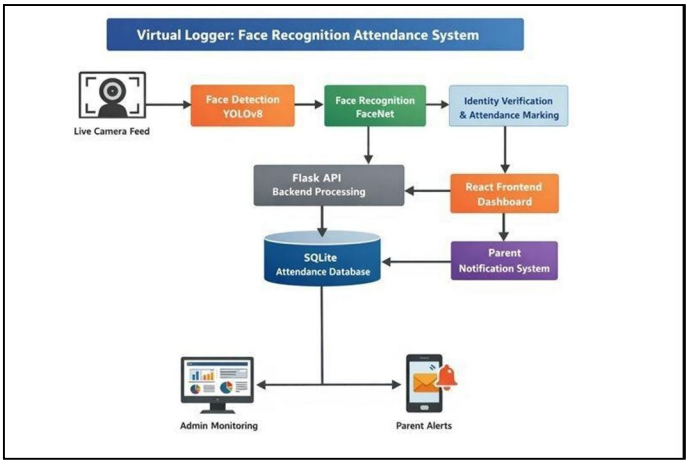


Fig. 2. Functional Flow of Virtual Logger

V. EXPERIMENTATION

A. Experimental Environment

The proposed Virtual Logger system was implemented using Python-based deep learning and web technologies. The system utilizes YOLOv8 for real-time face detection and FaceNet for facial feature extraction and recognition. A Flask-based backend manages model inference and attendance processing, while a React.js dashboard provides real-time monitoring and visualization. Attendance data and facial embeddings are stored in an SQLite database. The system was tested using a standard webcam to capture live video streams in real-time.

B. Data Collection

Since the system is designed for real-time attendance monitoring, a custom dataset was created by capturing facial images of registered individuals through a webcam. Multiple images of each individual were collected under different lighting conditions and facial orientations to improve recognition reliability. These images were pre- processed and converted into facial embeddings using the FaceNet model, which were then stored in the database for identity verification.

C. Implementation Procedure

The experimentation process begins with capturing live video frames through a webcam installed in the classroom or workplace environment. Each frame is processed using the YOLOv8 model to detect faces. The detected face regions are then passed to the FaceNet model to generate unique facial embeddings. These embeddings are compared with stored embeddings in the database using a similarity threshold. If a match is found, the system records the attendance along with the timestamp and displays the result on the web dashboard.

D. System Evaluation

The proposed system was evaluated based on its ability to detect faces accurately, recognize registered individuals, and record attendance in real time. Experiments were conducted under different environmental conditions such as varying lighting levels, multiple faces in a frame, and different camera distances. The system demonstrated reliable performance in detecting and recognizing faces while preventing duplicate attendance entries.

VI. RESULTS AND ANALYSIS

This section presents the results obtained from the implementation and testing of the proposed Virtual Logger system. The evaluation focuses on analysing the performance of the face detection and recognition modules as well as the overall functionality of the attendance management system. The system was tested using real-time webcam input to simulate a classroom environment with registered users. Various aspects such as detection accuracy, recognition reliability, attendance logging efficiency, and system response time were observed. The results demonstrate the effectiveness of the proposed system in providing a secure, automated, and contactless attendance solution compared to traditional attendance methods.

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A. Face Detection Performance

The face detection module uses the YOLOv8 model to detect faces from live video frames. During testing, the system successfully detected multiple faces simultaneously with high accuracy under different lighting conditions. The detection model produced stable bounding boxes around detected faces and maintained consistent performance even when users slightly changed their head position.

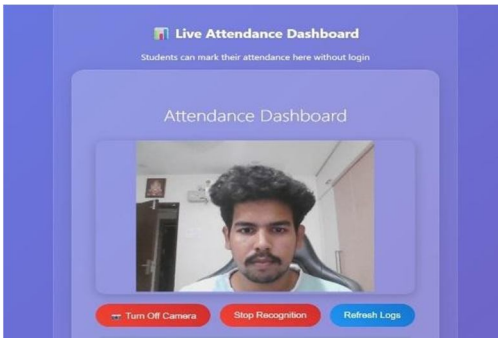


Fig.3. Virtual Logger Module

B. Face Recognition Accuracy

After detecting the face, the FaceNet model generates a 512-dimensional embedding vector which is compared with stored embeddings in the database. If the similarity score is below the predefined threshold, the identity is verified and attendance is recorded. During testing, the system successfully recognized registered users with high accuracy and prevented incorrect matches.

$$\text{Accuracy} = \frac{(TP + TN)}{(TP + FP + TN + FN)}$$

$$\text{Accuracy} = \frac{\text{Correct predictions}}{\text{Total predictions}}$$

C. Core Module Evaluation

Module	Technology	Performance Observation
Face Detection	YOLOv8	Successfully detected multiple faces simultaneously
Face Recognition	FaceNet	Generated 512-dimensional embeddings to verify identities with the high accuracy
Attendance Logging	SQLite/Flask	Records are created almost instantly after recognition and the system successfully prevents duplicate entries

Table. 2 Module evaluation

D. Attendance Logging Efficiency

Once a user is recognized, the system automatically records the attendance in the SQLite database along with the timestamp. The system also prevents duplicate attendance entries for the same user within a single session. The attendance marking process occurs almost instantly after successful face recognition.

E. Dashboard Monitoring and Analytics

The React-based web dashboard provides real-time visualization of attendance data. Administrators can view the list of present students, attendance percentages, and daily attendance statistics. The dashboard updates dynamically whenever new attendance is recorded, allowing administrators to monitor attendance activity in real time.

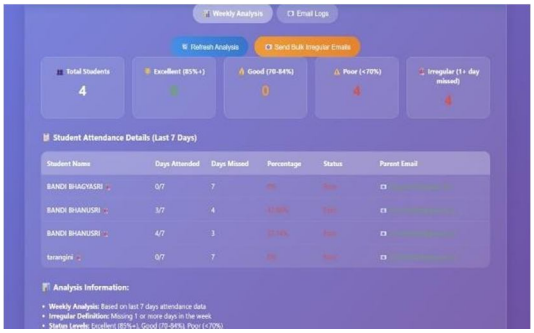


Fig. 4 Dashboard of virtual logger

F. Parent Notification System Performance

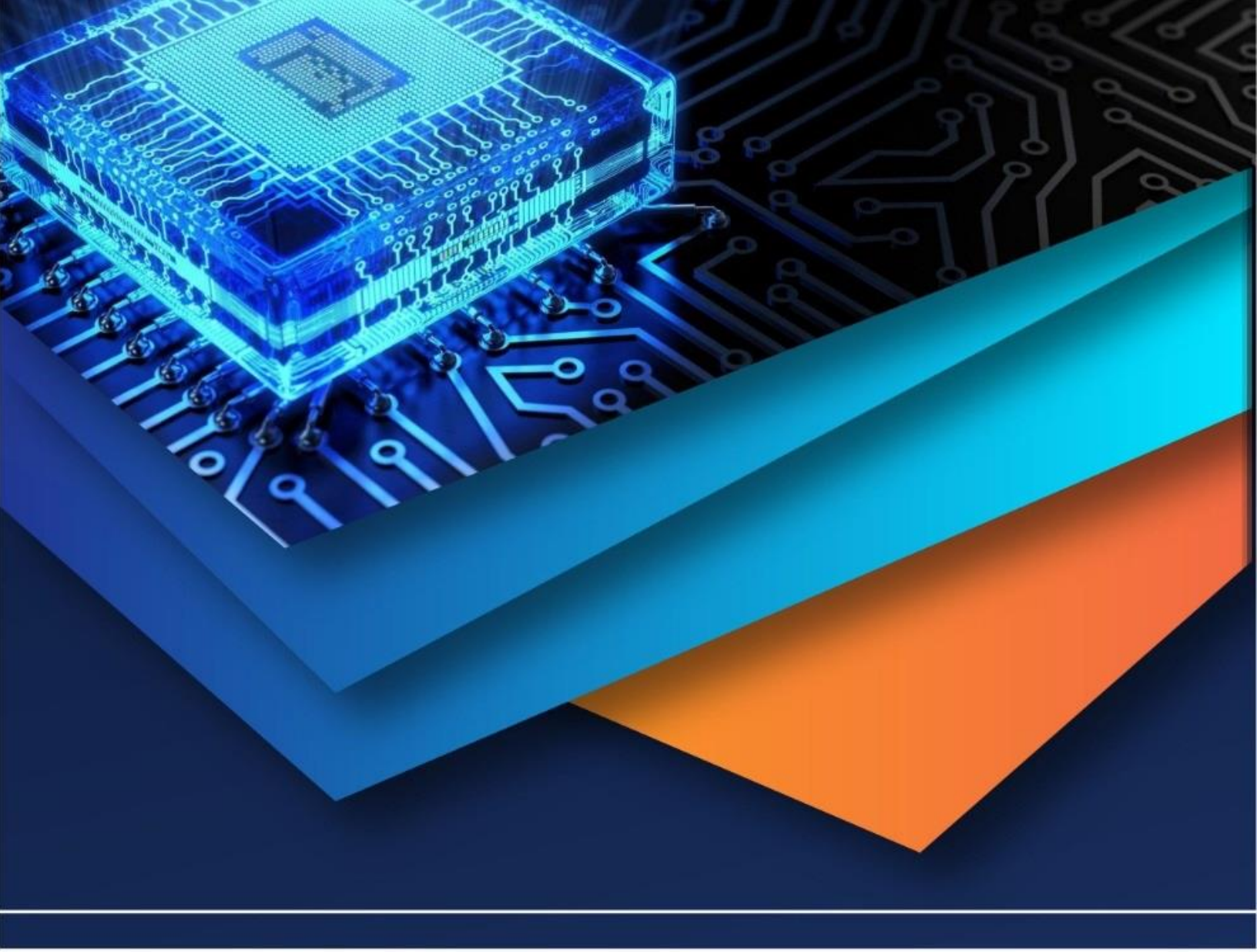
The automated parent notification module sends email alerts when irregular attendance patterns are detected. The notification system was tested by simulating absence cases, and emails were successfully delivered to registered parent email addresses.

VII. CONCLUSION

In this paper, a smart attendance management system called Virtual Logger was proposed to automate the traditional attendance process using face recognition technology. The system integrates YOLOv8 for real-time face detection and FaceNet for accurate face recognition, enabling reliable identification of registered users through live webcam input. The developed system successfully records attendance automatically, prevents duplicate entries, and stores attendance data securely in a centralized database. Additionally, the system provides an administrative dashboard for monitoring attendance statistics and includes an automated parent notification module to improve communication between institutions and guardians. Experimental results demonstrate that the proposed system achieves high detection and recognition accuracy while maintaining fast response time and efficient real-time performance. Compared with traditional manual or biometric attendance systems, the proposed approach offers a contactless, secure, and scalable solution for modern educational environments.

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