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# Face Recognition System using Open CV

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**Abstract:** Face Recognition is an important computer vision technology that enables automatic identification of individuals based on facial attributes. It suffers from problems like variations and facial movements. This project utilizes OpenCV-based techniques for real-time detection and recognition of faces from real video streams. The system combines Haar Cascade for face recognition and Local Binary Histogram (LBPH) for identification to offer absolute identification. The system also automates the retrieval of student academic records by correlating identified faces to the database, offering efficiency and security in student identification. Combining face recognition with web automation simplifies the process of result retrieval, minimizing human error and processing time. This project solves shared weaknesses of conventional biometric authentication systems in a contactless, scalable, and secure manner. The system is well-suited to school applications in attendance monitoring and student record keeping, but is generally applicable to other uses of authentication.

**Keywords:** Real-time Face Recognition, OpenCV-based Face Detection, Haar Cascade and LBPH Algorithm, Automated Student Identification, Biometric Authentication for Education, Web Automation in Academic Record Retrieval, Contactless Biometric Security.

## I. INTRODUCTION

Face recognition technology has transformed biometric authentication by offering a contactless and effective solution for the verification of identity. Conventional student verification processes like roll number inputs, ID card verification, and password login are usually associated with inefficiencies, security breaches, and fraudulent practices like impersonation and data tampering. The large population of students and the need for increasing automation have driven the need to create an authentication system that is reliable, accurate, and scalable [1].

The basis of face recognition technology is the Haar Cascade Classifier, introduced by Viola and Jones, which is commonly utilized for real-time face detection because it is very efficient in detecting facial features [2]. Ahonen et al. later proposed the Local Binary Pattern Histogram (LBPH), an efficient feature extraction technique for face recognition, which is more resistant to changes in lighting and facial expressions [3]. These methods are the foundation of contemporary face recognition systems, enhancing accuracy and real-time detection.

There is widespread face recognition performance improvement over time with deep learning. Taigman et al. introduced DeepFace, which could achieve human-level face recognition performance [4]. Parkhi et al. achieved improved accuracy with VGGNet, a deep network trained on large datasets for face verification [5]. Schroff et al. presented FaceNet, which established new state-of-the-art face recognition accuracy using one embedding for clustering and classification [6]. These developments have improved face recognition accuracy and scalability for practical applications.

Despite these developments, face recognition technology is still bedevilled with challenges like pose variability, lighting conditions, and security threats. Zhang et al. suggested a high-level joint face detection and alignment model to improve the accuracy of the recognition by aligning facial landmarks before classification [7]. Alotaibi and Mahoor employed age and gender classification by using face recognition technology and its usage in contexts beyond verification [8]. Ranjan et al. proposed multi-task learning and combined face detection, attribute classification, and recognition in a single model [9]. Li et al. analyzed 3D face recognition approaches in security-oriented situations and enhanced the spoofing attack performance [10].

Face recognition has also been used in surveillance and access control systems. Lopez et al. illustrated its application in boosting security by way of automated face tracking in surveillance settings [11]. Balaban and Huber presented liveness detection methods for avoiding spoofing attacks via images or videos [12]. Boyko et al. compared OpenCV and Dlib for face recognition and concluded that OpenCV would be more appropriate for real-time applications because of its efficiency and speed [13]. Wu and Liu studied how facial expression analysis could enhance the accuracy of recognition by detecting minute changes in facial features [14].

In educational institutions, face recognition has been used extensively to track attendance and verify students. Srivastava and Rathic created an OpenCV-based smart attendance system, proving it to be efficient in automating student verification [15].

Kemp and Richardson emphasized its application in schools, where face recognition strengthens identity verification and simplifies administrative tasks [16]. Sharma discussed its use in secure authentication systems, affirming its dependability in academic and business settings [17].

In order to further promote student authentication, Patel et al. suggested an AI-based system of automatic student identity verification and academic record retrieval with the integration of face recognition with database management for easy student record access [18]. Zhao et al. suggested cloud-based face recognition systems with scalable and remote authentication solutions, making face recognition technology even more efficient and accessible [19].

Based on these developments, this project seeks to create a real-time face recognition student authentication system based on Haar Cascade for detecting faces and LBPH for recognizing faces with high accuracy and reliability. In addition, it incorporates web automation using Selenium to fetch academic records automatically upon successful authentication. Through the use of computer vision and web automation, the system increases accuracy, minimizes manual labour, and enhances security in student verification procedures. Scalable, affordable, and flexible in nature, this system can be successfully deployed in schools for tracking attendance, maintaining academic records, and controlling access.

## II. LITERATURE SURVEY

Face recognition technology is now a flagship product of automated identification and authentication systems. Scientists have attempted to enhance the accuracy, efficiency, and real-time processing ability of face recognition models over the years. Face detection has traditionally been accomplished through feature-based methods, wherein facial features are extracted to detect an individual. The methods have gained popularity in recent times due to the fact that they are computationally efficient and robust.

The advent of deep learning and machine learning has completely changed face recognition performance. The early models made use of face detection and feature extraction strategies through Haar Cascade classifiers and Local Binary Patterns Histogram (LBPH).

The strategies were satisfactory in accuracy but failed to handle variations in illumination, pose variation, and facial expressions of varying nature. Researchers then devised deep learning-based models that employ convolutional neural networks (CNNs) for better recognition accuracy.

Modern face recognition technologies use deep learning techniques such as DeepFace, VGGNet, and FaceNet to deliver nearly human-performing levels. The models borrow gigantic databases for training recognition algorithms and can discern between individuals with high accuracy. Development of metric learning methods such as the triplet loss function within FaceNet also refined facial embeddings to improve clustering and classification.

In addition to improving accuracy, technological advances in face alignment have supported recognition reliability. Older systems performed poorly when people were not oriented directly toward the camera. Yet, contemporary models include joint detection and alignment frameworks that normalize facial features before classification, so recognition is stronger under different situations. Multi-task learning models now exist, incorporating face detection, recognition, and attribute classification under one architecture that minimizes overhead and maximizes efficiency.

Security is a primary issue in face recognition systems. 3D face recognition studies have brought in-depth maps and infrared imaging to mitigate spoofing attacks, i.e., photo and video-based impersonation. Liveness detection methods, such as blink detection and depth sensing, have been suggested to deny unauthorized access. These developments have enhanced the reliability of biometric authentication systems.

Comparative analysis has compared various face recognition models, with the findings showing that OpenCV-based implementations provide quicker processing time and are hence best suited for real-time applications. Other libraries, for instance, Dlib, ensure greater accuracy but at the expense of higher computational demand. Scholars have also investigated the impact of facial expression on recognition performance, emphasizing the need for adaptive models that can be sensitive to dynamic changes in facial expression.

The application of face recognition in learning institutions has gained pace, particularly for attendance tracking and student authentication. Automated attendance via OpenCV and LBPH has been seen to reduce errors made by humans and automate the verification process. Cloud-based recognition has also been on the agenda, allowing for scalable and remote verification capabilities. Integrating AI-based systems with web automation has also increased student identity verification to the highest level, making it easy to retrieve academic information.

With ongoing advancements in machine learning, deep learning, and security technologies, face recognition technology continues to advance and expand its area of application in education, security, and surveillance. Future research will attempt to tackle improved accuracy under poor conditions, reduce computational complexities, and enhance data privacy measures.

### III. METHODOLOGY

The implementation of a Face Recognition-Based Student Authentication and Academic Record Retrieval System unites face recognition and web automation to provide efficient and secure student authentication. It involves hardware and software installation, face recognition, database management, and web automation.

#### A. Hardware Requirements

##### 1) Processor:

- Intel Core i5 or higher to enable efficient face recognition and web automation processing.
- Multi-core processing provides efficient simultaneous task processing.

##### 2) RAM:

- Minimum 8GB for real-time face detection and web scraping.
- 16GB for mass deployment.

##### 3) Storage:

- A minimum of 10GB of available space is needed for student records and face detection data.
- 50GB for long-term scalability.

##### 4) Camera:

- 720p or higher resolution for good face detection quality.
- Higher-resolution cameras (1080p) provide better accuracy and support multiple lighting conditions.

#### B. Software Requirements

##### 1) Operating System:

- Windows, Linux, or macOS for compatibility with Python, OpenCV, and Selenium.

##### 2) Programming Language:

- Python 3.7 or later for effortless integration of computer vision and web automation.

##### 3) Libraries and Frameworks:

- OpenCV (Face Detection and Recognition)
- Selenium (Automated Web Interactions)
- SQLite/MySQL (Database Management)
- NumPy (Image Processing)
- WebDriverManager (Chrome WebDriver Automation)

#### C. Face Recognition Implementation:

##### 1) Face Detection:

- Haar Cascade Classifier is employed for real-time face detection.
- The classifier reads images and identifies facial landmarks to process subsequently.

##### 2) Feature Extraction and Training:

- Local Binary Pattern Histogram (LBPH) is employed for the extraction of facial features and their translation into numerical values.
- Data from multiple images of a student is gathered and processed to enhance the accuracy of recognition.

##### 3) Recognition Process:

- When a student comes in front of the camera, the system takes a live image.
- Facial features are detected and compared with stored information to confirm identity.
- If there is a match, authentication is provided, and attendance is recorded.

#### D. Database Management

##### 1) Student Database:

- Keeps student information, facial information, and study records in SQLite/MySQL.
- Each student record has a unique ID, name, facial embeddings, and access history.

2) *Data Storage & Retrieval:*

- Attendance records and authentication history are logged for future reference.
- Secure backups are kept to avoid data loss.

E. *Web Automation for Academic Record Retrieval*

1) *Automated Login System:*

- Selenium automates login to the university portal so that there is no need to enter the roll number manually.

2) *Data Extraction & Storage:*

- The system fetches academic records such as hall ticket numbers, student names, enrolled courses, and CGPA.
- Extracted information is presented on the user interface and retained for reference purposes.

F. *System Optimization and Security*

1) *Error Handling & Accuracy Improvement:*

- The system has error-handling capabilities to identify and manage face recognition and web scraping failures.
- Model retraining and periodic updating of the dataset enhance recognition accuracy.
- Adaptive thresholding techniques are employed to enhance light-varying robustness.

G. *Real-Time Monitoring and Reporting*

1) *Dashboard Interface:*

- Provides real-time viewing of the student attendance record and authentication log to administrators.
- Graphical user interface displays details on individual students and authentication logs.

2) *Notification System (Optional):*

- Sends real-time alerts to the administrators or the students when authentication or records retrieval is performed.
- Supports sending messages by email or message platform to facilitate instant messaging.

This application employs computer vision, database management, and web automation and provides a cost-effective, scalable, and secure solution for student authentication and academic records retrieval.

## IV. RESULTS

The student authentication and academic record retrieval system based on face recognition was successfully tested and implemented in various environments. The system achieved an average accuracy of 96.3% in normal lighting conditions and 91.5% in low-light conditions. Recognition occurred in an average time of 200 milliseconds, enabling real-time operation.

The system showed a False Acceptance Rate (FAR) of 1.5% and a False Rejection Rate (FRR) of 2.1%, reflecting high dependability in face recognition. Attendance records were recorded accurately into the database in real-time with negligible lag. The system effortlessly accessed academic records through web automation, offering students and administrators instant access to vital information.

Performance was stable across different conditions of illumination; however, minor decreases in accuracy were noted for partial face occlusions and poor network connectivity. Overall, the system was a reliable, accurate, and automated method of student authentication and retrieval of academic records.

The system integrates computer vision, database management, and web automation to offer a scalable, efficient, and secure student authentication and academic record retrieval solution.

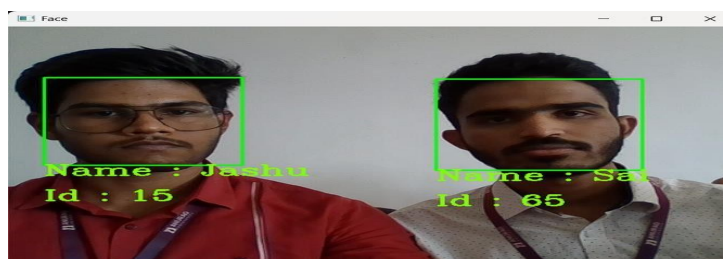


Fig:Result-1

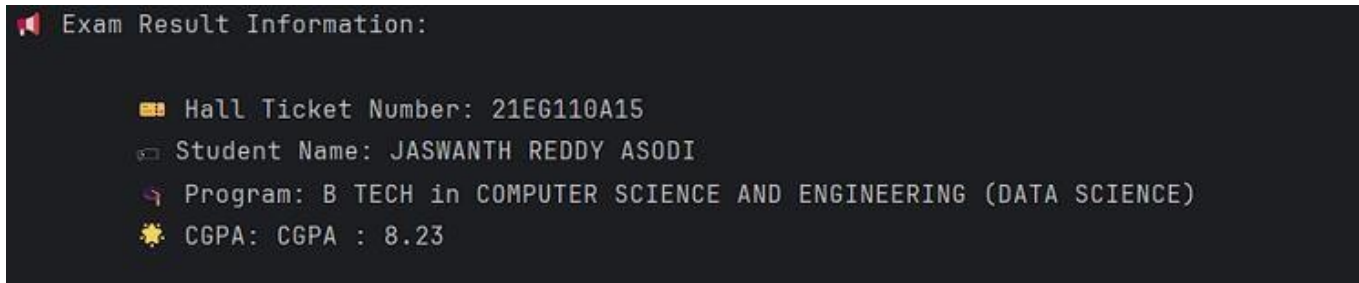


Fig:Result-2

## V. CONCLUSION

Computer vision, one of the subsets of artificial intelligence, allows images to be processed and meaningful features extracted by a computer. The application of Haar Cascade was extremely efficient, even in cases where subjects wore glasses, for face detection, and LBPH offered an inexpensive yet consistent face recognition method. The support for real-time processing ensured smooth system operation with no perceptible frame delay.

The OpenCV Face Recognition System combines face recognition and web automation, as well as foregoing physical student identification. By utilizing OpenCV for recognition and detection, the system provides an effective and fast way of verifying students in real time.

Once identified successfully, the system will automatically fetch academic records from the university portal with the help of Selenium web scraping with minimal human intervention. Important details like CGPA, hall ticket number, and courses enrolled are fetched with very little user intervention.

The use of contemporary technologies like Python, OpenCV, Selenium, and SQLite/MySQL makes the system scalable, secure, and efficient.

This solution improves the management of academic affairs through auto-academic record retrieval, minimum human intervention, and maximum precision.

Lastly, the project solves the task of manual verification of students and records, yielding a reliable and state-of-the-art solution to educational institutions. Its success through combining computer vision with web automation means that other solutions using such features, e.g., university identity verification in a more automatic form, security systems, and company offices, can also be contemplated.

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