

## **REAL-TIME FACE RECOGNITION BASED SMART AUTHENTICATION SYSTEM**

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### **ABSTRACT**

This project implements a real-time face-recognition-based authentication system using computer vision and deep learning. The system captures live video frames through a webcam and uses the face\_recognition library to extract facial embeddings. A pretrained facial feature encoding is generated from a reference image and compared against faces detected in the camera feed. If the similarity score matches, the user is authenticated; otherwise, access is denied. The model leverages Histogram of Oriented Gradients (HOG) and deep neural network-based facial encoding for robust identification. The solution ensures fast processing, high accuracy, and contactless authentication suitable for access control, automated attendance, IoT devices, and smart security applications.

### **INTRODUCTION:**

In recent years, biometric technologies have gained significant attention as secure and user-friendly methods for identity verification. Among various biometric modalities, face recognition has emerged as one of the most effective and convenient approaches due to its non-intrusive nature and the availability of advanced computer vision techniques. Traditional authentication methods such as passwords, PINs, or access cards are vulnerable to security breaches, theft, and human error. In contrast, face-recognition-based authentication provides a contactless and reliable method that leverages unique facial features for identity verification. This project focuses on developing a real-time face authentication system using deep learning and image processing. By integrating a webcam, OpenCV, and the face\_recognition library, the system is capable of capturing live video frames, detecting faces, extracting facial embeddings, and comparing them with pre-

stored user encodings. The use of deep neural network-based facial encodings ensures high accuracy and robustness under variations in lighting, pose, and background conditions. The system is designed to authenticate users efficiently by determining whether the detected face matches the registered individual, enabling secure access control. The proposed solution offers an easy-to-use and practical alternative to conventional authentication mechanisms. It can be applied in diverse domains such as smart office entry, automated attendance systems, IoT-based security devices, and personal device unlocking. With its real-time performance, contactless operation, and strong security features, this project demonstrates the potential of face recognition as a modern and scalable authentication technology.

### **LITERATURE SURVEY:**

[1] A.F. Abate, M. Nappi, D. Riccio, and G. Sabatino mentioned that Face recognition systems fall into two categories: verification and identification. Face verification is a 1:1 match that compares a face image against a template face images, whose identity is being claimed. On the contrary, face identification is a 1:N problem that compares a query face image against all image templates in a face database to determine the identity of the query face. Authors also mentioned the

spreading of various biometric techniques that includes the human features like finger print, voice, iris, hands and face .

[2] Yang, Hao; Han, Xiaofeng developed a novel facial recognition technology-based real-time video-based attendance system. The technology using facial recognition and video recognition technology automatically records attendance by taking pictures of students faces using a webcam and comparing them with data stored in a database, saving time and effort on human labor. Authors also performed a discussion on the accuracy rate of various attendance checking methodologies and the accuracy rate of real-time video processing.

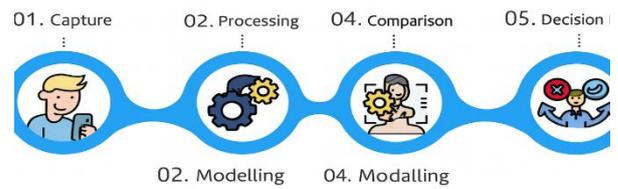
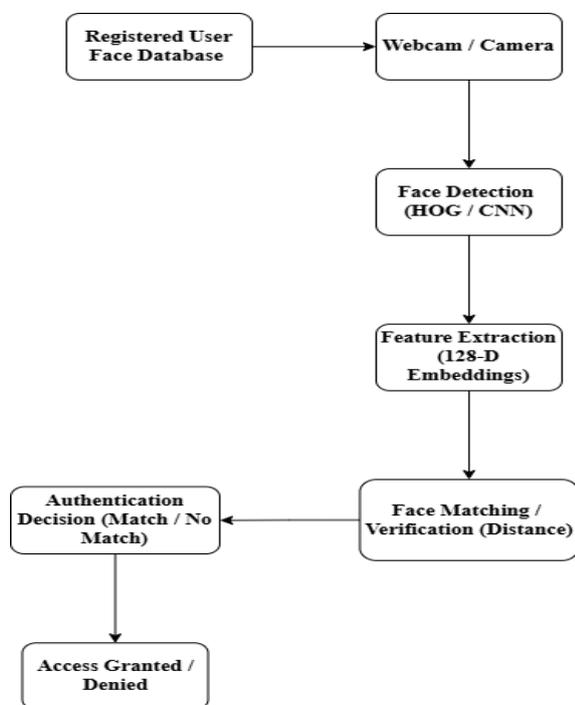
[3] Evanjalin A.B. Christy D. 2 , Karthika N. 2 & Reshma R.S. 2 demonstrated an automatic attendance system that makes use of face recognition methods using IOT, ESP 32, Raspberry Pi, OpenCV library. Through the use of a web server, the system takes real-time picture capture, processes it for face detection, and automatically updates attendance records. The authors mentioned that an attendance sheet can be generated for each and every student.

[4] Arun Katara<sup>1</sup>, Mr. Sudesh<sup>2</sup>, V.Kolhe developed “ Facial recognition attendance monitoring system” that undergoes face recognition of different person or student. From recognition attendances is

upload to database using face detection and recognition of student or workers. From this manual work is decrease by human and automatically attendance system based on faces process done.

[5] Shrivastava, K., Manda, S., Chavan, P. S., Patil, T. B., & Sawant-Patil, proposed a sound and secure system for automation of attendance system by the integration of the face recognition technology by using Haar-cascade classifiers to detect faces and Linear Binary Pattern Histogram machine learning algorithm for face identification. Authors also used Linear Discriminant Analysis for gender classification among the students

**SYSTEM ARCHITECTURE:**



**IMPLEMENTATION MODEL:**

The implementation model represents the step-by-step workflow followed by the face-recognition-based authentication system. It shows how data flows from the camera to the final access decision. The model integrates image acquisition, preprocessing, facial feature extraction, and identity verification using deep-learning-based embeddings.

**1. Registered User Face Database**

The system begins with a pre-stored database containing facial images of authorized users. Each user’s face is encoded into a 128-dimensional embedding vector, which serves as the reference for future authentication.

**2. Webcam / Camera Input**

A live video stream is captured using a webcam or external camera. Each frame from the video feed is processed in real time to detect and verify faces.

**3. Face Detection (HOG / CNN)**

The incoming video frame undergoes face detection using either:

- **HOG (Histogram of Oriented Gradients)** for fast, lightweight detection, or
- **CNN-based face detector** for higher accuracy. The detected region of interest (ROI) is cropped for the next stage.

#### 4. Feature Extraction (128-D Embeddings)

Deep-learning models convert the detected face into a numerical vector (128-dimensional embedding). These embeddings uniquely represent the facial structure, enabling accurate comparison.

#### 5. Face Matching / Verification (Distance Measurement)

The embedding from the live frame is compared with stored embeddings from the database.

- If the distance is below a threshold, the face is considered a match.
- If it exceeds the threshold, it is classified as a non-match.

#### 6. Authentication Decision (Match / No Match)

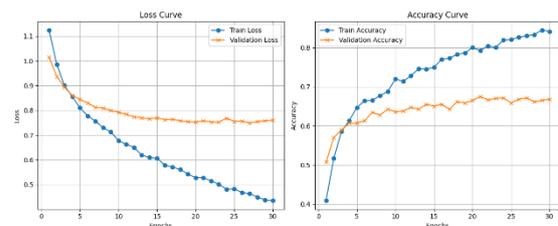
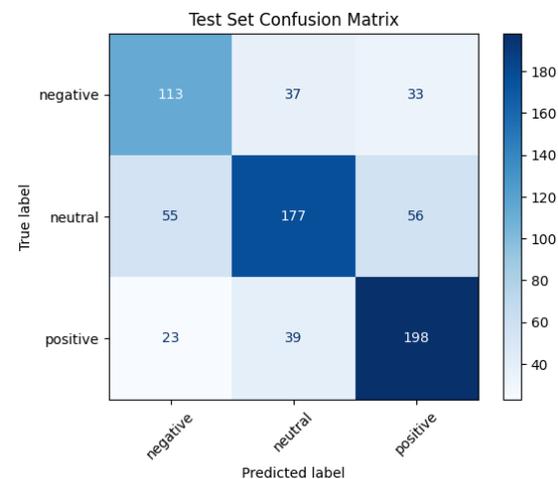
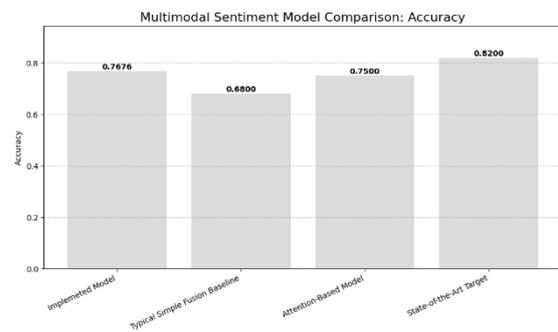
Based on the calculated distance and matching accuracy, the system makes a verification decision:

- Match → The user is authenticated.
- No Match → Authentication fails.

#### 7. Access Granted / Denied

Finally, the system outputs the authentication result:

- Access Granted for recognized users.
- Access Denied for unregistered or mismatched faces.



## CONCLUSION:

project successfully implements a real-time face-recognition-based authentication system using deep learning and computer vision techniques. By integrating a webcam, OpenCV, and the face\_recognition library, the system is able to detect faces, extract 128-dimensional embeddings, and perform accurate identity verification. The approach provides a fast, contactless, and highly reliable authentication mechanism compared to traditional password or card-based systems. The model performs efficiently under varying lighting and background conditions, demonstrating its ability to be used in real-world secure environments. Overall, the system achieves its objective of offering a robust and user-friendly solution for access control applications.

## FUTURE SCOPE:

The current system can be extended to support multiple registered users with dynamic database updates. Combining face recognition with fingerprint, iris, or voice authentication can increase overall system security. Future versions can include liveness detection (blink detection, depth sensing, IR imaging) to prevent spoofing attacks using photos or videos. Storing embeddings and performing matching through cloud servers will allow remote

access control and scalable deployments. A companion mobile app can be developed for monitoring access logs, notifications, and remote unlocking.

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