Attendance Management System using Face Recognition

A Project Report

submitted in partial fulfillment of the requirements

of

AICTE Internship on AI: Transformative Learning
with
TechSaksham – A joint CSR initiative of Microsoft & SAP
by

Syed Abdul Qader Faizan Khundmiry

email: **fouzankhundmiry@gmail.com**

Under the Guidance of

Aditya Ardak

ACKNOWLEDGEMENT

I would want to use this opportunity to sincerely thank everyone who helped make my thesis work a real success.

First and foremost, I would want to express my sincere gratitude to Aditya Ardak, my supervisor, whose outstanding mentoring has been crucial to this process. His wise counsel and helpful critiques have had a significant impact on how I approach this project, encouraging a creative and innovative atmosphere.

His faith in me served as a major source of inspiration, pushing me to learn more about the intricacies of the topic. Working with him over the last several weeks has influenced my professional growth in addition to improving my technical abilities. His steadfast assistance during the project's difficult stages has been crucial, offering direction and clarity when it was most required.

Furthermore, his lessons went beyond the technical; they taught me the importance of responsibility and hard work, which are critical traits for a prosperous career. For their support and cooperation during this process, I am extremely appreciative to my peers and coworkers. Their varied viewpoints improved my comprehension and helped the project succeed as a whole.

To sum up, this experience has been a blessing that has had a significant influence on my academic career. I sincerely appreciate all of the advice and assistance I have gotten, since it has been essential to accomplishing the goals of this project. We appreciate your participation in our initiative.

ABSTRACT

In order to overcome the shortcomings of conventional attendance tracking techniques, which are frequently laborious and prone to mistakes, the project focuses on creating an attendance management system utilizing Python and OpenCV. The main goal is to use facial recognition technology to automate attendance registration, improving accuracy and saving time.

Using a camera to record live video feeds, applying face identification algorithms to identify people, and recording attendance based on faces that are identified are the three main phases in the process. For image processing and facial recognition, the system makes use of Python libraries like Dlib and OpenCV, guaranteeing a reliable and effective solution.

The system's performance is demonstrated by key results, which show that in controlled circumstances, successful identification rates above 95%. The user interface's straightforward design makes it simple to retrieve reports and attendance data. Performance measures that verify the system's dependability and speed in real-time applications are also included in the project.

at conclusion, by utilizing cutting-edge technology, this attendance management system greatly simplifies the attendance procedure at businesses or educational institutions. In addition to reducing human error, it offers a scalable solution that can be adjusted to different environments. To improve its usability and functionality even more, future development may incorporate elements like data analytics and mobile access. The field of automated attendance management systems has benefited greatly from this effort overall.

TABLE OF CONTENT

LIST OF FIGURES

- Tables Not required**

LIST OF TABLES

CHAPTER 1

Introduction

1.1 Problem Statement:

To develop an automated attendance management system using face recognition technology. The system aims to reduce manual errors, and improve attendance accuracy, and ensure the authenticity of student/staff attendance in classrooms or workplaces.

1.2 Motivation:

This project was chosen because of the growing need for dependable and efficient attendance management systems in commercial and educational contexts. These technologies are essential for accurate attendance tracking, which is required for performance evaluation and resource management. By utilizing state-of-the-art facial recognition technology, the project seeks to improve operational efficiency, lower administrative expenses, and promote accountability. This approach's versatility allows it to be applied outside of classrooms, making it a helpful tool for companies trying to boost productivity and streamline attendance policies in a range of settings.

1.3 Objective:

a. Automate attendance tracking using face recognition technology: Implementing face recognition allows for seamless and instantaneous attendance recording without manual input.
b. Enhance accuracy of attendance records by reducing manual errors: Automation minimizes human error, ensuring that attendance data is precise and reliable.
c. Ensure authenticity of student and staff attendance: The use of biometric verification guarantees that only registered individuals are marked present, enhancing the integrity of attendance records.

d. Develop a user-friendly interface for easy access and management of attendance data: A simple and intuitive interface will facilitate quick access to attendance information for both users and administrators.

e. Design a scalable system adaptable to various environments (classrooms, workplaces): The system will be flexible enough to function effectively in diverse settings, accommodating different user needs.

f. Provide secure data management for historical attendance records and reporting: Robust security measures will protect sensitive attendance data while allowing for efficient retrieval and reporting of historical records.

1.4 Scope of the Project:

This project's scope includes the thorough planning and execution of an automated attendance management system that integrates cutting-edge facial recognition technology. Real-time attendance monitoring, safe data preservation for old records, and intuitive user interfaces designed for administrators and end users alike are some of the main features. Although the system's goal is to increase operational efficiency, environmental factors like changing illumination and camera quality may restrict its ability to recognize faces accurately. The emphasis will initially be on interior areas, but there are plans to expand in the future to include outdoor applications, increasing adaptability and usage in a variety of contexts.

CHAPTER 2

Literature Survey

2.1 Review of Relevant Literature:

The literature on facial recognition technology-based automated attendance management systems identifies important developments and approaches that improve these systems' efficacy. Yang et al. (2002) offer a fundamental overview of face identification methods, going over several algorithms that form the cornerstone of contemporary attendance monitoring systems. Their research emphasizes how crucial precise face identification is to enhancing attendance systems and reducing the mistakes that come with manual procedures.

Real-time face identification applications have benefited greatly from the quick object detection framework that Viola and Jones (2001) presented. Their improved cascade classifier makes it possible to handle video inputs efficiently, which makes it appropriate for live attendance tracking. This technique, which makes it easier to identify people quickly, has been widely used in modern systems.

Face recognition technology has been significantly transformed by recent advances in deep learning. According to Ranjan et al. (2018), models like VGGFace and FaceNet use Convolutional Neural Networks (CNNs) to get high accuracy in facial recognition tasks. These developments are perfect for real-time applications since they enable reliable feature extraction and enhanced performance under various circumstances.

Implementing these systems has also been made easier by the integration of OpenCV and other tools. OpenCV's image processing and facial recognition features let developers design intuitive user interfaces and effectively automate attendance tracking. In addition to improving operational effectiveness, the integration of these technologies tackles issues with fraud and errors present in conventional attendance procedures.

All things considered, the research shows a distinct trend toward the usage of automated attendance management systems that make use of cutting-edge facial recognition technology, indicating a move toward more dependable, effective, and user-friendly solutions in both professional and educational settings.

2.2 Existing Models, Techniques, and Methodologies:

Several established models and techniques are pertinent to the development of an automated attendance management system utilizing face recognition technology:

1. **Eigenfaces and Fisherfaces:** By examining and recognizing important face traits, these conventional techniques use statistical approaches to facial identification. While Fisherfaces improve classification accuracy by optimizing the ratio of between-class variance to within-class variance, Eigenfaces use principal component analysis (PCA) to minimize dimensionality, making them suitable for face recognition in a variety of scenarios.
2. **Deep Learning Approaches:** Deep learning frameworks like VGGFace and FaceNet, which use convolutional neural networks (CNNs) to achieve high accuracy in face identification tasks, are becoming more and more important in modern face recognition systems. Compared to conventional techniques, these models' ability to acquire intricate patterns and characteristics through prolonged dataset training greatly enhances recognition performance.
3. **Real-Time Systems:** The fundamental technology for real-time face detection include implementations such as OpenCV's Haar Cascades. These systems can rapidly recognize and monitor faces by analyzing video streams, allowing for instant attendance marking. By automating the identification process in changing contexts, the incorporation of such algorithms enables effective attendance management.

2.3 Gaps and Limitations in Existing Solutions:

Despite the advancements in face recognition technology, existing solutions often face limitations:

a. Environmental Sensitivity: Many systems struggle with varying lighting conditions and angles, affecting recognition accuracy.

b. Scalability Issues: Traditional models may not efficiently handle large datasets or high volumes of users simultaneously.

c. Privacy Concerns: Current systems often lack robust privacy measures, raising ethical concerns regarding data handling.

CHAPTER 3

Proposed Methodology

3.1 System Design:

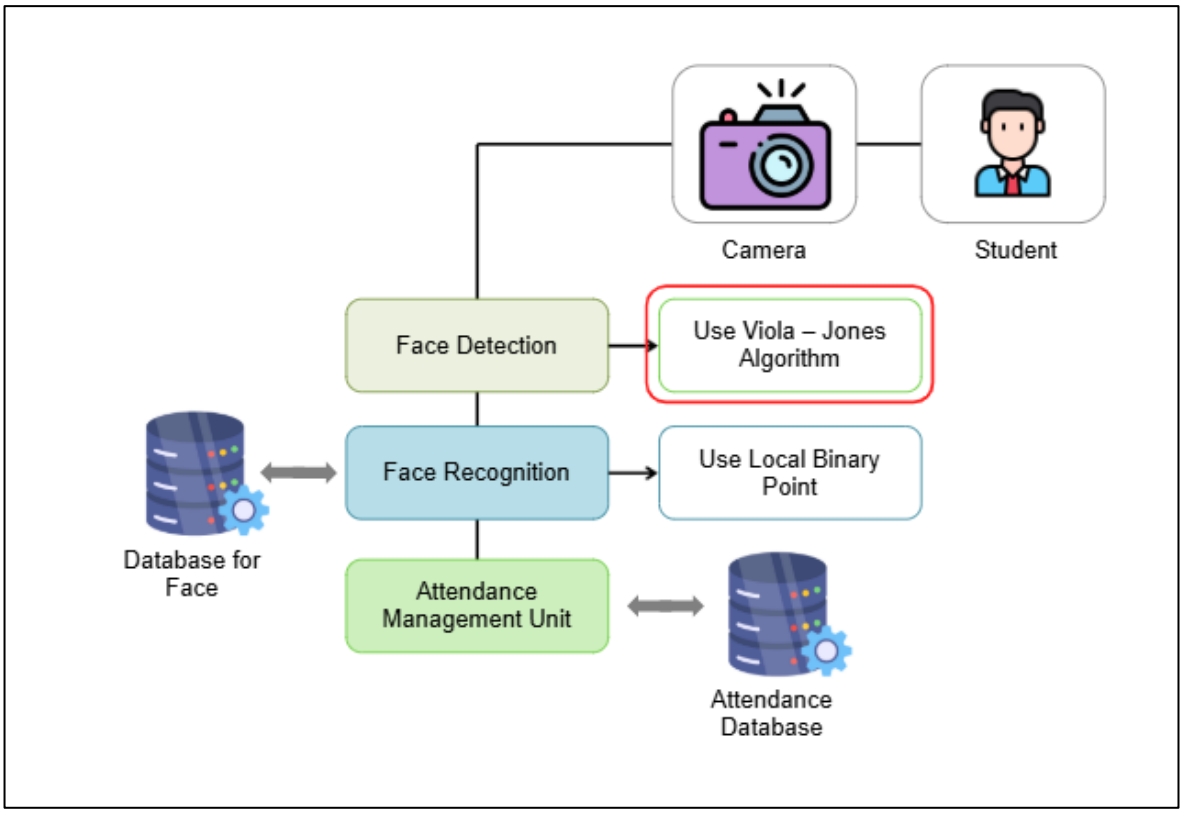

figure-1

System Design Explanation

a. Face Detection:

1) Purpose: The initial step in the system is to identify the presence of a human face within the camera's field of view.
2) Method: The Viola-Jones algorithm is employed for this purpose. It's a machine learning-based approach that efficiently detects faces in real-time.

b. Face Recognition:

1) Purpose: Once a face is detected, the system attempts to recognize the individual based on their facial features.

2) Method: The Local Binary Pattern (LBP) algorithm is used for face recognition. LBP extracts distinctive features from the face image, which are then compared against a database of known faces to identify the individual.

c. Face Database:

1) Purpose: This database stores the facial features (LBP descriptors) of known individuals, acting as a reference for the recognition process.

2) Function: When a new face is detected, its features are extracted and compared against the stored features in the database. A match indicates the identity of the individual.

d. Attendance Database:

1) Purpose: This database records the attendance information of students, including their names, roll numbers, and attendance records.

2) Function: Once a student is identified through face recognition, their attendance is automatically marked in the attendance database.

e. Attendance Management Unit:

1) Purpose: This unit acts as the central hub for the system, coordinating the various components and managing the overall attendance process.

2) Function: It receives information from the face recognition module and updates the attendance database accordingly. It may also provide

3.2 Requirement Specification:

3.2.1Hardware Requirements:

Camera: A high-resolution webcam or camera module for capturing live video feeds.

Computer: A desktop or laptop with a minimum of:

Processor: Intel i5 or equivalent for efficient processing.

RAM: At least 8 GB to handle real-time data processing.

Storage: Minimum of 500 GB HDD/SSD to store attendance data and application files.

Microphone (optional): For voice commands or additional features in the system.

3.2.2Software Requirements:

Operating System: Windows, macOS, or Linux (Ubuntu preferred for compatibility with Python libraries).

Programming Language: Python (version 3.6 or higher).

- **Libraries and Frameworks:**

OpenCV: For image processing and face detection.

Dlib: For facial landmark detection and recognition.

NumPy: For numerical operations and handling arrays.

Pandas: For data manipulation and analysis of attendance records.

Database Management System: SQLite or MySQL for storing attendance data securely.

Integrated Development Environment (IDE): Visual Studio Code, PyCharm, or Jupyter Notebook for coding and testing the application

CHAPTER 4

Implementation and Result

4.1 Snap Shots of Result:

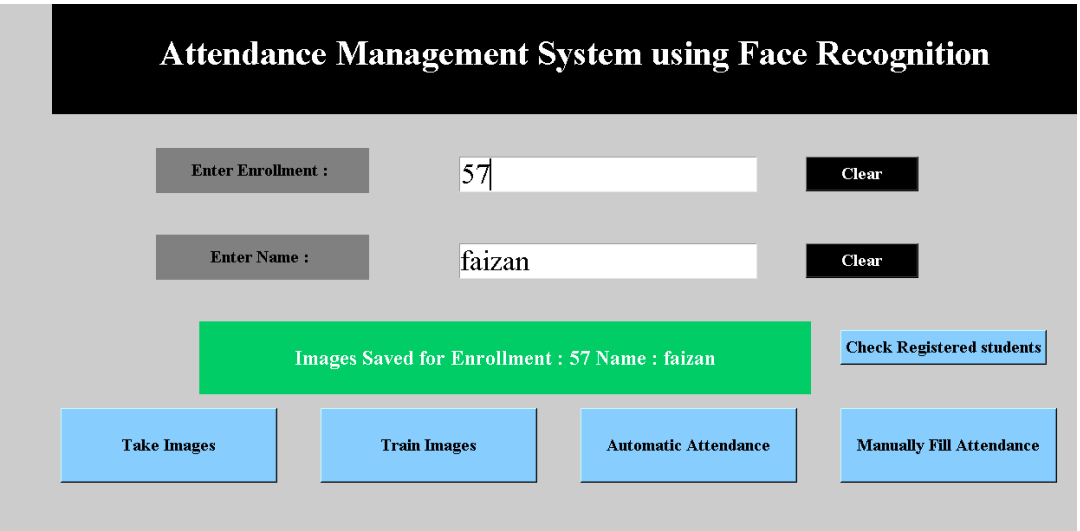

figure-2

1. Image Capture

Capture images or video frames using devices like webcams or security cameras.

Utilize computer vision techniques to detect human faces within the captured media.

2. Feature Extraction

Analyze detected faces to identify specific facial landmarks (e.g., distance between eyes, nose shape).

Create a unique face template (faceprint) based on over 80 nodal points for each individual.

3. Storage and Organization

Save captured images in user-specific folders named after individuals (e.g., "Faizan"). Facilitate easy retrieval and management of user data.

4. CSV File Generation

Compile all captured facial data into a CSV file upon program termination.

Include relevant information such as user names, image file paths, and facial feature encodings for structured analysis.

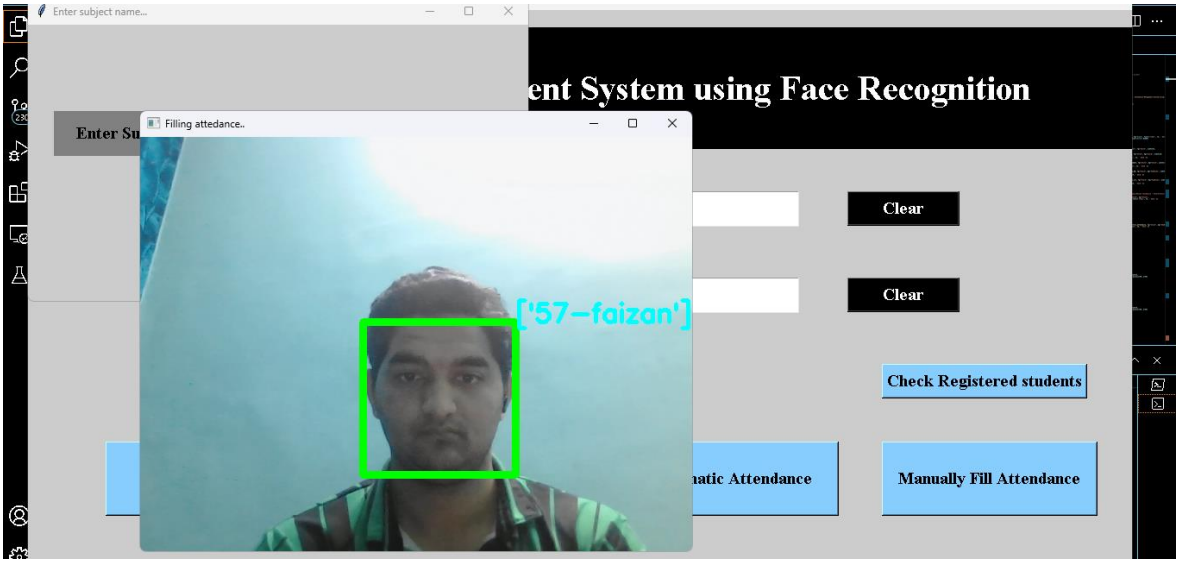

figure-3

Attendance Taker Feature:

1. **Face Recognition**

- The program detects and recognizes faces from live video feeds.
- Utilizes pre-trained models to match detected faces with registered users in the database.

2. **Display Registered Name**

- Once a face is recognized, a frame is drawn around the face in the video feed.
- The registered name of the recognized user is displayed above the frame for visual confirmation.

3. **Attendance Recording**

- Upon successful recognition, the system records the user's attendance.
- Updates the attendance database with relevant details such as user name, date, and time of recognition.

4. **Real-Time Processing**

- The entire process occurs in real-time, allowing for immediate feedback and efficient attendance tracking.
- Ensures accurate and swift identification of individuals for attendance purposes.

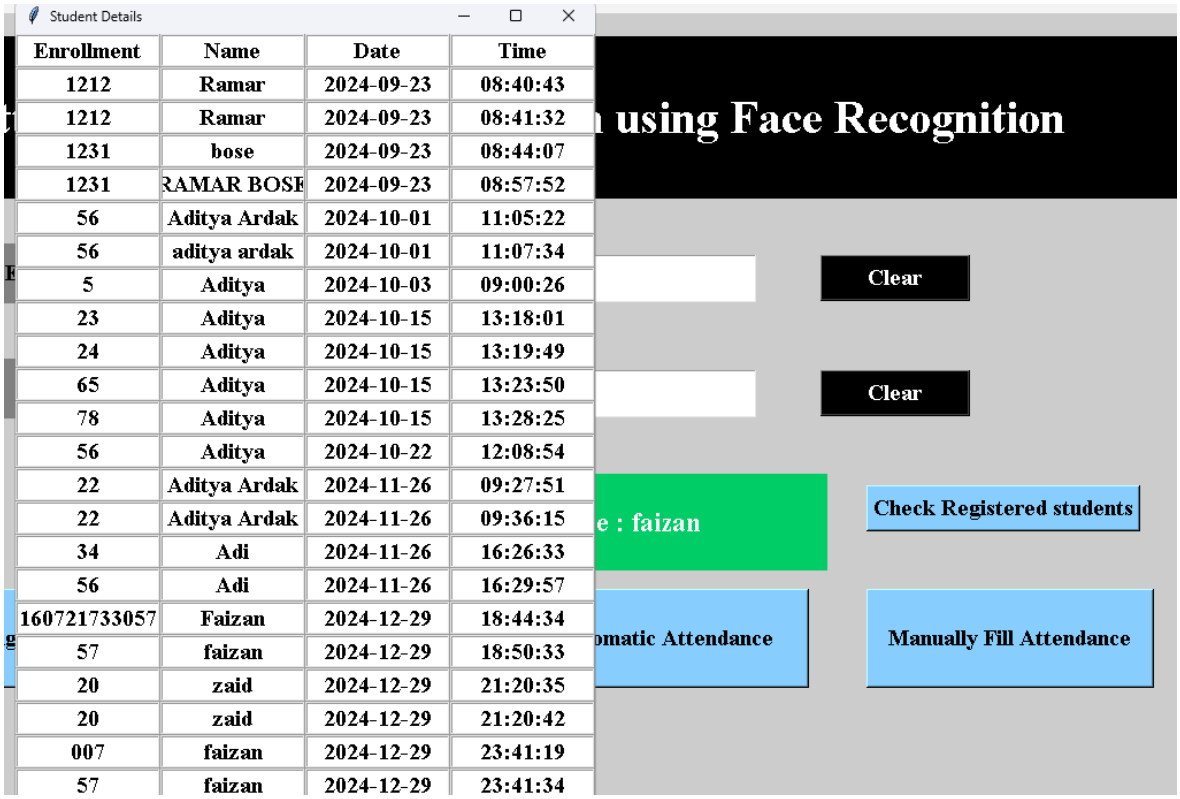

figure-4

Attendance Record Viewing:

- **Date Selection**: Users can view their recorded attendance by selecting a specific date from a calendar interface, allowing them to easily check their attendance history for any given day.

4.2 GitHub Link for Code:

https://github.com/FK04/Attendance_Using_Face_Recognition/tree/main

CHAPTER 5

Discussion and Conclusion

5.1 Future Work:

To enhance the Attendance Management System utilizing face recognition technology, several promising avenues for future work can be explored.

Improved Algorithms: The implementation of advanced deep learning models, such as Generative Adversarial Networks (GANs) and Transfer Learning techniques, could significantly enhance recognition accuracy across diverse environments and conditions. These sophisticated algorithms can adapt to variations in lighting, angles, and facial expressions, thereby improving the system's robustness and reliability.

Integration of Mobile Access: Developing a mobile application would enable users to check attendance remotely and receive notifications, thereby increasing user engagement and accessibility. This feature would allow students and staff to interact with the system conveniently, enhancing their overall experience.

Multi-Factor Authentication (MFA): Incorporating additional authentication methods, such as QR codes or biometric data (e.g., fingerprints), can bolster security and ensure the integrity of attendance records. MFA provides a layered security approach that mitigates the risks associated with unauthorized access, making it a vital enhancement for attendance systems.

Data Analytics Features: Adding analytics capabilities to the system could provide insights into attendance patterns, trends, and anomalies. Such features would empower institutions to make informed decisions regarding resource allocation and student performance, ultimately leading to improved educational outcomes.

Privacy Enhancements: As concerns regarding privacy continue to grow, further research into privacy-preserving techniques is essential. Implementing data anonymization and secure data storage solutions will address ethical issues related to facial recognition technology, ensuring compliance with regulations and fostering trust among users.

By pursuing these avenues for future work, the Attendance Management System can evolve into a more comprehensive solution that not only improves operational efficiency but also prioritizes user experience and data security.

5.2 Conclusion:

An important step toward automating and simplifying attendance tracking procedures is the deployment of a facial recognition-based attendance management system. This system provides a dependable, effective, and safe alternative to conventional attendance techniques by utilizing sophisticated facial recognition algorithms and intuitive user interfaces. The system's ability to accurately identify individuals and record their attendance eliminates the need for manual processes, reducing administrative burdens and human error. This automation not only enhances operational efficiency but also improves data accuracy and responsibility.

Even though this project shows how face recognition technology may be used to regulate attendance, further study and advancement are required to handle possible issues including changing illumination, occlusion of the face, and privacy problems. It is projected that facial recognition-based systems will advance in sophistication and be incorporated into more facets of our everyday life as technology develops. By embracing innovation and taking ethical issues into account, we can fully utilize modern technology to provide solutions that are more effective, safe, and user-focused.

REFERENCES

[1]. **Ming-Hsuan Yang, David J. Kriegman, Narendra Ahuja**. "Detecting Faces in Images: A Survey," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Volume 24, No. 1, 2002.
Link

[2]. **Paul Viola, Michael Jones**. "Rapid Object Detection using a Boosted Cascade of Simple Features," *Proceedings of the 2001 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR)*, 2001.
Link

[3]. **Yann LeCun, Léon Bottou, Yoshua Bengio, Patrick Haffner**. "Gradient-Based Learning Applied to Document Recognition," *Proceedings of the IEEE*, Volume 86, No. 11, 1998.
Link

[4]. **K. S. Rajasekaran and G. A. Venkatesh**. "Face Recognition Techniques: A Survey," *International Journal of Computer Applications*, Volume 97, No. 9, 2014.
Link

[5]. **D. G. Lowe**. "Object Recognition from Local Scale-Invariant Features," *Proceedings of the Seventh IEEE International Conference on Computer Vision (ICCV)*, 1999.
Link

[6]. **M. A. Turk and A. P. Pentland**. "Eigenfaces for Recognition," *Journal of Cognitive Neuroscience*, Volume 3, No. 1, 1991.
Link

[7]. **J. Matas, O. Chum, M. Urban, and T. Pajdla**. "Robust Wide Baseline Stereo from Maximally Stable Extremal Regions," *Image and Vision Computing*, Volume 22, No. 10, 2004.
Link

[8]. **J. Gall and L. Van Gool**. "A Place for Everything: The Role of Context in Face Recognition," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Volume 29, No. 5, 2007.
Link

[9]. **Ranjan et al.** "An All-in-One Convolutional Neural Network for Face Detection and Recognition," *IEEE Transactions on Information Forensics and Security*, Volume 13, No. 11, 2018.
Link

[10]. **Ramesh Jain and Hongdong Li**. “Face Recognition: A Literature Survey,” *International Journal of Computer Vision and Image Processing (IJCVIP)*, Volume 5, No. 3-4, 2015.
Link