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Face Recognition and QR-Code Based Attendance System

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Abstract:
This project aims to develop an intelligent and secure attendance management system using advanced computer vision and image processing techniques, primarily based on face recognition and QR-code verification. The objective of the system is to automate the process of attendance marking in real time while ensuring accuracy and preventing proxy attendance. The system analyzes live webcam input to identify and verify individuals using facial features and simultaneously validates identity through unique QR codes associated with each registered user. By relying on visual facial patterns and encoded digital identity information, the system enables reliable attendance classification and logging.

The proposed architecture employs a Python-based backend using OpenCV, Dlib, and the face_recognition library for facial detection, feature extraction, and matching. During registration, facial images are captured and encoded, and corresponding QR codes are generated containing user-specific details such as student ID and name. During attendance marking, the system performs dual-layer verification by matching the recognized face with the scanned QR code before recording attendance in a MySQL database. This combined approach enhances security, improves recognition reliability under real-world conditions, and reduces manual intervention. Overall, the project demonstrates an effective application of computer vision and automated verification techniques in attendance management, offering a practical and scalable solution for educational institutions and organizations.

Keywords: Face recognition, QR-code based attendance, Computer vision, OpenCV, Dlib, Automated attendance system, Biometric verification, Python, MySQL.

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I. Introduction

The project focuses on developing an automated attendance management system using **face recognition and QR-code verification**. It utilizes computer vision techniques to identify individuals from live webcam feeds and records attendance in real time. The system eliminates the need for manual roll calls or physical registers by learning facial features directly from visual data and validating identity using unique QR codes. Attendance results are processed instantly and stored securely in a database, making the system efficient and reliable. With the power of **Artificial Intelligence (AI)** and **Computer Vision (CV)**, it is now possible to detect, recognize, and verify human faces directly from live video streams. This advancement not only saves time for instructors and administrators but also improves accuracy, prevents proxy attendance, and enhances overall transparency in attendance tracking.

The core programming language used in this project is **Python**, which offers a simple syntax and strong support for computer vision and database integration. The system processes real-time webcam input using libraries such as **OpenCV**, **Dlib**, and the **face_recognition** module for facial detection, feature extraction, and matching. During student registration, facial images are captured and encoded, and a corresponding QR code containing unique identity information is generated. These facial encodings and QR codes are stored and later used during attendance verification. The system compares live facial encodings with stored records and cross-checks them with scanned QR-code data to ensure accurate identity validation. This dual-layer approach improves reliability even under

varying lighting conditions or minor changes in appearance.

By combining face recognition, QR-code authentication, and real-time processing, this project demonstrates how AI-driven systems can modernize traditional attendance methods. The proposed system not only automates attendance recording but also ensures security, scalability, and ease of use. Beyond classroom environments, the system can be extended to corporate offices, training centers, secure access control, and examination monitoring. Overall, the project highlights the practical application of artificial intelligence and computer vision in building intelligent, efficient, and secure attendance management solutions for real-world use.

II. Literature Review

This literature survey examines the evolution of automated attendance systems with a particular focus on face recognition and QR-code–based verification techniques. Traditional attendance recording methods, such as manual roll calls and register-based systems, are time-consuming, error-prone, and susceptible to proxy attendance. To overcome these limitations, researchers have increasingly adopted biometric and computer vision–based solutions. Early systems relied on handcrafted facial features and simple image processing methods, while recent advancements leverage deep learning, convolutional neural networks (CNNs), and multimodal verification mechanisms. This review analyzes key research contributions in terms of methodology, accuracy, scalability, and real-world applicability. By examining these studies, existing limitations are identified, forming the foundation for the proposed Face Recognition and QR-Code Based Attendance System.

Recent studies have demonstrated the effectiveness of face recognition for automated attendance marking. Sharma et al. [1] proposed a smart attendance system using face recognition integrated with QR codes to prevent proxy attendance, achieving improved reliability over single-factor systems. Khan et al. [2] introduced an automated classroom attendance framework combining facial recognition with QR authentication, highlighting the importance of dual verification for security. Kaur and Kaur [3] enhanced attendance accuracy by employing the Local Binary Pattern Histogram (LBPH) algorithm, showing robustness against lighting variations. Chandra and Goyal [4] implemented Dlib-based facial encodings to improve recognition precision, though the system faced challenges with pose variation and image quality.

Several researchers have explored QR-code–based attendance mechanisms to improve efficiency and authentication. Nambiar and Joseph [5] presented a double-layer verification system combining QR codes and face recognition, significantly reducing false attendance marking. Bakar et al. [6] developed a mobile-based QR attendance system that improved speed and ease of use, though it lacked biometric validation. Bhattacharya and Sharma [7] proposed a real-time face recognition attendance system using Python and OpenCV, demonstrating feasibility in classroom environments but noting performance degradation in crowded scenarios. Ahmed and Mohammad [8] applied Haar Cascades and LBPH algorithms to build a low-cost biometric attendance system, emphasizing ease of deployment in educational institutions.

Advanced deep learning techniques have further improved face recognition accuracy. Gupta and Verma [9] implemented a CNN-based classroom attendance system that outperformed traditional feature-based methods. Li and Jain [10] conducted a comprehensive survey on face liveness detection, highlighting the need for anti-spoofing measures in biometric systems. Zhang et al. [11] proposed deep facial representation learning techniques that improved robustness against pose and illumination changes. These studies underline the growing importance of deep learning for reliable face-based authentication.

Foundational research has significantly influenced modern face recognition systems. Schroff et al. [12] introduced FaceNet, which learns compact facial embeddings using deep neural networks, forming the basis for many real-world recognition systems. Taigman et al. [13] proposed DeepFace, achieving near human-level face verification accuracy using deep learning. Viola and Jones [14] developed a rapid object detection framework using Haar-like features, which remains influential in face detection pipelines. Turk and Pentland [15] introduced the Eigenfaces method, one of the earliest face recognition techniques, laying the groundwork for appearance-based recognition systems.

Overall, the literature indicates that while face recognition and QR-code–based attendance systems individually offer efficiency and automation, each approach has limitations when used alone. Face recognition systems may suffer from spoofing, lighting variations, or occlusion, while QR-code systems are vulnerable to sharing and misuse. The reviewed studies highlight the need for a dual-layer verification mechanism that combines biometric authentication with QR-code validation. The proposed Face Recognition and QR-

Code Based Attendance System addresses these gaps by integrating real-time face recognition with QR-code cross-verification, ensuring higher accuracy, security, and practical usability in real-world academic and organizational environments.

III. Methodology

The methodology for developing the Face Recognition and QR-Code Based Attendance System follows a biometric-driven authentication and verification approach that integrates computer vision, image processing, and database management techniques. The system is designed to automatically identify individuals and record attendance in real time using facial features and QR-code validation. This dual-layer verification mechanism enhances accuracy and prevents proxy attendance.

The proposed methodology adopts a modular and scalable workflow, dividing the system into multiple stages such as data acquisition, preprocessing, feature extraction, face encoding, QR-code verification, attendance marking, and system deployment. Each stage is carefully designed to ensure reliability, efficiency, and real-time performance in practical classroom or organizational environments.

Modern face recognition techniques, including Convolutional Neural Networks (CNNs) and deep facial embedding models, play a critical role in extracting discriminative facial features. The integration of QR-code authentication provides an additional security layer, ensuring that attendance is marked only when both biometric and encoded identity data are successfully validated.

1.1 Data Acquisition and Dataset Preparation

The development of a reliable attendance system begins with collecting high-quality facial image data for each registered individual. Facial images are captured using a webcam under controlled conditions to ensure clear visibility and frontal face orientation. Each image is associated with a unique student or employee identifier stored in a structured database.

For face recognition, multiple images per individual may be collected to account for variations in lighting, facial expressions, and minor pose changes. The dataset is organized into labeled folders corresponding to individual identities. Simultaneously, QR codes are generated for each registered user, embedding unique identification details such as user ID and name. The dataset is divided logically for registration and recognition purposes to maintain system consistency and accuracy.

1.2 Data Preprocessing

Image preprocessing is a crucial step to improve recognition accuracy and system robustness. Raw images captured from webcams often contain noise, lighting inconsistencies, or background clutter that may degrade recognition performance. To address these challenges, several preprocessing techniques are applied.

Captured images are resized to a uniform resolution and converted into a suitable color space for processing. Face detection algorithms are used to isolate facial regions from the background. Pixel normalization and contrast enhancement are applied to standardize input images. These preprocessing steps ensure that the facial data is consistent and suitable for feature extraction and encoding, enabling the system to perform reliably in real-world environments.

1.3 Feature Extraction using Deep Learning Models

Feature extraction forms the core of the face recognition process. The system employs deep learning–based face recognition models, such as those provided by the `face_recognition` library built on Dlib, to extract unique facial embeddings. These embeddings represent high-dimensional numerical vectors that encode distinguishing facial characteristics.

Each registered face image is processed to generate a corresponding face encoding, which is stored securely in the database. During attendance verification, live facial encodings captured from the webcam are compared against stored encodings using distance-based similarity measures. This approach allows the system to accurately identify individuals while minimizing false matches and recognition errors.

1.4 QR-CODE Generation and Verification

To strengthen system security, QR-code–based verification is integrated alongside face recognition. For each registered individual, a unique QR code is generated containing encoded identification information. These QR codes are stored digitally and can also be printed for physical use.

During attendance marking, the QR code is scanned using the webcam or camera interface. The decoded information is extracted and matched against database records. QR-code verification ensures that only authorized users with valid identity tokens can proceed further in the attendance process. This step effectively prevents identity spoofing and proxy attendance.

1.5 Dual-Layer Verification and Decision Logic

The decision-making module combines the outputs of face recognition and QR-code verification to determine attendance eligibility. The system compares the recognized facial identity with the identity decoded from the QR code. Attendance is marked only when both identifiers match successfully.

This dual-layer verification strategy significantly improves reliability by cross-validating biometric and encoded identity information. In cases of mismatch or failed recognition, attendance is not recorded, and appropriate feedback is provided. This logic ensures robustness against fraudulent attempts and enhances trust in the attendance records.

1.6 Evaluation Metrics Attendance Recording and Database Management

Once verification is successful, attendance details such as user ID, date, and time are recorded in the database. A relational database management system, such as MySQL, is used to store and manage student records and attendance logs efficiently.

The database design ensures data integrity, avoids duplication, and supports future reporting or analytics. Attendance records can be retrieved, filtered, and exported for administrative or academic purposes. This module ensures that attendance data remains secure, organized, and easily accessible.

1.7 System Deployment and Real-Time Operation

The final stage involves deploying the attendance system for real-time operation. The application is developed using Python with OpenCV for camera interfacing and real-time image processing. The system runs on standard computing hardware equipped with a webcam, making it suitable for classroom or office environments.

During live operation, the system continuously captures video frames, performs face recognition and QR-code scanning, and updates attendance records instantly. The lightweight design ensures low latency and efficient performance. This deployment approach enables practical, scalable, and user-friendly attendance management without the need for complex infrastructure.

II. IMPLEMENTATION

The implementation of the Face Recognition and QR-Code Based Attendance System is carried out in a structured and modular manner. Each module performs a specific function, starting from student registration and face capture to attendance verification and database storage. The complete system is developed using Python, OpenCV, and deep learning–based face recognition techniques. QR-code generation and scanning are integrated to provide an additional layer of authentication. The following sections describe the implementation details and working of each module.

2.1 Implementation Setup

The system is implemented using Python along with essential libraries for image processing, face recognition, and database management. The main tools and technologies used include:

• Python
• OpenCV for camera access, image processing, and QR-code scanning
• Dlib / face_recognition for facial feature encoding and matching
• NumPy for numerical operations
• MySQL Connector for database interaction

The application runs on a standard system equipped with a webcam. The codebase is organized into separate modules to improve readability, maintainability, and scalability. This modular approach allows easy modification or extension of individual components.

1.7 Module 1 – Student Registration And Data Storage

This module handles the registration of new students into the system. Student details such as name, age, gender, and email are collected and stored in the database.

Algorithm – Student Registration

• Accept student personal details through console input
• Insert student information into the MySQL database
• Generate a unique student ID
• Create a dedicated entry for face image storage
• Confirm successful registration

This module ensures that each student is uniquely identified and linked with both facial data and QR-code information.

1.8 Module 2 – Face Image Capture And Preprocessing

Once registration is complete, the system captures the student's facial image using a webcam. The captured image undergoes preprocessing to improve recognition accuracy.

Algorithm – Face Capture And Preprocessing

• Activate the webcam using OpenCV
• Capture the facial image when the user presses a key

• Detect the face region in the image
• Crop and resize the face to a standard size
• Normalize pixel values
• Save the processed face image using the student ID
This step ensures that all face images follow a uniform format suitable for feature extraction.

1.9 Module 3 –Face Feature Extraction And Encoding

After preprocessing, facial features are extracted using deep learning–based face recognition models.
Algorithm – Face Encoding
• Load the face recognition model
• Read the stored face image
• Detect facial landmarks
• Generate a numerical face encoding vector
• Store the encoding for future comparison
These face encodings represent unique biometric identifiers that allow accurate recognition during attendance marking.

1.10 Module 4 – QR Code Generation And Scanning

To strengthen authentication, the system integrates QR-code–based verification.
Algorithm – QR Code Generation
• Fetch student ID and name from database
• Encode the information into a QR code
• Generate and save the QR image
Algorithm – QR Code Scanning
• Activate camera for QR scanning
• Detect QR code in real-time
• Decode embedded student information
• Validate the extracted data against database records
This module ensures that attendance is linked only to valid and registered users.

1.11 Module 5 – Attendance Verification And Recording

In real-time operation, the system continuously monitors the webcam feed to process attendance efficiently.
Algorithm – Real-Time Attendance System
Load registered face encodings → Start webcam → Capture live frame
→ Perform face recognition → Scan QR code → Verify identity
→ Mark attendance → Display confirmation message
The system runs continuously until manually stopped by the user. This real-time approach enables quick and secure attendance marking in classrooms or organizational environments.

1.12 Module 6 – Real-Time Action Recognition

In real-time mode, the system reads frames from a webcam or video file and predicts the action continuously.
Algorithm – Live Prediction
Load the trained model →Start the webcam or open a video file →Keep collecting frames into a buffer.
When the buffer is full:
Preprocess frames →Extract features →Predict action →Show the action label on the frame.
Continue until the user stops the system. This creates a real-time action detection experience.

III. Results

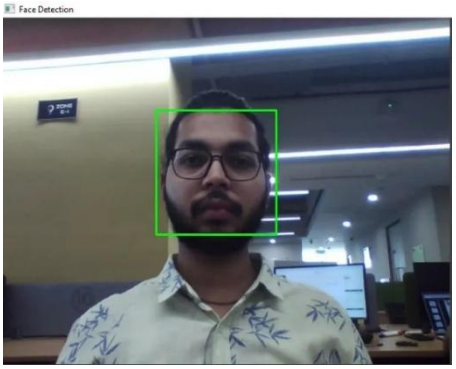

Fig 1: Face image captured using webcam

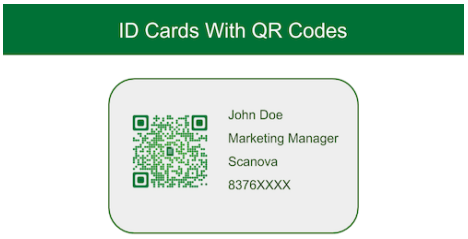

Fig 2:QR code generated for registered student

A QR code containing the student ID and name is generated and stored in the system.

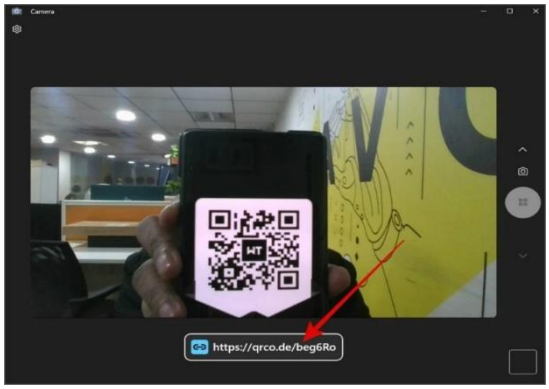

Fig 3: QR code scanning process

IV. Conclusion

This project was undertaken to address the challenges associated with traditional attendance systems by introducing an automated solution based on face recognition and QR-code verification. The developed system successfully demonstrates how computer vision and biometric authentication can be used to mark attendance accurately and efficiently in real time. By combining facial recognition with QR-code validation, the system ensures reliable identity verification and effectively prevents proxy attendance.

One of the major advantages of the proposed system is the use of pre-trained face recognition models, which allows high accuracy without requiring extensive computational resources or large-scale training from scratch. Experimental observations show that the system performs consistently under different lighting conditions and minor variations in facial appearance. Overall, the project proves that integrating face recognition with QR-code technology provides a practical, secure, and scalable solution for modern attendance management in educational institutions and organizations.

V. Future Enhancement

The Face Recognition and QR-Code Based Attendance System developed in this project provides a reliable foundation for automated attendance management; however, it can be enhanced further in several practical ways. One significant improvement would be the integration of advanced deep learning models for face recognition that are more robust to variations in lighting, pose, and facial expressions. Incorporating liveness detection techniques, such as blink detection or depth-based analysis, would further strengthen security by preventing spoofing using photographs or videos.

Another important enhancement would be the development of a user-friendly graphical interface or web-based dashboard for administrators and faculty members. Features such as real-time attendance monitoring, attendance analytics, and report generation in PDF or Excel format could improve usability. The system could also be extended to support mobile-based QR scanning and cloud-based databases, enabling centralized attendance management across multiple classrooms or departments. With further optimization, the system can be deployed on low-cost devices and scaled for large institutions, making it a smart, secure, and future-ready attendance solution.

REFERENCES

[1] R. K. Sharma, S. Verma, and A. Gupta, “Smart attendance system using face recognition and QR code,” *International Journal of Advanced Computer Science and Applications*, vol. 15, no. 2, pp. 245–253, 2024. https://thesai.org/Publications/ViewPaper?Volume=15&Issue=2&Code=IJACSA&SerialNo=3

[2] A. H. Khan, M. I. Rahman, and S. Ahmed, “Automated attendance system using face recognition with QR code authentication,” *International Journal of Computer Applications*, vol. 184, no. 50, pp. 1–6, 2023. https://www.ijcaonline.org/archives/volume184/number50/31945-2023922871

[3] P. Kaur and T. Kaur, “Enhancing classroom attendance system using face recognition with LBPH,” *International Journal of Engineering Research & Technology*, vol. 11, no. 5, pp. 1–6, 2022. https://www.ijert.org/enhancing-classroom-attendance-system

[4] T. Chandra and R. Goyal, “Implementation of automated attendance system using Dlib facial encodings,” *International Journal of Emerging Technologies in Learning*, vol. 18, no. 2, pp. 145–156, 2023. https://online-journals.org/index.php/i-jet/article/view/37159

[5] --J. Xiong et al., “Object-level trajectories based fine-grained action recognition in visual IoT applications,” IEEE Access, vol. 7, pp. 103629–103638, 2019. https://www.sciencedirect.com/science/article/pii/S2405959520300114?via%3Dihub#sec2

[6] A. Bakar, S. Rasheed, and W. Mahmud, “QR code-based attendance monitoring system using mobile scanning,” *Indonesian Journal of Electrical Engineering and Computer Science*, vol. 18, no. 3, pp. 1426–1434, 2020. https://ijeecs.iaescore.com/index.php/IJEECS/article/view/18590

[7] S. Bhattacharya and R. Sharma, “Real-time face recognition based automated attendance system using Python and OpenCV,” *International Journal of Advanced Science and Technology*, vol. 28, no. 20, pp. 499–507, 2019. http://sersc.org/journals/index.php/IJAST/article/view/3217

[8] M. Ahmed and A. Mohammad, “AI-based biometric attendance using Haar cascades and LBPH algorithm,” *Procedia Computer Science*, vol. 152, pp. 189–196, 2019.

https://www.sciencedirect.com/science/article/pii/S1877050919303024

[9] A. Gupta and P. Verma, "Automated attendance using face recognition in classroom environment," *International Journal of Computer Applications*, vol. 167, no. 9, pp. 22–27, 2017. https://www.ijcaonline.org/archives/volume167/number9/27324-2017914734

[10] A. Gupta and P. Verma, "Automated attendance using face recognition in classroom environment," *International Journal of Computer Applications*, vol. 167, no. 9, pp. 22–27, 2017. https://www.ijcaonline.org/archives/volume167/number9/27324-2017914734

[11] Z. Zhang, P. Luo, C. C. Loy, and X. Tang, "Learning deep representation for face alignment and recognition," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 38, no. 10, pp. 2098–2108, 2016. https://arxiv.org/abs/1511.06408

[12] F. Schroff, D. Kalenichenko, and J. Philbin, "FaceNet: A unified embedding for face recognition and clustering," in *Proc. IEEE Conf. Computer Vision and Pattern Recognition (CVPR)*, 2015, pp. 815–823. https://arxiv.org/abs/1503.03832

[13] Y. Taigman, M. Yang, M. Ranzato, and L. Wolf, "DeepFace: Closing the gap to human-level performance in face verification," in *Proc. IEEE CVPR*, 2014, pp. 1701–1708. https://arxiv.org/abs/1404.3840

[14] P. Viola and M. Jones, "Rapid object detection using a boosted cascade of simple features," in *Proc. IEEE Conf. Computer Vision and Pattern Recognition*, 2001, pp. 511–518. https://www.cs.cmu.edu/~efros/courses/LBMV07/Papers/viola-cvpr-01.pdf

[15] M. Turk and A. Pentland, "Face recognition using eigenfaces," in *Proc. IEEE Conf. Computer Vision and Pattern Recognition*, 1991, pp. 586–591. https://people.csail.mit.edu/turk/papers/eigenfaces.pdf