Development and Evaluation of a Facial Recognition-Based Computer Laboratory Attendance Monitoring System

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Abstract – Managing student attendance efficiently is critical in modern academic settings, particularly in computer laboratories where time and access control are vital. This study developed a Computer Laboratory Attendance Monitoring System using facial recognition technology to automate, secure, and streamline attendance recording. The system employs cameras at laboratory entrances to capture real-time facial images, which are compared with a centralized database to record attendance automatically, thereby eliminating manual logging, ID card swiping, and reducing risks of proxy attendance and human error. The system was developed using the Rapid Application Development (RAD) methodology and evaluated using the ISO 9126 software quality model, focusing on functionality, reliability, usability, efficiency, maintainability, and portability. Key challenges included facial recognition accuracy under varying environmental conditions, hardware limitations, and user privacy concerns. These were addressed through improved machine learning models, data encryption, multiple image registration, and user training sessions. System evaluation involved 30 respondents, including students and IT professionals, yielding a grand mean rating of 4.2 (Strongly Agree) across all ISO 9126 quality attributes, indicating high user satisfaction and acceptance. Findings suggest that the proposed system provides a reliable, user-friendly, and scalable solution for attendance management in academic institutions, with potential for broader adoption across multiple laboratories or campuses.

Keywords – Computer Laboratory Attendance, Facial Recognition, Automated Attendance System, Biometric Authentication

1 Introduction

Attendance management is a critical administrative task in academic institutions, particularly in computer laboratories where access control, time efficiency, and accountability are essential. Traditional attendance methods such as logbooks, ID cards, and manual verification are prone to errors, time delays, and proxy attendance, reducing their reliability and effectiveness. To address these limitations, this study developed a Facial Recognition–Based Computer Laboratory Attendance Monitoring System that automates attendance recording through real-time face recognition.

The proposed system uses cameras installed at laboratory entry points to automatically identify students upon entry. Attendance is recorded by matching captured facial images against a pre-registered database, eliminating the need for physical interaction such as tapping, swiping, or manual signing. This contactless approach improves efficiency, minimizes human intervention, and supports hygienic practices, which are increasingly important in modern educational environments.

Recent studies have demonstrated that facial recognition technologies provide a more accurate, secure, and efficient alternative to conventional attendance systems by significantly reducing human error and proxy attendance [1], [5]–[7]. However, the development of such systems presents technical and operational challenges, including sensitivity to lighting conditions, camera angles, partial facial occlusion, and the need for large and diverse training datasets to ensure recognition accuracy [10], [13], [15].

User acceptance and real-world deployment also pose challenges, particularly regarding data privacy, system usability, and infrastructure constraints. Concerns related to the storage and use of facial data necessitate strong data protection mechanisms and informed user consent [12]. Additionally, variations in hardware capability and network stability may affect real-time system performance, while limited user familiarity underscores the importance of intuitive interfaces and proper orientation.

To address these challenges, the system integrates a trained machine learning–based facial recognition model capable of handling variations in facial orientation and environmental conditions. Multiple facial samples were collected per user to enhance recognition accuracy. A centralized and secure database was implemented to store facial data and attendance records, with encryption and consent mechanisms to ensure compliance with privacy standards. These design choices align the system with current institutional platforms and enhance its reliability, scalability, and user acceptance.

2 Related Literature

Several studies have explored the application of facial recognition technologies for attendance monitoring in educational and organizational settings. Rohini, Sobhana, and Chowdary [2] developed an automated attendance monitoring system that replaces manual attendance processes with webcam-based face detection and recognition. Their system records attendance automatically and incorporates distinct modules for teachers and administrators, improving monitoring efficiency and system control.

Similarly, Sawhney et al. [3] proposed a real-time smart attendance system that captures facial images using cameras and applies deep learning algorithms to compare them against a registered database. Their findings highlighted the limitations of conventional attendance methods, such as manual recording and card-based systems, particularly in terms of accuracy and scalability.

Deep learning approaches have been widely adopted to enhance recognition performance. Thalor et al. [4] demonstrated that deep learning–based facial recognition systems significantly improve accuracy and reliability in both educational and business environments. Related studies further confirm that convolutional neural networks

(CNNs), hybrid CNN–LSTM models, and advanced architectures such as YOLO and FaceNet-based approaches yield robust attendance systems under diverse conditions [10], [13], [15].

Additional research has emphasized system scalability, environmental adaptability, and real-time performance. Dev and Patnaik [5], Grover and Chhabra [7], and Shashikala et al. [6] reported that facial recognition–based attendance systems reduce administrative workload and enhance operational efficiency in academic institutions. Recent advancements have also extended facial recognition applications beyond classrooms to libraries and human resource management systems, demonstrating broader applicability and system maturity [8], [9], [14].

Despite these advancements, privacy and ethical concerns remain significant. Laishram et al. [12] highlighted potential data leakage risks in facial recognition systems and emphasized the importance of privacy-preserving techniques. Comprehensive reviews by Vardhan et al. [11] further identified challenges related to accuracy, user acceptance, and infrastructure readiness, reinforcing the need for secure, efficient, and user-centered system design.

Generally, the reviewed literature supports the effectiveness of facial recognition–based attendance systems while underscoring the importance of accuracy, privacy protection, and usability. These findings guided the design and implementation of the proposed system, ensuring alignment with current research trends and best practices.

3 Methods

This chapter presents the method used to develop and evaluate the Facial Recognition-Based Computer Laboratory Attendance Monitoring System Recognition. The Rapid Application Development (RAD) was used as a model and ISO 9126 for the testing and evaluation of the system. The researchers applied Rapid Application Development (RAD), a software development approach that promotes prototyping over intensive design. Meanwhile ISO 9126 is based on the standards: Functionality, Reliability, Usability, Efficiency, Maintainability and Portability.

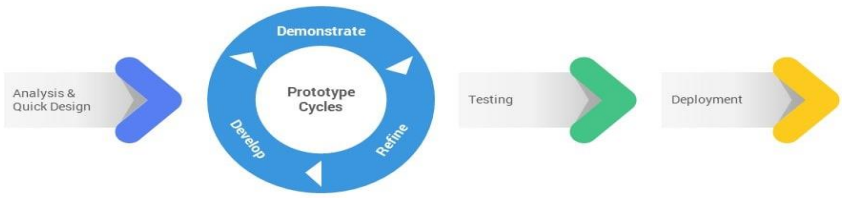

Fig. 1. Rapid Application Development Model

The Rapid Application Development (RAD) methodology is a fast-moving software development technique that prioritizes iterative feedback and quick prototyping. The process begins with a quick analysis and design stage, then moves into iterative prototype cycles where the system is constructed, tested with users, and continuously improved. This procedure enables quick and flexible responses to evolving needs. Once

the prototype satisfies user requirements, testing and implementation take place, leading to a quicker, more user-aligned final product.

3.1 System Analysis and Design

The Development and Evaluation of Facial Recognition-Based Computer Laboratory Attendance Monitoring System was developed to streamline and modernize the process of recording student attendance in computer laboratory classes. It integrates facial recognition technology with a centralized database to ensure accurate, secure, and efficient attendance tracking. The system has two main components: a back-end and web-based administrative panel for managing attendance data, and a camera-enabled front-end application for capturing and processing facial images in real time.

During the analysis phase, the researchers coordinated with the computer laboratory in-charge and faculty members to identify current challenges in manual attendance monitoring, such as time-consuming roll calls, susceptibility to proxy attendance, and difficulties in generating accurate records. Data was gathered through interviews, observation of actual classes, and review of existing attendance sheets. The study revealed a significant need for a digital, automated solution to enhance efficiency and accuracy.

The final design ensures seamless integration of facial recognition technology with the attendance database, allowing administrators to easily view, search, and generate reports, while students benefit from a fast and contactless attendance process.

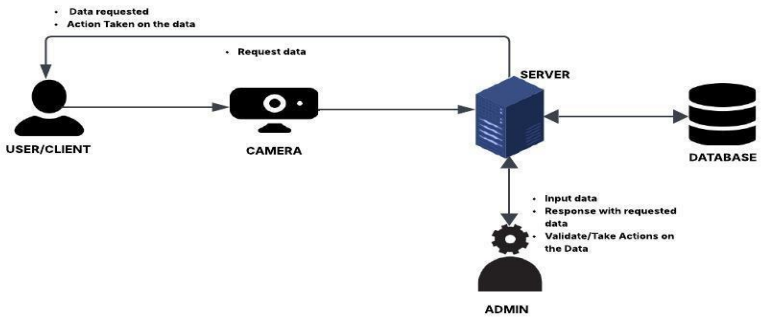

Fig. 2. System Architecture

3.2 System Development

The development of the system followed a structured and iterative approach to ensure functionality, usability, and scalability. The front-end of the system was developed using HTML and JavaScript, running locally through a localhost environment to facilitate rapid prototyping and testing. This provided an interactive and user-friendly interface for end-users. For the back-end, the system utilized PHP for server-side processing, integrated with FaceAPI for facial recognition capabilities. This combination allowed for efficient authentication and verification processes. The database was implemented using DB (MySQL) to store and manage user information, facial data, and other relevant records securely.

The development process involved close collaboration with stakeholders to gather requirements and ensure that the system meets the intended objectives. Continuous testing and feedback loops were employed to refine features, improve performance, and resolve issues. By adhering to best practices in both front-end and back-end development, the researchers successfully created a functional prototype that meets the expectations of users while ensuring secure and reliable operations.

3.3 System Implementation

The implementation phase of the Development and Evaluation of Facial Recognition-Based Computer Laboratory Attendance Monitoring System involved formal coordination with the target respondents, identified as key stakeholders for system testing and evaluation. The researchers issued formal letters to these respondents, seeking approval for the deployment and testing of the system under the title 'Development and Evaluation of a Facial Recognition-Based Computer Laboratory Attendance Monitoring System.'

The implementation process followed a structured evaluation framework based on the ISO 9126 software quality standards, which assess six critical factors: functionality, efficiency, usability, reliability, maintainability, and portability.

3.4 System Testing

The Development and Evaluation of Facial Recognition-Based Computer Laboratory Attendance Monitoring System was developed using PHP for backend operations and MySQL for secure and reliable data storage. The facial recognition functionality was implemented through a camera interface integrated with API-based facial recognition libraries, enabling accurate and real-time identification of students. The frontend was built with HTML, CSS, and JavaScript to provide an intuitive and user-friendly interface for administrators and teachers. Development was carried out in close collaboration with faculty members and laboratory personnel to ensure that the system's features met the specific needs of the institution, enhancing accuracy, efficiency, and security in monitoring laboratory attendance.

System testing played a vital role throughout the development process, incorporating continuous testing cycles and feedback to refine features, enhance performance, and promptly address any issues. This iterative testing approach allowed the system to evolve in alignment with user requirements, resulting in a prototype that is both user-friendly and functionally robust. By adhering to software development best practices and maintaining a focus on user-centered design, the researchers successfully created a prototype that meets the expectations of its users, thereby improving the overall process of attendance monitoring in the computer laboratory.

3.5 System Evaluation

The system functionality, efficiency, usability, reliability, maintainability and portability were based on the adopted instrument from John Brooke (1996) and ISO 9126. The instrument consisted of two parts. Part I covered the items personal information of the employee. Part II is the items that would determine the functionality, efficiency, usability, reliability, maintainability and portability of the system .To ensure the instrument truly fits the objectives of the study, the researchers underwent the process of establishing its validity. They asked the opinion of experts, IT Faculty, and SIIT Students and based on the instruments.

The total number of respondents in the system evaluation was 30 which are equally represented by the IT Professionals, and SIIT students. Purposive sampling was used in identifying the respondents. A validation survey instrument used by respondents in the application evaluation.

Table 1. Distribution of Respondents

Respondents	**Number**	**Percentage**
Students	25	75%
IT Professionals/Experts	5	25%
Total	30	100%

Table 1 shows the number of respondents. Thirty (30) persons evaluated. The system; to wit, twenty-five (25) SIIT students, five (5) IT Experts. Of the 25 SIIT students who personnel evaluated the system 75%, from the 5 IT experts have 25% evaluated the system, and a total of 100%.

3.6 Research Instrument

This study utilized an instrument adapted from ISO 9126 to evaluate the usability, reliability, efficiency, and portability of Computer Laboratory Attendance Monitoring System.

Usability determines the ease with which the systems function can be understood, usability exists about functionality and refers to the ease of use for a given function. Functionality is the essential functionality characteristic and refers to the appropriateness (to specification) of the functions of the software. Maintainability / Efficiency is concerned with the system resources used when providing the required

functionality. Portability is the ability of an application to run properly on a different platform to the one it was designed for, little or no modification. Where modification is needed, the task of modifying the software to allow it to run in the new environment is known as porting (ISO 9126). The instrument consists of two parts. Part I covered the items on the personal information of the end-users. Part II focused on the items that would determine the functionality, efficiency, usability, reliability, maintainability, and portability. Table 2 represents the scale of evaluation of the six indicators.

Table 2. Scale of Evaluation

Scale	Score	Verbal interpretation
5	4.2-5.0	Strongly Agree
4	3.4-4.1	Agree
3	2.6-3.3	Fair
2	1.8-2.5	Disagree
1	1.0-1.7	Strongly Disagree

Validity. The adapted research instrument was presented to the adviser for comments and/or modification.

3.7 Ethics and Data Gathering Procedure

In the administration of the questionnaire, the researcher observed cordiality and politeness. During the pilot testing of the system, there was an orientation conducted on the system before implementation. The developer oriented the respondents and asked them to answer the survey questionnaire after manipulating and implementing the system analyses.

4 Results & Discussion

4.1 System Evaluation Based on ISO 9126

The Facial Recognition–Based Computer Laboratory Attendance Monitoring System was evaluated using the ISO 9126 software quality model, covering functionality, efficiency, usability, reliability, maintainability, and portability. The evaluation involved end users who assessed the system using a five-point Likert scale. Overall findings indicate a high level of acceptability, with a grand mean of 4.2, verbally interpreted as Strongly Agree, suggesting that the system effectively meets institutional and user requirements.

4.2 Key Evaluation Highlights

The system achieved its highest rating in functionality, confirming its effectiveness in delivering essential features, ensuring data accuracy, and enforcing access control for secure attendance monitoring. Respondents also strongly agreed on the system's efficiency and usability, indicating timely processing, ease of use, and smooth integration into laboratory operations, although minimal user orientation may further

improve confidence. The system demonstrated reliable performance in data handling and error feedback, while maintainability and portability were rated acceptable, suggesting adequate support for updates and multi-environment deployment with opportunities for future enhancement.

Table 3. Summary of System Evaluation Results Based on ISO 9126

ISO 9126 Criteria	Mean	Verbal Interpretation
Functionality	4.5	Strongly Agree
Efficiency	4.3	Strongly Agree
Usability	4.2	Strongly Agree
Reliability	4.2	Strongly Agree
Maintainability	4.1	Agree
Portability	3.5	Agree
Grand Mean	4.2	Strongly Agree

4.3 Discussion

As shown in Table 3, the system achieved a Strongly Agree rating in four out of six ISO 9126 criteria, indicating strong overall software quality. The results demonstrate that the system is functional, efficient, usable, and reliable, making it suitable for deployment in computer laboratory environments. The slightly lower ratings for maintainability and portability highlight opportunities for enhancement, such as improving cross-platform compatibility and simplifying system updates. Overall, the evaluation confirms that the developed system is effective, acceptable, and ready for institutional use.

5 Conclusion

The Development and Evaluation of Facial Recognition-Based Computer Laboratory Attendance Monitoring System is designed to automate, secure, and streamline the recording of student attendance. The system eliminates the limitations of manual logging by capturing and matching real-time facial images with a pre-stored database. This ensures accurate and reliable attendance records, minimizes fraudulent entries and reduces the time and effort required in monitoring laboratory usage.

The system was developed with a user-friendly interface and a functional architecture and supports accurate facial recognition and real-time processing. It is integrated with a centralized database, which allows secure storage and efficient retrieval of records. Evaluation of the system was conducted following the ISO 9126 software quality standards, where the results showed favorable responses in terms of functionality, reliability, usability, efficiency, maintainability, and portability.

Generally, the Computer Laboratory Attendance Monitoring System is proven to be an effective solution that meets the institution’s requirements. It can be adopted as reliable tool to improve attendance tracking, enhance security, and support efficient laboratory management.

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