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Original Article

Graphical User Interface (GUI) for Camera-based QR Code Reader Attendance Monitoring System

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Abstract *- Ambiguously, logbooks and manual entry are alternative mechanisms widely used in traditional systems for attendance monitoring and controlling, which remain ineffective and cause misreporting, proxy attendance, and contentions. This article is a design of an effective automated Graphical User Interface (GUI) for a Camera-Based QR Code Reader Attendance Monitoring System to improve the reliability and speed of manual operations. Utilizing QR (Quick Response) code technology, ID data are read and decoded immediately with imaging equipment. It has a GUI with prompts, feedback, and logging/reports. The development of the proposed system followed the Software Development Life Cycle (SDLC), which organizes system activities into sequential and iterative phases to ensure reliability and maintainability of the system, which stresses an iterative process with stakeholder involvement at every stage of the design. By doing so, they would use real-world needs, rather than fixed specs, to decide what features they should add. Quantitatively investigating the effectiveness of our system, we conducted a study with 112 participants. Weighted mean Score was employed in the analysis of data, resulting in an overall weighted mean score of 4.40, which indicates that performance is "Very Satisfactory". In particular, the users declared performance efficiency and data confidentiality as strong points of the system, focusing on a good trade-off between computational speed and architectural security. In terms of application, along with practical significance, the system is in favor of the global development agenda 2030; it does contribute significantly towards some of these goals, given its contribution to efficiency and effectiveness in the academic control process through the enhancement of attendance monitoring, by providing non-exclusive creative access to technology. Going forward, some possible pathways include strengthening the system's ecosystem by supporting biometric authentication, multi-platform mobile compatibility, and advanced predictive analytics to make computing power more sophisticated.*

Keywords *- Agile Development, System Usability, Automation, Educational Technology, Graphical User Interface (GUI), Image Processing, QR Code.*

1. Introduction

Attendance tracking is a very important aspect in any organized setting for learning, and although many such applications exist, they are not always designed to adhere to the needs of institutions. Hardcopy and simple e-attendance are so far the usual routine and are prone to being labor-intensive, error-prone, and manipulable. Extraofficial and the Smart attendance solution -facial recognition, as more and more offices and schools become paperless, you will need a smart attendance solution that's paperless for both maintaining quality and accountability. Such capabilities are absent from most existing tools. Previous works have proposed different automations of attendance tracking systems using RFID-based systems, biometric authentication, mobile application check-in, and so on. Although these methods show better performance compared to manual methodology, they are usually involved with expensive hardware, privacy issues, or technical challenges, which are barriers to large deployment. More recently, QR code-based attendance systems are gaining momentum as a low-cost solution; however, most of them only consider backend automation and system feasibility, which surprisingly lack sufficient concern for user-friendly interface design, real-time feedback, and full performance evaluation. This leaves a critical research gap for the construction and empirical evaluation of attendance systems that incorporate requirements such as automation, usability, and security in one scalable framework. To fill this gap, the present research suggests a GUI for the Attendance Monitoring of QR Code Reader-Based Camera Innovation. A system that uses QR (Quick Response) code technology as a quick and inexpensive way to encode user identification data, in combination with a real-time image capture device like a web camera or mobile phone camera. The main focus of the project is to automate the attendance system and replace the existing manual system with this new system, in which a QR code is scanned during

entry time, thus making the attendance data capture real-time and inserted directly into an online database. The usability of a GUI-driven pipeline intended for low-threshold use by students, staff, administrators, or IT personnel constitutes one of the most important values of this work. Compared with the previous QR code attendance system, which only has automatic ones, our attendance system also sends feedback in time, sets the status symbol, installs a detailed record of attendance, and constructs a summary report to implement personalized management.

These features provide a better overall connection with the user, better monitoring accuracy, and more accountability in educational settings. The system is in line with global and institutional developmental objectives, such as Goal 4 (Quality Education) and the United Nations Sustainable Development Goals [7], which focus on sustainable industrialization, innovation, and resilient infrastructure. The project's digital attendance management system is a dependable, scalable, and user-friendly solution that helps promote more inclusive and innovative education at the school level. The rest of this paper describes the system architecture, software elements, implementation strategy, and performance evaluation of the proposed work. Conclusions: This study proposes a feasible attendance tracking solution applicable to different schools, and it paves the way for global contributions into digitalization and the construction of high-performing educational institutions.

2. Objectives / Statement of the Problem

2.1. Statement of the Problem

Conventional ways for records of measurements, e.g., logbooks or manual pen-to-paper writing, could be time-consuming and subject to human error or tampering. Manual attendance record keeping usually causes delay, human error, and mismatched records. Even though digital responses are increasingly popular, many continue to remain unavailable or hard to use. QR code attendance systems offer swift, secure solutions, but with limited intuitive user interfaces that allow for easy navigation, real-time monitoring, and effective management (by both admins and users). A lot of systems focus on backend decoding, but ignore human-computer interaction to avoid the user's frustration and the delay of scanning. In particular, the study addresses the following questions:

1. How can a GUI attendance monitoring system be designed and built using a camera-based QR code reader?
2. What are the key components of every good GUI design?
3. How well does the proposed system address functional adequacy, performance efficiency, and usability according to user feedback?
4. How can the Overall attendance system be optimized to save time, reduce error-handling, and avoid manual intervention, which corresponds with the company's work process?

2.2. Objectives of the Study

2.2.1. General Objective

Design and develop a user-friendly GUI for a camera-based QR code attendance monitoring system to automate and streamline attendance recording.

- To create a user-friendly GUI that provides smooth interaction for users and administrators.
- To build a camera-based QR code reader system that automatically identifies, scans, and reports attendance in real time.
- To integrate database administration functions to securely store and retrieve attendance data.
- To check that the system meets standards for function, performance, usability, and reliability using the ISO/IEC 25010 quality model.
- To eliminate errors, delays, and manual workload associated with traditional attendance tracking methods.

3. Materials and Methods

We are using Agile methodology to develop and deploy the QR code attendance system. The project is divided into three phases: Planning, Design and Development, and Testing. This approach allows us to continuously improve the camera's scanning capabilities and refine the user experience based on real-world feedback. By encouraging contributions from all team members, we aim to deliver a tool that is intuitive, responsive to our needs, and meets technical requirements.

Phase I, scheduled for December 2024 to January 2025, focuses on Planning and Requirements Analysis. During this phase, the engineer will work with stakeholders to collect and document both functional and non-functional requirements. For the GUI, this includes designing key elements such as the live camera feed interface, QR code scanning indicators, user login pages, and attendance log viewers. All requirements will be consolidated into a product backlog, which will guide subsequent development sprints. This stage also includes feature prioritization and initial sprint planning in line with Agile principles.

A System Design and Development strut is expected to run from February through March 2025. We will first design the UI layout and interaction flow based on wireframes, to make sure the design is user-centered. We aim to create a user-friendly, dynamic GUI that is compatible across devices.

The development process will be very agile- small sprints (iterations of 1 to 2 weeks) and adding to the interface step by step. We will implement in an agile way and continuously develop, integrate, and test features by real-time QR code scanning, receiving attendance confirmation feedback, and navigation control. Developers' feedback will be used to make changes each cycle.

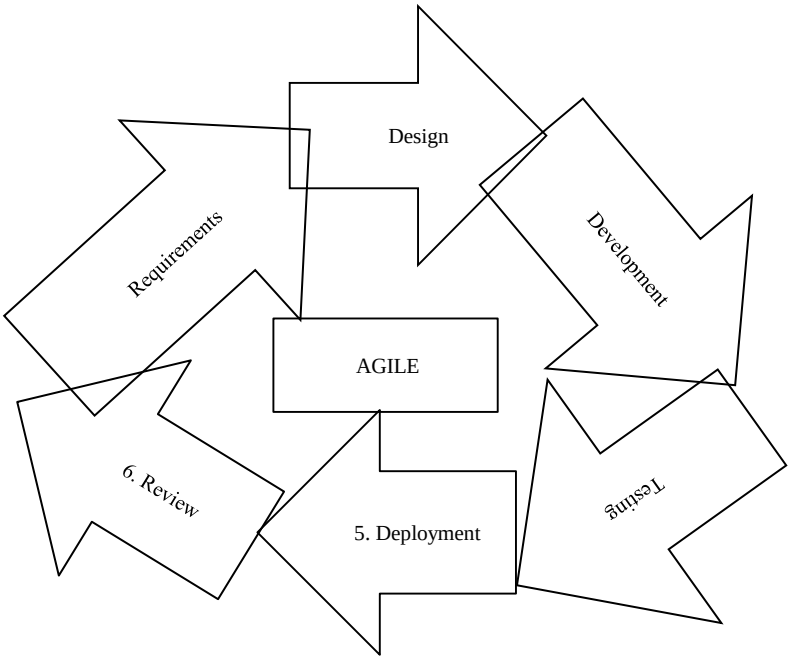

Fig. 1 Agile Software Development Life Cycle (SDLC) model

The project is slated to start the testing phase from March to April 2025. Although testing is integrated throughout the Agile process, this phase will implement a more structured and comprehensive methodology. The Graphical User Interface (GUI) undergoes functional testing to verify that all interface elements function as intended, and usability testing evaluates ease of use for students and administrators. The device and browser compatibility testing ensure that you can easily connect across devices and web browsers, scan a QR code with your smartphone or tablet to connect, and check the accuracy of scanning performance. Reported issues are systematically recorded and dealt with in the course of rapid iteration. Agile methods (including sprint reviews and retrospective meetings) are applied in all the phases of projects, to gather feedback, promote continuous improvement, and keep user intentions as well as project objectives aligned.

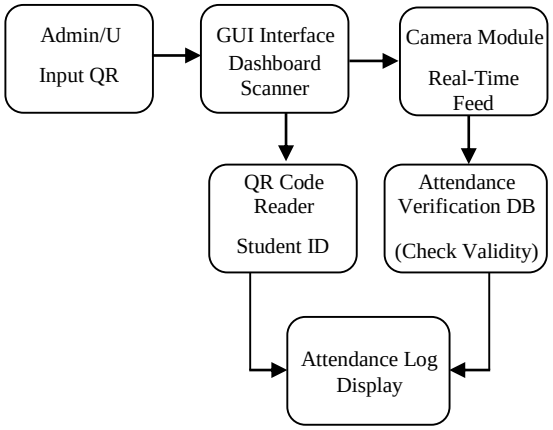

Fig. 2 Data Flow Diagram (DFD) level 1 of the system

With this structured yet flexible approach, another reliable and user-centered GUI for the camera-based QR code attendance monitoring system is established within the project timeframe. The DFD, which is depicted in Figure 2, highlights the flow of data and control between elements within the GUI of the camera-based QR code reader attendance monitoring system.

It starts when a user, either a student, employee, or administrator, holds his/her card to the system and presents it with a QR code appearing in one of its sectors, recorded through a camera that has stored the data entered. The GUI is the main interaction point for the user, showing a live feed from the camera and an area in which to scan QR codes, as well as a dashboard that is used by users and administrators alike to view attendance logs, as well as the current system's status.

After successfully reading the QR code, the camera module sends an image to the QR code reader module. The QR code is then scanned to extract the user's identifying data (e.g., student ID number, employee ID number). This is then communicated to the attendance check module, which checks that ID against the records system database. If the ID is verified, and the QR code submitted has not been used in this session yet, the system returns Successful Confirmation. The result of the verification process, whether an acknowledgment or failure message, is sent back to the GUI. Real-time feedback is instantly returned to the user, who sees the result on the screen. Upon successful verification, the ID of the user, date , and time of attendance are logged in an attendance database for recording purposes and monitoring.

Data flow diagram a continuous, tidy, and clear-cut data stream is depicted for QR code acquisition, verification, feedback, as well as information record. The Graphical User Interface (GUI) is essential for instant interaction, clear system answer executions, and speedy and clear user-friendly attendance recording.

3.1. Technical Specifications (Hardware and Software)

In order to have scalability and performance, they use the technical stack below:

3.1.1. Hardware Requirements

Camera: HD Web Camera or incorporated smartphone camera (min. 720p) for all-around clear QR decoding performance.

Processor: A generic personal computer or notebook (Intel Core i3 or equivalent, 4GB of RAM) for executing the backend validation logic.

Reading Medium Type: QR codes can be displayed on mobile screens or printed out to display on physical IDs (Version 1 QR and 21x21 matrix are recommended for speed).

3.1.2. Software Stack

Frontend (GUI): Developed using PHP, HTML5, CSS3, and JavaScript (using Bootstrap) for a responsive layout that is accessible on all devices.

Backend Logic: Written in Python 3. x, using the OpenCV library to capture real-time video and Prybar for QR code extraction at high speed.

The database MySQL has been used to serve as a relational database for maintaining secure student profiles, timestamps, and attendance logs in the tables.

4. Results and Discussion

The performance of the camera-based QR code reader attendance-taking system was evaluated in terms of some software quality factors, and the results showed superior performance. The response rate was 112 responses , and the system was ranked from one to five point. 16Results were interpreted by weighted mean. Concerning Functional Suitability, including completeness, correctness, and appropriateness of functions, the system received an average rating of 4.30. The above result proves that the system fulfils its purpose, so it is suitable to utilize for automatic attendance recording

The system scored the maximum sub-mean for Performance Efficiency, consisting of time behavior, resource utilization, and capacity (4.49). This behavior indicates that the system operated in stable mode, with fast access times and an effective exploitation of system resources during processing. This performance is especially critical in real-time scenarios, where delays quickly become unbearable, and the reliability of the system is compromised.

Regarding Security-Looking at confidentiality, integrity, non-repudiation, authenticity, and accountability-the system scored a sub-mean of 4.40. This high score is held for the mature security features that have been put in place to secure valuable user data, and the accurate trace records that will be left behind for you to easily verify.

In general, the system has achieved a grand average of 4.40, which means that it performs at a “Very Satisfactory” level. These results show that the developed system is neatly designed, operational, effective, and secure. While the results are generally positive, we identify opportunities for incremental improvement that could optimize system performance and set future evaluations on a path towards an “Excellent” rating.

Table 1. Level of the functional suitability, performance efficiency, and security of the system

Functional Suitability	**Score**					**Weighted Mean**	**Interpretation**
	1	**2**	**3**	**4**	**5**		
1. Functional completeness. The degree to which the set of functions covers all the specified tasks and user objectives.	0	0	22	38	52	4.27	Very Satisfied
2. Functional correctness. The degree to which the set of functions covers all the specified tasks and user objectives.	0	0	21	38	53	4.29	Very Satisfied
3. Functional appropriateness. The degree to which the functions facilitate the accomplishment of specified tasks and objectives.	0	0	15	42	55	4.36	Very Satisfied
Sub-Mean						**4.3**	**Very Satisfied**
Performance Efficiency	**Score**					**Weighted Mean**	**Interpretation**
	1	**2**	**3**	**4**	**5**		
1. Time Behavior. The degree to which the response and processing times and throughput rates of a product or system, when performing its functions, meet requirements.	0	0	5	37	70	4.58	Excellent
2. Resource Utilization. The degree to which the amounts and types of resources used by a product or system, when performing	0	0	15	33	64	4.44	Very Satisfied

its functions, meet requirements.							
3. Capacity. The degree to which the maximum limits of a product or system parameter meet requirements.	0	0	10	42	60	4.45	Very Satisfied
Sub-Mean						**4.49**	**Very Satisfied**
Security	**Score**					**Weighted Mean**	**Interpretation**
	1	**2**	**3**	**4**	**5**		
1. Confidentiality. The degree to which a product or system ensures that data are accessible only to those authorized to have access.	0	0	11	23	78	4.6	Excellent
2. Integrity. The degree to which a system, product, or component prevents unauthorized access to, or modification of, computer programs or data.	0	0	22	28	62	4.36	Very Satisfied
3. Non-repudiation. The degree to which actions or events can be proven to have taken place so that the events or actions cannot be repudiated later.	0	0	13	38	61	4.43	Very Satisfied
4. Authenticity. The degree to which the identity of a subject or resource can be proved to be the one claimed.	0	0	17	41	54	4.33	Very Satisfied
5. Accountability. The degree to which the actions of an entity can be traced uniquely to the entity.	0	0	20	20	51	4.28	Very Satisfied
Sub-Mean						**4.4**	**Very Satisfied**
Grand-Mean						**4.4**	**Very Satisfied**

5. Comparative Evaluation

A comparison was done to place the new camera-based QR code attendance monitoring system in relation to the already existing attendance systems available in the literature. This is compared with standard manual logbooks, RFID systems, biometric attendance systems, and mobile-based check-in applications.

Compared to the manual methods of taking attendance, the proposed system reduces recording time, removes entry errors, and also decreases the chances of the section proxy attendance. In contrast to RFID and biometric systems that require high-priced hardware, our QR code-based approach uses common cameras, making it more cost-effective and easily scalable.

Moreover, mobile application-based attendance systems are dependent upon the users' handheld devices as well as the internet for functioning, whereas the delineated system provides a controlled indoor scanning environment with real-time verification and log maintenance. Most of the current QR code-based attendance systems concentrate on backend automation, and unlike this proposed system, those place a greater emphasis on the enhancement of the GUI to provide an app that is oriented towards user needs and more real-time feedback, and a complete, detailed summary report.

In terms of performance, usability, security, and deployment cost, the proposed system offers a balanced and feasible solution for educational institutions when they are equipped with reliable and scalable attendance solutions.

6. UX and Usability Study

The UX and usability of the designed camera-based QR code reader attendance monitoring system were analyzed to assess the effectiveness of the graphical user interface in enabling reliable, timely, and user-friendly capturing of attendance. The assessment emphasized the use-related quality attributes of the ISO/IEC 25010 substandard model of software quality, namely functional suitability, operability, learnability, and user satisfaction. With a system interface (Figure 3) that displays an always-on camera live feed for the QR code capture, and immediate visual feedback of the recognized user identity and display ID number (Figure 4), this design approach minimizes the number of interactions required from users to record attendance, decreasing interaction complexity and potential operational mistakes. The user only needs to show their QR code to the camera, and identification and logging are automatically done by the system.

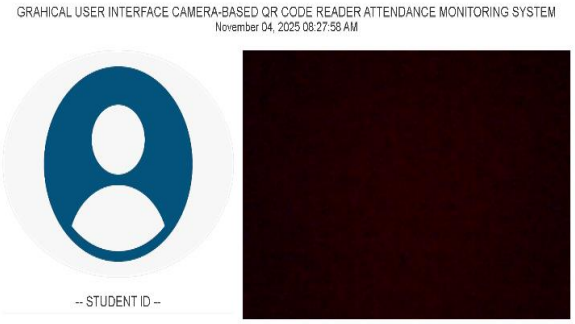

Fig. 3 Graphical user interface for camera-based QR code reader attendance monitoring system

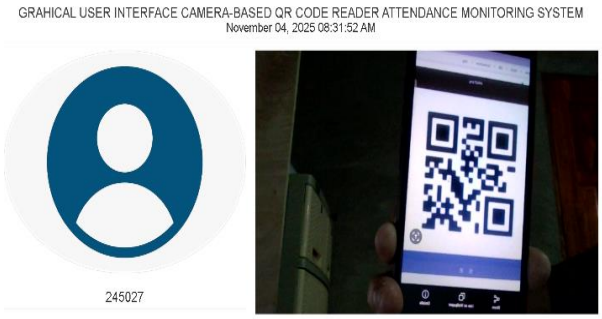

Fig. 4 Camera live feed for the QR code capture

The arrangement for the design of the interface and information provided was designed in order to enhance clarity and readability. Breaking apart scanning output from the user identification information allows users to quickly confirm that their attendance sign-in was completed. Date and time not only improves accuracy but also traceability, which are certainly important usability parameters within health care institutions' systems.

Usability evaluation results demonstrate good user acceptance, and participants found the system easy to learn and use without requiring any prior learning. When scanning finished, feedback was provided instantly, which made the user feel more confident and reduced the hassle of dealing with manual or delayed information. When used repeatedly, the responsiveness and consistency of the system increased perceived usefulness as well. According to the evaluation results, the GUI system successfully supports user tasks with a low cognitive effort level, and fulfils usability needs for routine institutional usage, and is in compliance with the considered UX evaluation criteria in engineering systems development. These findings confirm that the design of the system is adequate for using it in educational environments with high demands of efficiency, accuracy, and user-friendliness.

7. Security and Privacy

Security and privacy concerns are, however, embedded into the system architecture to protect sensitive user data and ensure that data is not tampered with. For personnel, attendance information is held in a 'central' database with limited access to avoid unauthorized tampering and disclosure. In this respect, implementations of the invention may implement authentication mechanisms that only permit certain commands, such as write, report, or configure, to be applied to a record by an authorized administrator. In addition, the QR code only contains relevant identity information and is scanned with less risk of sensitive personal information leakage. To ensure accountability and non-repudiation, the system preserves audit logs as it records timestamped attendance entries. Taken together, they satisfy various confidentiality, integrity, authenticity, and accountability needs as proven by the high security evaluation rating at system testing. As QR codes have well-known security vulnerabilities, if not implemented correctly, the scanned environment of QR code and server-side verification in this system mitigate attacks such as copied-and-reused attack and replay attack. The results show that the proposed scheme provides a fine trade-off between usability and security.

8. Scalability and Deployment

The proposed architecture is scalable and could be implemented in practice. Its modular design allows it to be deployed across multiple classrooms, departments, or campuses with only minor adjustments. The system has lower implementation costs than hardware-intensive systems because it employs off-the-shelf cameras and widely supported software technologies. The database model scales well with the number of users and attendance records, efficiency being very high (the system does not suffer from performance deterioration). The agile approach of the development methodology also supports ongoing improvements, so the institutions are able to customize the system based on their needs. It is deployable in LAN and over the internet, suitable for small and large academic institutions. This openness facilitates the long-term continuation and embedding in institutional infrastructures.

9. Future Work and Limitations

The results of the evaluation were encouraging, but there are some limitations. The current algorithm has restrictions on the quality of the camera and how good or bad the light is to capture an image with a level of accuracy in QR code recognition for certain scenarios. In addition, the system was evaluated in a single institutional setting. Wider testing on other campuses or with other academic terms is needed to assess long-term stability. Future initiatives include adding biometric (or multi-factor) authentication to more securely verify identity, building a mobile app for non-classroom attendance, and adding analytics and predictive reporting to track attendance patterns. Widening the cross-platform coverage and carrying out longitudinal evaluations would enable more profound system performance and scalability analysis. Overcoming these defects will make the system more reliable, secure, and applicable, providing a satisfactory solution to present attendance management.

10. Conclusion

GUI and effectiveness, reliability of the camera-based QR code reader attendance-tracking system is highly effective/reliable and reliable, based on user feedback and performance tests. This project is able to automate attendance in a simple way, and it reduces labor work, human mistakes, and fake entries. Results of the evaluation show very good performance in functional suitability, efficiency, and security, demonstrating a good match of this tool with user needs, as well as organizational goals. The following devices have been proposed to reinforce the system further:

- Develop a mobile app for remote and outside-of-campus attendance logging.
- Compatibility with analytics would enable organizers to chart the progress of attendance much better. Security can be further enhanced by incorporating biometric authentication or multi-factor identification.
- Longitudinal testing across multiple academic semesters is needed to study system robustness, scalability, and long-term reliability.

The incorporation of these features would place the system as an exemplary solution of digitized attendance tracking for both educational and professional environments.

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