

# Design and Implementation of a Web-Based QR Code Attendance and Monitoring System for Faculty Members in Tertiary Education at St. Clare College of Caloocan

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## ABSTRACT

This study looks at the inefficiencies and redundancies in faculty attendance system and management at St. Clare College of Caloocan. Currently, the institution uses a multi-layered approach involving manual log-books, ID-tapping, and an hourly "Learning Guide" signatures which has led to divided data silos, delayed payroll processing, and difficulties resolving attendance disputes. The main objective of the study is to design and implement a web-based QR Code Attendance and Monitoring System to streamline tracking, enhance data accuracy, and improve administrative efficiency.

The researchers used a Mixed Methods Research Design along with Evolutionary Prototyping Software Development. Data were gathered from 13 selected respondents consisting of St. Clare College of Caloocan's faculty members, Attendance Monitoring Team personnel and Department Head who were directly involved in the institution's attendance monitoring processes. This approach helped the development of a 3-Tier Hybrid Client-Server Architecture, using a Local-First Primary Node via Docker for offline resilience and a Cloud Secondary Node via Supabase for remote access and backups. Key features include contactless QR code scanning, a real-time administrative dashboard, and a specialized verification module for hourly monitoring rounds.

Results from the quantitative post-survey showed that the system is highly accepted among all respondent groups. Users evaluated the system positively in terms of usability, performance, and overall effectiveness. The study concludes that implementing a web-based QR code attendance system provides a reliable and scalable solution for modernizing attendance management in educational institutions, while also serving as a reference for future system development and research.

**Keywords:** QR Code, Attendance Monitoring, Tertiary Education, Web-Based System, Evolutionary Prototyping, Hybrid Architecture.

## INTRODUCTION AND LITERATURE REVIEW

### Introduction

In today's academic environment, an efficient attendance management system is important and required for making sure that the institution has accountability and seamless administrative operations. At St. Clare College of Caloocan, the current attendance tracking system relies on a "triple" redundancy. Faculty members sign a manual logbook upon arriving, tap an RFID card as a backup, and must provide physical signatures on a "Learning Guide" during hourly rounds conducted by the Monitoring Team. This fragmented process has created significant operational bottlenecks. Manual records are prone to illegible handwriting, missing entries, and physical data loss due to tampering or misplacement.

Furthermore, the lack of integration between face-to-face tracking and the Information Management System (IMS) used for online classes has resulted in "data silos," making real-time monitoring difficult for administrators. These inefficiencies directly impact faculty, leading to delayed reporting and payroll processing, as well as unresolved disputes regarding missing attendance logs. Therefore, there is an urgent need to transition from these error-prone manual methods to a centralized, digital solution that provides a "single source of truth".

With an increasing number of institutions turning to digital methods of recording attendance, they need to secure their personal attendance records from any form of tampering or abuse. According to Republic Act No. 10173 or the Data Privacy Act of 2012, data should only be collected, processed, and retained for legitimate institutional purposes. Hence, the proposed system takes into consideration the security of the attendance records of faculty members.

### **Statement of the Problem**

The major problem faced within the tertiary education department of St. Clare College of Caloocan is the inefficiency of ongoing reliance on paper-based attendance records that are prone to errors. By continuing to rely on handwritten logbooks alongside ID tapping, the institution faces a systemic inability to provide the real-time data accuracy required for seamless payroll processing and institutional accountability.

In particular, the study addresses the following problems:

1. **Manual Logbook Limitations** - The manual recording is prone to errors such as missing entries, illegible handwriting, tampering, and misplacement, which can affect data accuracy and reliability.
2. **Record Consolidation** - The separation of data across different methods leads to inefficiencies, such as delayed reporting.
3. **Lack of Real-Time Access** - Administrators encounter difficulties in promptly monitoring attendance and maintaining accountability.
4. **Limited Employee Access to Attendance Records** - Employees have only limited or one-time chances to verify their attendance, which may delay the correction of missed or inaccurate entries. In contrast, the proposed system allows them to check their attendance records anytime and anywhere through the web-based platform.

### **General Objective**

To design and implement a web-based QR code attendance and monitoring system that streamlines employee attendance tracking, enhances data accuracy, and improves administrative efficiency across the institution.

### **Specific Objectives**

1. To digitize manual logbook entry and exit process with QR code scanning to eliminate handwritten guard logbook and handwriting errors and data loss.
2. To enable automated report generation with filters for date, department, and attendance status.
3. To enable real-time administration with a live dashboard showing attendance status and summary analytics.
4. To develop an attendance history feature that allows employees to view, confirm, and verify their attendance records for accuracy.

## **REVIEW OF RELATED LITERATURE**

The global shift toward automated workforce tracking is driven by the inherent flaws of paper-based systems. Literature indicates that organizations relying on outdated platforms face high risks of payroll errors due to a lack of real-time data. Foreign studies highlight that manual systems struggle to prevent "time theft" and "buddy punching," where employees log in for absent colleagues. In contrast, Quick Response (QR) code technology has emerged as a superior, contactless substitute that reduces human error and speeds up check-in processes.

Locally, the Philippine administrative landscape is also moving toward digitization to improve workplace performance. Real-time monitoring systems in the Philippines have been shown to reduce administrative workloads by up to 50%. Case studies of public schools in Cavite demonstrate that QR-based tracking is viewed as "fast, convenient, and cost-effective". Academic research in the Philippines supports these findings, noting that users highly accept QR code systems for their accuracy and dependability.

Furthermore, security paradigms in the local context often incorporate GPS-enabled tracking or geo-fencing to ensure physical presence. For example, Bacolod City utilizes QR codes to monitor Job Order workers, fostering transparency and accountability. The transition to web-based platforms is particularly beneficial as it provides administrators with tools for immediate analysis and remote supervision. Studies by Perin (2023) and Agripa and Astillero (2023) emphasize that while technology-assisted systems are highly rated for functional suitability, local users place a premium on data security and system stability.

Local studies also indicate that digitization is directly proportional to increased punctuality. Garrido (2022) found that attendance rates improved to nearly 90% following the deployment of automated QR systems. This is further corroborated by foreign research, such as work by Sharma and Kumar (2025), which demonstrates that dedicated web applications significantly improve user experience by allowing seamless interaction between employees and administrators. Nasution et al. (2022) observed that web-enabled QR codes transform data flow in professional settings, making records far more manageable than traditional manual logs.

Finally, the maturity of QR technology ensures it is a reliable choice for institutional deployment. As noted in the Journal of the Association of Educational Management and Policy Practitioners (2025), there is a direct correlation between digitizing school management procedures and improved service quality. By automating repetitive tasks, employees can focus on strategic duties rather than balancing error-prone logbooks. This body of literature confirms that the development of a Web-Based QR Code Attendance and Monitoring System is not only feasible but essential for modernizing the academic operations of St. Clare College of Caloocan.

## METHODOLOGY

The research design used for developing and evaluating the Employee Attendance and Monitoring System of St. Clare College of Caloocan was the Mixed Method Research Design integrated with the Evolutionary Prototyping. The reason why the Evolutionary Prototyping design was chosen for the development process is because of its flexibility to address challenges faced while implementing and developing the system such as problems with internet access and workflow processes.

### Research Design and System Development

The software development process followed several iterative phases. During the requirements analysis phase, the researchers identified the need to replace manual and ID-based attendance procedures with a web-based QR code attendance system capable of real-time monitoring and centralized data management. An initial cloud-based prototype was developed using Node.js, Express.js, PostgreSQL, and Supabase. However, stakeholder evaluations revealed that unstable internet connectivity significantly affected system reliability. Feedback also showed that attendance operations were primarily handled by the Attendance Monitoring Team rather than the Human Resources Department. In response, the researchers redesigned the system into a hybrid local-first architecture using Docker and a local PostgreSQL server with cloud synchronization capabilities.

Further evaluations led to additional refinements. Schedule management and employee registration functions were reassigned to Department Heads to better reflect institutional workflows, while reporting features were simplified according to the actual practices of the Monitoring Team. The final system integrated QR code attendance logging, monitoring dashboards, report generation, and cloud synchronization within a three-tier hybrid client-server architecture.

## Development Environment

The development environment included Windows 10/11, Node.js with Express.js, PostgreSQL, Supabase, Docker, Visual Studio Code, GitHub, HTML, CSS, JavaScript, and NGINX. Namecheap and Cloudflare were utilized for domain and DNS management.

## Qualitative Sampling Technique

For the qualitative phase, purposive sampling was used to select participants involved in attendance monitoring processes:

Respondent Group	Number
Faculty Members	5
Department Heads	2
Monitoring Team	1
<b>Total:</b>	<b>8</b>

Table 1. Distribution of Qualitative Interview Participants

## Quantitative Sampling Technique

For the quantitative phase, purposive sampling was also used to select participants involved in attendance monitoring processes:

Respondent Group	Number
Faculty Members	10
Department Heads	1
Monitoring Team	2
<b>Total:</b>	<b>13</b>

Table 2. Distribution of Quantitative Survey Respondents

## Data Collection and Analysis

Qualitative data were collected through semi-structured face-to-face interviews focusing on attendance workflows, scheduling practices, system limitations, and improvement suggestions. Interviews were conducted after securing institutional approval and informed consent from participants. Responses were recorded, transcribed, and analyzed to identify operational issues and system requirements. Findings from this phase guided major architectural and functional revisions.

Quantitative data were gathered through structured post-survey questionnaires administered after system presentation and testing. Separate questionnaires were designed for the respondents using a six-point Likert scale. The surveys evaluated usability, attendance recording, monitoring functions, analytics, system performance, reliability, and overall acceptability.

## Statistical Treatment

Frequency count was used to determine the number of responses for each survey item. Percentage was employed to determine the proportion of respondents selecting a particular response. Weighted mean was used to measure the level of system acceptability and overall evaluation. Below is the interpretation:

Weighted Mean	Interpretation
5.17 – 6.00	Strongly Agree
4.34 – 5.16	Agree
3.51 – 4.33	Slightly Agree
2.68 – 3.50	Slightly Disagree
1.85 – 2.67	Disagree
1.00 – 1.84	Strongly Disagree

Table 3. Interpretation of Weighted Mean

The integration of qualitative and quantitative findings ensured that the final system was both technically functional and operationally suitable for institutional use.

## RESULTS AND DISCUSSION

### Qualitative Findings: Thematic Analysis

In the qualitative stage of the study, several themes emerged relating to the existing attendance system at the institution and the effects concerning the digital approach. Consistent themes found in the interviewees' responses included problems associated with lack of cohesion in attendance systems, redundant tasks, verification problems, and inadequate monitoring systems.

Among the major issues identified is the case of systematic redundancy, in which faculty staff found it difficult to undertake duplication of attendance processes in various means of registration and verification. This is because attendance was done manually, using the Learning Guides, RFID, and other mechanisms like taking pictures and screenshotting. This redundant process added more burden to both the teacher and the people in charge of recording these attendance activities. These findings clearly showed that there was no centralized process when it comes to the attendance of students in the institution.

Closely related to this issue was the strong preference for automated efficiency among respondents. Faculty members emphasized that a digital attendance system would significantly reduce repetitive manual work such as repeated attendance validation, and paper-based verification. Several respondents noted that automated attendance monitoring was more convenient, faster, and easier to manage compared to traditional manual logging. The respondents also appreciated the possibility of real-time monitoring and easier access to attendance history, which helped improve transparency and accountability.

Another important finding was the preference for automated monitoring despite operational limitations. While respondents generally favored digital systems due to their accuracy and convenience, some participants expressed concerns regarding technical interruptions such as internet instability and power outages. These concerns reflected the institution's operational realities and highlighted the importance of having a system capable of maintaining functionality even during technical disruptions. This influenced the design of the initial proposed system. The researchers adopted a hybrid local-first architecture that allows attendance transactions to continue even during temporary connectivity disruptions, where it maintains functionality while offline and automatically synchronizes records with the cloud database once internet is restored.

The qualitative findings also highlighted concerns regarding attendance validation and dispute resolution. Faculty members shared experiences involving inconsistent records, forgotten logbook entries, delayed monitoring updates, and the need for evidence such as screenshots or guard verification to confirm attendance. Monitoring personnel and administrators recognized that the absence of a centralized digital record often resulted in misunderstandings and time-consuming verification processes. The proposed system addressed these issues by creating a more reliable and traceable digital attendance record that could minimize inconsistencies and improve institutional accountability. To further strengthen attendance verification, the system incorporates

dynamic QR code, timestamp-based attendance logging, attendance history tracking, and monitoring-team verification procedures. These mechanisms establish a transparent audit trail that supports attendance validation, facilitates dispute resolution, and minimizes the possibility of proxy attendance or unauthorized attendance recording.

Additionally, the respondents discussed how challenging it was for them to manage their roles as teachers, where they plan lessons, manage extracurricular activities, and undertake administrative duties. In many cases, faculty members stated that the existing system of taking attendance ate up their time, which could otherwise be used in academic responsibilities. This implies that the improvement of the attendance system not only involves administrative tasks but is connected with increased faculty efficiency as well.

### Quantitative Findings: System Evaluation

The quantitative post-survey results confirmed that the system was highly successful across all respondent groups, with all categories achieving "Very High" interpretations.

**1. Faculty Evaluation** Faculty members (n=10) rated the system's usability and navigation between 4.40 and 4.60. They specifically highlighted the ease of the QR code scanning process (Weighted Mean: 4.60) and the system's usefulness in checking assigned schedules (Weighted Mean: 4.60). Notably, 90% of faculty respondents agreed that the digital system is significantly faster than manual recording (Weighted Mean: 4.40). In terms of records monitoring, faculty members gave a mean of 4.40 for both viewing attendance history and the accuracy of displayed information, confirming the system's transparency.

**2. Monitoring Team Evaluation** The Monitoring Team (n=2) provided exceptionally high ratings, particularly for core monitoring functions. They gave a perfect weighted mean of 5.00 for the real-time attendance table, the organization of attendance records, and the clarity of time-in/time-out details. Most significantly, the "hourly rounds feature" that digitizes the previously paper-heavy Learning Guide verification, achieved a perfect 5.00 for ease of use. While the distinction between pending and verified records received a slightly lower rating of 3.50 (High), the team unanimously recommended the system for regular institutional use (Weighted Mean: 5.00).

**3. Department Head Evaluation** The department head respondent (n=1) gave a perfect evaluation (Weighted Mean: 5.00) across every single category, including usability, real-time monitoring, reporting, and performance. This respondent strongly agreed that the system responds quickly and remains stable during actual operation. The administrator concluded that the system successfully meets the complex needs of attendance monitoring and is highly suitable for continuous implementation.

The findings demonstrate that the Web-Based QR Code Attendance and Monitoring System effectively addressed the institutional problems identified at the start of the study. By digitizing the manual logbook process, the system eliminated handwriting errors and data loss, fulfilling the first specific objective. The high ratings for report generation (5.00 from Admin and Monitoring Team) confirm the implementation of automated reporting with filters was successful, satisfying the second objective.

The "Very High" ratings for the real-time dashboard and summary analytics (means of 4.40 to 5.00) prove that the system provides administrators with the necessary tools for live institutional oversight, meeting the third objective. Finally, the positive feedback from faculty regarding their ability to independently review attendance history (Mean: 4.40) validates the achievement of the fourth goal which to empower employees through transparency.

The combination of qualitative and quantitative data suggests that the system is not just a technical success but a relevant solution. It moved the institution away from a fragmented and manual recording process toward a unified, automated platform.

By resolving the "triple redundancy" issue, the system reduced the administrative workload for both tertiary teachers and the Monitoring Team, allowing them to focus on their primary academic duties rather than clerical record-keeping.

Finally, the study proves that the implementation of this web-based solution significantly improves the daily experience of those managing attendance records. It provides a reliable "single source of truth" that enhances institutional accountability while offering a user-friendly interface that requires minimal training. The system stands as a practical solution that aligns with modern technological standards in education.

## CONCLUSION

This study shows how developing a web-based QR code system improved attendance tracking for faculty members in tertiary education at St. Clare College of Caloocan. The use of traditional paper logs, spreadsheets, or ID tapping often resulted in repetitive procedures, delayed reporting, inconsistencies in records, and increased administrative workload. This study successfully addressed these limitations for the institution's need for a more organized, accurate, and technology-driven attendance management system.

This study revealed that the created web-based QR code attendance and monitoring system was an effective solution to. Through the integration of this innovative web-based system and the use of QR codes, the process of attendance was made much better and efficient for the faculty members, monitoring team, and administrators of the institution. Since this new system decreased the need for manual data collection and the repetitive data validation procedure, attendance monitoring became more efficient and much easier.

Based on the findings prior to the interview, it was shown that respondents need modernization in attendance management. Faculty members, department heads, and monitoring staff have shown their concern regarding redundancy, inefficiency, and difficulties in maintaining accurate attendance records. Their responses show the importance of creating a system that could simplify attendance procedures while improving accountability and transparency. These insights became the foundation for the design and development of the proposed system.

Furthermore, the post-survey evaluation confirmed the effectiveness and acceptability of the developed system. Faculty members positively evaluated the system's usability, navigation, QR code attendance recording, schedule viewing, and monitoring features. The Monitoring Team also highly rated the system's real-time attendance monitoring, verification tools, and reporting capabilities, while the Department Heads strongly agreed that the system effectively met institutional attendance monitoring needs. The consistently high evaluation results indicate that the system was not only technically functional but also user-friendly, reliable, and suitable for continuous implementation within the institution.

Overall, the study confirms that the Web-Based QR Code Attendance and Monitoring System successfully achieved the objectives of the research by providing a more efficient, accurate, and centralized approach to attendance management. Beyond its technical contribution, it was also shown in the study the importance of developing systems that directly respond to the operational needs and daily experiences of institutional users. The developed system serves not only as a digital attendance tool but also as a solution that promotes efficiency, accountability, transparency, and improved workflow within tertiary education. Through this study, the researchers affirm that integrating modern technology into institutional processes can improve significantly both administrative operations and the overall user experience in managing attendance records.

## Recommendations

The findings of this study affirm that the Web-Based QR Code Attendance and Monitoring System for Faculty Members in Tertiary Education at St. Clare College of Caloocan has significant potential to improve the institution's attendance practices. By addressing recurring concerns in the existing process—particularly manual recording, repetitive verification, and delays in accessing attendance information—the system offers a more organized, efficient, and dependable approach to attendance management. At the same time, the study recognizes that systems of this nature continue to improve through refinement and actual use. For this reason, further enhancements are recommended to ensure that the system remains responsive to the institution's operational needs and sustainable for long-term implementation.

In light of the findings and conclusions of the study, the following recommendations are respectfully proposed for consideration:

1. **Integration with payroll processing** Future development of the system may include integration with payroll processing. Since attendance records are closely related to rendered hours, tardiness, absences, and corresponding deductions, connecting the system to payroll may help reduce manual computation, improve record accuracy, and make administrative processes more efficient.
2. **Development of a dedicated administrative dashboard for the IT team** A dedicated dashboard for the IT team is also recommended. This may include features for account management, system monitoring, activity logs, backup supervision, database status checking, and troubleshooting tools. Such a dashboard would allow technical personnel to maintain the system more effectively and ensure its continuous stability, security, and reliability.
3. **Automated Notification** System-generated feature designed to provide timely alerts and reminders to users regarding significant attendance events and updates. It automatically notifies employees, monitoring personnel, and administrative staff about successful attendance entries, missing logs, tardiness, and other attendance related concerns that may require action or verification. By providing immediate updates, this feature supports efficient monitoring, promotes accuracy in attendance recording, and strengthens communication among system users.
4. **Scheduled Uploading of Learning Materials** The process of uploading instructional documents, lesson files, and other educational resources into a system in advance, with a designated schedule for their release. This feature enables teachers or administrators to manage the timely distribution of learning materials according to the academic schedule. It promotes organization, efficiency, and accessibility by ensuring that the necessary materials are made available to learners on the intended date and time.
5. **Expansion of the system to include non-teaching staff** Since attendance management is also important for other personnel within the institution, it is recommended that future versions of the system be expanded to include non-teaching staff. Broadening the system's coverage beyond tertiary faculty members may help promote a more unified and centralized attendance monitoring process across the institution. This expansion may also increase the system's practical value by supporting a wider range of users and administrative functions.

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