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iTrack QR: An Intelligent Faculty Attendance Monitoring System with QR Code and Business Intelligence Integration for theUniversity of Perpetual Help System Manila

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Abstract

This study developed and evaluated iTrack QR: An Intelligent Faculty Attendance Monitoring System with QR Code and Business Intelligence Integration for the University of Perpetual Help System Manila. The system was designed to address the limitations of traditional attendance monitoring methods, which are often inefficient, error-prone, and lack real-time data processing and analytical capabilities. Specifically, the study aimed to improve attendance accuracy, enhance security through multi-layer validation, and support data-driven decision-making using Business Intelligence tools.

A descriptive-developmental research design was employed to guide the design, development, implementation, and evaluation of the system. The system integrates QR code scanning, device UID validation, and selfie-based identity verification to ensure secure and accurate attendance recording. It also includes Business Intelligence dashboards for generating reports and analyzing attendance trends. The system was evaluated using ISO/IEC 25010:2023 software quality standards. Data were collected from IT experts and faculty members through structured survey questionnaires using a Likert scale, and results were analyzed using weighted mean.

Findings revealed that iTrack QR achieved high levels of effectiveness in terms of functionality, performance efficiency, reliability, usability, and security, as evaluated by IT experts. Faculty members also demonstrated strong acceptance of the system, confirming that it is practical, user-friendly, and efficient in real-world use. The integration of QR technology with multi-layer validation mechanisms significantly reduced the risk of proxy attendance, while the Business Intelligence component enabled meaningful interpretation of attendance data.

The study concludes that iTrack QR is a reliable, secure, and effective solution for modernizing faculty attendance monitoring systems. It contributes to improving operational efficiency, ensuring data accuracy, and supporting evidence-based decision-making in higher education institutions. Future enhancements may focus on improving system scalability, cross-platform compatibility, and advanced analytics to further strengthen its institutional impact.

INTRODUCTION

In today's rapidly evolving landscape of higher education administration in the Philippines, institutions face increasing demands for operational efficiency, accountability, and data-driven decision-making amid resource constraints and administrative burdens. Faculty attendance monitoring is a critical institutional function, as it directly affects instructional continuity, payroll accuracy, transparency, and compliance with academic standards (Castillo & Flores, 2020; Rivera & Santos, 2025). However, many institutions, including the University of the Perpetual Help System Manila, continue to rely on hybrid or semi-manual systems that combine biometric logging, manual verification, and paper-based documentation. These approaches are time-consuming, prone to human error, and result in fragmented data management and delayed reporting. Existing studies emphasize that traditional attendance systems are inefficient, vulnerable to manipulation, and lack real-time monitoring capabilities (Gupta & Choubey, 2017; Yadav & Singh, 2019). While technologies such as RFID and biometric systems offer improvements, they are often limited by high implementation costs and technical complexity (Rao & Babu, 2021). In response, QR code-based attendance systems have emerged as a practical alternative due to their accessibility, flexibility, and ability to support real-time data logging (Adewale & Olatunji, 2024; Singh & Kaur, 2020). Furthermore, research highlights that integrating identity verification mechanisms such as image capture can significantly reduce proxy attendance and improve system reliability (Kumar & Patel, 2022; Rahman & Abdullah, 2021). Despite these advancements, a significant gap remains in the implementation of comprehensive attendance monitoring systems that combine QR technology with strong identity validation and analytical capabilities. Many existing systems focus primarily on attendance recording without incorporating additional layers such as device-based authentication or without transforming collected data into meaningful insights for administrative decision-making. The absence of Business Intelligence (BI) integration limits the ability of institutions to analyze attendance trends, monitor faculty performance, and support strategic planning (Hassan & Karim, 2020; Patel & Nair, 2024). To address these limitations, this study proposes and develops iTrack QR: An Intelligent Faculty Attendance Monitoring System with QR Code and Business Intelligence Integration for the University of Perpetual Help System Manila. The system integrates QR code scanning, selfie-based identity verification, and device UID validation to ensure secure and accurate attendance logging. In addition, it incorporates Business Intelligence dashboards that convert raw attendance data into visual reports and analytical insights to support data-driven decision-making. This study is grounded in the Technology Acceptance Model (TAM), which explains system adoption based on perceived usefulness and ease of use (Davis, 1989), and Business Intelligence Theory, which emphasizes the transformation of raw data into actionable insights (Sharda et al., 2020). Guided by these frameworks, the study hypothesizes that the integration of QR-based attendance monitoring with multi-layer validation and BI analytics will improve accuracy, efficiency, security, and user acceptance compared to traditional attendance systems. Methodologically, this study adopts a descriptive-developmental approach, involving system design, development, implementation, and evaluation using ISO/IEC 25010 software quality standards. Data were gathered through surveys and system testing involving faculty members and IT experts. This approach is appropriate as it allows both the technical performance and user acceptance of the system to be assessed in a real-world academic setting. The findings of the study indicate that iTrack QR achieved high levels of effectiveness in terms of functionality, performance efficiency, reliability, usability, and security, with strong user acceptance

among faculty members. These results suggest that the system is a viable and effective solution for modernizing faculty attendance monitoring and enhancing institutional efficiency.

METHODS

This study employed a descriptive-developmental research design to develop and evaluate the iTrack QR system in a real-world academic setting (Calderon & Gonzales, 2019). The development process included planning, design, development, testing, and implementation phases. During the planning phase, interviews and consultations with faculty and administrators at University of Perpetual Help System Manila were conducted to identify issues in the existing attendance system, such as manual verification, delayed reporting, and fragmented records. Based on these findings, system requirements were defined, including QR-based attendance, identity verification, and centralized reporting. In the design phase, the system architecture and database structure were developed using MongoDB to handle dynamic data such as attendance logs, QR codes, device UID, and user records. This approach was selected for its flexibility and scalability (Chodorow, 2013; Sadalage & Fowler, 2013). The system workflow incorporated QR scanning, device authentication, and selfie verification as layered validation mechanisms. During development, the system was implemented using the MERN stack (MongoDB, Express.js, React.js, and Node.js), chosen for its ability to support scalable and real-time web applications (Rogers & Blake, 2021; Adhikari & Thapa, 2023). Key features included QR code scanning, selfie verification, device UID validation, role-based access, and Business Intelligence dashboards. The system underwent functional and performance testing to ensure accuracy and reliability. Identified issues were resolved through iterative refinement. It was then implemented at Perpetual Help College of Manila, where faculty members recorded attendance by scanning QR codes, capturing selfies, and undergoing device and schedule validation. The data were automatically stored and processed to generate reports and analytics. Respondents included faculty members and IT experts selected through purposive sampling. Data were collected using structured questionnaires based on ISO/IEC 25010 standards (ISO, 2011), covering functional suitability, performance efficiency, compatibility, usability, reliability, security, and maintainability. Responses were measured using a four-point Likert scale and analyzed using weighted mean to determine system effectiveness and user acceptance.

RESULT AND DISCUSSION

This Chapter deals with the gathered data that were analyzed and interpreted for better understanding of the study. The framework of the analysis and interpretation was guided by the problems stated in chapter 1.

Table 1: Tabulated Results of level of Effectiveness in terms of Functionality

Descriptions	Weighted Mean	Interpretation
The system accurately records attendance through QR, Device UID, and selfie capture.	3.56	**HIGHLY FUNCTIONAL**

The system features support the intended functions of faculty attendance monitoring.	3.60	**HIGHLY FUNCTIONAL**
The BI-generated outputs are useful and clear.	3.56	**HIGHLY FUNCTIONAL**
AVERAGE WEIGHTED MEAN	**3.57**	**HIGHLY FUNCTIONAL**

As shown in Table 1, the Functionality domain achieved an average weighted mean of **3.57**, interpreted as Highly Functional. IT experts rated the system 3.56 for accurate attendance recording and BI clarity, and 3.60 for supporting the intended functions of faculty monitoring. These consistently high scores indicate that iTrack QR performs its core functions reliably and meets user expectations.

Table 2: Tabulated Results of level of Effectiveness in terms of Performance Efficiency

Descriptions	**Weighted Mean**	**Interpretation**
The system responds quickly after scanning a QR code.	3.56	**HIGHLY EFFICIENT**
The system performs consistently during repeated use.	3.56	**HIGHLY EFFICIENT**
The system loads BI dashboards and reports efficiently.	3.56	**HIGHLY EFFICIENT**
AVERAGE WEIGHTED MEAN	**3.56**	**HIGHLY EFFICIENT**

As shown in Table 2, iTrack QR received consistent scores of 3.56, yielding an overall average of 3.56, interpreted as Highly Efficient. The results indicate that the system responds quickly to QR scans, performs reliably during repeated use, and loads BI dashboards smoothly. These scores confirm strong performance efficiency, though further optimization may still enhance speed under heavier workloads.

Table 3: Tabulated Results of level of Effectiveness in terms of Compatibility

Descriptions	**Weighted Mean**	**Interpretation**
The system functions properly across different browsers (Chrome, Firefox, Safari).	3.56	**HIGHLY COMPATIBLE**
The system works well across major mobile OS (Android, iOS).	3.12	**COMPATIBLE**
The system runs without needing additional installations.	3.56	**HIGHLY COMPATIBLE**
AVERAGE WEIGHTED MEAN	**3.41**	**COMPATIBLE**

As shown in Table 3, iTrack QR obtained an average weighted mean of 3.41, interpreted as Compatible. The system performs well across major browsers and requires no additional installations, both receiving scores of 3.56. However, compatibility across mobile operating systems scored slightly lower at 3.12, indicating that some devices may experience minor performance variations. Overall, the results show that iTrack QR functions reliably across platforms and remains suitable for diverse user environments.

Table 4: Tabulated Results of level of Effectiveness in terms of Reliability

Descriptions	Weighted Mean	Interpretation
The system performs consistently without errors or crashes.	4.0	**HIGHLY RELIABLE**
The system produces consistent and accurate attendance logs.	4.0	**HIGHLY RELIABLE**
The system maintains stability during continued usage.	3.56	**HIGHLY RELIABLE**
AVERAGE WEIGHTED MEAN	**3.85**	**HIGHLY RELIABLE**

As shown in Table 4, iTrack QR obtained an average weighted mean of 3.85, interpreted as Highly Reliable. The system earned perfect reliability scores of 4.0 for error-free operation and for producing consistent attendance logs, indicating stable and dependable performance. It also maintained a strong score of 3.56 during prolonged use, showing that the system remains steady even under continuous operation. Overall, the results confirm that iTrack QR performs consistently as expected and can be relied on for uninterrupted attendance monitoring.

Table 5: Tabulated Results of level of Effectiveness in terms of Usability

Descriptions	Weighted Mean	Interpretation
The UI design promotes ease of navigation for both users and admins.	4.0	**HIGHLY USABLE**
Instructions and workflow steps are clear and understandable.	3.56	**HIGHLY USABLE**
Dashboard and attendance displays are easy to interpret.	3.56	**HIGHLY USABLE**
AVERAGE WEIGHTED MEAN	**3.70**	**HIGHLY USABLE**

As shown in Table 5, iTrack QR obtained an average weighted mean of 3.70, interpreted as Highly Usable. Respondents agreed that the system is easy to navigate, with a clear interface that supports both users and administrators. The workflow steps and dashboard displays also received high ratings of 3.56, indicating that users find the system intuitive and easy to understand. Overall, the results confirm that iTrack QR provides a positive user experience and meets usability standards suitable for faculty and administrative use.

Table 6: Tabulated Results of level of Effectiveness in terms of Security

Descriptions	Weighted Mean	Interpretation
The system securely stores attendance data and user information.	3.56	**SECURE**
Only authorized personnel can access sensitive attendance records.	4.0	**HIGHLY SECURE**
Device UID and selfie data are protected from unauthorized access.	4.0	**HIGHLY**

		SECURE

AVERAGE WEIGHTED MEAN	**3.85**	**HIGHLY SECURE**

As shown in Table 6, iTrack QR obtained an average weighted mean of 3.85, interpreted as Highly Secure. Experts rated access control and protection of sensitive data with the highest score of 4.0, indicating strong safeguards for attendance records, Device UID details, and selfie verification data. Secure data storage received a slightly lower score of 3.56, suggesting minor areas for improvement in enhancing storage-level protection. Overall, the results confirm that iTrack QR effectively protects user information and prevents unauthorized access.

Table 7: Tabulated Results of level of Effectiveness in terms of Maintainability

Descriptions	Weighted Mean	Interpretation
The system's code is easy to read and understand.	3.60	**HIGHLY MAINTANABLE**
System settings can be updated without difficulty.	3.30	**MAINTANABLE**
System issues can be fixed quickly when errors occur.	3.40	**MAINTANABLE**
AVERAGE WEIGHTED MEAN	**3.43**	**MAINTANABLE**

As shown in Table 7, iTrack QR obtained an average weighted mean of 3.43, interpreted as Maintainable. The highest rating of 3.60 reflects that the system's code is easy to understand, while scores of 3.30 and 3.40 indicate that updates and issue resolution are manageable. Overall, the results show that the system can be maintained effectively, with minor improvements needed to further enhance configuration and troubleshooting.

Table 8: Tabulated Results of level of Acceptance in terms of Functionality

Descriptions	Weighted Mean	Interpretation
The system records my attendance accurately.	3.78	**HIGHLY FUNCTIONAL**
The QR scanning and selfie capture process works consistently	4.0	**HIGHLY FUNCTIONAL**
The system provides the functions I need for attendance logging	3.78	**HIGHLY FUNCTIONAL**
AVERAGE WEIGHTED MEAN	**3.85**	**HIGHLY FUNCTIONAL**

As shown in Table 8, the Functionality domain achieved an average weighted mean of 3.85, interpreted as Highly Functional. Teachers rated the system highly for accurate attendance recording, reliable QR scanning, and consistent selfie verification, reflected in scores of 3.78 and 4.00. These results indicate that iTrack QR effectively delivers the core features needed for faculty attendance logging and meets user expectations for functional performance.

Table 9: Tabulated Results of level of Acceptance in terms of Performance Efficiency

Descriptions	Weighted Mean	Interpretation
The system responds quickly when I scan my QR code.	4.00	HIGHLY EFFICIENT
The attendance process works smoothly with no delays.	3.78	HIGHLY EFFICIENT

The system performs consistently each time I use it.	3.78	HIGHLY EFFICIENT
AVERAGE WEIGHTED MEAN	**3.85**	**HIGHLY EFFICIENT**

As shown in Table 9, Performance Efficiency obtained an average weighted mean of 3.85, interpreted as Highly Efficient. Teachers reported that the system responds quickly to QR scans, operates smoothly with minimal delays, and performs consistently during repeated use. These results demonstrate that iTrack QR provides fast and stable operations, supporting an efficient and seamless attendance experience.

Table 10: Tabulated Results of level of Acceptance in terms of Compatibility

Descriptions	Weighted Mean	Interpretation
The system works properly on my device.	4.0	**HIGHLY COMPATIBLE**
The system loads correctly on my browser.	4.0	**HIGHLY COMPATIBLE**
The system works without the need to install additional software.	3.78	**HIGHLY COMPATIBLE**
AVERAGE WEIGHTED MEAN	**3.92**	**HIGHLY COMPATIBLE**

As shown in Table 10, Compatibility achieved an average weighted mean of 3.93, interpreted as Highly Compatible. Teachers reported that the system works properly on their devices and browsers, reflected in the high ratings of 4.0. The score of 3.78 for operating without additional installations further indicates smooth accessibility. Overall, the findings show that iTrack QR is well-optimized for different user environments and functions reliably across various platforms.

Table 11: Tabulated Results of level of Acceptance in terms of Reliability

Descriptions	Weighted Mean	Interpretation
The system works properly every time I use it.	4.0	**HIGHLY RELIABLE**
My attendance logs appear accurately in the system.	4.0	**HIGHLY RELIABLE**
The system does not show errors during scanning.	3.60	**HIGHLY RELIABLE**
AVERAGE WEIGHTED MEAN	3.87	**HIGHLY RELIABLE**

As shown in Table 11, Reliability achieved an average weighted mean of 3.87, interpreted as Highly Reliable. Teachers reported that the system consistently works as expected and accurately records attendance logs, reflected in the high ratings of 4.0. The slightly lower score of 3.60 for scan-related errors.

CONCLUSION

This study developed and evaluated iTrack QR, an intelligent faculty attendance monitoring system that integrates QR code scanning, device UID validation, selfie verification, and Business Intelligence analytics. The findings showed that the system effectively improves accuracy, efficiency, and security

compared to traditional attendance methods. IT experts rated the system highly in functionality, performance efficiency, reliability, usability, and security, while faculty members demonstrated strong acceptance, confirming its practicality and ease of use. The integration of multiple validation mechanisms enhanced data accuracy and prevented proxy attendance, while Business Intelligence features enabled meaningful analysis for data-driven decision-making. These results highlight the effectiveness of combining automated attendance tracking with analytical tools in higher education. However, the study was limited to a single institution and may be affected by variations in device compatibility and internet connectivity. Future research may focus on expanding the system across multiple institutions, improving cross-platform performance, strengthening security features, and enhancing analytical capabilities to support long-term adoption and institutional decision-making.

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