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Enhancing Student Safety and Accountability through a QR Code-Based Gate Monitoring System for Patao National High School (PNHS)

Reyjane M. Ybañez¹; Jupiter E. Botilla²; Eleuterio I. Pacaldo Jr.³;
Ronald M. Fernandez Jr.⁴; Kurt Bryan S. Alegre, MIT(c)⁵

^{1,2,3,4,5}BS Information Technology & Madridejos Community College, Philippines

enajyerzenaby@gmail.com; acholitesjupiter@gmail.com; pacaldoeleuteriojr@gmail.com;
fernandezronald816@gmail.com; kurtbryan.alegre@mcclawis.edu.ph

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Abstract: With the increase rates of incidents involving high school students, effective monitoring of student entry and exit within school premises has become essential for ensuring safety and accountability. Cases such as motorcycle accidents, early pregnancy, violence, and truancy highlight the need for a more reliable monitoring system. Some students leave home for school but fail to enter the campus, while others escape by climbing fences or leaving during school hours without authorization. These situations expose students to potential risks and create concerns for parents and school administrators. Traditional manual gate monitoring methods are often time-consuming, prone to human error, and unable to provide immediate updates to parents or guardians. This study proposes the development and evaluation of Enhancing Student Safety and Accountability Through a QR Code-Based Gate Monitoring System for Patao National High School (PNHS). The system enables students to scan their unique QR code identification upon entering and leaving the school gate. Each scan is verified by a school guard to prevent misuse and proxy attendance. The system automatically records timestamped logs in a centralized database and sends instant email notifications to registered parents or guardians, ensuring transparency and real-time communication. The integration of automated logging and human verification enhances both security and operational efficiency. Using a developmental research approach with evolutionary prototyping, the system was designed, implemented, and evaluated through usability and functionality testing based on ISO/IEC 25010 standards. Results indicate improved monitoring accuracy, reduced manual recording errors, enhanced accountability, and effective, and scalable solution that strengthens school-home collaboration while promoting student safety, punctuality and data driven in public secondary schools.

Keywords: Gate Entry and Exit Monitoring System, QR Code Scanning, Real-Time Updates, Advance Announcements, Email Notifications

I. INTRODUCTION

The education sector increasingly emphasizes accurate, timely entry and exit monitoring to support student success, safety, and overall school efficiency. In the context of high school education, student absenteeism poses a significant challenge, not only for academic performance but also for safety and accountability. A common issue is students leaving home for school but diverting to other activities such as hanging out with friends without their parent's or guardian's knowledge. This behaviour, often termed "truancy", affect thousands of students annually and can lead to risks like exposure to unsafe environments or involvement in unintended incidents [1]. Automated systems using QR codes, often scanned via mobile devices or dedicated readers, have emerged as accessible, low-cost alternative. These enable real-time logging of student entry and exit, verification by school personnel (e.g., Guard), and instant notifications to parents/guardians via email, improving accuracy, reducing administrative load, and strengthening school-home partnerships. In the Philippine context, similar QR code-based systems have been implemented or studied in schools, such as a web-based QR attendance system with GSM/SMS parental notifications at Ciriaco Mariano Elementary School [2], and QR code + SMS entry/exit monitoring at Horacio Dela Costa Elementary School (e.g., research festival presentation), demonstrating reduced errors, faster processing, and enhanced parental awareness [3];[2]. Parents have a fundamental right and responsibility to monitor their children's whereabouts for safety, while schools require accurate attendance records to comply with regulations, identify at-risk students, and maintain operational efficiency. Traditional manual check-ins at school gates are unreliable, delay real-time communication, exacerbating these problems. Studies show QR code systems promote student accountability and punctuality by ensuring traceable, visible attendance records, discouraging tardiness or absences through transparency and real-time feedback [3]. They enhance entry/exit tracking efficiency and accuracy by automating verification at the gate, minimizing proxy issues, eliminating manual tallying, and providing tamper-resistant digital logs [4]. Balancing technology with human interaction remains key: QR scanning automates routine logging while guards provide on-site verification and personal oversight, freeing staff for relational support (various Philippine studies emphasizing hybrid human-tech approaches). Hybrid systems (combining QR/digital tools with manual backups) are feasible and scalable in public schools, addressing connectivity challenges or low resources common in settings like national high schools (systematic reviews on QR data accuracy and sustainability; DepEd-supported digital transitions). In response to these needs, this study proposes the Patao National High School (NHS) Entry and Exit Monitoring System with Real-Time Parents Update. The system enables students to scan their unique QR code identification at the school gate upon arrival and departure. Each scan is verified by a school guard to prevent misuse, automatically logs timestamped entry and exit records, and sends immediate email notifications to registered parents or guardians. By addressing the limitations of manual gate monitoring, the proposed system aims to improve attendance accuracy, enhance student safety, and support data-driven school management.

1. Objective of the study
 - 1.1. Enable real-time monitoring and reporting of student entry and exit for administrators, teachers, and guards;
 - 1.2. Promote student accountability and punctuality through visible and automated attendance tracking;
 - 1.3. Enhance the efficiency and accuracy of entry and exit monitoring by minimizing errors and proxy attendance;
 - 1.4. Balance technological automation with human verification to maintain security and student support; and
 - 1.5. Assess the feasibility of a hybrid QR-based attendance system in a Philippine public high school setting.
2. Determine the usability of the developed system based on USE Questionnaire: Usefulness, Ease of use and learning, and satisfaction [8].
3. ISO/IEC 25010 as software quality model [9].

By developing and assessing this context-specific system at Patao NHS, the research provides practical insights into affordable, scalable gate monitoring solutions with parental email updates. It contributes to safer campuses, stronger home-school ties, improved attendance outcomes, and support for DepEd's modernization goals in public secondary education.

II. METHODS

This study used developmental research approach [7] with evolutionary prototyping to design, develop, implement, and evaluate a real-time school gate entry and exit monitoring system for Patao National High School (Patao NHS). This method allowed iterative improvements based on user feedback, making it suitable for building a practical school gate entry and exit system. The system was developed and tested for Patao National High School, a public secondary school under the Department of Education (DepEd) in the Philippines.

The school has around 4,000 students in Grade 7-12 and uses manual gate monitoring.

A. System Development Process

The system was built using the evolutionary prototyping model within a Software Development Life Cycle (SDLC) [10];

1. Requirements Gathering – Before conducting a study we have consider the problems and the possible solutions. (National Center for Education Statistics, 2023) state the students in junior high school have been involved in truancy which may lead to student’s failure and incidents.
2. System Design – The students will scan their personal QR code id that will be verified by the school guard through analysing if the student presence and the id that came out of the system is similar. After the guard verified the student identity, the entry or exit notification will be sent to the parent or guardian of the student and the student data will be stored in the system’s database.
3. Development – Implementation using: Backend, QR code generation, email notification, Interface (fixed scanner). The backend component was accountable for handling server-side processing, including student data validation, transaction logging,
4. Testing – When the system was first being tested, there was no QR code encoded. We have conducted a system framework, where student’s will only scan their QR code ID, according to [3] QR code help to minimize time consumption.
5. Pilot Implementation – We have personally facilitated the process from QR code scanning and encode student ID number, to data recording and email notification at Patao NHS, to ensure that each function worked as intended.
6. Maintenance – We have to monitor the system’s functionality to avoid a system error in the future.

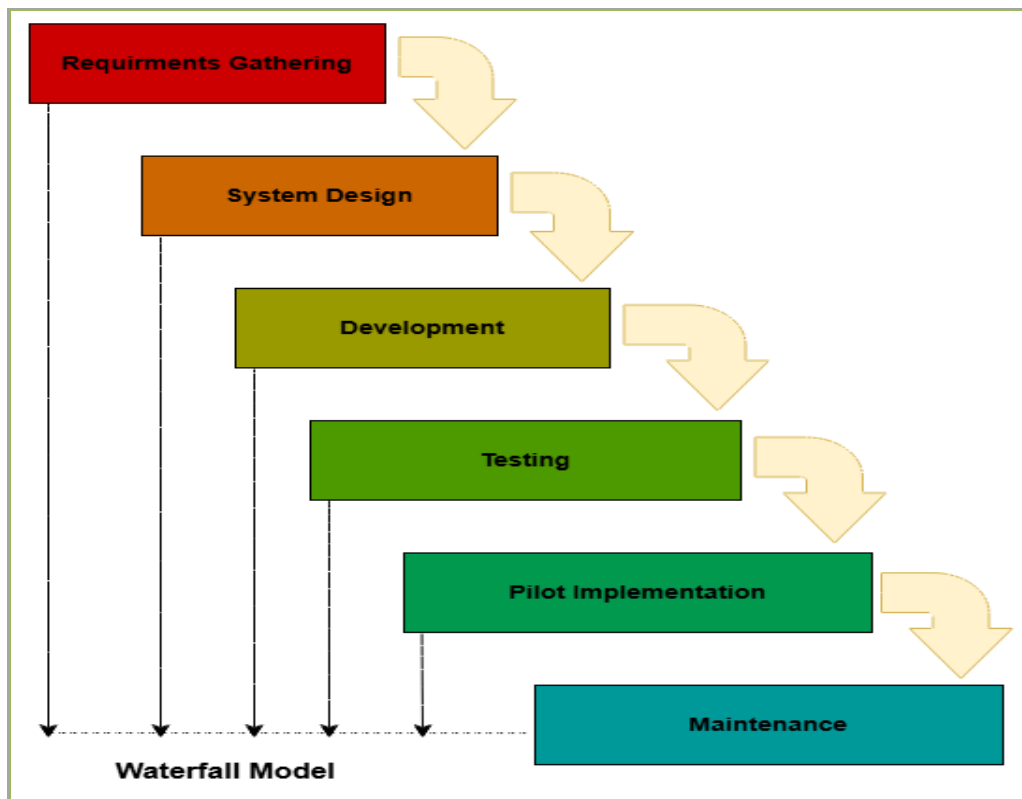


Fig. 1 Waterfall model (Hughey, D., 2009)

The waterfall model is a traditional, linear approach to systems analysis and design, where development progress sequentially through distinct phases, with each phase completed before the next begins, and progress flowing downward in a manner resembling a cascading waterfall. According to [6], this structured method often illustrated with phases such as requirements gathering, design, implementation, testing, deployment, and maintenance emphasizes thorough planning upfront, clear documentation, and minimal overlap between stages, making it suitable for projects with well-defined requirements but less flexible for changes once a phase is finished. This model contrasts with more iterative methodologies like agile, as it assumes that revisiting earlier phases is costly and should be avoided.

B. System Architecture

In the system we build, we have considered Analysis, Design, Development, Implementation, and evaluation as a developmental processes. By analysis phase we have to understand the requirements and needs of Patao HNS, as a result of the observation students often act in inappropriate way (e.g., not entering the school, cutting classes and jumping beyond the school fence/wall). To record and monitor Patao NHS student’s school gate entry and exit, we came up with the objective where the parents can be updated or informed if their children already in or out of school, enable real-time monitoring and reporting of student entry and exit for administrators and teachers, Promote student accountability and punctuality.

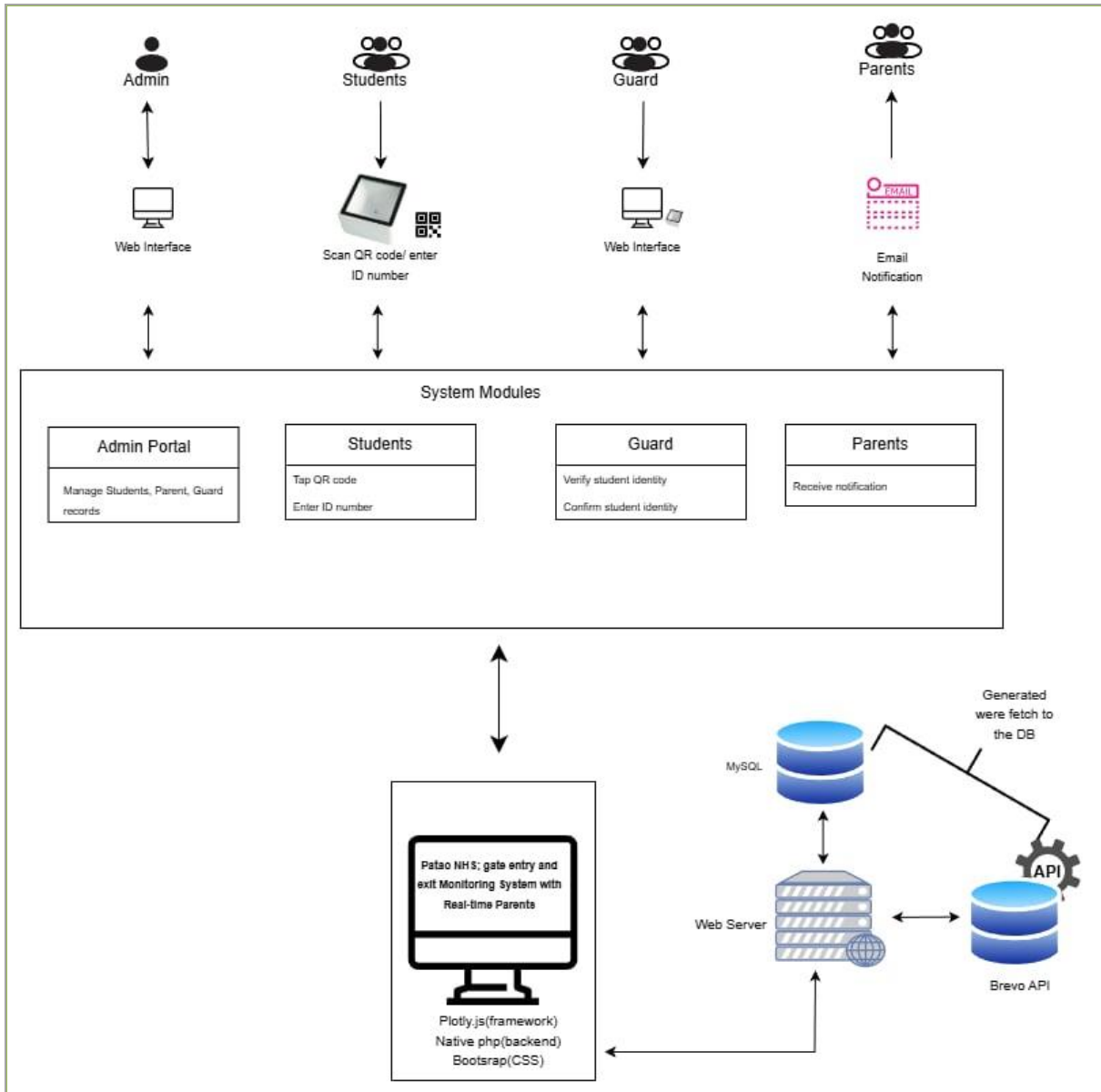


Fig. 2 System Architecture

The proposed system enables students to register their entry into or exit from the school premises through either manual input or QR code scanning. Upon successful QR code scan, the system queries the database to retrieve the relevant student information and presents it on a display screen for verification by the assigned security personnel.

The guard manually confirms the accuracy and validity of the displayed information. If verification is successful and access is authorized, the student is granted permission to proceed. Otherwise, entry or exit is denied.

Upon approval, the system transmits the transaction details to the Brevio API, which automatically dispatches an email notification to the student's parents or guardians. Concurrently, an attendance record (entry or exit) is inserted into the administrative database for real-time monitoring and reporting purposes.

C. Data Collection and Evaluation

Data were collected using standard questionnaire which is the USE [8] and ISO/IEC 25010 (2011) Questionnaire [9] and an Objective’s functionality Questions. The respondents of the study in data gathering were the thirty (30) PNHS students in different year level, two (2) faculty members handling different year level, one (1) school guard of PNHS, and three (3) IT experts. A set of questions were given to the selected respondents, the data collected from the respondents were analysed, consolidated and encoded as input and basis of system development that led an efficient School Gate Entry and Exit Monitoring System.

TABLE I
DESCRIPTIVE FUNCTIONALITY QUESTIONS

Criteria	Mean	Interpretation
Enable real-time monitoring and reporting	4.47	Strongly Agree
Promote student accountability and punctuality	4.59	Strongly Agree
Enhance the efficiency and accuracy of entry and exit monitoring	4.29	Strongly Agree
Balance technological automation with human verification	4.42	Strongly Agree
Assess the feasibility of a hybrid QR-based attendance system	4.02	Agree
Overall Mean	4.36	Strongly Agree

Table 1 is the overall means that are computed from combined responses of 36 respondents (30 students, 2 faculty members, 1 school guard, 3 IT experts) using a 5-point Likert scale (5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree).

TABLE II
USE QUESTIONNAIRE

Criteria	Mean	Interpretation
Usefulness	4.65	Strongly Agree
Ease of Use	4.56	Strongly Agree
Ease of Learning	4.48	Strongly Agree
Satisfaction	4.14	Agree
Overall Mean	4.65	Strongly Agree

Table 2 is the Use Questionnaire employs a 5-point Likert scale. Overall mean reflects high perceived usability across user groups. The slight drop in satisfaction may relate to initial learning curve or email delivery variability during pilot.

TABLE III
SOFTWARE QUALITY MODEL CRITERIA

Criteria	Mean	Interpretation
Functional Suitability	4.45	Very Good
Performance Efficiency	4.41	Very Good
Compatibility	4.59	Very Good
Reliability	4.36	Very Good
Security	4.49	Very Good
Overall Mean	4.46	Very Good

Table 3 shows the evaluation based on ISO/IEC 25010 product quality model using a 5-point Likert scale (5=Very Good, 4=Good, 3=Average, 2=Fair, 1=Poor). Gathered from 36 respondents (students, faculty members, guard, IT experts) that assessed core characteristics relevant to the QR-based hybrid system.

D. System Performance

Overall, the study shows a functional system that can perform a correct logs, average scan time and reliability (email success). By this study, the students are observed to be more attentive and minimize fence-jumping, parents are constantly updated on their children’s school whereabouts and Patao National High School are observed to be safer.

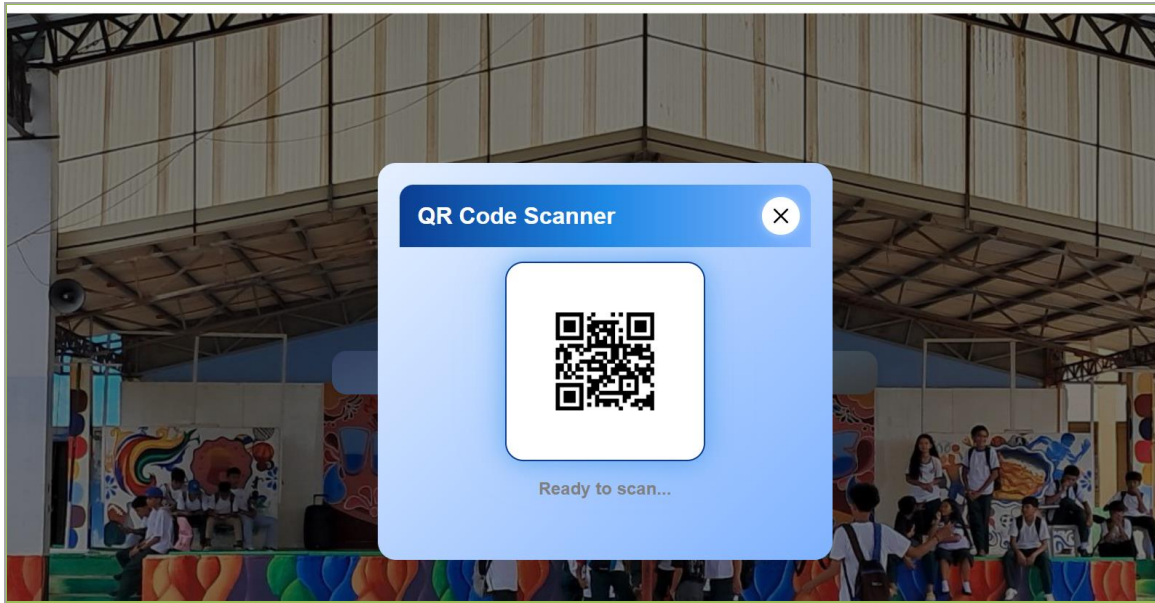


Fig. 3 QR code scanning page

The screenshot shows the "Students" page of the "School Monitoring System". At the top, there is a navigation menu with options: Dashboard, Logs, Graphs, Students (selected), Parents, Archived, QR Generator, Announcement, Settings, and Log. Below the navigation is a search bar labeled "Search by Student Name or ID" and an "Add S" button. The main content is a table with the following data:

Student ID	Student Name	Birthdate	Year Level	Section	Gender	Address	Actions
2026-0001	Jane Fernandez Rosales	2008-07-24	Grade 12	Neptune	Female	Patao, Bantayan, Cebu	Update Archive
2026-0002	Xyra Mae Anderson Entrata	2008-10-23	Grade 11	Libra	Female	Putian, Bantayan, Cebu	Update Archive
2026-0003	Blessie Joy S Quinatadcan	2009-05-08	Grade 11	Gemini	Female	Baod, Bantayan, Cebu	Update Archive

Fig. 4 Students records

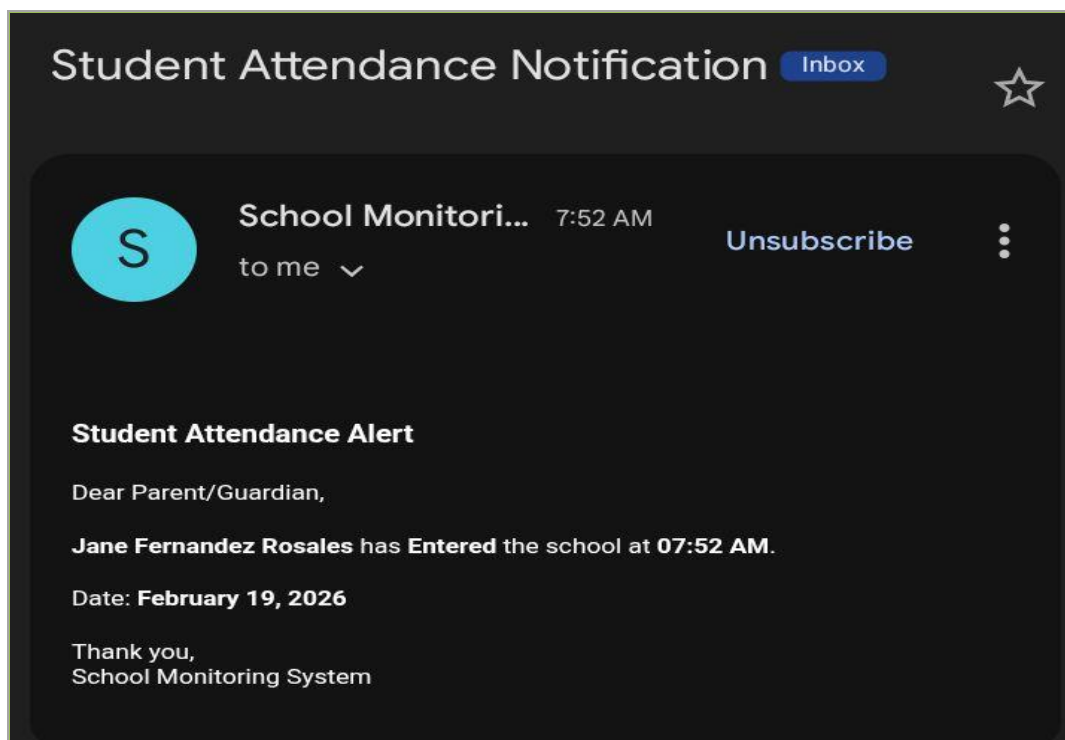


Figure 5 Email notification to student parent's

This study ensured that the system was practical, user friendly, and effective for real-time gate entry and exit monitoring with parental updates.

III. RESULTS AND DISCUSSION

This study is a web-based QR code attendance solution with manual student ID fallback. The system is developed using native PHP for backend processing, MySQL as the relational database for secure data storage, and bootstrap as the front-end framework for responsive user interfaces.

It automates gate verification: students scan unique QR codes or enter IDs; guards confirm identities in real-time; admins manage records, approvals, and oversight; and parents receive instant email notifications via Brevo API upon verified entry/exit (e.g., “Your child entered at 7:45 am” or “Exited at 4:15 pm”).

Results indicate reliable performance as accurate, timestamped logging with no duplicates or proxy entries due to built-in validation; fast processing (under 5 seconds per verification during peak tests), seamless real-time data flow from gate interactions to database updates and parent alerts, and high usability across roles, with successful handling of hybrid inputs in simulated school scenarios.

Discussion highlights significant improvements over manual gate monitoring in Philippine school reducing delays, human errors, unauthorized access, and lack of visibility while enhancing security, accountability, and parental engagement through cost-effective email alerts (via Brevo, avoiding SMS costs). The system promotes punctuality, deters truancy, strengthens school-home collaboration, and provides centralized admin access for reports. It aligns with local priorities for student safety and transparency, outperforming basic logs with digital accuracy and instant notifications.

IV. CONCLUSIONS

This study successfully addresses the critical challenges of student truancy, unauthorized exits, and limited parental awareness regarding their children’s school attendance. By integrating QR code scanning technology with guard verification and automated email notifications, the system provides a secure, efficient, and cost-effective alternative to traditional manual gate monitoring.

The implementation demonstrated that students can be accurately tracked upon entry and exit, minimizing proxy attendance, reducing time consumption during verification, and discouraging unauthorized departures such as fence-jumping or skipping classes. Real-time notifications empower parents with immediate information about their child’s arrival and departure, thereby strengthening home-school collaboration and enhancing overall student safety and accountability. Evaluation results from students, faculty, school guard, and IT experts confirmed the system’s strengths in real-time monitoring and reporting, promotion of punctuality and accountability, improved efficiency and accuracy of gate transactions, balanced hybrid approach (automation with human verification), and practical feasibility within the public high school environment with limited resources.

In conclusion, the proposed system proves to be viable, scalable, and impactful solution for modernizing gate monitoring in Philippine public secondary schools. It aligns with the Department of Education’s push for digital transformation while directly contributing to safer school premises, better attendance outcomes, reduced risks associated with truancy, and stronger parent-school partnerships. Future enhancements could include adding SMS notifications as a backup for email failures, mobile app access for administrators, and integration with the school’s existing attendance database for more comprehensive reporting. This study not only provides Patao National High School with a functional tool to improve daily operations but also offers valuable insights for other public high schools facing similar attendance and safety concerns.

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REFERENCES

- [1]. Irwin, V., Wang, K., Tezil, T., Zhang, J., Filbey, A., Jung, J., ... & Purcell, S. (2023). Report on the Condition of Education 2023 (NCES 2023-144). U.S. Department of Education, National Center for Education Statistics. Available: <https://nces.ed.gov/pubs2023/2023144.pdf>
- [2]. Bondoc, B.C. (2023). Web-based smart attendance monitoring system using QR code and GSM module for SMS notification. *World Journal of Advanced Research and Reviews*, 20(3), 1843-1849. Available: <https://doi.org/10.30574/wjarr.2023.20.3.2644>
- [3]. Galgo, J. J. (2020). Efficacy of Scan Attendance manager Application Using Quick Response Code in Dagohoy National High School, Bohol, Philippines. *International Journal of English Language Studies*, 2(4), 1-12. Available: <https://doi.org/10.32996/ijes.2020.2.4.1>
- [4]. Maleriado, M. A., & Carreon, J. R. (2019-2020). The features of quick response (QR) ode as an attendance monitoring system: its acceptability and implication to classroom. In *the Asian Conference on Education & International Development 2019 Official Conference Proceedings. The International Academic Forum (IAFOR)*. Available: https://papers.iafor.org/wp-content/uploads/papers/aceid2019/ACEID2019_44683.pdf
- [5]. RSIS International, (2024). Enhancing attendance tracking efficiency and effectiveness through the implementation of a QR code-base system. *International Journal of Research and Innovation in Social Science*, 13(9). Available: <https://rsisinternational.org/journals/ijriss/articles/enhancing-attendance-tracking-efficiency-and-effectiveness-through-the-implementation-of-a-qr-code-based-system>
- [6]. Hughey, D. (2009). The traditional waterfall approach. University of Missouri-St. Louis. Available: <http://www.umsl.edu/~hugheyd/is6840/waterfall.html>
- [7]. Richey, R. C., & Klein, J.D. (2005). Developmental research methods: Creating knowledge from instructional design and development practice. *Journal of Computing in Higher Education*, 16(2), 23-38. Available: <https://doi.org/10.1007/BF02961473>
- [8]. Lund, A. M. (2001). Measuring usability with the USE questionnaire. *Usability Interface*, 8(2),3-6. Available: [USE Questionnaire: Usefulness, Satisfaction, and Ease of use](#)
- [9]. International Organization for Standardization. (2011). ISO/IEC 25010:2011 System and software engineering – Systems and software Quality Requirements and Evaluation (SQuaRE) – System and software quality models. <https://www.iso.org/standard/35733.html>
- [10]. Sommerville, I. (2016). *Software Engineering* (10th ed.). Pearson.