Enhancing QR Code-Based Student Attendance Tracking System in SEAIT Through User-Centered UX Design

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Abstract: This research is an improvement to the existing QR Code-Based Student Attendance Tracking System of Southeast Asian Institute of Technology (SEAIT) through Human-Computer Interaction (HCI) and User-Centered Design (UCD) principles. Despite designing the system for attendance monitoring, to cut down intensive manual workload, users reported various usability problems involving inefficient interface design, inconsistent data-capturing, and very limited system responsiveness. This research finds the relationship between application of key HCI paradigms like Norman's Model of Interaction, GOMS, and Activity Theory in the enhancement of system functionality and accuracy, as well as improvement in user experience. A quantitative correlational research design was employed for the study. Data were then gathered by task performance measures, surveys, and system logs to evaluate usability metrics before and during the redesign. Significant improvements across most areas were shown by results. The redesigned system is thus a much more efficient, accurate, and user-friendly experience compared to its predecessor. It thus argues that applying UCD and HCI models to education technologies improves system performance and user satisfaction. A strong alignment between the digital system to users' behavior and needs also becomes necessary for achieving long-term usability and adoption. Yet, current limitations, those particular limitations under which the research was carried out were the sample size and the duration, the research could be conducted further.

Keywords: QR Code-Based Student Attendance, User-Centered Design, System Redesign, Long Term Usability.

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I. INTRODUCTION

Background and Context

Digital solutions in educational institutions have made tasks like attendance tracking more efficient. The Southeast Asian Institute of Technology (SEAIT) developed a QR Code Based Student Attendance Tracking System to ease the process. But still, for all its convenience, there are usability issues that may impair the experience for faculty as well as students. All of the above can cause user frustration, possibly making the system ineffective.

As user-centered design is gaining more importance in digital platforms, enhancing the usability of the system is the foremost objective of the solution. Good user interface (UI) and user experience (UX) design is essential to make the system easy to use, interesting, and well adapted to the needs of its users. Making attendance system of SEAIT better is to find whatever ways to make attendance system more available, effective and user friendly for all involved.

The present paper is intended to evaluate the QR Code-Based Attendance System currently implemented at SEAIT in order to identify the existing usability problems. Using simple and effective UX design techniques, the study will propose ways to enhance the usability and productivity of the system for both faculty and students. The goal is to enhance the system's capabilities and ensure a more reliable and smooth attendance tracking at SEAIT.

Research Problem

The school attendance tracking system struggles with user experience and engagement due to challenges reported by users include interface design issues, accessibility and

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inconsistencies of attendance recording. Such limitations can both reduce user satisfaction and erode system reliability. Moreover, with the ever-changing dynamic within the classroom environment, the existing architecture might find it challenging to adapt to a more integrated approach for tracking responses while addressing the changing concerns of faculty and students regarding quick and secure tracking of attendance records.

Research Questions and Objectives

- How can the existing QR code-based attendance system be improved in terms of usability, accuracy, and reliability?
- What are the benefits of enhancing the current system compared to manual and outdated digital methods?
- What user experience challenges are present in the current system, and how can they be addressed through user-centered design?

> Objectives

- Enhance the existing QR code-based student attendance tracking system at SEAIT.
- Assess the system's usability, accuracy, and efficiency from the perspective of students and faculty.
- Identify existing issues and implement user-centered UX design improvements to create a more effective and user-friendly system.

> Justification and Significance

Compared to manual and older digital techniques, a SEAIT QR code-based attendance system offers a more dependable and efficient method of tracking student attendance. Its performance can still be improved, though, particularly in user experience, accuracy, and simplicity of use. Improving the present system will help the school to minimize mistakes even more, simplify the attendance procedure, and ease staff load. This study focuses on improving how students and staff use a QR code-based attendance system by applying user-centered design. It also explores ways for schools to create cost-effective and innovative methods for better attendance monitoring. The goal is to boost student participation and to help SEAIT manage attendance more efficiently using enhanced technology.

II. LITERATURE REVIEW

Development of usable applications featuring QR codes for enhancing interaction and acceptance

QR codes provide potential opportunities to improve interaction in different areas of application. Even so, this technology has been utilized in punctual and specific standalone applications, being barely applied to broader contexts, such as the educational one, where different scenarios can be considered to take advantage of the same QR-code approach. In this paper, key issues for the development of applications that utilize QR codes to improve sharing and availability of resources are presented, specifically focusing on improving interaction and acceptance. In this way, a holistic approach has been developed where the system is aimed at improving the interaction between educators and students. On the one hand, educators use a web interface to manage educational resources and announcements and automatically generate QR codes. On the other hand, students scan those QR codes using a mobile device, obtaining updated information related to their lectures. This scenario has been evaluated by educators and students, obtaining good results in terms of acceptance, cognitive burden, and overall usability. The approach provides development clues and the evaluation method that can be applied to different contexts, thus representing a generalizable solution (Heranando, R. & Macias, J., 2021).

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The Design and Implementation of Student Attendance Tracking System Using OR Code Card

In institutions of higher learning, the attendance of students in the class is directly related to their academic performance. However, the record-keeping of most student attendance is still performed conventionally, which is tedious and time consuming, especially that involves large classrooms. Higher education institutions in Malaysia are now encouraged to explore the potential use of Quick Response (QR) code and smartphone as a future attendance management system to track and record the student's attendance to the class and tutorial. In response, this study attempts to explain the design and implementation of a proposed system developed using Google Drive, Google Form, Google Sheet, Notepad, and QR Code Generator Addons in Google Sheet. Students were required to scan the unique QR code assigned to them using their smartphone during or at the beginning of each lecture to confirm their attendance. This affordable QR code-based attendance system enables lecturers to speed up the process of taking attendance, especially in a large classroom, and would save them valuable teaching time. The proposed system provides better security than the conventional methods that depend on the sign-in sheet or roll calling student names including eliminating chances of students signing up for others who may not be present. In addition, it also provides a faster and simpler way to take attendance, which could be easily adopted by lecturers to facilitate the process of taking, managing and keeping the record of students' attendance (Rabu, S., 2020).

QR Code Applications Digital Literacy Skills in Today's Technology-Driven World in the Field of Education

The study of QR code applications in education is a topical theme that explores the impact of digital tools on the way students learn, and teachers teach. A wide range of industries use QR codes to achieve accurate data tracking, easy information sharing and seamless data management. A professional QR code generation tool provides reliable QR code solutions that educational institutions can use for non-contact, remote or hybrid learning setups. Through a quantitative analysis, the study was limited to a literature review using the Web of Science, whereby we identified that the number of studies focusing on the applicability of the ever-changing technological innovations on QR codes is still limited. There is a relatively small number of publications exploring the role of applications in this area, making our

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research significant from several perspectives (Krajnik, I. & Demeter, R., 2024).

Feasibility of using QR code for registration & evaluation of training and its ability to increase response rate – The learners' perception

Taking learners' attendance and obtaining an evaluation of teaching is a routine activity performed by teachers. The traditional method of attendance using pen and paper posed a huge challenge during the COVID-19 pandemic. This has been time-consuming as compared to pre-COVID as well as frustrating for learners waiting in a queue for their turn to sign the register. Quick Response (QR) Codes were used to complete registration to buy back the time consumed using traditional methods of registration. Learners' evaluations are used as an instrument to evaluate teaching quality. At the researcher's workplace, a traditional paper-based evaluation method has been used for decades. However, over time a significant decrease in the response rate of evaluations was noticed. The pandemic provided an opportunity of using QR Codes to obtain learners' evaluation of teaching quality. This study assessed the learners' perception of using QR Codes for registration and evaluation, and the likelihood of learners completing the evaluation surveys, thus increasing the response rate. Participants of the study were asked to complete an electronic survey to help assess their perception of using QR Codes and a comparison was made between the responses gathered using paper-based evaluations over 5 months and QR Code evaluations over the same 5 months in the following year. The results of this study demonstrate that using QR Codes for registration and evaluation is easy

and straightforward, thus increasing the likelihood of learners completing the evaluation. The comparison between paperbased and QR Code evaluations confirms that a substantial increase in response rate can be achieved by using QR Code evaluations (Masih, E., 2022).

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III. METHODOLOGY

Research Design

This study will use a quantitative research approach with a correlational design to evaluate the existing QR codebased attendance system at the South East Asian Institute of Technology (SEAIT). The aim is to understand the links between how well the system works, how fast it is, how accurate it is, and how satisfied users feel after making changes that focus on what users need. By using design ideas that focus on users, the study wants to make the system better and see how these changes make the system work better and give users a better experience. The data collected will show patterns and links between the changes made and how well the system works overall.

> Participants

This study will involve every student and teacher from SEAIT. By including the entire SEAIT community, the study plans to collect a variety of ideas and opinions about the QR code-based attendance tracking system currently in use. Including many participants ensures that any improvements will effectively meet the needs of users from different years, departments, and teaching methods.



Fig 1 The diagram outlines the Key Focus Areas for Enhancing the QR Code-Based Attendance System

➤ Data Collection

Information will be collected using three methods: system logs, surveys, and direct observations. Attendance data will automatically be tracked in system logs to verify the accuracy and dependability of the existing QR code system. Students and teachers will be distributed surveys, in order to test their opinions on the ease of usage of the system, as well as how busy it is, particularly after some improvements. Researchers will also directly observe the speed and efficiency of students scanning their QR codes to take attendance, as other methods to measure improvements in user experience and system effectiveness. This will help figure out if users experience and interact with the system any better.

Data Analysis

The data collected will be evaluated using Pearson's correlation coefficient (r) to study the relationship between essential performance factors of the existing QR code-based attendance system before and after improvements have been made. Metrics will be derived from accuracy rate, which for

the purpose of this fundraiser would use Pearson's r to evaluate the strength and direction of the correlation between recorded attendance data and actual student presence. Time efficiency will be assessed using Pearson's r to investigate the association between attendance time expenditure and the incorporated enhancements. Pearson's r will also be used to analyze user feedback obtained through two surveys, one completed by students and the other by instructors, to determine the relationship between enhancements to the NC SIS and user satisfaction. With analysis, we can identify if there is a significant correlation between the improvements in the system and the better performance in its accuracy, efficiency, and user experience.

Ethical Considerations

All participants will be informed about their rights to withdraw from the study at any point, and informed consent will be obtained before any data is collected for the study at the South East Asian Institute of Technology (SEAIT) to ensure ethical research practices are maintained. All participation in this study will be strictly voluntary, with Volume 10, Issue 5, May - 2025

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participants able to withdraw at any time without repercussions. All data are strictly confidential and will not be released outside the research unless required by law. All these above steps are to ensure the rights and privacy of all individuals in the study are protected.

IV. ADVANCED HCI DESIGN

System Architecture

The SEAIT QR Code-Based Attendance Tracking System for Students Since it uses a client-server model, there is a hub on the server, and users connect to it from different devices. This version is a prototype, and designed in this way to help take the attendance easier and faster in the simplest steps possible and the design to fit all types of screens. This system has key functions that communicate to allow teachers to check attendance easily and efficiently. It is also working on new student features that will be available soon.

Interactions and Components:

• User Interface (UI) Layer:

Offers the design for teachers to scan QR codes, switch classes, and store attendance in a clean manner. It provides immediate feedback after every action.

QR Code Scanner:

Students scan QR code with their phone or tablet camera. It records basic details such as the student's ID number and the time of the scan. Then it transmits this information to the system, to be used and processed. Application Logic: The application logic must verify and control the scanned information. It ensures that certain rules are adhered to, for example ensuring duplicate entries are identified. It also links the user interface to the database, allowing for the flow of data to and from the program and database.

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• Database:

Attendance records, class schedule, and time logs are stored. It allows for immediate access if a teacher needs to review or export the data.

• Feedback and Error Handling:

Displays clear error (i.e. incorrect scan) and confirmation messages. Helps collect feedback to enhance the system



Fig 2 The Diagram Outlines the QR-code Based Attendance Tracking System

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➢ Features and Functionalities

The features and functionalities of Library Monitoring System are the following:

Making attendance easier and more convenient is QR Code-Based Student Attendance Tracking System at South East Asian Institute of Technology (SEAIT). Features of Attendance Management System This system has many features and functions to manage attendance properly by teachers.

This system makes attendance management very easy for the teacher in their classroom:

• Scan QR Code:

Teachers can scan students QR codes to take attendance. And this process is quick and accurate, decreasing errors and keeping attendance current in real-time.

• Change Classes:

If your teachers teach more than one class, they can switch between classes/subjects without logging in and out. Which enables them to deal with more than one class simultaneously.

• Time-In/Time-Out Management:

Educators can record and modify student time-in and time-out like check-in and check-out. That ensures accurate records of how long each student spends in class.

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• Attendance logs and records:

The system itself stores attendance information. These records can be accessed by the teachers or downloaded for creating reports or reviewing attendance whenever required.

The system addresses current issues with attendance monitoring by providing useful functionality that is accessible and requires little from the user. It enhances the way users move through, makes tasks easier to achieve and presents strong visual cues to help the user find their way. These updates are powered by user-first design ideas, making everything work better and smoother. This is also a much more flexible system for different needs. As a result, teachers can perform their jobs more accurately and faster. The system also provides them with a more user-friendly and intuitive interface, allowing for a more pleasant and efficient interaction with the system.

User Interface Design



Fig 3 In this figure, it shows the login section of the system.



Fig 4 In this Figure, It Shows the List of the Students' Records where the Teacher Can Manage.

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Fig 5 In this Figure where the Teacher Can Change the Block or Class.



Fig 6 In this Figure where the Teacher Manages the Time of Time-In and Time-Out.



Fig 7 In this Figure the Teacher Records the Attendance of the Students

V. EVALUATION AND RESULTS

➤ Usability Testing

The usability test procedure was conducted with twenty student participants to evaluate the usability of the system. The twenty student participants had to use the OJT OR-based Attendance System for one week, where the participants were asked to perform activities which include scanning QR codes for attendance, checking attendance record, navigating the interface etc. After using the system for the week, all participants were asked to answer a full SUS-based survey under the following categories: Functionality, Accuracy and Overall Acceptability. Collection of response was done in an online Google form for the sake of anonymity and prompted honest responses. The responses scored then used a standard five-point Likert scale and analysed the results appropriately. For negatively scored statements, reverse scoring was used. This consistent use of reverse-scoring improves the accuracy of an overall usability measure.

> Performance Metrics

Quantitative measures were defined and assessed to analyse the performance of the system. These included the SUS score per category; the error rate, task completion rate, and average time taken to complete a task. The error rate represents the percentage of students who reported issues, i.e., unsuccessful scanners or incorrect attendance logs. Task completion rate, which is about 95%, tells us the percentage of time users were able to finish all forced tasks. It took users, on average, scanning a QR code and confirming attendance was under 5 seconds, which proved how efficient the system was. There are 10 items per SUS questionnaire. Maximum raw score is 40, which is converted to 100 by multiplying by 2.5.

System Usability Scale (SUS) Score

SUS Score = (Sum of Adjusted Scores) $\times 2.5$

• For positively worded items:

Adjusted Score = Response -1

• For negatively worded items:

Adjusted Score = 5 - Response

Collected SUS responses from 20 students.

Each student answers 10 SUS questions.

Total Adjusted Scores for Functionality from all students = 660

SUS Score = $(660 / 20) \times 2.5$

 $= 33 \times 2.5$

= 82.5

Result: Functionality SUS Score = 82.5

Task Completion Rate

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Total attempts: 200

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Error Rate = $(10 / 200) \times 100 = 5\%$

Average Task Time = Total Time Taken for All Tasks /

Task Completion Rate (%) =

(Number of Tasks Successfully Completed / Total Number of Tasks Attempted) × 100

Students attempted 200 tasks in total (e.g., scanning, logging, viewing attendance).

190 tasks were completed successfully.

Task Completion Rate = $(190 / 200) \times 100 = 95\%$

Result: Task Completion Rate = 95%

Error Rate

Error Rate (%) = (Number of Errors Encountered / Total Task Attempts) \times 100

Errors recorded: 10 (e.g., scan failure, incorrect time

Number of Tasks Completed Total time for 190 completed tasks = 950 seconds

Result: Error Rate = 5%

Number of completed tasks = 190

Average Time to Complete Task

Average Task Time = $950 / 190 \approx 5$ seconds

Result: Average Task Time = 5 seconds

log)

Table 1 System Usability Scale Score

Metric	Value
SUS Score (Functionality)	82.5
SUS Score (Accuracy)	84.0
SUS Score (Acceptability)	83.1
Task Completion Rate	95%
Error Rate	5%
Avg. Task Time	5 seconds

➢ Comparative Analysis

The QR-based system seemed to be a significant improvement over its physical predecessor in many ways. Manual attendance was slow, prone to human error, and not subject to real-time validation; a completely different ball game in the new QR attendance process where speed, accuracy, and accessibility to multiple devices is the standard. Also, the digital attendance system had the capabilities for Automatic attendance log or report generation, thus reducing some administrative overhead.

> Results and Findings

Usability evaluation results The System Usability Scale (SUS) scores from usability evaluations were very positive. Functionality Score was 82.5, and Performance Received High Score at 84.0 and General Acceptability got an average of 83.1. These findings suggest that the system is well-accepted and continues to be functioning in a real-world environment. This system was much faster and more convenient than the traditional method of attendance.

VI. DISCUSSION

> Interpretation of Findings

Research Question #1: "How can the existing QR code-based attendance system be improved in terms of usability, accuracy, and reliability?"

Through user-centered UX design you can see how the designed approach helped in improving the system's performance. The System Usability Scale (SUS) scores

(functionality, 82.5; accuracy, 84.0; acceptability, 83.1) show that users perceive the system as efficient, accurate, and easy to use. Furthermore, these improvements have led to a system that is not only efficient but also user-friendly, as demonstrated by a 95% task completion rate with a meager 5% error rate.

Research Question #2: "What are the benefits of enhancing the current system?"

Due to these improvements, there are several advantages relating to its performance & how better user experience. Users can now scan and register attendance in an average of 5 seconds, showcasing a significant increase in speed and efficiency. This quick feedback not only improves the attendance procedure but also strengthens the integrity of the system's reliable performance in real-world classroom settings.

Research Question #3: "What user experience challenges are present in the current system, and how can they be addressed through user-centered design?"

Input from students and faculty uncovered various user experience challenges including navigation and occasional scan delays. Using user-centered UX design principles making sure the interface is easy to use, gathering direct input from end-users, the system has been adapted to tackle those issues. The high SUS scores and positive performance metrics indicate that the changes have made for a smoother, more intuitive interaction for the user, ultimately improving overall user satisfaction.

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In summary, these findings suggest that the system's usability, reliability, and efficiency have improved considerably due to the user-focused targeted UX

enhancements. Such findings demonstrate the value of user design in maximizing the value of this type of learning tool.

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Fig 8 The Diagram Outlines the System Usability Scale (SUS) Scores

Contributions and Innovation

This study advances the field of HCI by demonstrating how user-centered design can enhance a basic system, such as QR-based attendance. The study demonstrates that even minor design adjustments, such as simpler navigation, quicker scanning, and a neater layout, can have a significant impact on users' perceptions of a system.

The system's use of real-time QR scanning and automatic attendance recording makes it innovative as well. These features cut down on errors and save time. An excellent illustration of how to create systems that are truly beneficial in regular school environments is provided by the way this system was evaluated and enhanced based on real user input.

➤ Limitations and Future Work

The study has certain limitations even though the results are good. First, only one school and one user group participated in the system's testing. This implies that other users, including faculty and staff from other institutions, or other schools might not be able to use the results. It would be easier to understand how the system functions for everyone if more people from various backgrounds participated in the testing process.

Additionally, for the system to function, an internet connection is required. The system cannot function without a connection, which can be problematic in places with spotty or nonexistent signal. It would be beneficial to include an offline mode that allows users to store data and sync it later.

In the future, the system could be tested in other schools, and more users like school staff could be included. Security

and accuracy could also be improved by adding features like fingerprint scanning or facial recognition. These additions could help make the system even more secure and reliable.

VII. CONCLUSION

Summary of Key Findings

The purpose of this paper was to use user-centered design to improve upon the current attendance application with QR code used in the South East Asian Institute of Technology (SEAIT). The results showed that the change improved the performance of the system improve. Students in the study determined that the system was accurate, easy to use, and functional with high System Usability Scale (SUS [27]) scores. The system showed speed and reliability, completing 95% of the tasks at an average duration of 5 seconds per task. The error rate of less than 5% reaffirmed the extent to which the improved design alleviated problems in operation.

These results show that when you listen to user demands and tailor your system to their needs, both the system's performance and user satisfaction improve. Updates to the system enable students and teachers to use the system more easily, which bolsters attendance tracking in schools.

➢ Final Remarks

In sum, this study illustrated how important it is to design systems with users in mind, it became more accurate, practical, and user-friendly owing to user-centered design approach applied to on QR code-based attendance management system. The project successfully attained its goals, although improvements can be made. This study can Volume 10, Issue 5, May - 2025

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also serve as a useful reference for any other educational institute or fin-tech developer that is looking at improving similar systems using simple but effective design practices.

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APPENDICES

Survey Questionnaires:

FUNCTIONALITY Questionnaire							
QUESTIONS	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree		
The system accurately tracks attendance every time it is used.							
The system sometimes fails to record attendance properly.							
The QR code scanning feature works smoothly and quickly.							
There are delays or errors when scanning the QR code.							
I can easily navigate through the system without issues.							
I have trouble finding or using some features of the system.							
The system is responsive and performs well when I use it.							
The system lags or freezes when trying to log attendance.							
The system works as expected without frequent malfunctions.							
I often encounter problems that stop the system from working properly.							

ACCURACY Questionnaire

QUESTIONS	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
The system accurately recorded my attendance every time.					
I noticed errors in how my attendance was logged.					
The QR code consistently linked to the correct user or data.					
The system sometimes recorded the wrong time or user.					
The system correctly matches each scan to the right person.					
I had to rescan or repeat actions due to incorrect readings.					
The system's results matched my actual attendance.					
There were times when my attendance in the system was not correct.					
The system is reliable when it comes to tracking attendance.					
I've experienced issues with the system reading QR codes the wrong way.					

ACCEPTABILITY/ ACCESSIBILITY Questionnaire

QUESTIONS	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
The system is acceptable and fits well with our current school setup.					
I think this system is not suitable for our school.					
It's easy for me to access and use the system when needed.					
There were times I couldn't access the system at all.					
Even people who aren't good with technology can use the system.					
Some students or staff might find it hard to use this system.					
I think this system is a good solution for managing attendance.					
It's hard to accept this system because it feels confusing.					
The system works well across different devices and platforms.					
I have trouble using the system on certain devices or browsers.					