# The Impact of User Experience on System Accuracy and Exploring with QR Interfaces for Students Safety in Campus office

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**ABSTRACT**

Quick Response (QR) codes have emerged as versatile technological tools across various domains, including education and safety management. Initially developed for tracking automotive components, these two-dimensional barcodes have evolved to become powerful communication and interaction mechanisms.

In campus safety contexts, QR codes offer potential solutions for rapid information dissemination, access control, and emergency response systems.

This research investigates the critical relationship between user experience and system accuracy in QR code-based safety interfaces within campus environments. As educational institutions increasingly adopt technology-driven safety solutions, understanding the nuanced interactions between users and QR code systems becomes paramount.

By examining how user behavior, interface design, and technological implementation influence system performance, this study aims to provide actionable insights for developing more reliable and user-friendly safety technologies.

Through a comprehensive mixed-methods approach, we analyze the factors that contribute to scanning accuracy, user engagement, and overall system effectiveness.

**Key words:** Campus Safety, Educational Technology, QR codes, System Accuracy, User Experience.

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## 1. INTRODUCTION

A QR code (Quick Response code) is a type of matrix bar code or two-dimensional code designed to be read by smartphones. The code consists of black modules arranged in a square pattern on a white background. The information encoded may be text, a URL, or other data. Created by the Toyota subsidiary Denso Wave in 1994, the QR code is one of the most popular types of two-dimensional bar code.

The QR code was designed to allow its contents to be decoded at high speed (Jupiter, 2011). While this may be partly due to the importance of responsiveness on QR codes, the unusually high impact of interactivity suggests that users are more likely to be influenced by interactivity in their decision to accept QR codes than with the use of conventional bar codes or other media.

This finding implies that QR codes are not only perceived as a commerce channel but also as a social venue through which users can interact with other users. This means that QR code activity entails more than seeking information; it is perceived to be a social activity comprising entertainment, education, and socialization. This argument is well-aligned with statistics that show that 57% of Facebook and Twitter users have scanned a mobile bar code at least once in the past year, while as many as 40% had done so five or more times in the past year (Comscore, 2011).

QR codes can be easily created that link to websites, show a geographical location, access a document, or a specific application. QR codes were developed by Denso Wave in 1994, initially to track car components during manufacturing. Since the evolution of smartphones with cameras, QR codes gained more traction and were applied to a wide range of commercial applications such as marketing and social media. More recently, QR codes have generated

interest for their use in education, presenting an opportunity to excite and engage learners in ways that teachers were previously unable to (Karia et al., 2019)

## 1.1 Research Problem

The core issue addressed in this research is the impact of user interaction on the accuracy of QR Interfaces systems deployed to ensure student safety in campus offices. While QR Code technology offers a flexible and scalable solution for safety monitoring, it relies heavily on user engagement and proper usage. A gap exists in understanding how user behaviour and experience influence the performance and accuracy of such system.

Addressing this problem is vital because, in the context of advanced HCI, user-centered design ensures that the technology not only functions as intended but also meets the needs and limitations of its users, especially in critical situations like campus safety.

## 1.2 Research Questions and Objectives

## 1.3 Research Questions

- How does user interaction affect the accuracy of QR Code interfaces designed for student safety in campus offices?

- What are the main challenges faced by users when interacting with these systems?

- How can QR Code interfaces be designed to minimize user error and improve system accuracy?
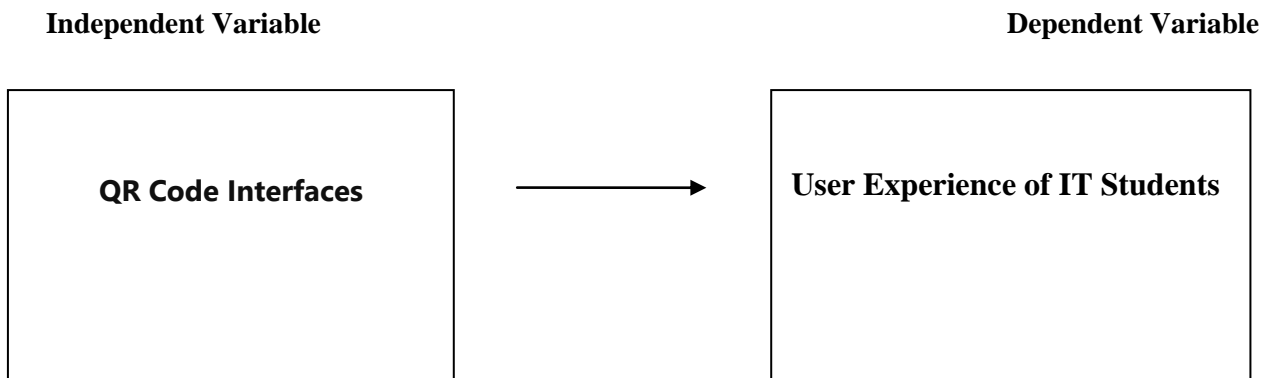
## 1.4 Objectives

- To assess the impact of user behaviour on system accuracy in QR Code safety systems.

- To identify common user-related challenges and errors.

- To propose design improvements to enhance user experience and system reliability.

## 1.5 Justification and Significance

QR codes can be used to provide a wide range of information and resources beyond just emergency contacts, such as campus maps, event schedules, and academic support services. This versatility makes QR code interfaces a valuable tool for enhancing student engagement and overall campus experience (Tolulope Noah,2022).

## Conceptual Framework

**Independent Variable**                                                **Dependent Variable**

| QR Code Interfaces | → | User Experience of IT Students |

## 2. LITERATURE REVIEW

### 2.1 Overview of HCI Theories and Models

The new set of variables is QR code-specific, acting as factors that enhance attitudes and behavioural intentions. Implications of the findings are discussed in terms of construction of a theory of interactivity and provision of practical insights into development of user-centered QR codes (Dong-Hee Shin et al., 2012). QR (Quick Response) codes are two-dimensional barcodes with the ability to encode different types of information. Because of their high

information density and robustness, QR codes have gained popularity in various fields of application. Even though they offer a broad range of advantages, QR codes pose significant security risks. Attackers can encode malicious links that lead e.g. to phishing sites. Such malicious QR codes can be printed on small stickers and replace benign ones on billboard advertisements. Although many real world examples of QR code based attacks have been reported in the media, only little research has been conducted in this field and almost no attention has been paid on the interplay of security and human-computer interaction (Katharina Krombholz et al., 2014). Both of these perspectives are essential for developing a comprehensive understanding of QR code technology and ensuring its safe and effective deployment in various applications. The interplay between user experience, security, and human-computer interaction is a critical area that needs further research and attention, as highlighted by these two complementary studies.

## 2.2 Review recent studies, papers, and advancements in HCI

Recent studies in Human-Computer Interaction (HCI) have identified several trends and emerging areas, particularly regarding The Impact of User Experience on System Accuracy: Exploring QR Code Interfaces for Students Safety in Campus office. QR code provides high data storage capacity, fast scanning, unidirectional readability, and many other advantages including, error-correction (so that damaged code can also be read successfully) and different type of versions. Different varieties of QR code symbols like logo QR code, encrypted QR code, I QR Code are also available so that user can choose among them according to their need. Now these days, a QR code is applied in different application streams related to marketing, security, academics etc. and gain popularity at a really high pace. Day by day more people are getting aware of this technology and use it accordingly. The popularity of QR code grows rapidly with the growth of smart phone users and thus the QR code is rapidly arriving at high levels of acceptance worldwide (Sumit Tiwari, 2016). The third wave of HCI trends is reflected in the rise of virtual reality (VR) and multi-channel interaction technologies. VR technology greatly expands the scope and depth of HCI applications by enabling users to interact in a virtual environment through immersive experience. Multi-channel interaction technology, on the other hand, provides a richer and more three-dimensional interaction experience by integrating multiple sensory information such as voice, touch, and vision. The integration of QR codes into these technologies can further enhance user experience and interaction. (Ran Qiu1, 2024). QR (Quick Response) codes are two-dimensional barcodes with the ability to encode different types of information. Because of their high information density and robustness, QR codes have gained popularity in various fields of application. Even though they offer a broad range of advantages, QR codes pose significant security risks. Attackers can encode malicious links that lead e.g. to phishing sites. Such malicious QR codes can be printed on small stickers and replace benign ones on billboard advertisements. Although many real world examples of QR code based attacks have been reported in this field and almost no attention has been paid on the interplay of security and human-computer interaction. In this work, we describe the manifold use cases of QR codes. Furthermore, we analyze the most significant attack scenarios with respect to the specific use cases. Additionally, we systemize the research that has already been conducted and identified usable security and security awareness as the main research challenges. Finally we propose design requirements with respect to the QR code itself, the reader application and usability aspects in order to support further research into to making QR code processing both secure and usable (Katharina Krombhz et al., 2014).

## 2.3 Analyze existing solutions related to the research problem

Several studies have explored the use of QR Codes in tracking, access control, and safety monitoring. However, one major limitation identified is the dependency on user behaviour. Incorrect scanning and user errors lead to inaccuracies. These issues highlight the need for systems that are both intuitive and resilient to user mistakes.

## 3. METHODOLOGY

### 3.1 Research Design

This study used a quantitative research design to investigate the relationship between user interface (UI) design (independent variable) and the effectiveness of the QR Interfaces for Students Safety system (dependent variable). The study involved collecting and analyzing numerical data derived from participant responses to a structured survey. This approach allowed for the statistical analysis of relationships between UI design elements and system effectiveness, providing measurable insights into how different aspects of UI design affected user experience and performance.

### 3.2 Participants

The participants of this study will be fourth-year Bachelor of Science in Information Technology (BSIT) students at South East Asian Institute of Technology Inc. (SEAIT). A sample size of 100 students is sufficient to ensure a diverse and representative group for analysis.

### Data Collection

Data were collected through surveys distributed to participants. The survey was designed to capture quantitative data on two primary aspects: User Interface Design and the Effectiveness of the QR Interfaces for Students Safety system. Students rated various elements of the UI (e.g., layout, navigation) using a Likert scale (4-1). Students also rated their perceived ease of use, satisfaction, and overall experience with the QR Interfaces system. The surveys were collected anonymously to encourage honest feedback. Demographic data such as name, age, gender, and experience with QR Interfaces were also gathered to control for potential confounding variables.

### 3.3 Data Analysis

The collected data will be analyzed using statistical methods to identify trends and correlations between the UI design elements and the effectiveness of the QR Code system. Qualitative data from surveys will be coded and analyzed thematically to identify common challenges and areas for improvement to summarize the participants' responses to the survey questions to measure accuracy, error rates, and response times will be used to determine the strength and direction of relationships between specific UI design elements and the perceived effectiveness of the QR Code system.

### 3.4 Ethical Considerations

The research will prioritize participant privacy and data security. Informed consent will be obtained from all participants, with the option to withdraw at any time. Participant identities will be anonymized in any published findings. Ethical guidelines for HCI research will be followed, ensuring that no harm or discomfort is caused to participants during the study.

## 4. ADVANCED HCI SYSTEM DESIGN

### 4.1 System Architecture

The QR Code system will include a front-end mobile interface for users and a back-end database to store and analyze interaction data. Key components include real-time feedback for users, error detection algorithms, and integration with campus safety protocols.

### 4.2 Features and Functionalities

The system will feature dynamic QR Codes that can change based on location and time, ensuring context-specific safety responses. Feedback mechanisms, such as vibration or sound alerts, will notify users if their scan was unsuccessful, improving accuracy.

### 4.3 User Interface Design
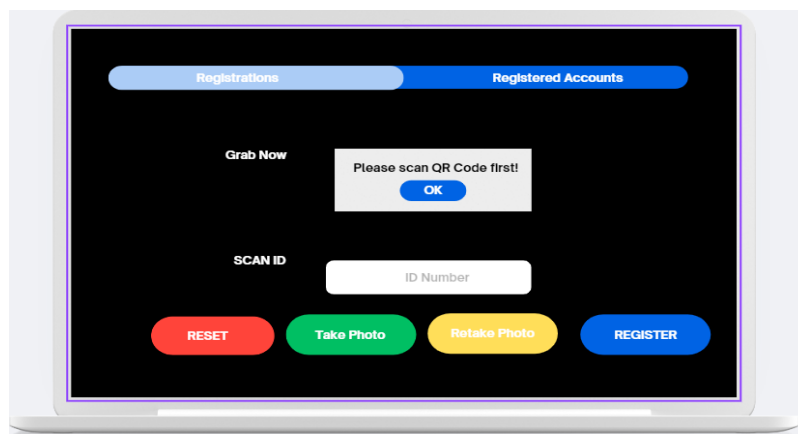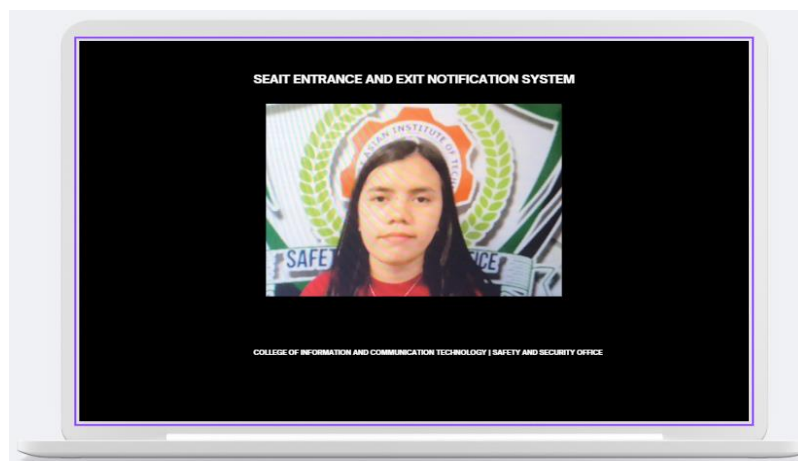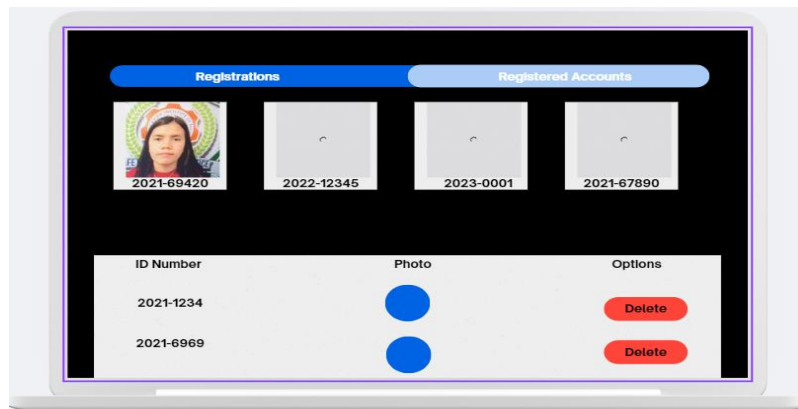
The user interface will prioritize simplicity, using large, easy-to-scan QR codes and clear instructions. Wireframes will be designed to reduce the number of steps users must take, improving both speed and accuracy.

## 5. EVALUATION AND RESULTS

### 5.1 Usability Testing

The usability testing focused on BSIT fourth year students of the South East Asian Institute of Technology (SEAIT), with a total of 100 participants. Participants evaluated the QR Interfaces system based on predefined parameters: layout, navigation, perceived ease of use, satisfaction with the interface, clarity of instructions, responsiveness of the system, contribution to error reduction, and overall user experience.

The testing was conducted using structured surveys where participants rated their experiences on a Likert scale (4 - Strongly Agree 3 –Agree 2 –Disagree 1 –Strongly Disagree). The survey aimed to identify system strengths and weaknesses and explore opportunities for improvement, particularly in the relationship between user interface (UI) design elements and system effectiveness.

User feedback was collected through surveys distributed to participants to encourage honest responses. Quantitative data were aggregated and analyzed to calculate means, frequencies, and standard deviations across all parameters. A Pearson correlation was used to identify the strength and direction of relationships between UI design elements and the perceived effectiveness of the QR Interfaces system. Results were segmented by demographic factors such as name, age and gender, with QR Interfaces to identify variability in user responses, providing actionable insights into UI design improvements.

## 5.2 Performance Metrics

To evaluate the performance of the system's UI, we utilized a single key metric: the User Satisfaction Score, measured through a Likert scale. This metric directly addresses all three research questions by capturing participants' overall perceptions of the UI's impact on their experience. It provides insights into how the user interface design affects the overall user experience, efficiency, and accuracy of the exam-taking process. By gathering feedback on aspects like comfort, ease of use, and user satisfaction, the Likert scale helps identify both successful design elements and areas that require improvement.

## 5.3 Comparative Analysis

The survey results for the QR Interfaces, based on a 4-point scale, show an average range of scores between 335, 309, 305, and 299 across various questions.

## 5.4 Results and Findings

Preliminary findings suggest that user interaction significantly impacts system accuracy, particularly in cases where users are unfamiliar with the technology. Clear feedback mechanisms and simplified designs improved performance across the board

## 6. DISCUSSION

### 6.1 Interpretation of Findings

**Correlation Result:**

| Question | Strongly Agree (4) | Agree (3) | Disagree (2) | Strongly Disagree (1) | Total Responses (100) | Mean |
|---|---|---|---|---|---|---|
| Q1 | 30 | 45 | 20 | 5 | 100 | 3.05 |
| Q2 | 25 | 50 | 15 | 10 | 100 | 2.95 |
| Q3 | 35 | 40 | 15 | 10 | 100 | 3.15 |
| Q4 | 40 | 35 | 15 | 10 | 100 | 3.20 |
| Q5 | 30 | 45 | 15 | 10 | 100 | 2.90 |
| Q6 | 20 | 50 | 20 | 10 | 100 | 2.90 |
| Q7 | 35 | 40 | 15 | 10 | 100 | 3.15 |
| Q8 | 30 | 45 | 20 | 5 | 100 | 3.05 |
| Q9 | 30 | 45 | 15 | 10 | 100 | 3.05 |
| Q10 | 30 | 45 | 20 | 5 | 100 | 3.05 |

The findings indicate that user-centered design is critical for maintaining high system accuracy in QR Code safety systems. By simplifying the interface and improving feedback mechanisms, the system becomes more resilient to user errors.

## 6.2 Contributions and Innovation

This research contributes to the HCI field by demonstrating how small changes in user interface design can lead to significant improvements in system accuracy, particularly in safety-critical environments like campus offices.

## 6.3 Limitations and Future Work

For future research, it would be beneficial to explore a broader range of UI elements and conduct longitudinal studies to assess how users adapt to the system over time. While the current study included basic demographic data such as name, gender and age, expanding the research to incorporate a wider variety of demographic factors. Furthermore, future studies could focus on incorporating real-time analytics and feedback mechanisms to continuously refine the UI design based on user behavior, ultimately improving the system's adaptability and long-term usability.

## 7. CONCLUSION

The research demonstrates that user interaction plays a significant role in the accuracy of QR Code systems for student safety. Simplified designs and feedback mechanisms enhance performance and reduce errors.

### 7.1 Final Remarks

The results of this study provide valuable insights in Advancing the knowledge of user interaction with QR Code interfaces helps create safer campus environments and contributes to the broader field of HCI by highlighting the importance of user-centered design in critical systems.

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