

# QR Code Based Attendance System as an Innovation for High School Management

Ika Devi Perwitasari\*, Jodi Hendrawan, Nadya Andhika Putri, Yumna Tamimah Bilqis

Faculty Science and Technology, Computer System, Universitas Pembangunan Panca Budi, Medan, Indonesia

Email: <sup>1,\*</sup>ikadeviperwitasari@dosen.pancabudi.ac.id, <sup>2</sup>jodihendrawan@dosen.pancabudi.ac.id,

<sup>3</sup>nadyaandhika@dosen.pancabudi.ac.id, <sup>4</sup>yumnatamimahbilqis@gmail.com

Correspondence Author Email: ikadeviperwitasari@dosen.pancabudi.ac.id

**Abstract**—This study aims to design and implement a QR Code-based attendance system as an innovation in managing student attendance at SMA Negeri 1 Binjai. Traditional paper-based or manual attendance systems often take a long time, are prone to errors, and are inefficient in archiving student attendance data. To overcome these obstacles, a QR Code-based attendance system was developed using scanning technology that allows each student to take attendance quickly and accurately. Using research and development methods, this system was designed through the stages of needs analysis, system design, development, and testing in the school environment. This system uses a mobile device combined with an online database, so that attendance data can be directly stored and accessed by the school in real-time. The test results showed that the QR Code-based attendance system was able to reduce attendance time from around 5 minutes to 1-2 minutes per class, increase the accuracy of attendance data recording, and automatically save data in the database. Surveys of users, namely students and teachers, showed a positive response, with 87% of students feeling that attendance was easier and more efficient, while teachers stated that this system reduced the administrative burden. This system also provides added value in terms of transparency, accuracy, and ease of access for teachers, students, and parents. This innovation is expected to be a solution in more modern and effective attendance management in other schools

**Keywords:** Attendance system, QR Code, attendance management.

## 1. INTRODUCTION

In the increasingly developing digital era, information technology has become an important part of various sectors, including education. One of the innovations that has emerged is the use of QR Code (Quick Response Code) as a tool to facilitate the student attendance process. QR Code is a type of two-dimensional barcode [1] that can be launched using a mobile device, allowing for fast and efficient collection of attendance data. QR codes have become widely popular because they are easy to use, fast, and highly adaptable [2]. At SMA Negeri 1 Binjai, the implementation of a QR Code-based attendance system is expected to increase the effectiveness of student attendance management, reduce recording errors, and minimize incidents that often occur in conventional attendance systems [3], [4]

Student attendance is an important aspect in the learning process, because it can affect the quality of education received. However, traditional attendance methods that are still widely used, such as manual signatures on attendance lists, often result in wasted time and resources. In addition, this method is also susceptible to data manipulation, which can harm the integrity of the education system [5], [6]. Therefore, a more efficient and accurate solution is needed to record student attendance.

QR Code-based attendance systems offer an innovative approach to addressing this problem [7]. By utilizing commonly used technology, students can take attendance quickly and easily by simply filling in the code provided. This not only speeds up the attendance process but also increases the accuracy of the attendance data recorded. In addition, this system can reduce the administrative burden on teachers, so they can focus more on the learning process [8], [9].

One relevant study is research by Patel et al., who developed a smart attendance system using QR Codes. This study shows that the system not only speeds up the attendance process but also increases the accuracy of student attendance data [10]. In addition, Mohammed and Zidan also highlight the importance of using QR Codes in improving real-time attendance tracking, allowing teachers to display student attendance more effectively [11]. By encoding QR Codes, students can take attendance quickly, reducing the time required for the process.

Furthermore, research by Rimando and Corpuz revealed that the use of QR Codes can overcome problems often encountered in paper-based attendance systems, such as lost forms and recording errors (Rimando & Corpuz, 2022). With a QR Code-based system, attendance data can be stored digitally and accessed easily, which is very important in managing educational data. This is in line with Irawan's findings, which show that a QR Code-based attendance system can improve the security and integrity of student attendance data [13].

In other research, QR Code provide instant building information on campus. By scanning QR codes, users access maps, amenities, and emergency contacts. Built with Java on Android Studio and using Firebase for data storage, the system enables administrators to manage data via a website. Tested at Universitas Pembangunan Panca Budi, the application successfully delivers comprehensive building details and enhances visitor accessibility across campus [14].

The implementation of a QR Code-based attendance system also has the potential to increase student involvement in the learning process. With the integration of technology into daily activities, students are expected to be more active in participating in learning. In addition, a better attendance system can provide more accurate data on student attendance, which in turn can be used for further analysis in an effort to improve the quality of education at SMA Negeri 1 Binjai. Thus, the implementation of a QR Code-based attendance system not only provides practical benefits, but also contributes to the development of better education that is more responsive to the needs of students and teachers.

## **2. RESEARCH METHODOLOGY**

### **2.1 Research Stages**

This study uses the Research and Development (R&D) method to design and implement a QR Code-based attendance system at SMA Negeri 1 Binjai. The goal is to develop an efficient and easy-to-use digital attendance system, and to evaluate the effectiveness of the system in managing student attendance. This methodology consists of several stages as shown in Figure 1.



**Figure 1.** Research Stages

### **2.2 Needs Analysis**

The initial stage involves collecting information related to the school's needs for an attendance system [15]. Data is collected through interviews with teachers and administrative staff as well as direct observation of the existing attendance system. This stage aims to understand the problems faced in manual attendance and the desired features in the new system.

### **2.3 System Design**

Based on the results of the needs analysis, a QR Code-based attendance system is designed. This design includes: 1) Design of the user interface (UI) of the attendance application; 2) The process of creating a unique QR Code for each student. 3) Compilation of the system flow starting from scanning the QR Code to recording attendance data in the database.

### **2.4 System Development**

At this stage, a QR Code-based attendance system is developed using software that supports scanning and managing QR Code data, such as a web-based application or a simple mobile application. A QR Code is generated for each student, and the scanning system is designed to be operated by teachers in the classroom.

### **2.5 System Testing**

The system that has been developed was tested in several classes at SMA Negeri 1 Binjai. This testing was carried out to: 1) Test the functionality of the system in recording student attendance; 2) Ensure that the QR Code can be read properly and attendance data is stored in the database; 3) Analyze the time required for scanning the QR Code and user convenience.

### **2.6 Evaluation and Improvement**

Based on the test results, an evaluation is carried out to identify system weaknesses, such as difficulty in scanning or other technical problems. The system is then repaired according to input from users, both teachers and students.

### **2.7 Final Implementation and Monitoring**

After the system was assessed as meeting needs, the QR Code attendance system was fully implemented at SMA Negeri 1 Binjai. Monitoring was carried out for several weeks to ensure smooth operations collect student attendance data.

### 2.8 Data Analysis and Reporting Results

The collected data was then analyzed to assess the effectiveness of the QR Code-based attendance system. This analysis includes a comparison of time efficiency, data accuracy, and responses from system users. The final results are compiled in a research report that includes the benefits and challenges of implementing QR Codes in student attendance.

## 3. RESULT AND DISCUSSION

### 3.1 System Needs Analysis

The QR Code-based Attendance System for high schools in Binjai aims to address the inefficiencies of manual attendance processes by introducing a modern, automated solution. This system will generate unique QR codes for students and staff, which can be scanned by teachers using smartphones or tablets to mark attendance in real-time. The system will synchronize data instantly to a centralized database, ensuring accurate and up-to-date attendance records. Administrators will have access to customizable reports and dashboards to analyze attendance patterns, while parents will receive notifications about their child's attendance status. The system will also integrate with existing school management software, providing a unified approach to managing student information.

In terms of technical requirements, the system will require QR code printers, scanning devices, and a cloud-based database to securely store attendance data. It will also need to be compatible with mobile devices and desktops, ensuring ease of use for both teachers and administrators. The system will be designed with security in mind, encrypting attendance data and using secure authentication methods to prevent unauthorized access. Scalability will be a key feature, allowing the system to accommodate an increasing number of students and staff as the school grows. Additionally, the system will be user-friendly, reliable, and capable of working offline in areas with intermittent internet access. This innovative solution will not only save time but also improve the accuracy and security of attendance tracking, benefiting both the school staff and students.

### 3.2 System Design

The QR Code-based Attendance System for high schools in Binjai is designed to streamline and automate the process of recording student attendance. The system integrates multiple components including QR code generation, data collection, user management, real-time synchronization, and reporting. It is built to be user-friendly, scalable, and secure, meeting the needs of students, teachers, administrators, and parents.

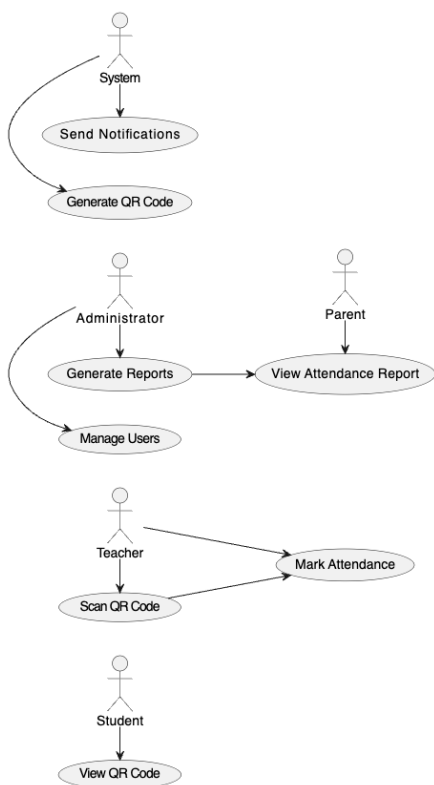


Figure 2. Use Case Diagram

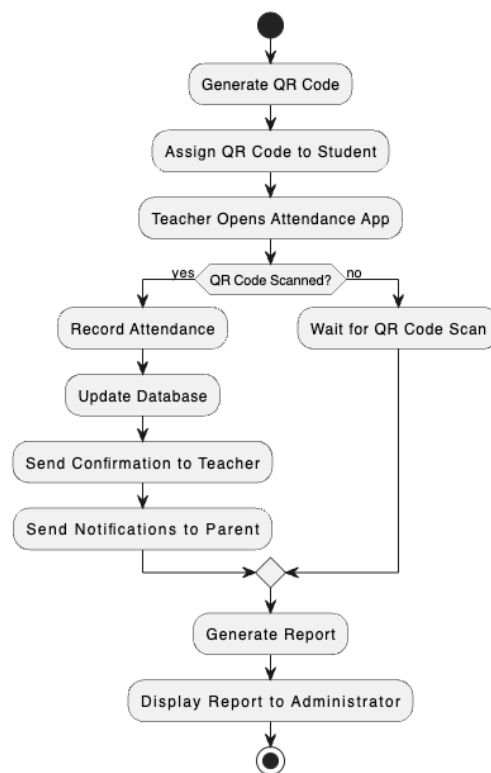


Figure 3. Activity Diagram

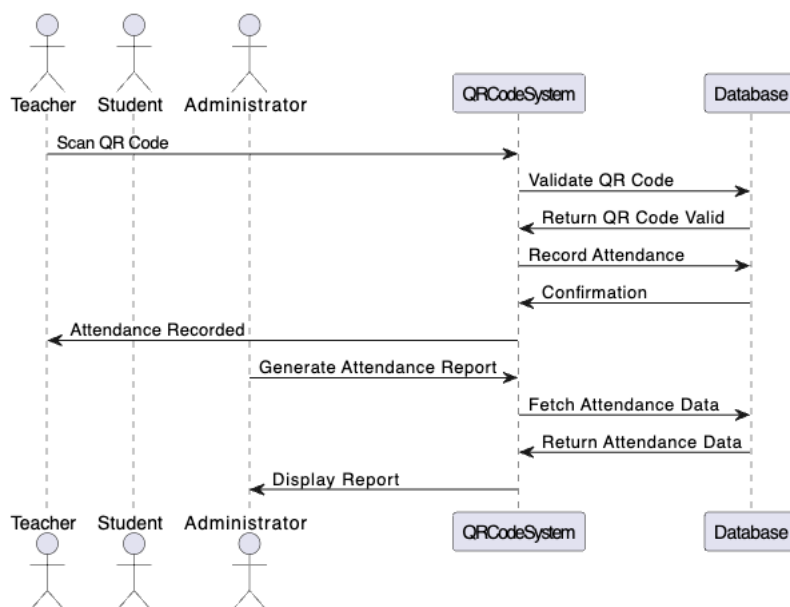


Figure 4. Sequence Diagram

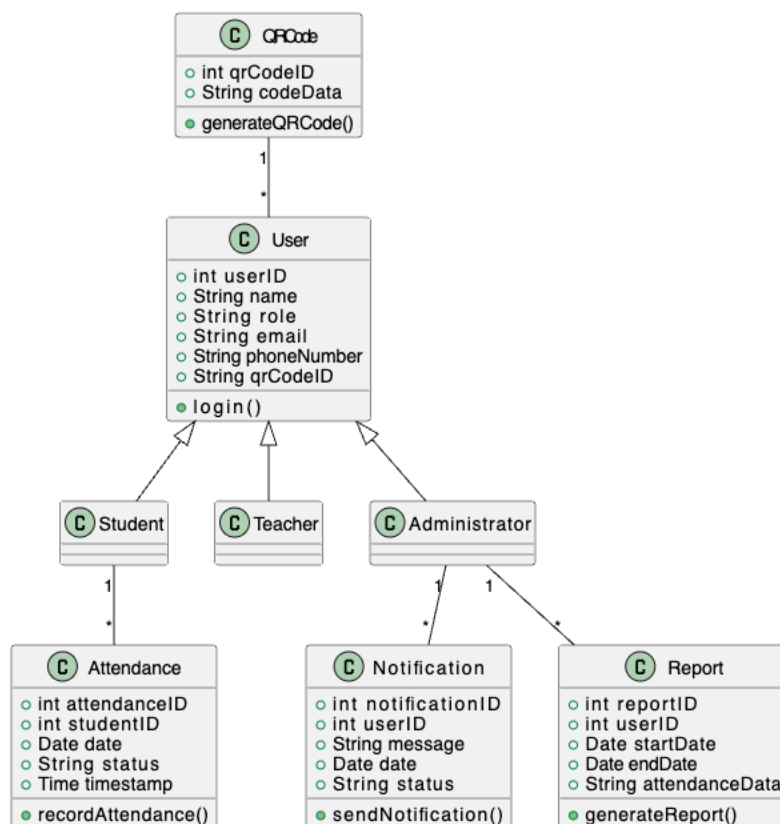


Figure 5. Class Diagram

Use Case Diagram describes the interactions between the actors (Teacher, Student, Administrator, Parent) and the system. It shows the main functions of the system, such as QR Code generation, attendance marking, and report generation.

### 3.3 System Implementation Results

The implementation of the QR Code-based attendance system was carried out in a one-month testing period in class XI IPA. This system allows students to take attendance by scanning the QR Code on a device provided by the teacher.

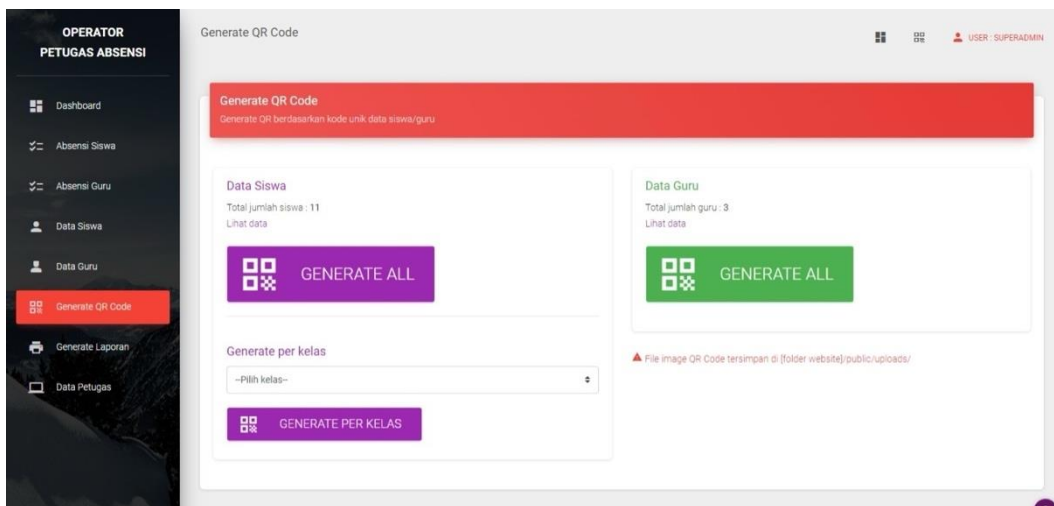


Figure 6. Display of Generate QR Code on Officer

Here are the results achieved during the implementation process: 1) Attendance Time Efficiency: The use of QR Code reduces the time required for the attendance process compared to the manual method. The average attendance time for each class is reduced from around 5 minutes to only 1-2 minutes, especially in larger classes with more than 30 students; 2) Attendance Data Accuracy: Attendance data is recorded directly and automatically stored in the database system, reducing the risk of recording errors that commonly occur in manual attendance methods. The recorded data includes accurate attendance time information, so teachers can monitor student tardiness more easily.

### 3.4 User Response (Students and Teachers)

Based on the survey conducted, student and teacher responses to this system were positive with the following key findings: 1) Ease of Use: 87% of students felt that the QR Code-based attendance system was easier and faster than manual attendance. Teachers also felt that this system reduced their administrative burden because the data was recorded directly in the system without the need for manual recording; 2) Perception of System Effectiveness: Teachers acknowledged that the QR Code system helped reduce recording errors and ensured better student attendance monitoring. They also felt that the system could be implemented in all classes if adequate technical support was provided; 3) Technical Challenges: Some students faced difficulties during scanning, especially when the network signal was unstable or there were technical problems with the device. This shows that the readiness of infrastructure and internet connection greatly influences the success of the QR Code system implementation.

### 3.5 Comparison of QR Code System with Manual Attendance

Data collected from the attendance process shows that the QR Code-based system is superior in terms of speed and accuracy. The following table illustrates the main comparison between the manual attendance system and QR Code attendance is shown in table 1.

Table 1. Comparison of QR Code System with Manual Attendance

Aspek	Absensi Manual	Absensi QR Code
Waktu Rata-rata	±5 menit per kelas	±1-2 menit per kelas
Akurasi Data	Rentan kesalahan	Akurat, data langsung tersimpan
Dokumentasi Kehadiran	Pencatatan manual	Otomatis tersimpan di database
Risiko Kehilangan Data	Tinggi	Rendah
Kenyamanan Pengguna	Tergantung pada guru	Mudah dan cepat bagi siswa

## 4. CONCLUSION

The conclusion of this study shows that the QR Code-based attendance system at SMA Negeri 1 Binjai has succeeded in becoming an innovative solution in managing student attendance that is more efficient and accurate compared to the manual attendance method. With this system, the average time required for the attendance process is reduced from around 5 minutes to 1-2 minutes per class, while student attendance data is automatically recorded in the database, thus minimizing the risk of recording errors. Responses from users, namely students and teachers, also show high satisfaction with this system. Most students feel the ease and speed in taking attendance, while teachers are helped by the reduction in administrative burden and the ease in monitoring the punctuality of student attendance. However, technical challenges such as the need for a QR Code scanner device and a stable internet connection are still major obstacles in implementing this system. This shows that adequate infrastructure readiness is needed to support the successful implementation of QR

Code technology in the school environment. However, this QR Code attendance system has the potential to be applied more widely in other schools as an effort to modernize student attendance management. In the future, improving technological infrastructure and training for teachers and students is highly recommended so that this system can operate more optimally. As an additional recommendation, the integration of cloud computing technology can be considered for more secure and centralized data storage, allowing easier data access and management. Future research is also expected to evaluate the long-term impact of this system on student discipline and compliance with attendance time.

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