



Enhancing Vocational College Student Attendance Management and Rural Revitalization Awareness Through a WeChat Mini Program-Based System

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Abstract. This research presents an attendance system based on WeChat applets to address the challenges of slow attendance and poor results in traditional class attendance. The system utilizes a MongoDB database and comprises six main tables. Additionally, a new module featuring a carousel image gallery is introduced to incorporate content on rural revitalization. This allows students to gain a deeper understanding of rural revitalization efforts. The system effectively improves class attendance efficiency and reduces unnecessary time wastage, providing a foundation for further development of additional features to meet other challenges in students' and teachers' daily academic lives.

Keywords: formatting: Attendance management · WeChat Mini Program · Vocational college students · Rural revitalization · QR code · Database design · User registration and login · Geolocation

1 Introduction

With the rapid development of the Internet and the continuous improvement of network speed, more and more transaction processing is transferred to the mobile terminal. As the protagonist of the mobile terminal, mobile phones are playing an increasingly important role. Through the investigation of college students and the author's own experience, we can find that the attendance-checking methods of university teachers are relatively traditional, and there have been some fresh attempts. Still, they have yet to be implemented on a large scale. Improve. However, attendance status can be used as a reference for teaching quality and has a supervisory effect on students' learning. Hence, an efficient attendance method is essential [1]. Considering that most students use smartphones every day, if attendance can be combined with smartphones, it will undoubtedly significantly reduce the pressure on students' daily attendance in the classroom and improve the work efficiency of teachers [2].

This study aims at the current classroom attendance management needs of students in higher vocational colleges by developing a product for the attendance system of colleges and universities. It reasonably proposes a design framework for the class attendance

management system of students in higher vocational colleges, which will be able to provide future higher vocational education. It provides a theoretical reference for designing and optimising the student attendance management system in colleges and universities. The classroom attendance management system for students in higher vocational colleges will further optimise student attendance management by counsellors and teachers in higher vocational colleges, improve the work efficiency of the student management department, and accelerate the modernisation of the daily management of students in higher vocational colleges [3]. It plays an essential role in the management of students in vocational colleges. Therefore, this study has specific theoretical value and application values.

2 System Requirements Analysis

2.1 Analysis of Requirements and Functional Modules

The proposed attendance system must fulfill several critical requirements to achieve its primary objectives. To address these requirements effectively, the system is divided into functional modules. The user registration and login module manages user authentication and access to the system. It must support different user types, such as students and teachers, and provide a secure and reliable authentication mechanism.

The attendance management module is responsible for tracking and recording attendance information for students and teachers. It must include features for checking attendance status, marking students who ask for leave or are late, and generating relevant reports. A carousel image gallery module is dedicated to showcasing rural revitalization content. It must offer an intuitive interface that allows users to access the content by clicking on images in the carousel and display pertinent information on rural development initiatives. Integration with the WeChat applet is a crucial aspect of the system. This module ensures seamless integration with the WeChat applet, including compatibility with the applet’s design and functionality and the development of the necessary APIs.

Finally, the database design and management module is responsible for managing the MongoDB database, including the design of the six main tables and the relationships between them as shown in Fig. 1.

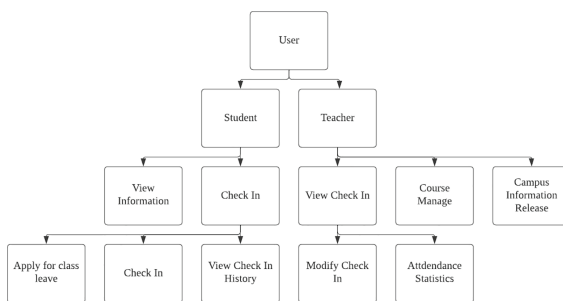


Fig. 1. System function structure diagram

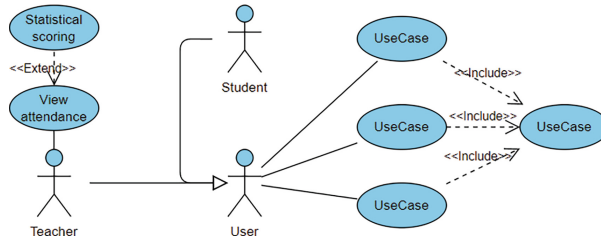


Fig. 2. Use case diagram

2.2 Overall System Analysis

The overall system design must ensure that the aforementioned functional modules work cohesively to create a smooth user experience. This involves analyzing how each module interacts with the others and identifying any potential bottlenecks or dependencies that may impact the system's performance.

Scalability is a critical factor in the system design. The system must be designed to accommodate growth in the number of users, courses, and attendance records over time. This involves choosing an appropriate database design and optimizing the system's architecture to support scaling.

Security is another essential consideration. The system must provide robust security measures to protect user data and ensure the integrity of the attendance records. This includes implementing secure authentication mechanisms, access controls, and data encryption.

Performance optimization is vital for the system's success. The system must be designed to handle high levels of concurrent users and minimize latency when retrieving and processing attendance data. This requires optimizing database queries, system architecture, and resource allocation.

Usability is a key requirement for the system's user interface. The system must be designed with ease of use and accessibility in mind, ensuring that users can quickly and easily navigate the applet and access the desired content (Fig. 2).

2.3 Demand Analysis

To ensure the success of the proposed attendance system, it is essential to analyze the demands and expectations of the target users, namely, students and teachers. For students, the primary demands are ease of use, quick access to attendance information, and the ability to view rural revitalization content. They require an efficient and straightforward process for signing in and checking their attendance status. Additionally, students seek engaging and informative content related to rural development initiatives.

Teachers, on the other hand, demand a reliable and efficient system to manage attendance records, generate course QR codes, and monitor attendance status. They expect a robust and secure platform that allows them to perform their duties effectively while also providing insights into rural revitalization efforts.

2.4 System Module Analysis

The functional relationship of the system is shown in Fig. 3.

Based on Fig. 3, the system functions has been divided into the following five categories:

The functional modules must be designed to address the system requirements and user demands identified in the previous sections. The user registration and login module should incorporate secure authentication methods, such as OAuth, to ensure the privacy and security of user data. It should also provide a user-friendly interface for registering and logging in to the system, catering to both students and teachers.

The attendance management module should offer a comprehensive set of features for tracking and recording attendance. This includes the ability to mark students as present, absent, late, or on leave, as well as the generation of detailed attendance reports. It should also allow teachers to create course QR codes for easy student sign-in.

The carousel image gallery module is a key component in promoting rural revitalization. This module should be designed with an engaging and visually appealing interface that encourages users to explore the content. The carousel should display high-quality images accompanied by informative captions or descriptions, providing users with valuable insights into rural development initiatives. Furthermore, the carousel should be easily navigable and responsive, ensuring a seamless user experience.

The integration with the WeChat applet module is vital for the system’s accessibility and widespread adoption. To achieve this, the module should be developed in compliance with the WeChat applet’s design guidelines and technical requirements. The module should also provide well-documented APIs, allowing for seamless communication between the applet and the attendance system’s backend services.

The database design and management module plays a crucial role in ensuring the system’s performance, scalability, and reliability. The MongoDB database should be designed with appropriate table structures and relationships that facilitate efficient data retrieval and storage. The module should also implement best practices for database

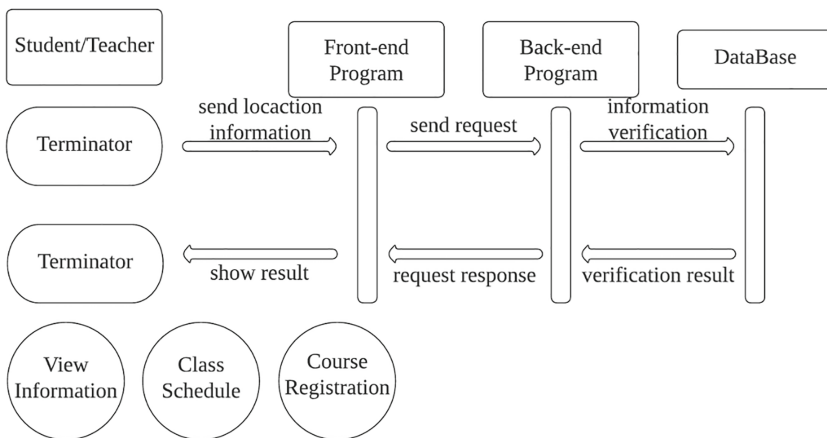


Fig. 3. System function diagram

management, such as indexing, data normalization, and backup strategies, to ensure the system's overall stability and robustness.

3 System Design

The system design phase is crucial in the development of an attendance system based on WeChat applets. This phase involves creating an efficient and user-friendly client interface and designing a robust database structure that can manage and store data effectively. In this section, we will discuss the client interface and database design aspects of the attendance system in detail.

3.1 Client Interface Design

The client interface design plays a pivotal role in ensuring the system's usability and user satisfaction. The interface should be visually appealing, intuitive, and easy to navigate. The following are key considerations for designing the client interface as shown in Fig. 4.

- **User Onboarding:** The onboarding process should be smooth and straightforward, requiring minimal input from the user. Users should be able to quickly register and log in according to their role (student or teacher) and access the appropriate module.
- **Navigation:** The system should have a well-structured navigation menu that allows users to access various functionalities, such as attendance management, information viewing, and rural revitalization content. Clear and concise labels should be used to improve the user experience and minimize confusion.
- **Responsive Design:** The client interface should be responsive and adapt to various screen sizes and devices, ensuring a seamless user experience across different platforms.
- **Carousel Image Gallery:** The carousel image gallery module for promoting rural revitalization should be prominently placed on the main interface, enticing users to engage with the content. The carousel should be visually appealing and support smooth transitions between images, providing an engaging user experience.
- **Attendance Management:** The attendance management interface should be designed to streamline the process of marking attendance for both students and teachers. This may include features such as QR code scanning, geolocation validation, and manual adjustments for absences or late arrivals.
- **Accessibility:** The client interface should comply with accessibility guidelines, ensuring that users with disabilities can easily interact with the system.

3.2 Database Design

The database design is a critical component of the attendance system, as it determines the efficiency and reliability of data storage and retrieval. The system adopts a MongoDB database, consisting of six main tables: teacher information table, student information table, class information table, course information table, class schedule table, and sign-in information table. The data relationships are illustrated in Fig. 5.

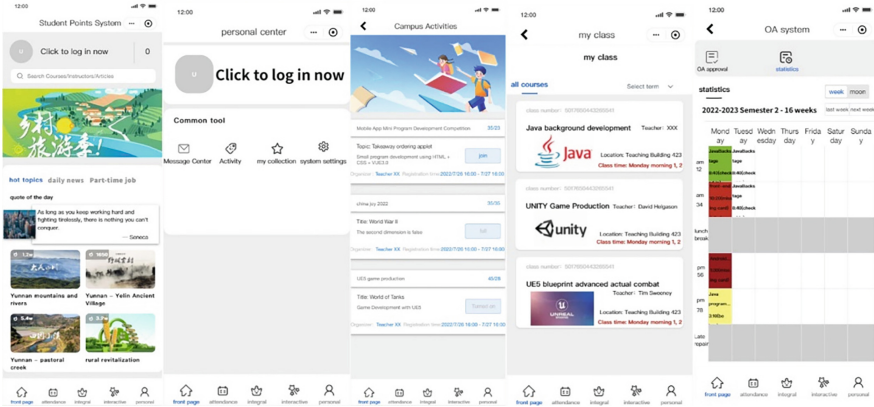


Fig. 4. System main interface design diagram

- **Teacher Information Table:** This table stores information about teachers, using the `_id` automatically generated by the database as the primary key. It includes fields such as the teacher's `OpenID` and `teacher_name`.
- **Class Information Table:** This table stores information about classes, with the `_id` automatically generated by the database as the primary key. It includes fields such as `class_name`.
- **Student Information Table:** This table stores information about students, with the `_id` automatically generated by the database as the primary key. It includes fields such as student's `openid`, `student_name`, and `class_id` (foreign key association with the `_id` in the class table).
- **Course Information Table:** This table stores information about courses, using the `_id` automatically generated by the database as the primary key. It includes fields such as `course_name`, teacher's `openid` (foreign key association with the `openid` in the teacher table), `course_loc`, and `class_id` (foreign key association with `_id` in the class table).
- **Class Schedule Table:** This table stores information about class schedules, with the `_id` automatically generated by the database as the primary key. It includes fields such as `course_id` (foreign key association with the `_id` in the course table) and `time_arrangement`.
- **Sign-in Information Table:** This table stores information about student attendance, using the `_id` automatically generated by the database as the primary key. It includes fields such as student's `openid` (foreign key association with the `openid` in the student table), `course_id` (foreign key association with the `id` in the course table), `time_id`, and `register_status`.

The database design should account for various data relationships between tables, including one-to-one, one-to-many, many-to-one, and many-to-many relationships. In the context of this attendance system, the one-to-many and many-to-many relationships are particularly important to understand:

- **One-to-Many Relationship:** There is a one-to-many relationship between teachers and courses, which implies that a single teacher can open multiple courses, and

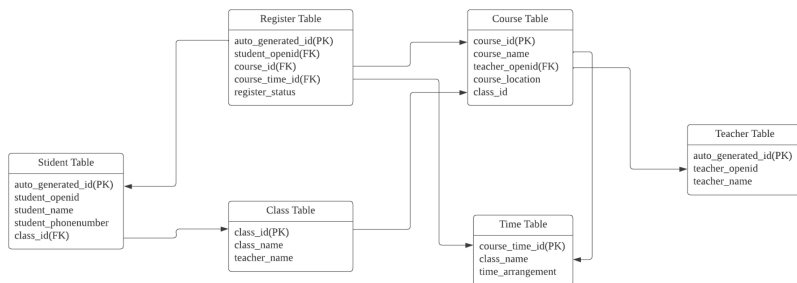


Fig. 5. The main data relationship of the database

various teachers can open the same course. However, the course numbers are different, reflecting the unique combination of the teacher and the course.

- **Many-to-Many Relationship:** There is a many-to-many relationship between students and courses, signifying that multiple students can enroll in a single course, and a student can enroll in various courses simultaneously. To manage this relationship, the course information table includes only one record for each unique combination of a student's OpenID and a course number.

Incorporating the rural revitalization content into the system involves updating the client interface design and expanding the database design. The client interface design should include a carousel image gallery module prominently placed on the main interface, allowing users to access rural revitalization content with a simple click. The database design should be extended to include a new table for storing rural revitalization content, including fields such as content_id (primary key), title, description, image_url, and other relevant metadata.

4 Development

The development of this WeChat-based attendance system involves creating several modules to address different user requirements. These modules include:

4.1 User Registration and Login Module

Before accessing the Mini Program, users must register or log in according to their user type (student or teacher) and enter the corresponding module. For first-time users, the system binds the user's mobile phone address, WeChat OpenID, and account information. For returning users, the system compares the mobile phone address, WeChat OpenID, and account information with the database before allowing access to the student or teacher module. This approach prevents one device from logging into multiple WeChat accounts or one person signing in for others.

The following code demonstrates the implementation of the Mini Program login functionality:

```
const userLogin = async () => {  
  try {  
    const result = await Taro.login();  
    // Successful login returns user information  
    return Promise.resolve(result);  
  } catch (error) {  
    // Returns false if the user is not logged in  
    return Promise.reject(false);  
  }  
};
```

4.2 Teacher Registration and Login Module

The primary functions for teacher users include creating classes, generating course QR codes, checking attendance status, and marking students who are on leave or late. Integrating the rural revitalization content within the teacher module ensures that educators can access and share this information with their students.

4.3 Attendance Check Module

After successful sign-in, users can review their attendance status, including time, student number, name, course, teacher, and more. The system verifies whether the student scans the QR code within the specified geographical range. The interface also features “Logout” and “View Attendance” buttons, allowing users to log out or check their attendance status for a specific course.

4.4 Information Viewing and Other Functional Modules

This module, which does not require a forced login for students, focuses on information viewing and accessing the rural revitalization content. The carousel image gallery displays a collection of visually engaging images highlighting various aspects of the rural revitalization initiative. Users can click on an image to access detailed information about the topic, fostering a deeper understanding and appreciation of this critical national endeavor.

5 Conclusion

This study presented the design and implementation of an attendance system based on WeChat Mini Programs, addressing challenges associated with traditional class attendance procedures, such as time-consuming processes and inaccurate results. Through the integration of various modules tailored to user requirements, this system enhances class attendance management efficiency, minimizing unnecessary time waste and providing a comprehensive solution to students and teachers in their daily academic lives.

Furthermore, the incorporation of rural revitalization content within the Mini Program serves as an innovative approach to disseminating crucial information on this national initiative. By providing users with an interactive platform showcasing visually engaging content, the attendance system fosters a deeper understanding and appreciation for rural development efforts, promoting a more informed and engaged student population.

In the future, the WeChat-based attendance system can be further developed by introducing additional functionalities and expanding its scope to address other challenges faced by students and teachers. With continuous improvement and innovation, this system has the potential to become an essential tool for education institutions in managing attendance while simultaneously promoting awareness and understanding of significant national initiatives, such as rural revitalization.

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