Design and Implementation of an IoT-based Student Attendance System

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Abstract: The traditional attendance methods of colleges and universities, such as roll calls, are not efficient. Under the background of building an intelligent campus, we analyze the system requirements of the attendance system based on IoT technology and design a college student attendance system based on ibeacon to achieve accurate positioning and batch fast attendance to improve the efficiency of teaching management.

Keywords: College attendance, Ibeacon, Bluetooth, Indoor positioning.

1. Introduction

Attendance is a vital part of students' daily management in universities. Attendance management is essential for students themselves and the evaluation of the teaching effectiveness of university teachers. Moreover, attendance management is relatively the easiest way to quantify compared with other student management evaluation indexes. From the perspective of the whole college population, students’ course learning effect is often positively correlated with attendance rate[1]. Therefore, attendance management has always been the most critical factor for universities. Therefore, attendance management has always been one of the critical points in university teaching management. The traditional attendance management method in colleges and universities is mainly the teacher’s roll call or paper sign-in mode, which is time-consuming, laborious, and easy to make mistakes. At the same time, it is difficult to prevent and check the cheating methods of students in the traditional attendance methods, which makes the attendance management weaken the management role of college students significantly. At present, with the improvement of various technologies, especially the rapid development of Internet of Things (IoT) technology, each university is speeding up the construction of an intelligent campus. In the construction of the intelligent campus, new attendance management methods are developed with the support of the Internet of Things, cloud computing, Internet plus, and other technologies to eliminate the traditional verbal attendance management methods of teachers and paper sign-in and develop efficient and low-cost anti-cheating college student attendance methods with the help of Internet technology[2]. The new attendance management system has been developed. As a result, various new attendance systems have emerged. For the new attendance system, the main directions are to improve the speed of attendance, increase the accuracy of attendance, reduce the interference to the classroom, eliminate students’ cheating behavior, and reduce the application cost.

2. Attendance System Design Elements

The attendance system applied to the college classroom requires to efficiently record student data located in the specified range within the specified time frame, and according to the college classroom’s attendance characteristics, the system’s main design elements are attendance time point, location, and student information[3]. The main design elements of the system are attendance points, location, and student information. It is relatively simple to record the student check-in time point, and there are various options for student location and information recording.

2.1 Location Information

Identifying location information is very helpful to reduce students’ cheating behavior and effectively improve the effectiveness of attendance management. The typical location identification methods are GPS geographic information fence and WIFI location identification. Attendance system based on GPS geographic information fence is the most common type of attendance system with location information recognition. However, due to the limitation of the GPS signal itself, its positioning accuracy is limited, generally only 1 0-20 meters[4]. Although this kind of attendance system is widely used, it does not apply to the attendance scenario of colleges and universities because of its low positioning accuracy, and it can only determine whether students are in the teaching building or not. It is difficult to determine whether students are in the corresponding classrooms. The positioning accuracy of a WIFI-based attendance system is much higher than that of a GPS positioning system, which is based on the positioning of students’ cell phones after connecting to a specific router and comparing the relevant information of students’ cell phones. However, because of the penetration of the WIFI signal, it can only locate students in several classrooms in the vicinity. This method still has some limitations when applied to classroom attendance in colleges and universities[5]. This method still has some limitations when applied to classroom attendance in universities.

2.2 Record of Students’ Personal Information

A critical evaluation criterion of the attendance system is accurately recording students’ personal information corresponding to the attendance. The existing major attendance systems record students’ personal information, such as QR code scanning and personal biometric identification. QR code scanning is a low-cost method, but it is difficult to prevent students from cheating. Personal biometric identification includes fingerprint identification and faces recognition, which requires additional personal biometric equipment. Such devices are relatively expensive,
significantly increasing the attendance cost when applied to students’ attendance in colleges and universities. At the same time, such devices do not support batch identification, so students need to take attendance one by one, which is very costly in terms of time. Many students gather near the attendance equipment, which will quickly cause chaos. At the same time, personal privacy leakage is a severe problem in the era of big data. With the improvement of national laws and regulations, the cost of collecting and managing such unchangeable personal privacy information as personal biological information will also rise significantly[6]. With the improvement of national laws and regulations, the cost of collecting and managing personal biometric information will also increase significantly.

It can be seen that the existing time and attendance system designs all have different defects to be improved.

3. Ibeacon Technology

Ibeacon technology is a new indoor positioning technology based on Bluetooth 4.0 specification launched by Apple, which is based on Bluetooth Low Energy(BLE), not limited by the user’s system, both iOS and Android system can be used, it has the characteristics of low cost, small size, low power consumption, and short coverage distance[7]. Compared with the aforementioned attendance management system, the ibeacon based student attendance management system in colleges and universities can improve student attendance accuracy and efficiency. Regarding attendance accuracy, ibeacon is a BLE Bluetooth communication method with short effective communication distance, generally less than 20 meters, and weak signal penetration ability, generally limited to single open room communication[8]. It can effectively locate students accurately in a specific classroom. And there is no limit to the number of ibeacon communication devices at the same time, which can be used to take attendance for all students simultaneously. It can be seen that the ibeacon based attendance system for college students has excellent potential for practical application.

4. The Attendance System Design and Implementation

An attendance system is achieved by teachers carrying ibeacon transmitting devices and turning them on when they arrive at the classroom. The ibeacon device used by the teacher is a Bluetooth beacon based on the nRF 52810 chip, with an output power of -20dBm+4dBm, adjustable, communication distance less than 50 meters, using CR 2032 batteries, and a standby time more than 9 months. After turning the device, ibeacon will broadcast specific information to the surrounding area with a pre-set frequency. Due to the nature of ibeacon, this specific broadcast information is confined to the classroom area. When a student enters the broadcast range with a Bluetooth receiver device, the Bluetooth receiver device will automatically receive the broadcast from the teacher’s device and send back the relevant information to the server, which will use the corresponding information to attend the student. Both the teacher’s ibeacon device and the student device in the database are pre-associated with themselves. The specific student attendance time is recorded, and the attendance record is formed by comparing it with the pre-set data. The specific process is shown in Figure 1.

![Figure 1](image.png)

**Figure 1**: Attendance system overall implementation process

5. Conclusion and Outlook

The ibeacon broadcasting feature makes students’ attendance positioning accurate, and the device is associated with students in advance, which can effectively reduce the occurrence of students’ attendance cheating. In constructing an intelligent campus, this attendance system has more potential for expansion based on ibeacon technology and IoT-related technology characteristics. For example, fixed ibeacon beacons can be arranged in classrooms, and teachers can use beacons to achieve accurate indoor positioning of students; ibeacon beacons can be integrated with other IoT sensors to monitor environmental data in real-time to help achieve the security management function of the intelligent campus.

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References