The lesson sign-in system based on face recognition and location restriction

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The lesson sign-in system based on face recognition and location restriction

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Abstract: At present, the application scenarios of the sign-in system are very extensive. For example, in various types of conferences, forums, training, classes, etc. In these scenarios, it is necessary to sign-in the presence of the personnel. So how to carry out efficient and safe sign-in has become a crucial issue. Using face recognition technology and location service technology, an efficient check-in system is proposed. This paper takes the university classes as the scene, and carries on the detailed design and implementation of the teacher end and student end of the lesson sign-in system. The traditional sign-in method takes up a lot of valuable class time, and the system shortens the sign-in time to about one minute. The teacher end generates the sign-in two-dimensional code[1] after selecting the course and the classroom, and the students scan the two-dimensional code by the student end and then verifies the face feature value and the geographical location to implemented the sign-in. Both the teacher end and the student end have implemented the functions of class selection, inquiry sign-in records and leave. It is more convenient the teaching interaction between teachers and students.

1. Citation

Sign-in is an effective way to record the presence of personnel. Various types of sign-in systems are widely used. For example, before the start of various types of meetings, the attendees will be sign-in, students will be sign-in at the training class or in the college class. However, most of the sign-in scenarios still use the traditional method of sign-in, which is inefficient and cannot avoid problems such as some students sign-in for others. Therefore, a sign-in system based on face recognition and location restriction is proposed. This article will be introduced in the context of college classes.

Sign-in in class is an important basis for improving students' self-consciousness and considering students' usual performance in college classes. After a detailed investigation and study, it took about 4 minutes to sign-in in a class about 50 people, and about 10 minutes to sign-in in public class about 100 people. The large amount of time spent on sign-in has seriously affected valuable teaching time and teachers' teaching enthusiasm. And unless the teacher can know all the students, it is difficult to solve the problem such as replace others on sign-in, but it is not an easy thing for teachers with heavy teaching tasks. Therefore, it is a crucial issue for college teachers to simplify sign-in process and avoid some students sign-in for others.

At present, mobile terminals[2] are becoming more and more popular, and most smart phones provide location services and 4G networks[3]. Biometric technology[4] has become a booming field and is widely used in mobile terminals. Among them, face recognition technology is widely used. The multimedia teaching computer in college classrooms has been popularized, after the teacher selects the course and classroom, the teacher end will match the student information of this course and generate

the sign-in two-dimensional code. The student uses the mobile terminal to collect facial feature value in advance and uploads them to the database, and scans the two-dimensional code generated by the teacher end. The student end obtains the geographical location of the classroom and compares it with the geographic location of the student, and then obtains the facial feature value in the database to compares with the facial feature values collected at present. And by using the live detection technology to determine whether it is a photo or video sign-in. Therefore, the lesson sign-in system designed by using face recognition technology and location service technology is feasible.

The teacher end system adopts B/S structure, applies Web technology, combines lightweight J2EE framework SpringMVC[5] and front-end display framework LayUI, JS, JSP and other technologies. The student end adopts the C / S structure, based on the Android platform development[6], using ArcFace v2.1 and BDLocation engine to Implement the core functions of face recognition and location service positioning. The system database uses MySQL as the underlying database of the system[7].

2. Research status and related technologies

2.1. Research status

After investigating current commonly used sign-in methods, it is found that the face recognition technology is more commonly used to the face recognition attendance machine[8], this way of sign-in is to use Infrared Ray to scan face then identify and sign-in. Although this way limits people's location, there are huge drawbacks to this way. First, installing face recognition attendance machines in each classroom is a huge expense. Second, this way will also take a huge amount of time when there are more students waiting in line, which will bring great inconvenience to teachers' teaching activities.

2.2. Face recognition technology[9]

Face recognition, is a biometric technology, which is based on the value of face feature to identify people's identity. A series of related techniques for capturing a picture or video stream which contains a face with cameras, and recognizing the detected face, usually called portrait recognition or face recognition. Live detection is mainly carried by identifying physiological information on the living body. It uses physiological information as a life feature to distinguish biological feature forged with non-living substances such as photographs, silica gel, and plastic. This paper uses ArcFace v2.1 independent offline SDK provided by ArcSoft, which contains face detection, live detection, face comparison, face tracking, face attributes, etc.

2.3. Location service technology

Location-based service, which obtains the location information of mobile terminal users through the telecommunication mobile operator's radio communication network (such as GSM network, CDMA network) or external positioning mode (such as GPS)[10]. With the support of the GIS platform, a value-added service provided by the user.

3. Overall system design

After the sign-in starts, the teacher uploads the information of classroom and lesson to the server through the web end, then the server will generate a two-dimensional code. Students scan the two-dimensional code through the Android end, then get the latitude and longitude of classroom and the value of face feature. Android end calculates locally and returns the sign-in result. The whole process is shown in Figure 1.

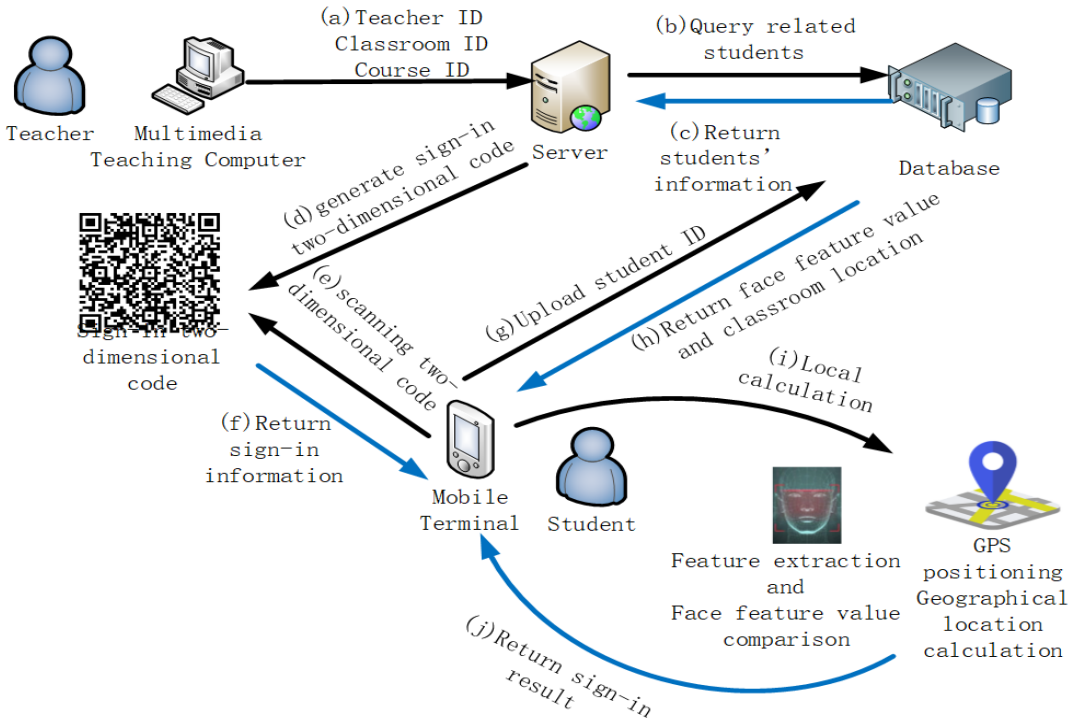

Figure 1. sign-in system overall design.

3.1. Student end system overall design

The APP of student end is designed into three main modules: the sign-in module, the lessons management module and the personal information management module. The sign-in module is the core module of system, and the rest of modules are designed to ensure the normal sign-in activities in the background of college classes. The student end system module diagram is shown in Figure 2.

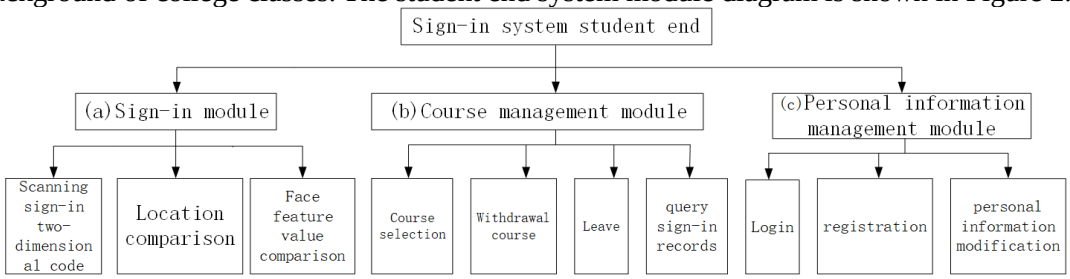

Figure 2. Student end system module diagram.

Sign-in module: The core module of student end. During the sign-in process, after students scan the two-dimensional code to obtain the information of lesson and classroom, the position and face feature value are compared and verified, and the successful verification means that the sign-in is successful.

Lessons management module: Includes the functions such as course selection, withdrawal, leave, and inquiring sign-in record, which meet students' management needs for lessons.

Personal information management module:Includes the functions such as login, registration, and modification of personal information, which meet students' management and certification needs for personal information.

3.2. Teacher end system overall design

3.2.1. Teacher end system architecture design

The teacher end system must be designed to meet the needs to view student sign-in status in real time

and manage student. The system architecture shown below.

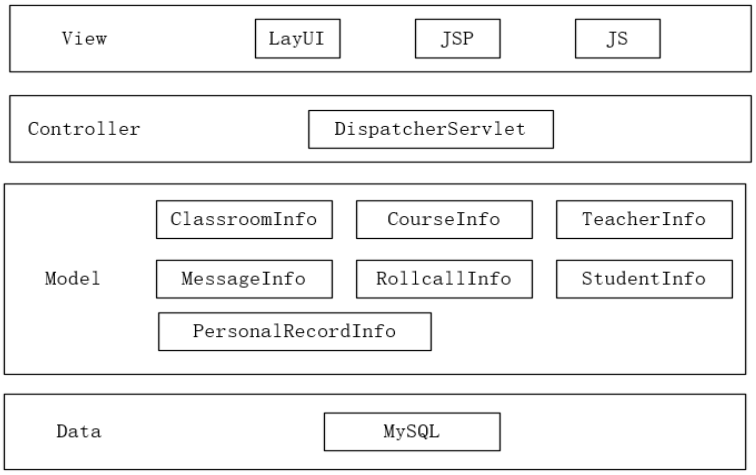

Figure 3. teacher end system architecture design.

3.2.2. Teacher end system module design

The teacher end is designed into two main modules: the sign-in module and course management module, which meet the core needs of sign-in activity in the class and other needs to ensure the normal teaching activity. The teacher end system module diagram is shown in Figure 4.

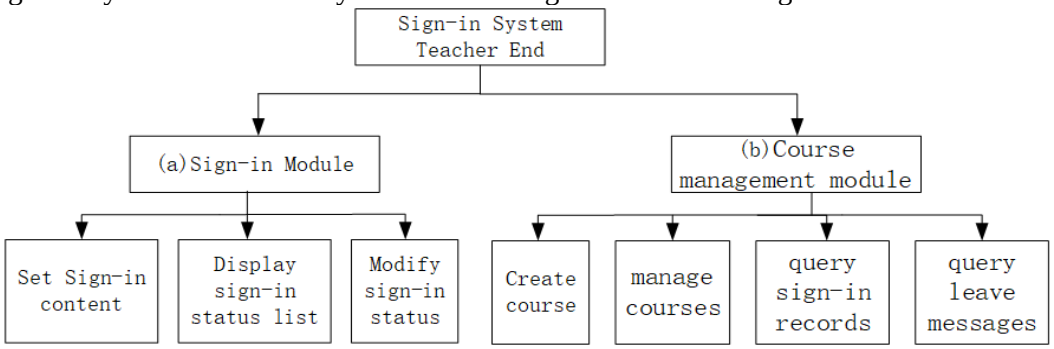

Figure 4. teacher end system module diagram.

Sign-in module: The core module of teacher end. Teacher selects the current course and classroom, matches the student's information who has selected the course and matches the classroom's location in database, the students' information list and two-dimensional code required for sign-in will be shown on the web page. The information of student who signs successfully will be deleted from student's information list.And then, after teacher clicks the "stop" button, the teacher can modify the status of the student who has not signed in successfully, and submit the modification information to complete this sign-in activity.

Course management module: Includes the functions such as creation of courses, management courses, inquiring sign-in records, and inquiring vacation information, in order to adapt to the function of teacher's daily management in the background of college classes.

4. Detailed design and implementation of system software

4.1. Design and implementation of student end

4.1.1. Design and implementation of sign-in module

Step 1: Students scan the sign-in two-dimensional code generated by the teacher end, and parse the

two-dimensional code to obtain a string. If the string is in json format and contains the required information, the two-dimensional code is considered to be legal and go to Step2, otherwise sign-in failed.

Step 2: Obtain the latitude and longitude of the designated classroom, collect the latitude and longitude of student, and calculate the distance between the two points by the spherical distance formula. If the distance is less than 30 meters, the student is considered to be in the corresponding classroom and go to Step3, otherwise sign-in failed.

Step 3: Student end obtains the facial feature value uploaded when the student registers, open the front camera and collect the facial feature value of the student at that time to compare the two facial feature values. If the similarity is greater than or equal to 75%, it is considered that the his operation and go to Step4, otherwise sign-in failed.

Step 4: Sign-in and return the sign-in result.

The Sequence diagram and ArcFace calling procedure are shown in Figure 5.

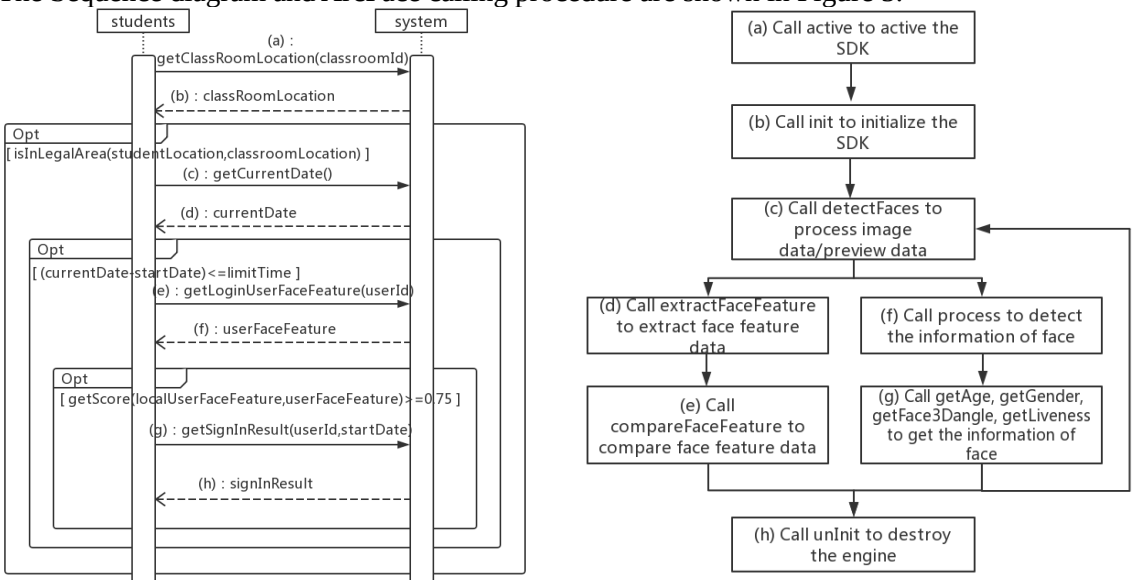

Figure 5. Sign-in module Sequence diagram and ArcFace calling procedure.

4.1.2. Design and implementation of Course management module and Personal information management module

The Course management module mainly includes course selection, withdrawal course, leave and inquire sign-in records functions. The Personal information management module mainly includes student login, registration and personal information modification functions. In this paper, the above two modules are designed and implemented in a simple way, only to meet the needs of student' daily inquiry and modification, so the specific implementation method will not be described in detail.

4.2. Design and implementation of teacher end

4.2.1. Design and implementation of sign-in module

Enter the Sign-in function, the first step is set sign-in information. Teacher needs to select the current course information and the current classroom information, after submitting will generate the sign-in two-dimensional code and store its physical path. Sign-in two-dimensional code store the teacher ID, course ID, classroom ID, sign-in time limit and sign-in start time in json format, as shown in Figure 6.

{"TID":"1001","CID":"20190331","CLASSROOM":"jsjxy-315","LIMIT_TIME":"3","START_TIME":"2019-04-01-17-16-21"}

Figure 6. Content recorded on Sign-in two-dimensional code.

The sign-in page displays the sign-in two-dimensional code and the list of student who participated in the sign-in, as shown in Figure 7. The student list is asynchronously refreshed through the iframe to view sign-in status in real time. Click the “stop” button to enter the page of modifying the student sign-in status.

This page shows the information of the students who have not sign-in. Click the “Arrived”, “Sick Leave” or “Personal Leave” button behind a student information and submit form will set the status of this student to the corresponding sign-in status and delete this information in the list.Student who are still not sign-in will eventually apper in the list and be marked as “Not Arrived”. The sign-in module flow chart is shown in Figure 8.

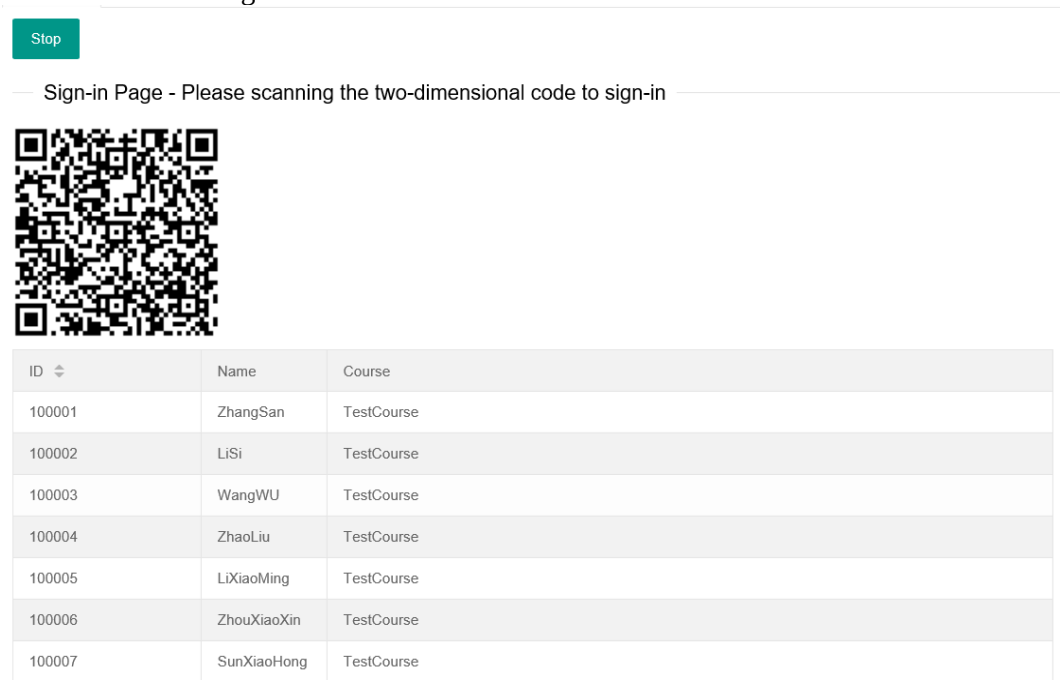

Figure 7. Sign-in Page. Students need to open the app and scan the two-dimensional code shown in the figure to sign-in. After signing in, they will not appear in the list again.

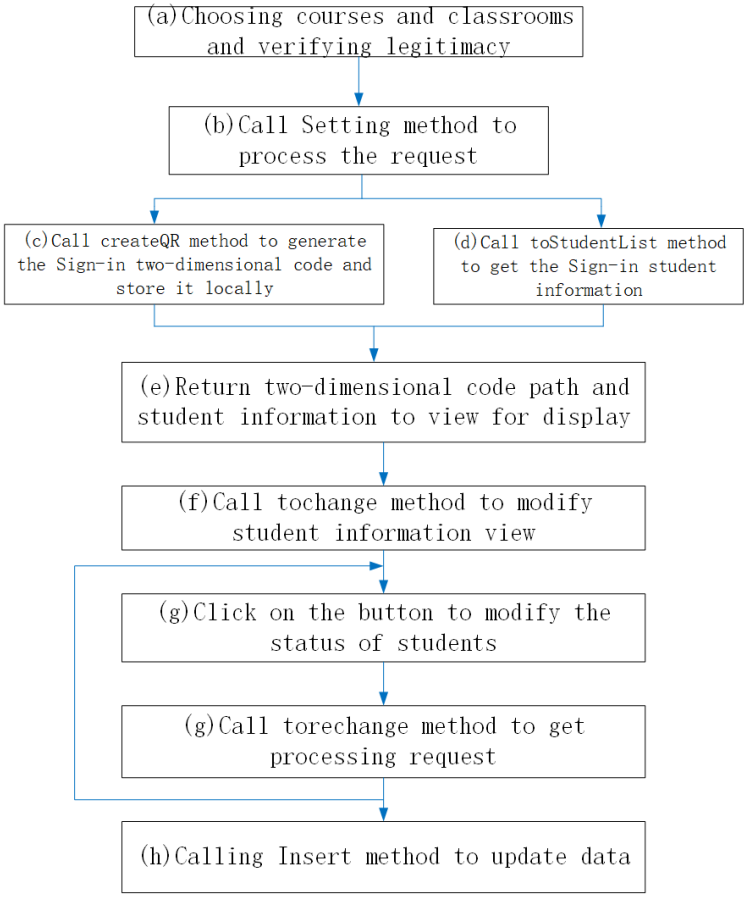

Figure 8. Sign-in module flow chart. The teacher can modify the student's check-in status many times after the sign-in.

4.2.2. Design and implementation of Course management module

The Course management module includes create course, manage course, inquire sign-in records and inquire leave messages functions. The implementation method of the above functions is similar to the implementation method of the sign-in module. In this paper, the course management module is designed to enable the teacher to mange and inquire in the context of college and universities. Therefore, the specific implementation method will not be described again.

5. Software testing

After many sign-in tests in different courses of our school, it was found that the time spent in sign-in through the system was about 1 minute, and the time-consuming vary with the number of sign-in students' increasing or decreasing, but it still greatly shortening the time spent in sign-in, and effectively improve the student's attendance rate and the efficiency of the teacher's statistical course sign-in situation later. The sign-in results is shown in Table 1.

Table 1. Test Results

Course Title	Number of students participating	Time spent in sign-in
advanced mathematics	53 people	1 minute 07 seconds
.Net Architecture and Programming	46 people	1 minute 02 seconds
National Theory and Policy	107 people	1 minute 46 seconds

Software Architecture and Design Pattern	23 people	38 seconds
Linux Operating System	87 people	1 minute 25 seconds

6. Conclusion

The lesson sign-in system introduced in this paper, greatly simplifies the sign-in process of teachers and students in the daily class through designed and implemented the teacher end and student end. And effectively improves the students' attendance rate in the class, to ensure that all activities in the sign-in process are carried out normally and conveniently. Therefore, not only in the background of colleges and universities, the lesson sign-in system based on face recognition and location restriction can be transplanted and applied to other scenarios, which greatly simplifies the sign-in method and makes the sign-in process in various scenarios efficient and secure.

Acknowledgments

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