Attendance System Based on Face Recognition and GPS Tracking and Positioning

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***Abstract*—This paper analyzes the current attendance system with time-consuming, labor-intensive, low efficiency and many other shortcomings, and proposes an attendance system based on face recognition and GPS tracking and positioning. We have set up a number of functions in this system, not only adding a manual part, but also solving the phenomenon of students asking for leave and being late on the attendance system. At the same time, the system can meet the basic needs of classroom attendance. Whenever the class teacher is ready to start attendance, students can sign in according to the teacher's instructions. Facial recognition is used to determine the identity of the student, and the location of the teacher and the student is further determined through the mobile phone GPS tracking and positioning. If the specified range is met, the sign-in can be successfully achieved. After the course is over, turn on the sign-out function, and perform face recognition and GPS positioning again. Accurate and more efficient make up for the shortcomings of traditional mode of attendance.**

Keywords- attendance system; mobile phone positioning; GPS tracking; face recognition; system design

I. INTRODUCTION

In recent years, artificial intelligence technology has developed rapidly. Face recognition has been widely used in various scenes in life, and the recognition rate and safety of this technology have been well tested in practical applications. Compared with the outdated attendance method based on the Internet of Things and roll-in, the two-in-one attendance system with GPS positioning system and face recognition is a new, convenient and accurate check method.

II. ANALYSIS OF THE CURRENT STATUS OF CLASSROOM ATTENDANCE

In university classrooms, the attendance rate of students is an important data basis for the evaluation of teaching results, and it is also the content of the letter construction of standardized management of the school. For a long time, classroom attendance has been mainly done manually. However, neither the teacher's roll call nor the paper version of the sign-in can provide good supervision for some students. Investigation and statistics have found that over 60% of college classroom attendance methods are still manual answering methods. Facts have shown that there are many loopholes in this kind of attendance method at this stage. Therefore, I think it is particularly important to design and develop an efficient and accurate time attendance system based on existing facilities.

III. ANALYSIS OF CURRENT GENERAL ATTENDANCE METHODS

(1) Answer the attendance manually. The attendance is presented in the traditional way of oral roll call by the teacher, students' answers and manual recording. The disadvantages are that it takes a long time, is low in accuracy, and is artificially arrived. Attendance information cannot be well archived.

(2) Face recognition to check attendance. This kind of test mainly depends on the quality of the camera and the environment. A series of collection devices must be installed at the entrance of the classroom, which consumes manpower and financial resources. Because the dynamic recognition rate of the equipment is unstable, and the face recognition requires the collection of the face images of the students in the early stage, it will cause long queues to check attendance before dispersing, which takes a long time.

(3) Fingerprint recognition to check in and attendance. Similar to face recognition, you need to check in yourself, but there are also situations where you need to queue to check in. When there are many students, the classroom scene will be chaotic.

(4) The novel attendance method proposed in this design uses the GPS positioning of the student's handheld device combined with face recognition to determine the uniqueness of the student's identity, thus ensuring high accuracy.

Attendance method	Accuracy	Rapidity	Simplicity
Manual attendance	low	low	easy
Face recognition attendance	high	low	difficult
Fingerprint recognition attendance	low	low	difficult
Face recognition and GPS tracking location attendance	high	high	easy

Figure 1. Comparison of the above methods of attendance

IV. OVERVIEW OF THE OVERALL DESIGN IDEA OF FACE RECOGNITION + GPS TRACKING AND LOCATION ATTENDANCE SYSTEM

The novel attendance method proposed in this design, the attendance system based on GPS positioning + face recognition is composed of student end (smartphone), teacher end, mobile attendance end, face recognition server, third-party interface server, communication link, etc. composition. The face recognition server is used for a face scanning function when students check in and sign in, and the mobile attendance terminal is used to monitor the shift of

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students. The third-party interface is used to connect the educational administration system and campus network information platform, mainly to obtain basic data such as students, teachers, and courses. The teacher terminal is for teachers to use, and at the same time the teacher has the editing authority and can customize the prescribed distance. After logging in, the teacher can turn on the sign-in and sign-out commands, check the specific situation of attendance, and modify and edit the attendance information. The student terminal provides students with browsing records, and can also ask the teacher for leave. Not only can you look at your previous attendance records, but students can log in with a single click to complete daily attendance work.

V. Design Principles and Functions of Classroom Attendance System

A. Technical principles of system operation

a) Principles of face recognition technology

The human face is one of the most direct biological characteristics of the human body, with a high degree of non-replicability and uniqueness, and it provides a good foundation for identity authentication.

Face recognition technology is to judge the input face information, if it meets the basic characteristics of the face image, compare it with the data information already in the database, so as to realize the recognition and identification of the personal identity shown in the image [1]. The basic flow chart is shown in Figure 2:

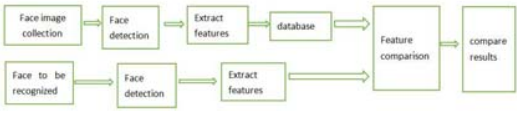

Figure 2. Face recognition process

b) Principles of GPS tracking and positioning technology

The GPS-based positioning method uses the GPS positioning module on the mobile phone to send its position signal to the positioning background to achieve mobile phone positioning[2].GPS can not only obtain the specific location of the longitude and latitude of the mobile phone, but also obtain the three-dimensional coordinates and precise time, which solves the problem of students signing in within the same radius on different floors[3]. In today's daily life, most of them use GPS positioning to obtain the location of the mobile phone. The technology mentioned in this paper will judge whether the distance between the two is within the range issued by the teacher's mobile phone through the deviation of the teacher's mobile phone GPS positioning and the student's mobile phone GPS positioning information, and vice versa. No. After the sign-in is completed, the background will continue to track the location of the student. If it exceeds the specified range, the background will send student information to the teacher, waiting for the teacher to confirm whether the student is in the classroom.

B. The composition of the main functions of the system

(1) Login function: used for teachers, students and administrators to login

(2) Student terminal: You can view your previous attendance information, and set up a manual part, which can be used for leave, and you need to submit relevant leave slips.

(3) Teacher terminal: You can view course information, enable sign-in and sign-out commands, and check attendance details. At the same time, it can also operate the manual part to solve the problem of students being late and asking for leave.

(4) Mobile attendance terminal: It not only provides students with the functions of sign-in and sign-out, but also supports shift monitoring of students to realize rapid and multiple positioning to accurately obtain the real-time location of students. If the distance exceeds the specified range before get out of class is over, the background will submit relevant information and send it to the teacher to remind the student of abnormal behavior, and the teacher needs to confirm whether the student is in the classroom.

(5) Face recognition detection: Send the photo to the terminal, compare and analyze the collected face with the picture, and calculate the matching degree.

(6) GPS positioning: realize mobile phone positioning function[4].

(7) Third-party interface function: connect the interface of educational administration system and campus network information platform to provide real-time data for the attendance system to obtain basic data such as students, teachers, and courses.

(8) MySQL database: store student attendance related information

Demand Modeling of Classroom Attendance System

The system consists of three types of participants, namely teachers, students, and database administrators.

Student: The operation authority is low. You can only view your previous attendance information.As shown in picture 3:

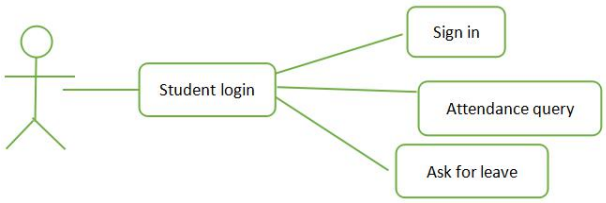

Figure 3. Example diagram of student client

Teacher: With high operating authority, you can turn on sign-in and sign-out commands, view student attendance information, and add, modify, and delete student attendance data records.As shown in Figure 4:

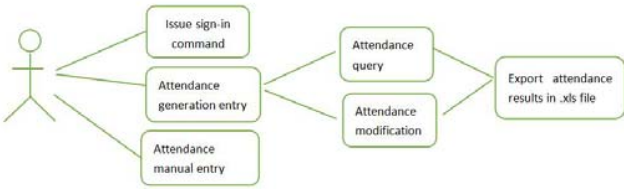

Figure 4. Example diagram of teacher client

Database administrator: Get basic data of students, teachers, courses, etc. for the attendance system by connecting to the campus third-party interface. As shown in Figure 5:

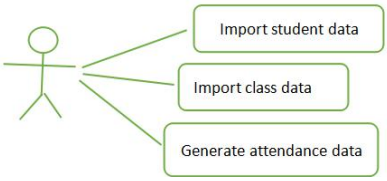

Figure 5. Sample diagram of the database administrator client

VI. FRAMEWORK TECHNOLOGY PROCESSING OF CLASSROOM ATTENDANCE SYSTEM

A. Face recognition

(1) Face image collection and detection

Face image collection: Store the collected face images in the database.

Correction of face image quality

The face images collected by the face recognition time attendance system cannot be used directly because of many uncertain factors, and professional and complex processing of the face images is required.

(3) Feature extraction of face image

It can extract the key points of the human body's facial features such as eyes, chin, ears, nose, and mouth, and compare them as an important basis for facial judgment

(4) Face image matching and recognition

After the facial image feature extraction is completed, it is matched with the previously stored facial image, and the similarity between the two is calculated to determine the student's identity information. In this design, the judgment method used to calculate the similarity is to calculate the Euclidean geometric distance between the detected face feature vector and the face feature vector of all people in the class. The recognition process is to compare and match the feature vectors of the image, such as the judgment based on Euclidean distance[5].And sort the results from small to large. If the smallest value after sorting is less than 0.55, it is considered that the pair of faces belong to the same person.

B. GPS location tracking

The teacher sends a roll call request by logging in to the mobile terminal. During this process, the teacher's mobile terminal will send the teacher's current location (latitude and longitude) and the specific time of sending the request (including sign-in, sign-out time, and GPS positioning interruption time). server. The students confirm the information to the server on the student side through the smart phone. The student side will send the student's current location information (latitude and longitude) and the time of sending the request to the server. The server first compares the student's location information with the teacher's location information. Compare, and then compare the time data sent by the students with the time data specified by the teacher[6].If the distance between the two is within the effective range specified by the teacher and the time is less than 10 minutes, it can be used to judge that the student is in the classroom and record the attendance result as a sign-in success. Otherwise, the student's The attendance result is recorded as absence.The flowchart is shown in the figure 6:

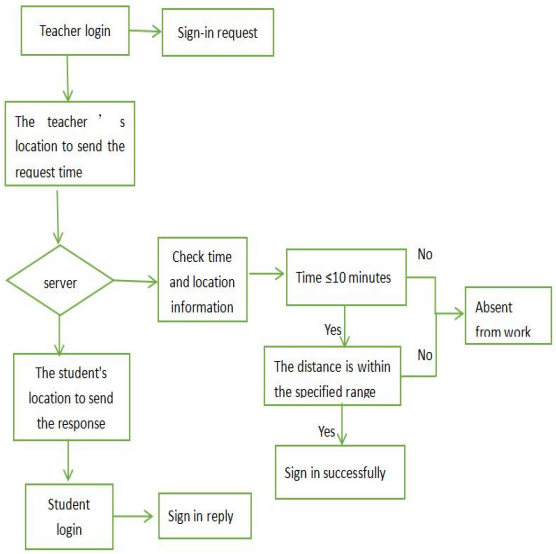

Figure 6. Server working process

In order to avoid the situation that students have not entered the classroom after signing in, the background will perform real-time tracking. However, considering that a large amount of data will be accumulated on the server, the system is optimized to track every ten minutes. During the tracking process, if the student is found to be out of the specified range, the background will send the student's related information to the teacher to wait for the teacher to confirm whether the student is in the classroom. As the current GPS system technology has become more mature[7]. GPS can obtain three-dimensional coordinates and accurate time, which solves the problem of students signing in within the same radius on different floors. But at the same time, in order to prevent students from handing their mobile phones to classmates to avoid tracking after signing in, the system is designed with a sign-out function after class, and it is still necessary to perform face recognition and location recognition identification within the specified time frame.

For every school, there will be breaks. When students take a break during breaks, the scope of activities will inevitably exceed the specified range. At this time, in order to avoid the interference of continuously sending information and data to the teacher, the server will stop the tracking

service, and the duration of the stop service is set by the teacher itself. This system also retains the record function. The teacher needs to enter relevant information and time when logging in for the first time, and can directly select the time period when it is used next time. The specific operation is shown in the figure 7:

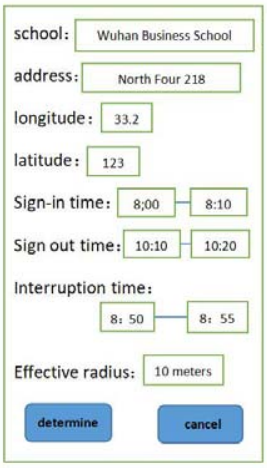

Figure 7. Operation interface design drawing

VII. Interface Design and Function Realization of Classroom Attendance System

A. Process and function realization of independent attendance

Before the roll call starts, the teacher's computer is connected to the server to obtain information about the current time period of the student's course, teacher, and classroom from the third-party interface of the educational administration system. After the teacher locates the mobile phone, it sends the attendance command to the background. The student enters the classroom to open the device location information. After the student receives the attendance information, click to sign in, and the mobile phone will automatically turn on the front camera for shooting if allowed. After collecting the student's real-time face photo, the mobile phone will display the face picture Send to the server. The system will then analyze the images received by the server and calculate the similarity of the images stored in the database.If the similarity value is consistent, the student will be positioned; otherwise, the sign-in will fail. Secondly, if the student's location meets the requirements, the sign-in success will be displayed on the phone screen, and the data information of the sign-in success will be stored in the database, otherwise, the sign-in failed[8].

B. Process and function realization of manual operation attendance

In the actual sign-in process, the sign-in may fail due to various reasons. Even if the probability of this happening is small, in order to improve the accuracy of the sign-in system and user experience, the system has set up a manual part, which is operated by the teacher and can only be done within 10 minutes after class. The teacher can modify the student's sign-in status after identity authentication, and the sign-in label can be changed to "late" or "signed".As shown in Figure 8:

However, various situations are unavoidable in daily life. When special circumstances occur, the option of asking for leave can be selected, and the teacher can change the student sign-in status after confirmation. The specific operation is shown in the figure 9:

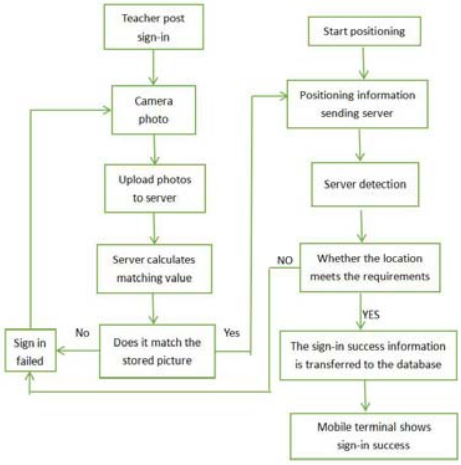

Figure 8. Autonomous attendance flow chart

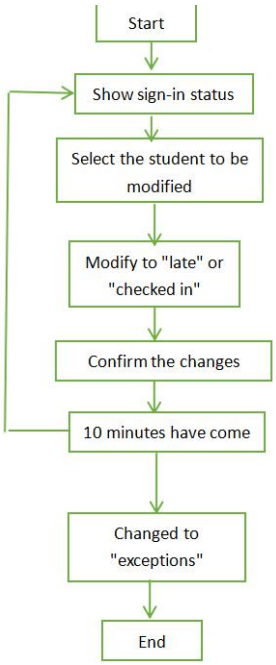

Figure 9. Manual Attendance chart

C. Interface design of main attendance system

a) Login interface design

As shown in the figure 10, the user needs to enter his student ID and password (the last six digits of the default ID

card) when logging in for the first time. After clicking to log in, after successful background data authentication, it will be transferred to the main interface of the system. Otherwise, the login fails.

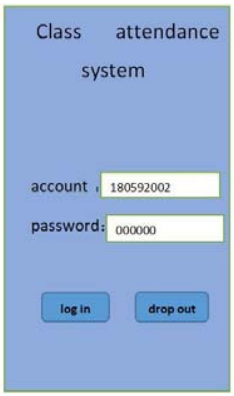

Figure 10. Login interface

b) System main interface

After the students log in successfully, they will enter the main interface of the system, which includes "sign in", "attendance inquiry", and "leave", as shown in the figure 11.

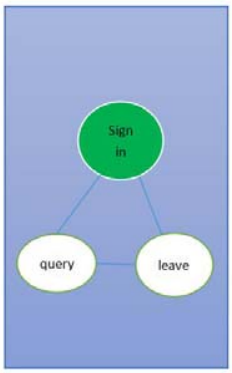

Figure 11. System main interface

c) The main interface of the sign-in process

In order to prevent students from recording video in advance for face recognition, the process adds a random instruction action, which will also be included in the matching result in a certain proportion. After passing, the mobile phone client generates a GPS location monitoring mechanism, and at the same time, it can determine the current user's attendance point and prompt the user whether to confirm the attendance. Attendance includes sign-in and sign-out. The client will automatically display "sign-in" or "sign-out" according to the class time of the educational administration system.As shown in Figure 12、13、14.

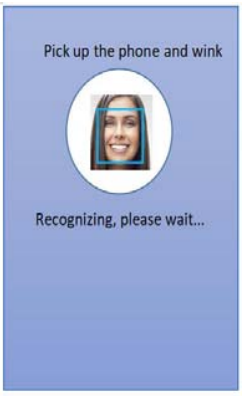

Figure 12. Face capture process

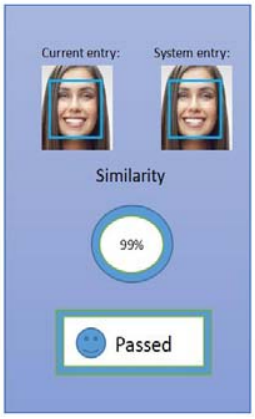

Figure 13. Comparison resule

Figure 14. Sign-in display interface

d) Modify the main interface of the teacher

In order to prevent students who fail to sign in or arrive late to affect the background attendance data, teachers can modify the attendance records of classmates. Once the modification operation is performed, the reason for the modification should be indicated in the remarks.

The check-in status in this module includes "sign-in successful, requested leave, late, absenteeism"; check-out

status includes "sign-out successful, ask for leave, leave early, absenteeism".As shown in Figure 15:

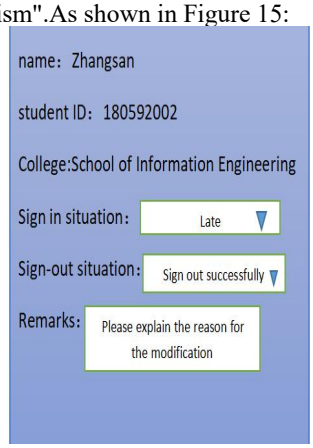

Figure 15. Modify the main interface of the techer

VIII. CONCLUSION

This system combines GPS positioning technology and face recognition technology. Compared with the old-fashioned attendance system in the past, the adaptability and intelligence of attendance are significantly improved, and no additional hardware is required. The current attendance data is more accurate. Classroom management provides an intuitive data reference, and plays a good exemplary role in improving the teaching management efficiency of adult colleges and introducing technology to promote teaching management. In the future, we can continue to introduce emerging technologies such as artificial intelligence and VR into teaching management.

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