Design and Implementation of Classroom Attendance System Based on Video Face Recognition

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***Abstract*—Classroom attendance, as an indispensable part of teaching activities, plays a very important role in classroom teaching. Classroom attendance can effectively supervise students to attend classes on time and ensure the quality of classroom teaching. However, the current classroom attendance is mainly achieved by the way of teacher's name-calling, which will cause a lot of waste of classroom time. This paper presents a classroom attendance system based on video face recognition technology. The system uses a camera installed in the classroom to obtain classroom video information. For the collected video information, it is first divided into a frame of static pictures, and from the pictures, several pictures with clear face and better light are selected for face recognition, and finally the recognition results are aggregated and merged. In order to solve the influence of the location of the camera on the recognition results, the system can be combined with the platform control system to control the rotation and focusing of the camera through the platform, and further improve the recognition accuracy.**

Keywords- attendance in class; face recognition; image segmentation; deep learning

I. INTRODUCTION

In recent years, colleges and universities continue to promote the process of education and teaching reform, various teaching modes are constantly introduced, such as "flip classroom" and other teaching modes continue to develop. The fundamental purpose of the development of various teaching modes is to solve the problem of classroom teaching efficiency and improve the quality of college students' education. Classroom, as an important place for college students to acquire knowledge, has an important impact on the development of College students. Classroom attendance is an important part of classroom teaching activities. Its efficiency often affects the teaching effect. How to improve the efficiency of classroom attendance has become an urgent problem to be solved.

The purpose of attendance in class is to count the number of students and urge them to attend classes on time so as to improve the quality of teaching. The traditional classroom attendance is mainly done by the teacher through the manual way of roll-call. Although this method can ensure the accuracy of naming, it usually wastes a lot of time, which not only occupies the classroom time, but also affects the enthusiasm of teachers and students, and reduces the quality of the classroom [4]. This way of attendance can play a certain role in urging less-known classes, but for more classes, there may be a phenomenon of "substitution", which is difficult for teachers to find.

With the development of technology, electronic attendance has gradually replaced manual attendance. Electronic attendance mainly refers to the way that students sign in by swiping cards on the attendance card reader in the classroom with the help of campus cards with personal information. Although this method improves the efficiency of attendance, it still can not solve the problem of signature and early retirement. The method of attendance based on face recognition proposed in this paper can not only improve the efficiency of attendance, but also effectively solve the problems of signature and early retirement.

II. RELATED TECHNOLOGY

A. Face detection technology

Face detection is a hot research direction in the field of computer vision. With the rapid development of biometric technology, face detection technology has been widely used in various fields, which has a certain commercial value, and also has a very important academic value. The Haar feature proposed by Viola et al. [5] combined with AdaBoost cascade classifier can detect face quickly. Since then, many researchers have devoted themselves to using more advanced features to improve the accuracy of face detection, such as Local Binary Pattern (LBP) [6], Histogram of Oriented Gradient (HOG) [7], Scale-invariant Feature Transform (SIFT) [8].

B. Face recognition technology

Face recognition is a kind of biometric recognition technology which extracts the feature information of face image to classify and recognize. Because of its convenience and friendliness, and with the development of information technology, it has been widely used in security, aerospace, medical and other fields. In ideal environment, face recognition technology has made great progress and application. Face recognition has become a research hotspot in the field of computer vision.

C. Deep machine learning

Machine learning mainly refers to learning the regular information in data by computer, so as to acquire new knowledge and experience, so as to improve the intelligence of computer, and then make the computer have the same decision-making ability as human. Deep learning is mainly the extension of neural network algorithm in machine learning. The first stage of machine learning is shallow learning, while deep learning is the second stage of machine learning. The layers of neural network are described by depth. Generally, the single-layer perceptron in machine learning can solve the linear separable problem, but it can

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not solve the linear separable problem adequately. At this time, the use of deep learning multi-layer perceptron can solve the problem of linear inseparability, aiming at the disadvantages of shallow learning can be effectively remedied. Common types of deep learning include cyclic neural network, convolutional neural network and restricted Boltzmann machine [9].

III. System Design and Implementation

A. Whole system design

According to the main functions and different locations, the system designed in this paper can be divided into two parts: camera acquisition terminal and server computing terminal. The camera acquisition terminal is installed in the classroom. Its main function is to collect real-time student portrait videos in the classroom, and transmit the collected portrait videos to the server through the line for storage and processing. The main function of the server is to segment the video information of the human image obtained by the camera, get the frame image, then segment the frame image, recognize the human image of the segmented image, and filter and improve the recognition results using multi-frame images. The server will feedback the recognition results to the terminal, and control the movement and focusing of the terminal through the terminal platform, so as to obtain the second video of the area with poor recognition effect, and then improve the recognition accuracy. The workflow of the whole system is shown in Figure 1.

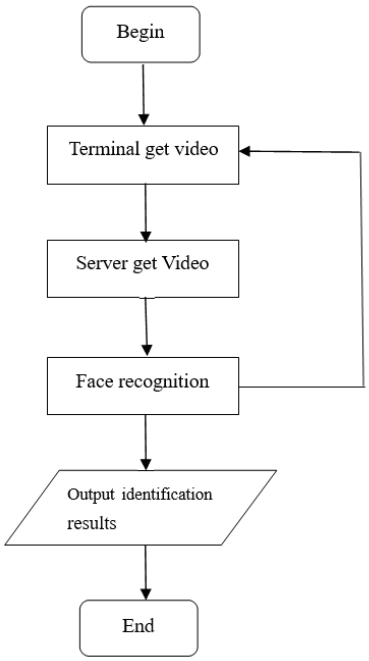

Figure 1. System flow chart

B. Terminal system design

The system terminal is mainly composed of a camera and a platform. The camera uses a zoom camera. The platform controls the movement range of the camera from 0 to 250 degrees horizontally and from - 10 degrees to 55 degrees vertically. When the terminal is in the initial state, it is in the initial position where all the seats in the classroom can be photographed. The video captured is sent to the server in real time.

After facial recognition in the server, according to the feedback signal from the server, the location is captured by the mobile camera on the platform, and zoom is made according to the distance of the captured area, so as to obtain the scene video needed by the server. The working process of the terminal is shown in Figure 2.

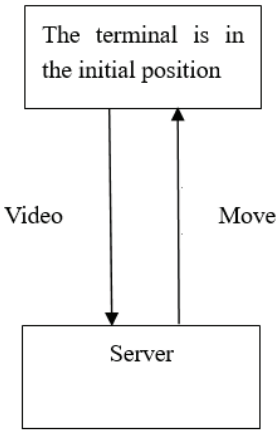

Figure 2. Schematic diagram of terminal operation

According to the graph, the terminal sends the video information to the server in real time, and focuses and moves accordingly according to the instructions of the server in order to achieve more accurate face recognition.

C. Server side design

Because the terminal collects video data, and face recognition needs image data, we need to pre-process the data collected by the terminal, divide the video data obtained by the server into frame pictures, and use deep learning algorithm to recognize the face of the acquired frame pictures.

In order to reduce the computational burden of the server and make it possible for the server to recognize faces in multiple classrooms at the same time, we decided to take the same class and only randomly extract a certain number of pictures for face recognition, and then automatically check in the identified students. In order to determine the appropriate number of extracted pictures, we conduct simulation experiments in classrooms with different numbers of students. For the same class, we extract different numbers of pictures, carry out face recognition, and make statistics on the accuracy. The following tables can be obtained.

Table 1 Classroom Recognition Effect of 50 Persons

People number	Picture number	Discern number	Accuracy rate
50	1	35	70%
50	3	40	80%
50	5	41	82%

50	7	45	90%
50	9	46	92%

Table 2 Classroom Recognition Effect of 150 Persons

People number	Picture number	Discern number	Accuracy rate
150	1	100	67%
150	3	113	75%
150	5	117	78%
150	7	125	83%
150	9	132	88%

Through the above two tables, we can find that for different numbers of students in the classroom, the recognition rate increases with the increase of the number of pictures collected. But if too many pictures are collected, it will result in too much burden on the server and slow recognition speed. By analyzing the experimental data, we find that there are some differences between the number of faces detected in the experiment and the number of students correctly identified, as shown in the following table.

Table 3 Classroom Discovery and Recognition Number of 50 Students

People number	Picture number	Find number	Discern number
50	1	37	35
50	3	42	40
50	5	45	41
50	7	46	45
50	9	47	46

Table 4 Classroom Discovery and Recognition Number of 150 Students

People number	Picture number	Find number	Discern number
150	1	108	100
150	3	120	113
150	5	123	117
150	7	127	125
150	9	139	132

By observing the table data, it can be found that the number of faces that can be detected is always greater than the number of faces that can be recognized. The main reason for this phenomenon is that the camera is installed in the front of the classroom, which results in the blurred image of the students in the back row, which leads to the students in the back row can be detected face, but can not be recognized. To solve this problem, we use the cloud platform to control the camera movement to get more effective pictures. The basic idea of cloud control is to make the camera in the initial position and get the whole picture of the classroom. Then according to the whole picture, the classroom is divided into four areas. The cloud control camera is used to move and focus, and the four areas are captured separately. When the recognition rate does not reach this limit, the server divides each area into two areas for recognition, in order to improve the recognition rate. Using this method, the two classes mentioned above are identified again, and the following tables are obtained.

Table 5 Re-recognition effect of 50 students in class

People number	Picture number	Discern number	Accuracy rate
50	1	35	70%
50	4	43	86%
50	8	47	84%
50	16	48	98%
50	32	48	98%

Table 6 Re-recognition effect of 150 students in class

People number	Picture number	Discern number	Accuracy rate
150	1	100	67%
150	4	128	85%
150	8	139	93%
150	16	145	97%
150	32	146	97%

According to the data in the observation table, the accuracy of face recognition can be greatly improved by segmenting the image area and zooming the different areas using the cloud platform as the camera.

IV. Experimental Testing and Analysis

In order to verify the effectiveness of the system designed in this paper, we use the system designed in this paper to carry out face recognition check-in for a medium-sized classroom, which has 82 students. Through face recognition in the classroom, the following table data are obtained.

Table 7 Classroom Recognition Effect of 82 Persons

People number	Picture number	Discern number	Accuracy rate
82	1	70	85%
82	4	79	96%
82	8	80	98%
82	16	81	99%
82	32	81	99%

By observing the table data, we can see that the highest recognition accuracy of this class can reach 99%, and 81 of 82 students can be identified when the highest recognition accuracy is achieved. By analyzing 16 pictures and 32 pictures of 81 students' two experiments, we find that one of the 16 and 32 pictures in the two experiments has been in a low position. Playing on mobile phone status, so it is not recognized. Therefore, it can be considered that the system designed in this paper can replace the traditional way of classroom attendance and improve the efficiency of classroom attendance.

V. SUMMARY AND EVALUATION

In this paper, a video-based face recognition attendance system is proposed, and the accuracy of face recognition is improved by monitoring the platform. Compared with the traditional classroom attendance method, the system designed in this paper has the following advantages:

(1) Save time. The classroom attendance system designed in this paper is real-time in the classroom. It will not waste any classroom time and avoid the waste of time caused by manual roll-call.

(2) It will not interfere with the classroom. When the system is used for classroom attendance, it will not produce factors such as voice that interfere with the classroom order, so it will not affect the classroom order.

(3) It can improve students' learning efficiency. The system uses face recognition to check attendance. If students sleep in class or play with their mobile phones for a long time, they may not be recognized and then be judged absent. Therefore, the system will have a binding effect on students, and then can improve the efficiency of classroom learning.

At the same time, the system also has some needs to be improved, for example, the interval in the classroom may lead to a decline in recognition rate. Therefore, the system needs to be continuously improved in the future.

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