

Design and Implementation of Intelligent Attendance Management System Based on Face Recognition Technology

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Abstract: Based on the application status of various biometrics in attendance management, combined with the actual needs of attendance management of enterprises, institutions and universities, the function, performance requirements and overall design scheme of face recognition technology intelligent attendance management system are proposed. This paper provides a reference for the development and application of face recognition attendance management system.

1. Introduction

With the development of computer, communication and intelligent technology, as well as the improvement of enterprise information management level, various types of attendance methods are applied to the attendance management of enterprises and institutions. The traditional attendance method is mainly manual attendance, and there are problems such as complicated attendance statistics and data storage difficulties, which cannot meet the requirements of modern attendance management. Later, the microcomputer mechanical time clock system was popularized and applied, but it still could not solve the problem of replacing other people's punches. In order to ensure the uniqueness of identification, biometric technologies such as fingerprints, sounds, irises and faces are applied to the attendance system. This can identify the identity quickly, accurately and reliably, and achieves the interconnection of information management systems such as monitoring and automation management. These biometric technologies have a wide application space and some drawbacks. For example, voice recognition technology is affected by noise and reduces recognition rate; retinal scanning recognition technology is not suitable for verification of a large number of people; fingerprint recognition technology cannot be recognized because of finger injury. In order to overcome these shortcomings, face recognition authentication techniques have been proposed and applied. Face recognition technology is a popular biometric technology in recent years. It identifies the input face image or video stream based on the facial features of the person, and can be used to detect the face information in the image and identify the identity of the person corresponding to the face [1]. Face recognition technology has the advantages of non-close contact, non-invasiveness, and no sense of rejection. It is a very friendly way of identification. In this paper, the face recognition technology is applied to the attendance management system, and through reasonable design, it is used to solve the common problems in the current attendance management system.

2. Demand analysis of face recognition intelligent attendance management system

2.1 System function requirements

Based on the actual needs of enterprises, institutions and college attendance management, the functions required by the face recognition intelligent attendance management system are mainly face recognition, personnel registration, information management, attendance information management, equipment information management, system management and so on.

2.1.1 Face recognition

Face recognition includes functions such as face detection, image preprocessing, feature

extraction and recognition. Face detection is the basic premise of face recognition, and the detection process can be performed after the face is detected. If no face is detected, a message is sent to inform the retest. In order to ensure the quality of the face image, it is necessary to use certain preprocessing methods such as image enhancement and equalization to enhance the image quality, which is more conducive to later feature extraction and recognition. Feature extraction and recognition is a very important step in face recognition. The obtained image is extracted using appropriate methods and compared with the existing face templates in the database. If the image to be tested finds a matching template in the database, the attendance is successful, and there will be a prompt message for successful attendance. If no matching template is found, the abnormal attendance should be prompted, indicating that the personnel information is not registered and needs to be processed by the administrator.

2.1.2 Personnel registration

Everyone needs to register their personal information in advance before attendance. First, the image information of the face is obtained through the face collection device, and transmitted to the administrator attendance system client through the network, and saved to the local database together with other information such as the name, number, home address, and contact information of the person. Here, it is necessary to collect a plurality of face images of the attendance personnel, and generate corresponding templates to be stored in the database for the comparison recognition phase in the face recognition process. Each picture in the collection process must be of high quality to reduce recognition errors during attendance.

2.1.3 Personnel information management

First of all, it needs to completely list the information of the currently registered personnel, and then delete, change and save the information. Personnel information should include name, mobile number, home address, etc.

2.1.4 Device parameter settings

Multiple attendance equipment can be placed in different locations to facilitate quick attendance of personnel. First, the system can add and remove devices and be able to change information such as device names, transport methods, and IP addresses. Secondly, the system has the function of detecting the connection status of the device. If the connection is good, the connection is successful. If the device is not connected, the connection is faulty. Please check it. Devices can transmit face image data in two ways, one using TCP/IP protocol packets and the other using short-range serial ports.

2.1.5 Attendance time setting

The time period for attendance needs to be changed in some cases. For example, in the summer, the daytime is long and the night time is short, and the sign-in time can be 8:00-8:30 in the morning. In the winter, the daytime is short and the night time is long, and the sign-in time can be changed to 8:30-9:00. In order to flexibly meet the change requirements of the attendance time period, a time period setting function of attendance is required.

2.1.6 Attendance information management

This part of the demand is divided into two modes. The first one is to be able to obtain the specific attendance of the personnel of each day, that is, the time of signing up at work, the time of signing off from work, and so on. The other is to be able to count the attendance information within one month, how many times each person should attend the job within one month, how many times the actual attendance, how many times late, how many times to leave early, how many times to take leave. These should be reflected in the system at a glance. These functions facilitate the distribution of personnel management and compensation. Attendance for a certain period of time can provide query function, and can print and export attendance information for other purposes.

2.1.7 System information management

System information management mainly includes the following functions: (1) Manage system parameters to facilitate adjustment of system functions and performance. (2) Management administrator's login name and login password information, which can easily modify the login name and login password to ensure that only the administrator has permission to operate the system data. (3) Record the operation log of the system to be used as a check error, and can query and delete logs according to the date. (4) Manage database information, which can back up and delete data.

2.2 System performance requirements

In addition to meeting the functional requirements, a good attendance management system needs to meet many performance requirements, such as security, reliability, and compatibility.

2.2.1 Performance indicators

The performance indicators of the face recognition intelligent attendance system generally include two components: the correct recognition rate and the system identification efficiency. A correct recognition rate of more than 95% is recognized. If the correct recognition rate is too low, the attendance work cannot be performed normally. For the recognition efficiency of the system, the identification time of a single person is used as a criterion. Generally, the time required to identify a single face should be controlled within 5 seconds.

2.2.2 Security

System security is reflected in the fact that only administrators of the system have the authority to change, add and delete system personnel information and device information. Other people without permission are unable to perform the above operations. The system login password is invisible, cannot be copied and pasted, and the user name and login password cannot be duplicated to ensure that people without permission cannot log in to the system. At the same time, it must ensure the security of database information. Encryption technology can be used to encrypt data to prevent data leakage and destruction.

2.2.3 Reliability

Reliability refers to the failure rate of the system and the speed of failure recovery. It is necessary to timely repair and quickly recover the system after a failure, so as to avoid delaying normal attendance. For abnormal operations, warnings are displayed and there is no damage to existing information. This requires design and development as well as testers to do their work in the early stages and consider everything as thoughtful as possible.

2.2.4 Compatibility

Compatibility includes multiple aspects. First of all, from the hardware point of view, the required transmission mode, physical line, etc. should be applicable to most image acquisition devices on the market. Secondly, the attendance management software can be used normally on the platforms such as Win7 and Win8, and can run simultaneously with other functional software. Finally, different operations on the data should maintain data consistency.

3. Overall design of face recognition intelligent attendance management system

Based on the above requirements analysis, the overall design of the face recognition intelligent attendance management system is analyzed from two aspects: hardware design and software design.

3.1 System hardware design

In order to achieve the above various functions and performance requirements, the face recognition intelligent attendance management system should include three parts in hardware. The first part is the face acquisition device, which must have the function of an infrared probe and a camera to obtain a face image. The second part is the attendance system software client. This part

can be used as an ordinary PC host. It can realize the processing and recognition function of face image and the function of attendance information management in the client software. The third part is the server part of the system, which is used to deploy the database management system. Considering the operating efficiency of the system, higher requirements are placed on the reliability, security and scalability of the database server. It can use the apache server, which is a server that is currently used in large numbers and shows good performance in all aspects.

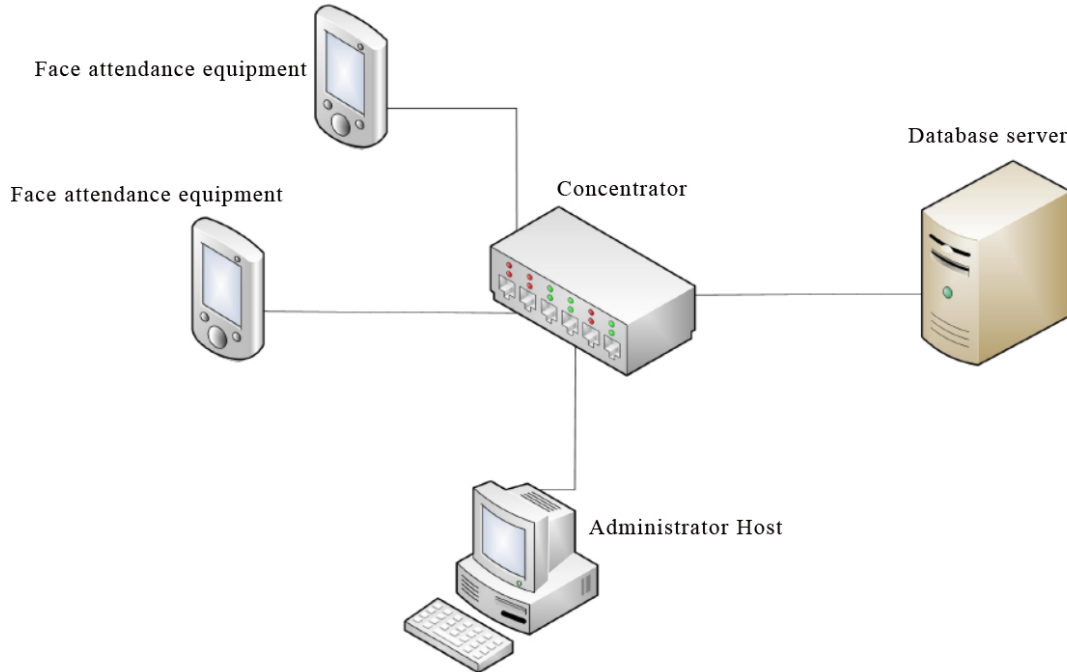


Figure 1 System hardware architecture

Figure 1 shows the hardware structure of the system. As shown in Figure 1, the face attendance device is an important part of the system face recognition. The device needs to have an infrared probe and a camera. When the infrared probe senses that a human face is close, the camera will take an image of the face and transmit it to the background system. The client on the background system of the administrator system detects, preprocesses and extracts the image after receiving the image, and compares it with the template in the database to determine the category of the person in the image to determine whether the attendance is successful. If the attendance is successful, the success message will be reported. If the attendance fails for three consecutive times, the manager needs to find the specific reason. The attendance client software is run on the administrator host, and the SQL Server 2008 database management system is deployed on the database server. The attendance device, the administrator host, and the database server communicate data through a hub connection, and the communication mode can communicate using the TCP/IP protocol.

3.2 System Software Architecture

The software part of the system adopts the Client/Service (C/S) mode and the three-layer architecture design system [2]. The client is the client software running on one or more computers. The client in the face recognition intelligent attendance management system runs the attendance management client on the administrator host. There are two types of servers, the database server and the Socket server. The database server is used here. Once the database server is started, it must be running all the time, waiting for the request sent by the client program and responding promptly. The system's program is divided into two parts. In the client software part, the user interaction interface of the program is run, the business logic processes, and the corresponding database processing part is submitted to the database server, and the processing result of the server is displayed to the user again, which can improve the response speed of the client. The server part is mainly used to store the data of the system, receive the database processing statement sent by the client, such as SQL, and process the data and return the result to the client. This can effectively

reduce the amount of computation of the database server part, and can reduce network traffic and network pressure, and improve communication efficiency.

The three-tier architecture design system used by the system is the user interface layer, the business logic layer and the data connection layer. (1) The user interface layer is the part that interacts with the user, and can display various functions of the system to the user. The user can perform various operations at the user page level, such as inputting content, clicking a button to perform additions, deletions, and changes. This part is implemented by using the Windows Form control that comes with Microsoft Visual Studio 2010. (2) The business logic layer processes the content input by the user or the click operation, stores the input content using the data model, processes the data according to a certain business logic for the user operation, and invokes the interface provided by the data connection layer. This layer is the intermediate connection part of the user interface layer and the data connection layer. (3) The data connection layer provides an interface to the upper layer and connects with the database to persist the model data of the previous layer, or to perform corresponding addition, deletion and change of the data. The structure of the software part of the system is shown in Figure 2.

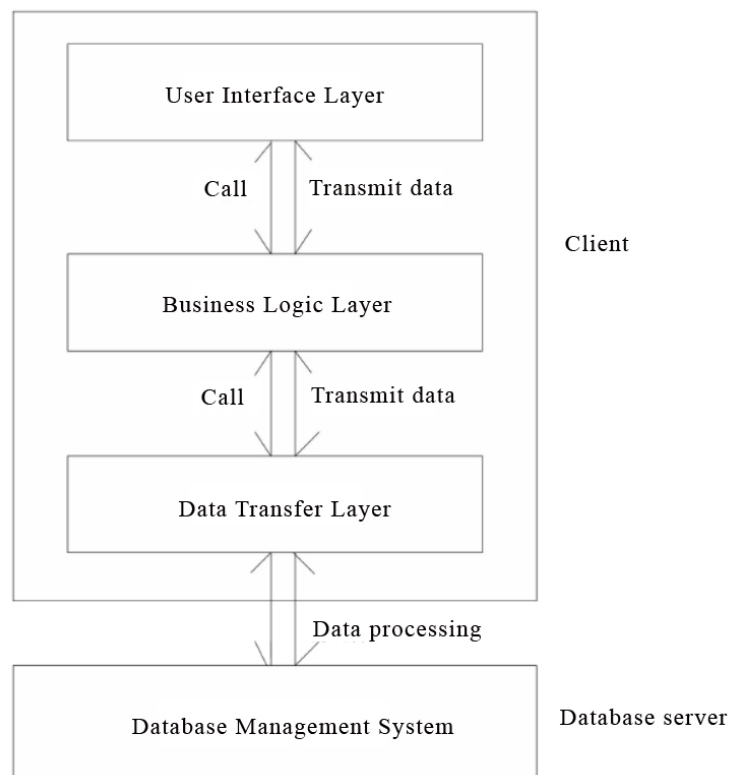


Figure 2 System software architecture

4. Conclusion

This paper designs a smart attendance management system based on face recognition technology for the actual needs of attendance management. The system is accurate, efficient, convenient and friendly, and is worthy of widespread promotion and application. In addition, with the popularization of smart phones, the face recognition intelligent attendance management system based on mobile phone client will be the research and development trend in the future.

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