Research on Automated Information System of Non-sense Attendance Using Face Recognition and Large Database

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Abstract. In order to meet the needs of today's large-scale enterprise human resource management attendance business, this paper designs an embedded face recognition attendance system, and designs and analyses the implementation method of the system in detail. The system consists of two parts: face-swiping attendance and attendance management. Among them, face-swiping time attendance uses the Face Boxes model to detect faces, and the Face Net model to identify the person who punches in. Tests have found that the system is simple to operate, has high recognition accuracy, and has a certain practical value.

Keywords: Face recognition, non-sense attendance, embedded, management information system.

1. Introduction
With the continuous development of electronic technology and computer technology and the advent of the digital age, society has put forward higher requirements for identity authentication. Nowadays, there are three main ways of identity authentication: (1) Identity identification items, such as various documents; (2) Known information, such as passwords or passwords; (3) Biometric recognition technology, such as fingerprints, faces, iris, Voice, signature, etc. Although the identification items and the learned information can guarantee security in theory, the identification items are easy to forget, stolen or forged; the information learned is easy to remember, forget or decipher. Therefore, the first two identity authentication methods cannot meet the needs of identity authentication in terms of security and convenience, and biometric identification technology provides a good solution to the above problems. Biometric identification technology has the characteristics of universality, uniqueness, stability, and collectability. Therefore, biometric identification technology has been more and more widely used in the field of identification [1]. Among the many biometric recognition technologies, human faces are like fingerprints and fundus iris, which are unique and non-invasive. With the rapid development of image processing technology, especially in the 1990s, the emergence of large-scale image databases, face recognition Has become a hot research topic today. This article focuses on the research, design, and implementation of an embedded face recognition system.

2. Scheme design
The system mainly includes the embedded time and attendance terminal and the face recognition server 2 parts. Use a PC as the face recognition server to store the large-capacity miner’s face image
database and the miners’ basic information and scheduling sequence. The server system platform uses the WINDOWSXP system and the SQLSERVER2008 large database to count and manage attendance data; combined with the face Recognition technology, choose VC++6.0 to write the monitoring interface, and then use HUB to connect each client attendance machine into a local area network.

The attendance terminal uses embedded ARMS3C2440B chip control to collect, process and transmit IC card and face image data [2]. Using modular design ideas, the equipment is divided into the following main modules: embedded S3C2440B core control module; RFID module; camera image acquisition module; network communication module; LCD display module. The structure diagram is shown in Figure 1.

![Figure 1. Facial recognition time attendance system terminal system block diagram](image)

3. Software and hardware design

3.1. System hardware circuit design

In the design process of the attendance system based on embedded face recognition, a sub-module design method is adopted, the hardware scheme is designed as a whole, and the design method of each module is determined, so that the hierarchical design is carried out in an orderly manner according to the methods and steps [3]. Because the system uses a common bus and the same interface, it can expand other functions and add other system modules according to needs, and the system has scalability. The face recognition attendance system includes the following functional modules: control module based on S3C2440A as the core, face image acquisition module, external memory expansion module, network communication module, keyboard input module, LCD display module.

3.1.1. The transplantation of Boot loader. Boot loader is a small section of program when starting up the system, through this section of program to initialize the hardware and establish the mapping table of the memory space, thus establish the appropriate software and hardware environment. u-boot is the most used Boot loader. It is an open-source universal boot program that supports multiple processor architectures such as x86, ARM, and PowerPC.

3.1.2. Cutting and transplanting of Linux kernel. It is necessary to make appropriate modifications to the kernel to better adapt to the development board. It is necessary to configure the kernel and remake the Make file. (1) Download the kernel version corresponding to the development board from the
official website, and makes PLATFORM deconning determines the platform. (2) make minicontig enters the graphical interface to configure the kernel information and cuts the kernel. (3) make uImage compiles the kernel source code. (4) tftp 0x30008000 uImage downloads the kernel image in uboot environment, bootm 0x30008000 starts the kernel.

3.1.3. The construction of the root file system. In the Linux system, we also need to divide the disk and Flash into multiple partitions to facilitate daily use. Commonly used storage device file system types include jffs2, yaffs2, ubifs, ramdisk, nfs, and so on. Download a commonly used root file system from the Internet and place it in the nfs directory of the virtual machine, and then build the root file system by nfs mounting.

3.1.4. Network communication circuit design. The PC can be used as the backup device of the ARM system. The face recognition log is saved in the PC, and the status of the ARM system can be obtained from the PC at any time. The system adopts the CS8900A extended network interface [4]. The S3C2440B uses data, address, control line and chip selection The signal controls and communicates with the CS8900A. The CS8900A is strobed by the nGCS3 signal of the S3C2440B. The INTRQ0 terminal of the CS8900A is used to generate an interrupt signal, which is connected to the 16-bit data bus of the S3C2440B. The address bus uses A [24:0], and the CS8900A Ethernet control the chip transfers data through the DMA channel.

3.2. Software design
The design of the embedded face recognition attendance system includes the face recognition algorithm-PCA and the design of the attendance system on the PC server. The attendance system server uses a database to store face information, face pictures, and check-in records, and can update employee information and face images in real time; the face recognition algorithm module uses the PCA algorithm to automatically find the face in the input image, And perform face location, feature extraction, and then compare the face image collected by the camera with the face image information of the server database to determine the identity of the attendance employee. PCA uses VS2010 to develop the attendance system software on the server, which can query the employee's attendance records, and perform data storage management through the ADO interface and SQLSEVER. The use process of the system is as follows: After the system is powered on or reset, first perform self-checking to check whether the equipment is operating normally, and then perform initialization and basic configuration settings. When someone wants to perform attendance, press the attendance button to send out video capture control Signal to start the image acquisition function. The collected images are stored in the SDRAM in file format [5]. After the image signal storage is completed, the image is processed by the face detection algorithm, and the characteristic data is obtained and compared with the face database. The interface displays the relevant information of the employee. And save the employee's attendance record to the server's database. The system process is shown in Figure 2.
4. Face recognition algorithm
Based on the traditional LBPH algorithm that comes with OpenCV, this article uses the Face Net deep learning general network proposed by Google for the situation that the image required for face recognition requires 1: N. The network has been improved based on the traditional CNN face recognition model, and the model training has also been greatly changed compared with the traditional model. The traditional method first extracts the facial features, and then uses the classification algorithm to classify. Face Net directly changes the feature into a point on the plane by learning, and then compares the distance between the points to judge the category [6]. The model uses the triple loss function to optimize, and finally outputs a 128-dimensional vector. The constraint condition of the triple loss function is shown in formula (1):

\[
\|x^a_i - x^p_i\|_2^2 + a - \|x^a_i - x^n_i\|_2^2, \forall (x^a_i, x^p_i, x^n_i) \in T
\]

This formula indicates that the distance within the left class (plus margin) is smaller than the distance between the right class, and this constraint needs to be true for all triples. Where \(a\) represents a constraint range between a positive sample pair \((x^a_i, x^p_i)\) and a negative sample pair \((x^a_i, x^n_i)\), and \(T\) represents any possible ternary in the training set. The group set has a base of N. After optimizing the formula, the loss function is obtained as shown in formula (2).

\[
L = \sum_{i=1}^{N} \left[ \|f(x^a_i) - f(x^p_i)\|_2^2 - \|f(x^a_i) - f(x^n_i)\|_2^2 + a \right]
\]
Finally, the optimization of the model is achieved by reducing the value of the loss function. The input triples mainly include a sample image thumbnail, a thumbnail image of the same type as the sample, and a thumbnail image of a different type from the sample [7]. The loss function mainly divides the triples through the distance boundary to obtain the positive and negative classes, and finally narrows the Euclidean distance between the same samples, and pushes the Euclidean distance between the non-same samples. The principle of the loss function is as follows as shown in Figure 3.

![Figure 3. Portrait recognition diagram of triple loss function](image)

5. System Test
Through both hardware and software, this face recognition attendance system was designed. Through the principal component analysis algorithm, the face recognition database shown in Figure 4 can be obtained. Different expressions of people can be clearly expressed in the database, and the system can effectively realize the processing of different facial images in face recognition, thus laying a solid foundation for the application of the attendance system.

![Figure 4. Face recognition library](image)

6. Conclusion
This article introduces the principle and software design of the face recognition attendance system. System personnel management, attendance settings, and statistical functions are packaged into Webservice, which increases the reusability of modules and facilitates integration into the existing business system of the enterprise. The face recognition attendance management system of B/S
architecture can realize standardized and automated management of attendance, mobilize work enthusiasm, reduce attendance management costs, be efficient and accurate, and improve corporate efficiency. It can also carry out access control management with fast processing speed and simple operation. It is believed that in the next few years, it will be widely used in security inspection, identification, intelligent attendance, and other aspects.

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