

Design and Implementation of Intelligent Access Control Alarm System for Face Recognition

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Keywords: Face Recognition; Intelligent Access Control; Alarm; System Design

Abstract: With the continuous improvement of people's living standards and the gradual enhancement of public safety awareness, safety prevention has been widely concerned. As a part of the whole security system, access control system has become one of the focuses in the field of security. With the rapid development of computer technology, face recognition technology has been favored by most R & D institutions in the field of security. In this paper, the design of functional access alarm system for face recognition is carried out, and the test results show that the application effect of the system is good.

1. Introduction

With the rapid development of social economy and the continuous improvement of people's living standards, the people's awareness of security and defense has also been gradually improved. As a result, people have higher and higher requirements for the security and defense system. How to use the new technical means to design a more reliable security system and increase the sense of security of residents' lives has become the focus of attention in the field of security research. Among them, as an important part of the whole security system design, access control system has been favored by most users because of its intelligent, automatic and other characteristics. The traditional authentication methods of access control system mainly include password, magnetic card and so on. However, these authentication methods are divisible from the user. Detached, easy to be deciphered and stolen, can no longer fully meet the modern concept of security [1]. However, the biological characteristics of human body are unique and can not be separated from ontology. If applied to access control system, it can make up for the shortcomings of traditional access control system.

Face is a unique biometric feature, and face recognition technology realizes identity recognition by collecting face images and extracting face features from images. Because of its simple operation and intuitionistic results, face recognition technology is widely used in information security, entrance and exit control and other fields. The face recognition access control system designed and implemented in this paper is mainly aimed at small offices, families and other applications with a small number of people [2]. Considering the portable and easy to use of the system, the power consumption cost and other factors, this paper uses the embedded hardware platform with good performance to build the system.

2. System Application Analysis

With the rapid development of economic level and the continuous improvement of quality of life, burglary cases have been common. Therefore, people are very worried about their own personal and property safety, and pay great attention to the security measures. With the development of science and technology, theft means are also improving [3]. According to CCTV's Weekly quality report, at present, most of the anti-theft doors on the market have a very low safety factor, and the so-called "tin foil unlocking" tool can open the door in just ten seconds. This poses a great threat to the personal and property security of the masses. Although more reliable security doors can be used, But the price is not cheap. In addition, in many office space, there are often endless salespeople, unauthorized access to internal staff in important places such as conference rooms, finance rooms,

and unknown personnel who spy on or steal company secrets. These phenomena not only disturb the normal order of work, but also affect the management of the company, and pose a threat to the confidential security of the company [4].

In order to prevent the occurrence of this kind of things, it is necessary to change the traditional concept of security prevention, even if the high-tech preventive measures are used to deal with it, so as to ensure the personal and property safety of family personnel and ensure the normal order and confidential security of office space. At present, the development of science and technology and the improvement of social security demand promote the emergence of intelligent access control system, such as induction card access control system, fingerprint access control system, iris access control system, face recognition access control system, random order keyboard access control system and so on. Although they have their own advantages in security and convenience, compared with other intelligent access control systems, the access control system based on face recognition is easy to operate. The result is intuitionistic, does not need user contact, the equipment is universal and the cost is low. Moreover, with the continuous improvement of the processing performance of embedded devices, a set of face recognition access control system with remote request and authority management, stable and extensible can be built according to the advantages of low price and low power consumption of embedded devices. In order to provide higher security for families and small office space [5].

3. System Design Goal

This research uses face recognition technology to build a set of access control system on embedded devices. The system is located in a small number of applications, such as home, small office and so on. It combines camera, embedded device and electronic control lock, installs it at the entrance of the room, and automatically manages the visitors' access. The system is composed of face image acquisition module, face recognition module and access control system execution module, and can run independently from PC control [6].

The design process of the system can be divided into two stages: training and recognition. Among them, the main task of the training stage is to process the collected face images and provide data items for the face database. The identification stage is much the same as the former process, but the purpose is different. The specific steps are as follows:

First, the image acquisition device acquires the face image of the visitor; second, the collected face image is preprocessed and the feature extraction process is carried out to generate the face feature data of the visitor. Thirdly, the face feature data of visitors are matched one by one with the data items of face database. If the matching is successful, the control device sends the door instruction to the electronic control lock. Otherwise, keep the door lock closed and prompt the visitor whether to send a remote request to the user [7]. Fourth, if the visitor sends a request, the visitor's face image is sent to the user over the network, and then the user considers whether the visitor is allowed to enter the room and sends the phase to the control device. Instructions should be given; at the same time, feedback to visitors on the wishes of the user. As shown in figure 1.

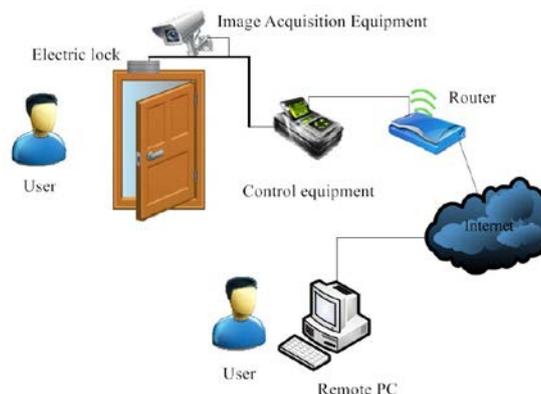


Fig.1. System identification flow

4. Overall Structure of the System

From the design goal of the system, it can be seen that the access control system designed in this paper is composed of hardware and software. Among them, the hardware includes control equipment, camera, remote PC machine, electronic control lock, software includes recognition algorithm and embedded database. The main work of the system is to collect face images. After a series of processing, the face images are matched with the face data in the database, and the electronic control lock is opened for the users with the correct matching results. The face image acquisition of the system is completed by the camera. It should be noted that the analog-to-digital conversion (A / D) process must be carried out before handing over the face image to the control module, which must be transformed into an analog-to-digital conversion (A / D) process. A digital image format that can be processed. At present, the mainstream cameras on the market are based on CMOS sensor and CCD sensor. Compared with the latter, the camera based on CMOS sensor does not need to connect the A / D conversion circuit because of the internal integration of A / D conversion module, in addition, it has the price advantage. In this paper, we decide to use the camera based on CMOS sensor as the face image acquisition equipment of the system. As the core part of the whole access control system, the control equipment is composed of hardware equipment and software platform. Among them, the hardware equipment adopts the OK6410 development board produced by Feiling Company, and the software platform It provides support for the design and implementation of the system, mainly involving the face recognition algorithm and other functions selected by the system on the hardware equipment. The main task of this part is to complete the established processing process of face image and give the corresponding instructions according to the processing results, such as sending the door instruction to the electronic control lock [8].

As the execution module of the access control system, the electronic control lock is responsible for receiving the instructions from the control equipment and making the corresponding actions. For example, when you receive an order to open the door, open the door lock; otherwise, keep the lock state. The design of remote PC machine mainly takes into account the special situations in practical application, such as the situation that strange visitors visit users, at which time visitors can be prompted to send remote requests to users. If the visitor sends the request, the visitor's face image is sent to the PC machine used by the user, and then the user issues the instruction whether to open the door or not. As the core of the system, the recognition algorithm is responsible for the realization of the face recognition function of the access control system. It is related to the recognition performance of the system. The storage of the face feature data of the person in charge of the embedded database is convenient for the system to match the face image and to manage the related information of the visitors at the same time.

5. Main Algorithms of Face Recognition

In general, the original image obtained by the system can not be used directly, so gray correction, noise filtering and other image preprocessing operations must be carried out in the early stage of image processing. The causes of this phenomenon include noise points, lighting effects, differences in the distance between face and acquisition equipment, and so on [9]. This section needs to provide a good image preprocessing solution to these problems, because each pixel of the color image has three color components R, G, B. The calculation of three color components should be fully considered in the process of image processing, which will lead to large system overhead and influence. Image processing speed. At the same time, color image recognition is often easily affected by complex background, and the amount of information saved by the image is relatively large. However, it is easier to segment face region and background region by using gray image, and it is helpful to reduce the amount of computation in subsequent image processing. Therefore, the research of face recognition generally takes gray image as the research object [10].

The image obtained by the acquisition equipment selected in this paper is a color image. Therefore, it is necessary to convert the color image into the gray image, that is, the grayscale

processing of the color image. The following three schemes are generally used for grayscale processing of color images:

Average value method. In the color image, the average values of the three components of R, G and B of each pixel are obtained, and the average value is output as the gray value, and the gray image is obtained. The expressions are as follows:

$$f(i, j) = \frac{1}{3}(R(i, j) + G(i, j) + B(i, j)) \quad (1)$$

The maximum value method. The maximum value of R, G, B components of each pixel in color image is found as the gray value of the pixel. The expressions are as follows:

$$f(i, j) = \max\{R(i, j), G(i, j), B(i, j)\} \quad (2)$$

Weighted average method. Because the human eye is the most sensitive to green and the lowest to blue, the R, G and B components of each pixel are weighted and averaged with different weights. In this paper, this method is used to realize grayscale processing. In order to obtain a more reasonable gray image, the weighted average of three components is carried out by using the following empirical formula.

$$f(i, j) = 0.30R(i, j) + 0.59G(i, j) + 0.11B(i, j) \quad (3)$$

Among them, $f(i, j)$ is the gray value of pixel (i, j) , and $R(i, j), G(i, j), B(i, j)$ is the RGB component of pixel (i, j) .

6. System Result Test

The system test mainly includes two functional tests: remote request and face recognition. Remote request test, mainly used to test the face image sent by the access control device received by the remote PC machine. First of all, the remote PC machine starts the remote request server program, binds the local IP address and port number, and is ready to accept the connection request from the client program. Once the connection is created successfully, you can begin to receive the face image sent by the access control device. Next, the face recognition test is the focus of the system test. In this paper, 5 people, 3 face images each with a total of 15 face images, were selected as training samples. To generate a face feature database. After systematic processing, the test samples are compared with the matching values of each face data in the database. The matching value is represented by Euclidean distance, and the smaller the value is, the more similar the two are. The test results show that the recognition rate of the system is 90% and the recognition time is 5 seconds in the above face image sample set.

7. Conclusion

With the development of modern society, great changes have taken place in people's production and life, paying more attention to privacy and security in life. In this paper, the intelligent access alarm system is designed by face recognition technology, and finally the system is tested. The test results show that the system has the characteristics of good ease of use, low cost, low power consumption and stable performance. In view of the small office space, family and other small occasions, the system can obtain higher recognition rate and recognition speed, so as to make up for the defects of the security system in small occasions, and has good application value.

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