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Practical Tracking System of Intelligent Workshop Product Based on Wireless Sensor Network

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ABSTRACT. *At present in our country, most of the intelligent access control system use password and card recognition technology. Although it brings convenience to people's life in some aspects, there are still security risks in some aspects, such as password leakage, or access control card lost or stolen. With the continuous improvement of China's living standards and the rapid development of science and technology, especially more obvious in the face recognition technology development, the speed and accuracy of face recognition has reached the level of practical application after investigation, such as identification and application of resident identity cards. In this paper, the face image is acquired by the camera through research, and then the high-dimensional features of the face are extracted by the classical neural network formula. The face recognition access control system of whether to open the electronic door is finally determined through matching with the features of the family face database..*

KEYWORDS: *Deep learning, Face recognition, Access control system*

1. Introduction

In recent years, with the rapid development of science and technology, face recognition technology in the society, no matter in which aspect, attracts more and more attention, especially it made a great breakthrough in the basic theory. Through some recognition algorithms, the accuracy of face recognition has completely exceeded the level of human recognition. Coupled with the rapid development of computer-related hardware in recent years, face recognition technology has been applied in many aspects, such as many mobile phones we use have face recognition system. Therefore, it is of great value to apply face recognition technology to access control system efficiently[1].

2. Face Recognition Access Control System Process

2.1 Design Principles

Due to the demand for security and efficient management of the access control system, when the access control system is designed at the very beginning, its designers should consider the following key principles: 1) Practicability of the system. First of all, the access control system must meet the most real needs of users to ensure the practicability of the system. The consideration of advance of the access control system is easy to cause the high actual cost of the system from the original idea. Therefore, the availability of access control system is the most critical. At the same time, the hardware and software of the system are must easy to learn and operate. Users could master the use of the system only through simple learning. 2) Stability of the system. As the access control system is a special system, it is closely related to people's life. So it needs to be stable at anytime and anywhere[2]. It is closely related to people's life. If there is a problem, it will not only affect people's life and work, but also bring inestimable trouble to users. 3) Security of the system. Ensure that all the equipment in the access control system can operate normally in abnormal environment, and the abnormal problems could be quickly and efficiently dealt with under special circumstances, at the same time, it must also meet international safety standards. 4) Easy maintainability of the system. No matter what kind of product needs irregular maintenance. So the maintenance process should should be simple and easy. The operation of the access control system requires that it could start to work normally after it is electrified. The equipment should be integrated as far as possible and can be normally used after simple maintenance and replacement. At the same time, during maintenance, we must reduce the dependence on professional tools, secure the system failure rate is very low and maintenance is convenient. It is also necessary to consider the occurrence of some unexpected faults. In case of such problems, the hardware of access control system should timely save data and quickly recover data to ensure that the door can be opened quickly in case of emergency.

2.2 Identification Modes of Access Control System

2.2.1 One-Way Induction Mode (Face Recognition + Exit Button + Electric Lock)

The authorized person is identified outside the door. He first goes through the access control host identification, after confirming his legal identity, then open the electric lock to open the door through the controller drive and record the date of the authorized person entering the door. Press the button to open the door, open the electric lock, go out directly and lock the door automatically. This access control system mode is generally applicable to the situation where the security requirement is not very high.

2.2.2 Bidirectional Induction Mode (Face Recognition + Face Recognition + Electric Lock)

The authorized person is identified outside the door. He first goes through the access control host identification, after confirming his legal identity, then open the electric lock to open the door through the controller drive and record the date of the authorized person entering the door. The way of users' going out is same as the way of going in. This mode of the access control system is applicable to the relatively high security level . It can not only prevent outsiders from entering illegally, but also record the time when the users leave, so as to facilitate the specific situation, implement responsibility and provide evidence.

2.2.3 Face Recognition + Card Mode

After face recognition, a card must be swiped to open the door. The biggest advantage of this kind of access control system is that it is more secure. Only after the two-block defense system be met could open the door. This mode can be more flexible in the process of use. Through the mode setting, some people can only enter the door by card + face recognition, while others can open the same door only by face recognition.

As to the access control system designed in this paper, the security level is relatively high. It is a multi-functional intelligent access control system, including automatic opening and closing, user information status detection, security alarm and other functions. First, the access control system will set up a super user, known as the authority manager, who can control the access rights of other users. Moreover, the access control system also has the function of identifying users. When a user with the permission of the access control system walks to the door, the access control system will automatically identify the user through the camera in front of the door, and open the access control system after successful identification. Non-additive users will be alerted that face authentication failed and will be asked to choose whether to turn on the doorbell function. The core of the access control system designed in this paper is face recognition function, and its recognition workflow is as follows: There are four modules: image acquisition, image preprocessing and face region extraction, face feature extraction and decision recognition, as shown in figure 1. In fact, the image acquisition part of the access control system is very simple. The hardware part uses a common HD camera. Through the camera installed in front of the door, the camera direction is pointed at the security door to take photos, and finally the face image is obtained. For the designed face detection part, we only need to process the acquired face image with face detection algorithm, cut out the contrast detection image, and transfer it to the pre-trained VGGNet to extract high-dimensional features. Finally, the high-dimensional features extracted from the face are compared with the face information of registered users one by one, and the decision recognition is carried out, finishing the complete system of whether to unlock the access control.

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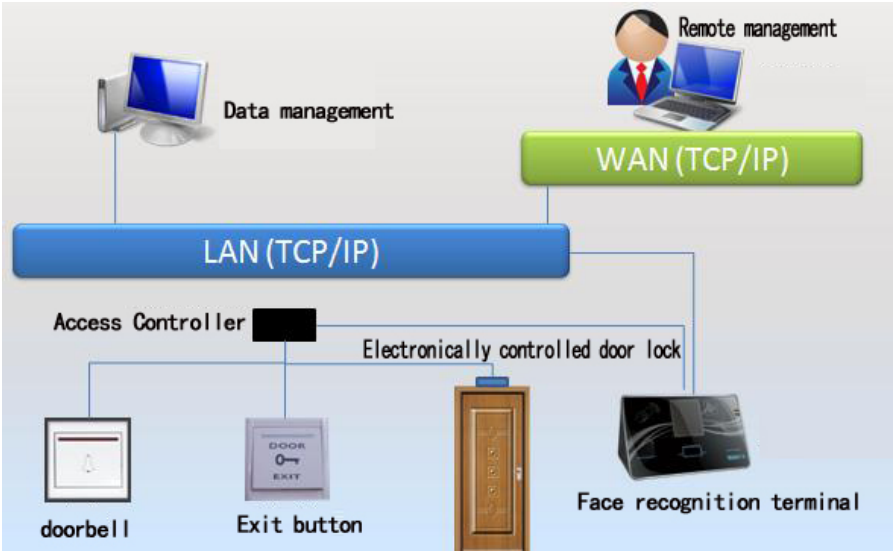

Fig.1 Face Recognition Access Control Schematic Diagram

2.3 Image Preprocessing and Face Area Extraction

2.3.1 Image Pre-Processing

As for the selection of photo hardware equipment, we mainly consider two aspects: one is the pixel of photo hardware, which is often referred to as sharpness, and the other is the price of hardware. We combine these 2 aspects of factors, choose a cost-effective best camera. After obtaining the user's image, the camera usually does a simple pretreatment, which needs to be carried out by the design software. The purpose is to remove the roughness in the image, refine and enhance the sharpness of the image, and finally obtain a face recognition image with data representation[3].

2.3.2 Face Area Extraction

Face region extraction, in fact, is to cut out the face in the pre-processed image through the designed software. This software is called face detector, and in this paper we use viola-jones face detector. The detector is widely used at present. The principle of the detector is very simple, which is to use a fixed size window to slide selection on our image to determine whether the area of the window contains a face. In the case of storing multiple faces in the image memory, our system selects the window with the highest probability of the suspected face and cuts out the window with the lower probability. Finally, we transfer the acquired face image to the next

step for processing, and compare it with the image of the registered user, as shown in figure 2.

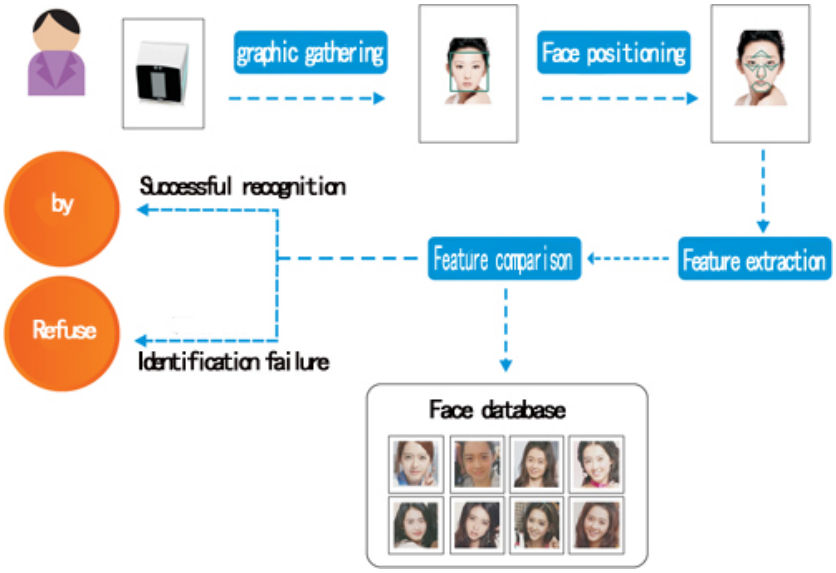

Fig.2 Face Recognition Schematic Diagram of Access Control

3. Face Feature Extraction Based on Deep Learning

3.1 Deep Learning Concept

In recent years, China's science and technology industry has developed rapidly, especially in terms of artificial intelligence, which can be described as hot, such as smart phone industry, intelligent robots, drones, etc. The technology behind the relevant functions is deep learning. Deep learning is mainly manifested in the models proposed by computer researchers through the inspiration of human brain nervous system in some research projects. At present, the computer application of this model has developed to a height that you can't imagine, and it can independently complete some special tasks, such as image recognition, object classification, voice recognition and machine translation, which are almost superior to human instinct recognition and irreplaceable. The most fundamental essence of deep learning is to build a network model through the computer[4]. After a large amount of data training with known labels, the model constructed by the computer can independently complete relevant special tasks and realize intelligence. An important network in deep learning is the convolutional neural network (CNN).CNN is a kind of deep neural network, which is usually used in various research tasks.

3.2 Face Feature Extraction Based on Cnn

In face recognition image processing, the traditional image processing method is mainly aimed at extracting face characteristics. Although it can reflect face characteristics well to a certain extent, the accuracy of this recognition method is not high enough, which is not ideal in practical application and often causes problems. If it is based on the method of deep learning, the features of the face extracted through calculation include all aspects of the face, such as face contour and information of key parts of the face. Its accuracy fully meets the requirements of current applications and its recognition accuracy is very high[5]. The neural network used in this paper is VGGNet-19. VGGNet is a convolutional neural network proposed by the computer vision group of Oxford University, the world's top computer vision research laboratory. As shown in figure 3, VGGNet-19 has five sets of convolution segments, and each convolution layer is the convolution kernel of 3&3. After each convolution, there is a maximum pooling layer. Finally, the result is output through

Softmax after passing through three full connection layers.

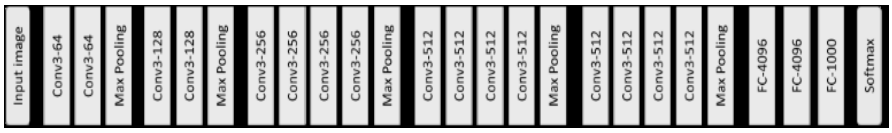

Fig.3 Vggnet-19 Network Structure

First of all, we train VGGNet-19 with the large face database VGGFace, and trained face recognition accuracy must be over 99%, so as to save the model built by the computer. Secondly, establish a database of registered users. First, collect face photos of registered users, establish a face database, input the photos into the trained vggnet-19, and then save the 4096-dimensional features output from the pen-to-last layer of the network full connection layer to the database. In this way, users are registered and the extraction of face features are completed[6].

$$D(M,\ I_i) = \sqrt{\sum_{j=1}^{4096} (a_j - b_j)^2}$$

4. Recognition Decision

After the establishment of the face recognition model and the face feature database of registered users, the work to be completed is to conduct face feature matching and recognition decision through the model built by the computing mechanism. When the user appears in front of the access control system, the access control system will automatically take photos, quickly preprocess the photos, and complete face area extraction through the calculation of the access control system.

Then the extracted facial features will be transferred to the trained VGGNet19, and the 4096-dimensional feature M output by the pen-to-last layer of the network full connection layer will be extracted and saved. Then the system will match the saved high-dimensional facial feature M to be recognized with the registered users' face feature database F{F1, F2...Fn}. The definition formula is as follows:

$$D(M, I_i) = \sqrt{\sum_{j=1}^{4096} (a_j - b_j)^2}$$

So far, we have obtained the matching Dn of facial features to be recognized and facial features of each registered user. We compare Dmin, the minimum matching degree in Dn, with the threshold Dtarget. If Dmin<=Dtarget, we consider that the user is registered and will open the access control to let the user enter; otherwise, we consider that the authentication fail and will remind people to choose whether to ring the doorbell.

5. Conclusion

To sum up, as an important part of artificial intelligence technology, face recognition access control system is widely used and can be seen everywhere in our life. This paper mainly studies deep convolutional neural network - VGGNet, and designs a face recognition access control system. First, the large face database-VGGFace is used to train VGGNet, and then the features of the face to be recognized will be extracted from the trained computer model and matched with the previously registered users. At last, it will be determined whether to open the access control through the matching degree. Compared with the traditional access control system such as fingerprint, access control card and password, this system is obviously superior to the traditional access control systems whether in terms of security or reliability. Moreover, the operability of the access control system is more convenient and fast. Of course, there are still some places which need improvements in the access control system we designed. For example, more face data sets can be used to train our model to further improve the accuracy of the access control system, which also provides directions for our future work.

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References

[1] Yu, Hai Cun(2018). Application on Campus Dormitory Management System Based on WiFi Technology. Applied Mechanics & Materials, vol.427-429, pp.2908-2912.
[2] Youbing R , Haili X U , Xu W , et al (2019). Intelligent Community Access Control System Based on Face Recognition. Video Engineering, no.12, pp.12-19.
[3] Ji, En Qing, Shi, Hai Gang, Li, Hong Yi, et. al. (2014). Research on New Remote Control Platform for Smart Home System Using Mobile Phones. Applied Mechanics & Materials, vol.473, pp.267-274.
[4] Qi, Chang Xing, Zhao, Lei, Dong, Qiao Ling (2018). Design and Implementation of Safety Lock Based on Face Recognition. Applied Mechanics & Materials, vol.596, pp.346-349.
[5] Jianling Hu, Lei Shao, Honglong Cao (2012). Design and Implementation of an Embedded Face Recognition System on DM642, Springer Berlin Heidelberg.
[6] Xu, Zhi Hui, Li, Wei Zhong, Xiao, Yong Jun (2018). The Design of Infusion Monitoring System Based on STM32 Microcontroller. Advanced Materials Research, vol.756-759, pp.395-398.