Research on Intelligent Attendance Management Mode Based on Finger Vein Algorithm

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Abstract: This paper presents a new finger vein recognition algorithm for checking in attendance, based on the research of finger vein recognition. At first, the principle of finger vein image acquisition is analyzed, and then the image was processed by wavelet Gabor technology to make the processed image better show the features of human finger vein texture, and then the template matching algorithm was used for recognition. Finally, the improved finger vein recognition algorithm, UDP protocol and Socket components were used comprehensively to realize the attendance system of extracurricular physical exercise for students. The application results show that the improved algorithm in this paper has achieved high recognition accuracy, also reduced the false detection rate, and the speed of operation has been greatly improved, basically meeting the application needs of attendance check.

1. Introduction

We have entered a new era with the rapid development of information and big data technology. People put forward higher requirements on the efficiency and security of personal information processing. Traditional manual check-in and swipe card check-in cannot guarantee the efficiency and authenticity of check-in. Biological recognition to identify people based on the biological characteristics of human body, is living, non-contact, anti-jamming, uniqueness and security etc. based on fingerprint, voice, iris and facial recognition biometric technology in the security check, entrance guard, exams and other scenarios are widely used, but these biological recognition technology has disadvantages such as low accuracy, easy to damage. In recent years, with the development of biomedical technology, the development of finger vein recognition technology has been promoted, and more scholars have joined the research team of finger vein recognition technology. Finger vein recognition is a more advanced biometrics technology at present, with the advantages of fast identification speed, good performance, and characteristics security and not easy to forge. It is a biometrics technology with broad development prospects. Different from the traditional biometric optical imaging, according to the characteristics of finger veins located under the skin and combined with the basic mechanism of vein imaging, near-infrared light transmission can be used to generate finger vein imaging. The key to finger vein recognition is feature extraction and similarity calculation [1]. Wang kejun proposed that first determine the direction of finger vein and then use the template in this direction to extract the characteristics of thin lines. The extraction efficiency is high, and the noise of templates in other directions is suppressed, but the image processing of low-quality finger vein is not good. Lin jian obtained the Hessian matrix of the image by using the convolution image of the second derivative of Gaussian template, and then obtained the thin line features based on the trace and feature values of the Hessian matrix. Finally, by adjusting the standard deviation of Gaussian function to obtain the finger vein images of different thickness and thickness, the best experimental results were obtained.

Recognition technology based on template matching based on the research, the Phase correlation (Phase only correlation and POC) template matching was studied on the basis of the cut out from the

beginning to vein image Interest Region (Region of Interest, ROI), based on the wavelet transform algorithm to enhance image, then according to the table vein image is used to identify the traversal of the offset range, use match the peak for the template matching, finally, based on the algorithm is combined with object-oriented programming algorithm, realize employees sign in recognition system of check on work attendance, The results show that the proposed algorithm is superior to the traditional biometrics algorithm.

2. Finger Vein Recognition Algorithm Based on Gabor Transformation

In recent years, finger vein recognition technology has developed rapidly. According to medical research, the characteristics of the human finger vein will accompany the whole life of the person, and each person's image of each finger vein is not the same, it is stable biometric information of the human body. According to hemoglobin in the blood of the human body absorb certain wavelengths of light, you can use a specific wavelength of light to illuminate, fingers can get a clear picture of the finger vein is available, then use of Gabor algorithm to enhance image, then the template matching algorithm of the enhanced image and template image identification.

2.1 Finger Vein Image Acquisition

The absorption rate of near infrared light in finger tissues is different. Recent medical studies have shown that deoxyhemoglobin in finger veins has a strong absorption effect on near infrared light. Therefore, near-infrared light can be projected from one side of the finger, and infrared images of finger veins can be collected from the other side of the finger by image sensors [12].The collection process and principle of the original are shown in figure 1. As an imaging light source, infrared laser has the advantages of high brightness and small divergence. Studies have shown that finger veins are best imaged by near-infrared light with a wavelength of 850 nm.
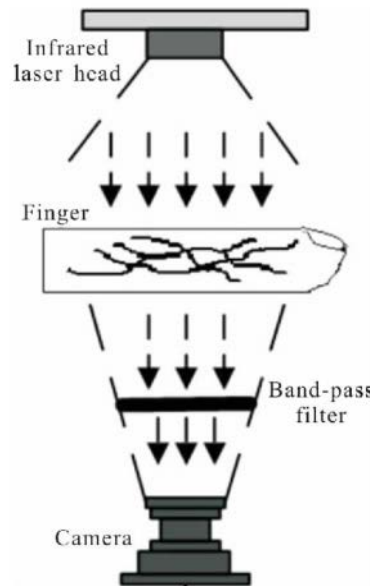

Figure 1 Schematic diagram of finger vein image collection

2.2 Finger Vein Feature Processing Based on Improved Gabor Algorithm

Gabor wavelet transform has the characteristics of biological vision and biological background. Based on this, we can better abstract the working principle of visual nerve cells and have a wide range of applications in computer vision and texture analysis. The finger vein image texture we want to study is relatively rich in information. It is suitable to use Gabor wavelet for feature extraction. However, the traditional wavelet transform technology should be appropriately improved to better abstract the features of the finger vein image. According to the vein image curvature feature, in order to obtain the image characteristics of has better robustness, while keeping algorithm, on the basis of

the original advantages, adjust the Gabor filter, center frequency and direction, base band width, multi-scale, multiple direction Gabor filter can be set, and then with the collected vein image convolution, can filter out the image of the dc component, avoid the influence of illumination characteristics of finger vein.

The commonly used filter Gaussian function is:

$$G(x, y, \theta, \mu, \sigma) = \frac{1}{2\pi\sigma^2} exp\left\{-\frac{x^2+y^2}{2\sigma^2}\right\} exp\{2\pi i(\mu x' + \mu y')\} \tag{1}$$

Substitute the following formula in expression (1):

$$x' = xcos\theta + ysin\theta \quad y' = -xsin\theta + ycos\theta \tag{2}$$

The formula (1) can be converted into the form of formula (3).

$$G(x, y, \theta, \mu, \sigma) = \frac{1}{2\pi\sigma^2} exp\left\{-\frac{x^2+y^2}{2\sigma^2}\right\} exp\{2\pi i(\mu xcos\theta + \mu ysin\theta)\} \tag{3}$$

Human finger vein image texture vein is composed of a large number of non-linear components. In order to make it have a good curvature characteristics, We have adjusted the parameters x' and y' according to formula (3).

$$x' = xcos\theta + ysin\theta + k(xsin\theta - ycos\theta)^2 \tag{4}$$

$$y' = xsin\theta + ycos\theta \tag{5}$$

In the above formula, k is the size of curvature in the local area of the image, similar to the texture vein of human vein image.

The results of finger vein image processing based on the improved wavelet transform algorithm are shown in figure 2. It can be seen that more image effect is obtained to better display the features of human vein texture
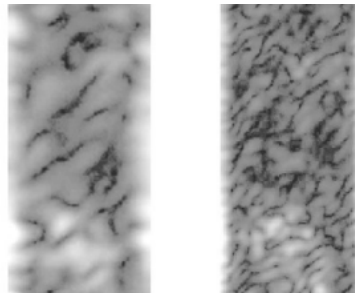

Figure 2 Rendering of traditional Gabor filter and improved algorithm

2.3 Recognition of Finger Vein Matching Based on Template

There are a large number of heterogeneous finger vein images in the template library. If we only match and identify them by one-by-one comparison, the recognition speed of the algorithm will surely be reduced. In the case of a large sample size, the result is not good. Then, how to quickly and effectively identify heterogeneous finger vein images? We conducted block processing on the vein images processed by wavelet Gabor transformation, and recorded the number of different types of elements in each block unit to form a set C.

3. Realization of Attendance System based on Finger Vein Recognition

We selected an application scenario to test the improved algorithm based on the previously designed finger vein recognition algorithm. Due to the popularity of smart phones, college students are generally lack of physical exercise, physical quality is generally not high, in order to mobilize students to participate in extracurricular sports activities, improve the physical quality of college students, many colleges have introduced the corresponding incentive methods. We combined with the characteristics of the campus based on this, around the campus road in different locations, the placement of multiple finger vein attendance machine, students to participate in an extracurricular sports, must be in each attendance point to identify the finger vein attendance.

The user roles of the system can be divided into student users and administrator users. Among them, the main functional requirements of the student role module are to carry out check-in activities

and display check-in information. The check-in activity includes information entry and simple processing of the input information (packaging and packaging according to certain rules and transferring to the data server). It can be said that the two main parts of the system (the data collection end and the data service end) are two interdependent interfaces, and the interaction and invocation between the interfaces need to follow certain specifications.

The main functions of the administrator module include the collection of student information and personnel management. The personnel management includes the behavior control of the role account, including but not limited to: logout, lock, increase permissions, etc. The whole operation process is completed at the acquisition end and the data processing is deployed on the server side. The operation of inputting student information needs the administrator to start the corresponding process before it can be executed. Otherwise, the collection of finger vein information by students on the device defaults to a check-in operation. If the student information does not exist in the database, it is only possible to return the result of check-in failure. We designed the system structure of attendance check based on this.

System implementation, in strict accordance with the MVC layered design pattern, the integrated use of the improved means the vein recognition technology, combined with the UDP protocol and the Socket components, according to the logic operation, in front of the system function encapsulation for the class, based on the object-oriented programming method, implemented refers to the vein recognition of extracurricular physical exercise in attendance system, system sign in recognition testing interface as shown in figure 3.
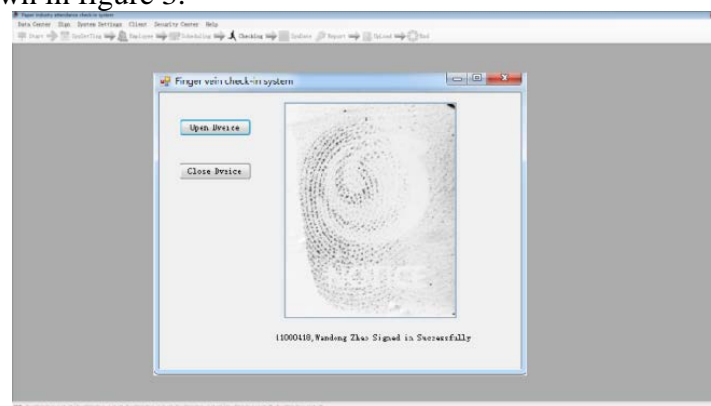

Figure 3 System sign in recognition testing interface

4. Conclusion

In this paper, wavelet transform Gabor algorithm is used to improve the traditional finger vein template matching algorithm, and based on the improved algorithm, a system for students to check in for extracurricular physical exercise is implemented. The experimental results show that the improved algorithm in this paper has achieved high recognition accuracy, reduced the false detection rate, and the speed of operation has been greatly improved, basically meeting the application needs of attendance. Thus, finger vein recognition technology will have a better development prospect.

References

[1] J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68-73.

[2] K. P. Bingulac, "On the compatibility of adaptive controllers (Published Conference Proceedings References)," in Proc. 4th Annu. Allerton Conf. Circuits and Systems Theory, New York, 1998, pp. 8–16.

[3] Wu chao. Finger vein recognition based on deep learning. Nanjing University of posts and

telecommunications, 2018.

[4] Liu guandong. Identification of finger vein. Nanjing University of posts and telecommunications, 2018.

[5] Jiang peizhou. Design and development of attendance system based on finger vein recognition. Fujian computer, 2019(01), pp.132-134.

[6] Wang Yang. Design and implementation of a door control system based on biometrics. Shandong University, 2018.

[7] Wu chao, shao xi. Finger vein recognition based on deep learning. Computer technology and development, 2018, 28(02):5-9.

[8] Chen huaxuan. Principles of finger vein recognition system. Electronic technology and software engineering, 2016, vol.22, pp. 81-85.