

Application of Wavelet Transform Combined with Coherent Enhancement Diffusion Algorithm in Fingerprint Image Enhancement

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Abstract

As computer vision technology continues to mature, the technology has also been applied to various areas. As the name suggests, computer vision is to allow computers to "see" things like humans. A very important point of computer vision technology is the need to process images. Diversifying fingerprint images is a hot research topic in computer fingerprint image processing technology. The fingerprint identification control program uses a defined 8-bit array gTxBuf to distinguish the three working states of user identification, adding users and clearing all fingerprint data, and check the checksum to ensure that the working state is accurate. Through actual tests, the accuracy of user fingerprint recognition in this system is almost 100%, and it takes about 1 second for the system to give feedback on a successful recognition. The core of the wireless transmission control system ESP32 works in a low-power mode, which can continuously monitor the status changes of the fingerprint identification control system. The ESP32 determines whether to enable WIFI transceiver by judging the working status. This system can better realize wireless fingerprint sign-in. The fingerprint recognition data collected from fingerprints and processed by TFS-9 algorithm is accurate and effective, and three working modes of user identification, adding users and clearing all fingerprint data are set. The communication distance of the ESP32 onboard WIFI can reach about 20 meters, and the external antenna, cascade or relay amplification can make the communication distance longer.

Keywords: Image Enhancement, Wavelet Transform, Fingerprint;

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1. Introduction

Aiming at the low color sensitivity of traditional fingerprint image image equalization enhancement system, a fingerprint image image equalization enhancement system based on dark primary color prior is proposed. The software design of the system is mainly composed of two parts: the total controller of the access control system and the client for users. The master controller of the intelligent door lock

control system is the main means for professionals to manage each access control system. Managers can manage the user's access control system permissions and reset the access control system with the user's permission. The client mainly realizes the data interaction function between the host computer and the server, and at the same time realizes the control of the fixed terminal.

When the client software is used for

communication, the router allocates a dedicated port for it, and uses TCP to communicate with the mobile terminal device. Usually, the smart door lock is in a listening static state. When a user applies for connection, it will complete the connection and communication with the mobile terminal device, and the mobile terminal device can control the fixed terminal. One is to randomly select and determine a binary polynomial (such as X^3+X^2+1 , which can be expressed as 1101) with the highest and lowest bits as 1, and conform to the international standard, which is used as a divisor on both the sending and receiving ends; The CRC is calculated by dividing the original frame by the binary polynomial value randomly selected and calculated by modulo 2 division operation. The specific steps can be as follows? description. First, choose an appropriate number as the divisor. Then, calculate the binary digits of this suitable divisor by calculation, and divide the generated data frame by the selected divisor by modulo 2 division. CRC is the remainder obtained by dividing in this way, and the CRC Because the number of digits in the remainder is one less than the number of divisors, the first digit 0 of the obtained value needs to be kept in the CRC, can't it? ignore. Finally, add the calculated CRC with the first bit of 0 to the original data frame to form a new data frame and send it to the receiving end. After the receiving end obtains the data frame, it is divided by modulo 2 and the number of bits is one less than the number of divisors. The remainder, if the calculation result can be divided evenly, it means that the data frame received by the receiving end has no error, that is, there is no error in the transmission process. If the calculation is wrong, it needs to be checked again and notified to resend the data frame.

Background of Checking Algorithm Design
When realizing network entity communication by computer, first divide the information to be exchanged into numerous data segments, and add the header and check code before and after each data. Form a complete data package. Because each data packet contains various useful information and

can be controlled manually during data transmission, the CRC check method is used to improve the accuracy of the data communication process.

When the CRC is added to the end of the data packet and sent by the computer sending end, the data sent by the computer is connected with the CRC and a coding relationship is established. Then the computer receiver receives the data packet from the sender and decodes it to obtain the information, and then compares and analyzes the information sent by the sender. If the two data are consistent, it means that the data packet is not affected by other interference factors during the transmission, Get the correct coding information. If the data obtained after the calculation is inconsistent with the data sent by the sender, it means that the data packet has a deviation during the transmission process, and the data packet needs to be retransmitted in an automatic retransmission manner. The data packet is translated through the same process. The codes are compared again until the data decoded by the receiving end is consistent with the data transmitted by the sending end. Through this method, the accuracy of the information in the computer information transmission process is ensured, and it is powerful for the safety of computer information transmission? Guaranteed.

2. Wavelet transform technology

Mallat algorithm is a fast algorithm for wavelet decomposition and reconstruction developed based on the theory of multi-resolution analysis. The Mallat algorithm of the image uses a separable filter design, which actually performs one-dimensional wavelet transformation on the rows and columns of the image data. Two-dimensional wavelet transform decomposes the image to produce a low-frequency image and three high-frequency images and each image only occupies a quarter of the original image. The low-frequency image contains more image information and is close to the original image; The video image contains less information and is more different from the original image. The

two-dimensional inverse wavelet transform is based on the decomposition result to get the original image. The single-scale Retinex algorithm is a commonly used image enhancement method. The Gaussian surround function is constructed first, the image is filtered and then the original image and the illumination component are subtracted in the logarithmic domain to obtain the reflection component as the output result image. The algorithm can compress the dynamic range of the image and maintain the enhancement of the color and details of the image to a certain extent^[1]. The fingerprint image system is in the figure below.



Figure1.Fingerprint image system.

Wavelet transform heating the part under test is a new non-destructive testing technology developed in recent years. Choose a horseshoe-shaped magnetic body with a coil and pulse the square wave for the coil. When it is placed on the surface of the tested part, a loop will be formed, resulting in a strong The eddy current heats up instantaneously; and then uses an infrared camera to record changes in the surface temperature field of the measured object. When the measured object has pits or breaks, the defective parts and non-defective parts generate different electromagnetic heat due to different magnetic permeability, resulting in different corresponding surface temperatures of the defective and non-defective parts of the measured object. Know the approximate location of the defect. Heating the DUT based on wavelet transform has great flexibility.

Different waveforms and frequencies can be selected according to different materials and the

power of the wavelet transform device is adjustable, which can achieve the best experimental results. Furthermore, the wavelet transform device can locally excite and heat the DUT without considering the uniformity of excitation and the temperature field in the defect-free area as a reference. Therefore, wavelet transform devices are widely used in the field of non-destructive testing^[2]. The fingerprint image management system is in the figure below.

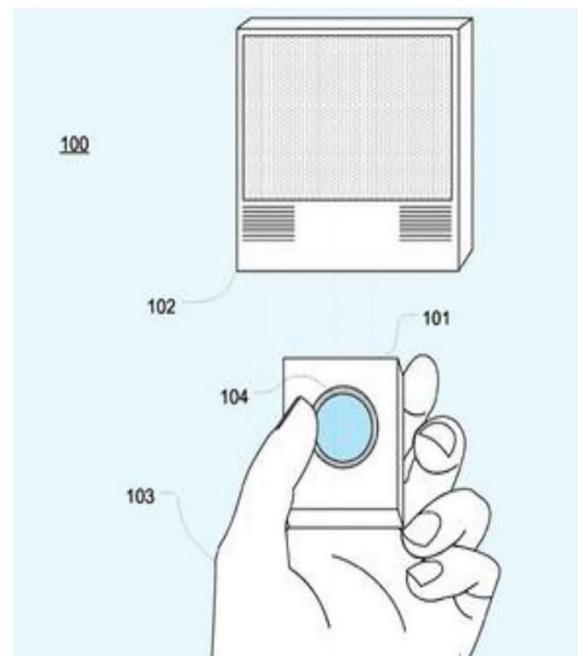


Figure2.Fingerprint image management system.

3. Fingerprint image analysis

In order to improve the quality of fingerprint images, domestic and foreign experts and scholars have introduced many techniques to study the problem of fingerprint image quality enhancement. Foreign fingerprint image quality enhancement research started early. There are relatively many fingerprint image quality enhancement algorithms proposed and the enhancement technology is relatively mature. Due to the relatively large investment in human and financial resources, the rapid development of fingerprint image quality enhancement research has also been achieved. Many important research results. Originally designed a fingerprint image quality enhancement algorithm based on histogram

equalization. The original fingerprint image pixels were enhanced to improve the fingerprint image quality, but this method is very sensitive to noise and has poor versatility. Later, some scholars proposed a fingerprint image quality enhancement algorithm based on wavelet transform, which performs spatial transformation on the original fingerprint image, removes the noise in the fingerprint image from the transformed space and suppresses the influence of noise on the fingerprint image quality, but it cannot. The fingerprint image contrast and brightness are improved and the ideal fingerprint image quality enhancement result cannot be obtained. Finally, some scholars proposed a fingerprint image quality enhancement algorithm based on the Retinex algorithm. The fingerprint image is processed according to the characteristics of the human retina to improve the quality of the fingerprint image. Especially for fingerprint images with relatively large changes in illumination, better results can be obtained, but the assumption is that the illumination is uniform, which is inconsistent with the actual situation, causing the fingerprint image quality to appear "over-enhanced" phenomenon and the fingerprint image quality needs to be further improved. In order to solve the problems of low brightness, high noise and low contrast in the current fingerprint image quality enhancement process, this paper designs a fingerprint image quality enhancement algorithm based on a fingerprint image sensor and the verification test results of fingerprint image quality enhancement performance. It shows that the algorithm in this paper has solved some problems in the current fingerprint image quality enhancement process, improved the signal-to-noise ratio of the fingerprint image and the brightness and contrast have also been significantly improved. Compared with the contrast algorithm, it has obtained better. The fingerprint image quality enhancement results^[3]. The fingerprint image structure is in the figure below.

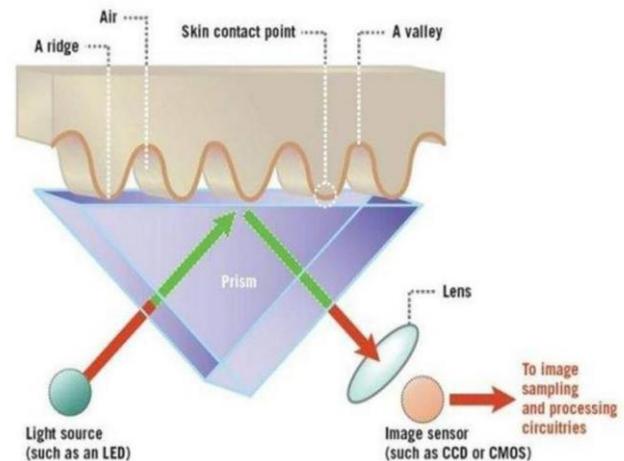


Figure 3. Fingerprint image structure.

4. Application of wavelet transform technology in fingerprint image

Image enhancement does not consider the reasons for the degradation of image quality. It only selectively highlights the features of interest in the image while attenuating the unneeded features. Its purpose is mainly to improve the readability of the image. The article uses MATLAB software as a platform to enhance the quality of digital images through algorithms such as histogram equalization, linear contrast broadening and dynamic range adjustment. The existing color image segmentation method is based on the color similarity principle to define regions. Using this method, it will be difficult to segment the color image of the light spot and the shadow area, causing unevenness on the target surface, that is to say, the region boundary. There is a certain difference with the target boundary. Although HSI solves this problem to a certain extent, the hue may be unstable at low saturation. Some scholars have proposed some segmentation methods based on physical models to solve this problem and use three-dimensional color space modeling. The modeling of this method is simple, but there are too many constraints and higher requirements on the external environment, so the application range is relatively small and only for some specific situations^[4]. The fingerprint image system is in the figure below.

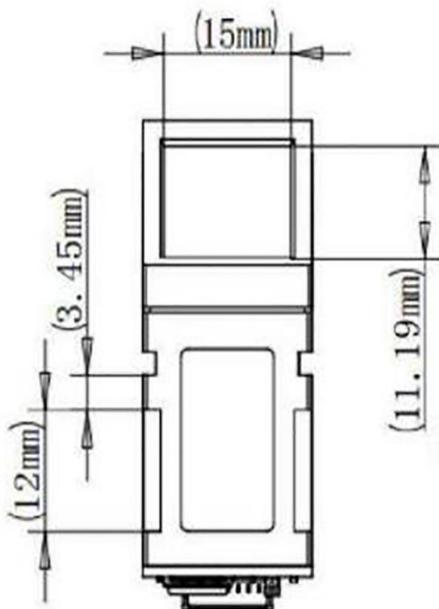


Figure4.Fingerprint image system.

4.1. *Contrast linear broadening* Contrast: In layman's terms, it is the contrast between light and dark. Contrast usually expresses the clarity of image quality. The greater the contrast, the more gradual levels from black to white, the richer the performance of grayscale and the clearer and more eye-catching image. The smaller the contrast, the lower the picture clarity and the worse the sense of hierarchy. The purpose of contrast broadening is to emphasize the part that people care about by expanding the difference between light and dark (ie, contrast). The principle is: perform a linear mapping of pixel to point gray levels. This insinuation relationship can expand the difference between brightness and darkness by adjusting parameters. In order to achieve the purpose of contrast expansion, a certain gray-scale area of the image can be expanded. The linear expansion usually refers to the piecewise linear expansion of the gray-scale image. Linear contrast broadening processing essentially reduces the contrast of unimportant information, thereby leaving extra space to broaden the contrast of important information^[5]. The fingerprint image

quality analysis is in the figure below.

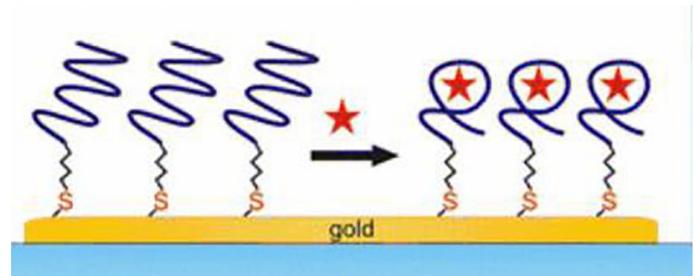


Figure5.Fingerprint image quality analysis.

4.2. *Dynamic range adjustment* The dynamic range refers to the range of brightness changes in a scene captured by the camera at a certain moment, that is, the range of changes from the darkest to the brightest described in an image. The impact of dynamic range on human vision: As the range of gray scale that can be distinguished by the human eye is limited, when the dynamic range is too large, the high brightness value will cover up the signal in the dark area. Dynamic range adjustment is to use the characteristics of the dynamic range's impact on human vision to compress the dynamic range and expand the range of grayscale changes in the part of interest, thereby achieving the purpose of improving the picture effect. When the dynamic range is too large, the range of brightness changes that can be distinguished by the human eye is limited. In other words, the range of gray scale changes that can be described on the image is limited. Therefore, the signal in the dark area is often covered by the signal in the high gray value area, which affects the performance effect of the target area, making the details of the target area, especially the details of the dark area difficult to recognize^[6]. The fingerprint image adjustment system is in the figure below.

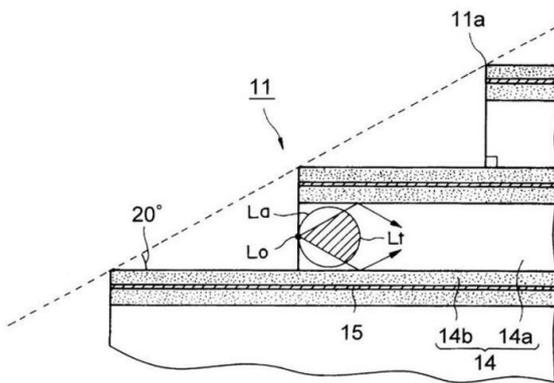


Figure 6. Fingerprint image adjustment system.

4.3. Histogram equalization The basic principle of the histogram equalization method is: broaden the gray values with a large number of pixels in the image and merge the gray values with a small number of pixels, so as to achieve the purpose of clear images. If the gray levels of the image are concentrated in a narrow interval, which causes the blur of the image details, in order to enhance the image, it can be achieved by improving the proportional relationship of the brightness of each part, that is, by the method of histogram equalization. According to the histogram statistical value of the original image, the gray value of each pixel after equalization can be calculated. On the histogram, the denser gray distribution is stretched and the sparse gray distribution is compressed, so that the overall image contrast is enhanced. Computer algorithms are still using dichotomy and comparative analysis. You can find useful information faster when using computers. Compared with looking up various related books in the library, using computer algorithms has a higher efficiency. , Checkerboard coverage, binary search technology, merge sorting, point-to-point problems, mathematical algorithms, etc., which are often used in computer algorithm problems, make a reasonable and reliable evaluation based on the actual problem solving. In the face of high complexity of calculation problems, it should be reasonably judged whether it is included in the computer algorithm program. For example, when the calculation is about pressure, it is

necessary to analyze the actual situation of the existence of various situations and accurately Calculated, the scope of application, because computer errors also exist. For example, many search engines now have some very vague algorithms. Computer algorithms can only guarantee most of the accuracy, but there is no way to do it. 100%, and then there is a problem in the compression conditions such as JPEG and MP3, which will cause errors in the provided data, and then because the storage method of the computer is binary, it cannot run in other non-binary storage. Some external reasons can also affect computer algorithms. For example, the computer hardware has problems, causing errors in the computer algorithm. The evaluation criteria for computer algorithms need to face these deficiencies, and It's not about computers that are correct. The rational use of computer algorithms is not only to improve the computing power and search capabilities of the computer, but also to improve the technology of computer algorithms. Be able to apply computer algorithms to more places in real life as soon as possible. Judging from the current situation, there are still many areas where computer algorithms can be developed, so there are many possibilities in the evaluation criteria of computer algorithms.

5. Conclusion

Image enhancement methods are getting more and more attention and are widely used in the field of image segmentation with significant effects. Although the image recognition method deals with the uncertainty of the image to a certain extent, it takes a certain amount of time to process the uncertainty of the image, so it is a more effective method to blur the image. Most importantly, fuzzy inference technology can also personify decision-making. Therefore, with the advent of the era of big data and artificial intelligence, as well as the improvement of our computing and processing levels, fuzzy methods will be able to achieve unexpected results. In addition, since changes in illumination will affect the surface color of the

imaging target and applications such as robot vision systems need to use segmentation algorithms to eliminate the effects of illumination, segmentation algorithms based on color constancy will also receive more and more attention.

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