1999년도 대한전기학회 하계학술대회 논문집 1999. 7.19-21

VHDL을 이용한 구순문 인식 시스템의 구현 연구

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An Implementation of Lip Print Recognition system using VHDL

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Abstract - The human has recognizable part of body such as a fingerprint, a crimson, a blood vessel. This part has been investigated constantly, its confidence for personal recognition is high. In spite of specialized part of human body, a lip print recognition is developed less than the other physical attribute that is a fingerprint, a voice pattern, a retinal blood-vessel pattern, or a facial recognition. This paper is to implement hardware for lip print recognition system using VHDL.

1. Introduction

In recent, human recognition research has been investigated such as fingerprint, a crimson, a blood vessel, signature, voice pattern, typing pattern. As one goes information society, almost secretes and national documents is changes digitalization. The preservation of public peace is more important. We can't believe in computer's password and security material. The solution is biometric recognition system, it is more confidence than such coding method. Each person's lip has unique lip print and differs from the others. The lip print inherent wrinkles pattern on lip. It is differ from each and every person such as fingerprint, crimson, and so on. We can identify a man using lip print pattern. The input lip image receive from CCTV camera. The input gray scale image is code by various pattern kernel that considered diverse pattern form of lip print. Using pattern kernel, various and peculiar lip print pattern information is change numerical information in proper computers. Then we must design cost function that sectionalize a person before biometric recognition and identification, using numerical information. For implement hardware, each section is need to remake as module. The recognition system is consist of five section as shows in Figure 1. The first section is input part that receive gray scale image from CCTV camera.

Figure 1. Block diagram of lip print recognition system

And second section is preprocessing part. In this part, input image process by histogram equalization and down-sampling. Third is analysis part that input image analyze by various pattern kernel. The next comparison part is that formalized gray scale image is compare with database. Finally, if input image value is in bounded area, it passes. And if not, image is not define so it refuse.

2. The Lip recognition system

2.1 Preprocessing Architecture

The recognition system has three parts, it is input part and control part and output part. It has to define the rules that input images are what kind of form and shape. The processing in the input part is called preprocessing. This part have an influence on system confidence rate so much. It is the part that compare image format in the database with input image efficiently. The preprocessing contains denosing and histogram equalization. It need to the part that abstract lip print image from input image. Histogram equalization is spread dynamic range of gray scale level. It is the preprocessing part that It receive image from camera and process histogram equalization and goes prior to main processing.

2.2 Local Pattern Mask

The local pattern mask is designed on 4x4 pixels, and extract the uniquely local pattern information from the preprocessed input image. Some examples of local pattern mask are shown in Figure 2, in which the arrows represent the relation between a pixel marked in white and a pixel marked in black. The relation is designed on a difference of pixel value. The image of a lip print has a vertical or horizontal or diagonal edge that is called as a lip print. A pixel value of the lip print has lower than other pixel value. (A gray value of the black pixel is 0 and a gray value of the white pixel is 255) Each pattern mask is scanned over the entire input image, and the mask is compared with the input image. If the mask is matched with the region of the input image, the pattern kernels is computed in the region. The local pattern mask represents the pattern consisting of lip print's pattern. The lip print pattern compose local pattern mask in limit area.

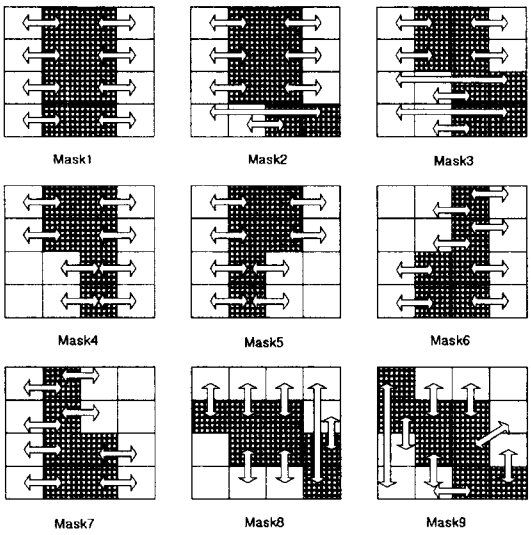

Figure 2. Local pattern mask

2.3 Pattern Kernel

The pattern kernels used throughout this paper consist of some kernels. Each kernel extracts a uniquely global pattern information on the input image.

The pattern kernel number	The pattern kernel type
No. 1	Vertical direction detector
No. 2	ES(east-south) diagonal direction detector
No. 3	WS(west-south) diagonal direction detector
No. 4	W(west) horizontal direction detector
No. 5	E(east) horizontal direction detector

Table 1. Pattern kernel

It is important that the kernel acquire the global pattern information. A lip print is represented by the global pattern information. The pattern kernels use some masks to analyze the local pattern information. The characteristic of a lip print is explained by three measures. The first measure is its length. The second measure is its frequency. The third measure is its shape. The pattern kernels must recognize these measures and convert them into digital data. Therefore, the design of the pattern kernels are based on these measures. If any pattern of the object is detected by the local pattern mask, a kernel of the detected pattern is executed. All the products corresponding to a kernel are stored so as to provide the pattern information. This operation is performed using the five different pattern kernels, thus providing the 5-information vectors. above Table 1 is five pattern kernel.

2.4 Discrimination Criteria

The discrimination criteria discriminate an information vector of the input image from other vectors. The input image is transformed to the 5-information vectors. The vectors consist of three parts that are personal information, kernel name, pattern information and row-vector. Figure 3 shows that the personal information denotes personal name, and the kernel name denotes the specific pattern kernel, and the pattern information denotes a value of the pattern kernel.

Figure 3. Information vector

Equation (1) illustrates discrimination criteria of the information vectors. A threshold value is set on the minimum value and the information vector. If T exceeds a threshold value from the information vector, the specific information vector is rejected.

$$T=\sum_{p=1}^{5}\frac{\sqrt{(K_p^s-K_p^m)^2}}{K_p^s+K_p^m}\quad (m=1,2,3,\ldots,N) \quad Eq.(1)$$

K_p^s = the specific information vector

K_p^m = the information vector

where N is the number of the information vector.

2.4 Estimation Structure

The value T of Equation 1 is a standard value that how input image match up to database image.

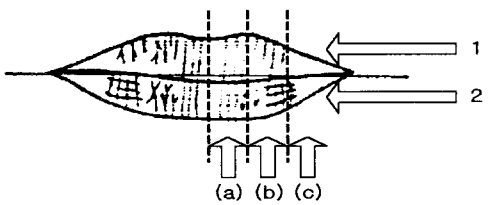

Figure 4. The processing sequence of lip print

For the fast processing, the lip structure divided into six parts. It's division upper and lower lip in first partition, and second partition is shown in Figure 4 as a and b, c.

$$T_a=\sum_{p=1}^{5}\frac{\sqrt{(K_p^s(a)-K_p^m(a))^2}}{K_p^s(a)+K_p^m(a)} \quad \text{Eq. (2)}$$

The information vector is saved a and b, c in

first partition, next a and b, c in second partition as sequence. If input lip print image

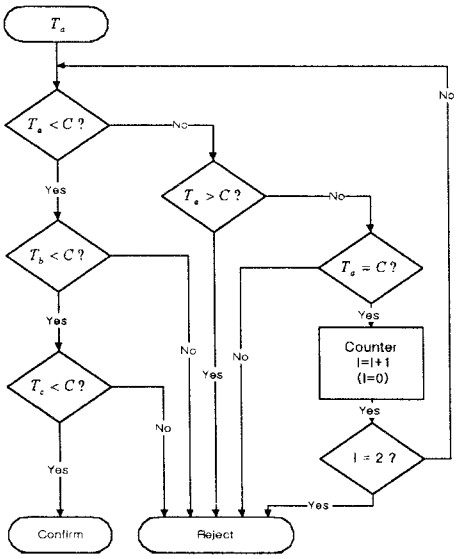

Figure 5. The estimation procedure

identify two images at least, then part b of input image compared with two images. The estimation procedure shows in Figure 5. T_a in flowchart is the value between part (a) of information vector and part (b) of database. $K_p^s(a)$ is the specific information vector of input image in part a and $K_p^m(a)$ is the information vector in the database.

3. Conclusion

The lip print gray image received from CCTV camera that it's gray scale value is 8 bit and has 320×240 pixel resolution. The image data coded by twenty four local pattern mask of 4×4 pixel and five pattern kernel in this paper. Implementation purpose of biometric system is how its performance is near the real-time execution and how similar to theoretical recognition rate. Recognition system is lower maximum ten percent than result of theoretical. This paper used Altera and sinopsys as compiler. If combine lip print recognition system with crimson recognition system, this system would increase recognition rate.

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