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Vein Recognition Using Biometric Using Feature Extraction Algorithm

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Abstract

Vein recognition is very simple and newly enhanced technology for the researcher today. Many implementation of this method are now in commercial phase and there is great need for system that can detect , extract the correct human vein pattern while keeping a low cost reducing need of image processing algorithm. The vein recognition can be done in two ways. Either in traditional that is using database and its processing another way is using biometrics techniques. Here in this paper we use the database collected and process it using the MATLAB. The feature extraction algorithm is used here for the operation of acquired image. Vein recognition technology has some fundamental advantages over all other type of recognition systems. The vein is hidden inside the body and is mostly invisible to human eyes, so it is difficult to forge or copy.

Keyword- *eigen vector & value, edge dectection, Euclidean distance, feature extracton*

Introduction

Digital Image Processing is an emerging field of research for researchers. It has got wide range of applications areas like face recognition, vein recognition, medical sciences, remote sensing, weather forecasting, robotics etc. Biometrics is one of the popular used techniques for the question of who you are. In general, it can be divided into behavioral-based and physiological-based methods (Weaver, 2006**).** A biometric system is essentially a pattern-recognition system that recognizes a person based on a feature vector derived from specific physiological or behavioral characteristic that the person possesses. Vein pattern detection has been proved to fully comply with this definition and it provides many important biometric features-

• Uniqueness and permanence of the pattern
• Non-contact detection procedure
• Almost impossible to forge or copy.

The biometric parameter is hidden from general view

The vein pattern is intricate enough to allow sufficient criteria for positively detecting various subjects, even identical twins. The vein detection process consists of an easy to implement device that takes a snapshot of the subject's veins under a source of infrared radiation at a specific wavelength.

The system is able to detect veins but not arteries due to the specific absorption of infrared radiation in blood vessels. Almost any part of the body could be analyzed in order to extract an image of the vascular pattern but the hand and the fingers are preferred. The reason for this choice is the general availability of the hand.

Frame work-

Feature extraction algorithms-

The basic processing algorithm and different variations of the standard approach can be described using the following steps[2]

Without further processing, the image is similar to what is depicted Figure. The vein model can be easily seen but the image is not clear enough for machine vision and pattern recognition purposes.

Figure1. Raw image of a human vein pattern collected from the back of the hand

As it can be seen in the figure1 above, hair is sometimes an obstacle especially when acquiring images from male subjects. The back of the hand is the area many producers of vein scanners prefer and therefore the algorithm has to take this into account since it can lead to false representations of the vein pattern. Consecutive contrast operations in conjunction with a low-pass Gaussian filter are used to enhance the image of the vein model then a threshold is applied thus creating a binary image

outlining the vein pattern. The threshold cannot be applied statically, since the images will differ due to the depth of the vein pattern for different subjects. The best approach is to use an adaptive threshold calculated in different parts of the image [1]. The resulting image suffers more transformations. A thinning algorithm is applied and all lines are converted into 1 pixel width lines in order to compensate for the effects of aging, temporary vessel constriction or dilation, and other medical factors that can modify the width of the veins. This is also necessary if the measurement data has been collected at various timestamps and the vein pattern has modified in size (usually a global increase of the pattern). One of the most important problems of a feature extraction algorithm is the preservation of the connectivity of the vein model since a regular edge detection technique is not optimized for finding vein structures. Several sub-algorithms can be used to find the lines of the model, either by the same technique used in fingerprints (ridge finding) or by following the connectivity of each line. Different algorithms will differ in terms of complexity and therefore the needed computational resources will vary.

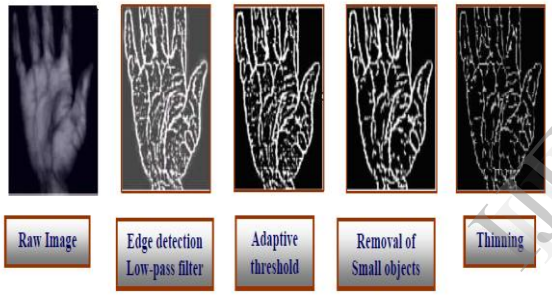
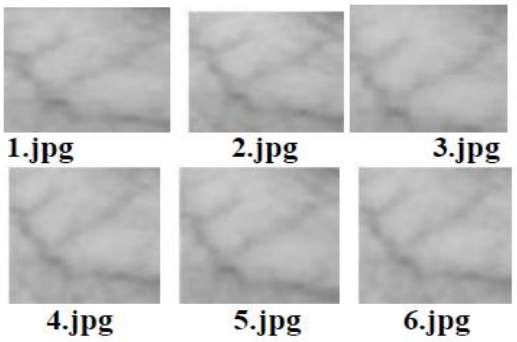


Figure2. Proposed steps for a vein model feature extraction algorithm

These are the different steps in feature extraction algorithm. These are as follows.

- Data acquisition
- Image preprocessing
- Image segmentation
- Image enhancement
- Low pass filtering
- Adaptive thresholding
- Image thining

Input Images [14]



Data Acquisition

We have to get images of the vein from IR LED camera and after that we need to process these images of the vein. Since the cost of implementation is high, instead we have taken the raw set of images of vein on which we worked and preprocessed these images for the vein recognition.

Image preprocessing

Preprocessing images commonly involves removing low-frequency background noise, normalizing the intensity of the individual particles images, removing reflections, and masking portions of images. Image preprocessing is the technique of enhancing data images prior to computational processing. In image processing applications this generally involves performing operations on the particle flow images acquired by the cameras in order to decrease the number and magnitude of the errors produces during image processing.

Low pass filtering

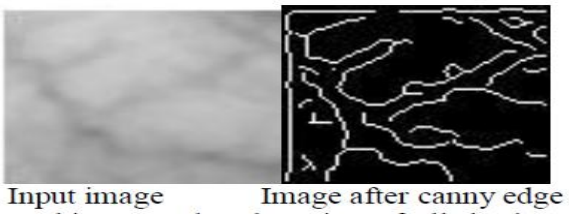
A low-pass filter is an electronic filter that passes low-frequency signals but attenuates signals with frequencies higher than the cutoff frequency. In this process the noise from the vein are removed in the output. The blur in the images and extra noise is removed.

We are concerned with the pattern of vein structure which is used in the last step of the recognition stage. So we have to deals with only edges of the images. With the help of edge detection we can edge of the vein structure.

Edge Detection

Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of

curved line segments termed edges. There are many methods of edge detection but we are using the canny method for the detection of vein patterns. The image and the output image after edge detection are shown below.



Input image Image after canny edge

Storing And Recognition Procedure

1. Create matrix of all the edge detected images [13]
2. Calculate average matrix of the all the images.
3. Subtract average matrix from the individual image.
4. Find the transpose matrix of all the images.
5. Find eigen vector and eigen value

The vector is an eigen vector of matrix A with eigen value **λ** for following equation,

$$Ax=\lambda x$$

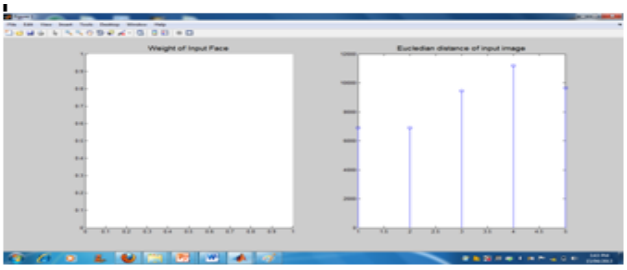
Eigenvectors And Eigen value

These vectors are the eigenvectors of the matrix A. Matrix acts on an eigenvector by multiplying its magnitude by a factor, which is positive if its direction is unchanged and negative if its direction is reversed. This factor is the Eigen value associated with that eigenvector. An Eigen space is the
set of all eigenvectors that have the same Eigen value, together with the zero vector.

Histogram Equalization

Histogram equalization is the process where the image with low contrast is converted in to higher contrast image. A cumulative transformation function is applied on the input low contrast image such that we get an image whose pixels occupy the entire range of possible gray levels and in addition tend to be distributed uniformly which is an high contrast image[13].

Following are some images which explain the histogram equalization technique the input and output images along with their histograms are shown below. Here the given low contrast input image is converted in to high contrast output image



INPUT IMAGE HISTOGRAM OF INPUT IMAGE

Thresholding

Thresholding is the simplest method of image segmentation. Thresholding can be used to create binary images. Adaptive thresholding takes grayscale or coloured images as an input..This extraction is done by the process of adaptive thresholding. During the thresholding process, individual pixels in an image are marked as "object" pixels, if their value is greater than some threshold value (assuming an object to be brighter than the background) and as "background" pixels otherwise.

The edge detected image is further processed using adaptive threshold operation as it improves the contrast of the image. The smaller objects which are present in the image are removed using morphological operations so as the vein pattern may be noise free.

Euclidean distance

To calculate the L2 Euclidean distance between points in MATLAB -The Euclidean distance between points p and q is the length of the line segment connecting them (pq). In Cartesian coordinates, if p = (p_1, p_2,..., p_n) and q = (q_1, q_2,..., q_n) are two points in Euclidean *n*-space, then the distance from p to q, or from q to p.[13] set of all eigenvectors that have the same Eigen value, together with the zero vector.

Result

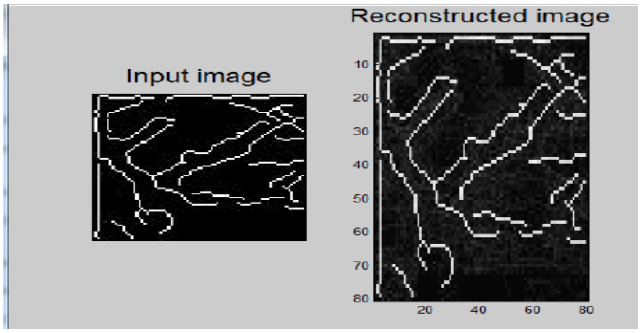


Figure3- The fig shows the input and output images after the all recognition process input image is 2.jpg and output image is same matched with 2.jpg

Conclusion

To evaluate the effectiveness of the proposed vein based recognition scheme, we have built a simple system and also performed simulation experiment by MATLAB .The vein database in our experiment collected a total of 20 images which were organized by acquiring 6 images for the vein recognition. The database images which we have taken from internet were of different sizes so for better recognition we resized them into unique size of 80*80 pixels with an 8-bit gray-scale image. For the further processing we used the feature extraction algorithm[1] .

In this project, we have presented a new vein based user recognition system for personal security and recognition. The system provides effective and efficient features using feature extraction algorithm. The vein based recognition technology has high security and reliability compared to the traditional authentication mode. It also can be applied in public or private equipment, such as entrance control systems, home or office door entry control systems, and ATM (Automatic Teller Machine) systems.

Here we used different techniques like Canny method for Edge detection, low Pass filtering, thresholding etc. to get best result. We experimented with these operations for more than twenty times. With our experimental images it showed very good repeatability.

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