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Approach for Recognition of a Person Based on Its Palm Vein Pattern

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ABSTRACT

Biometric refers to the technology, which works on the human appearance, fingerprints, palm patterns etc. Palm pattern recognition system is the part of the biometric system, which identifies the individual on the bases of internal structure of blood vessel. Near infrared light device is used to acquire the image of internal structure of blood vessel because light in the 700 to 1000 nm (infrared light) ranges can penetrate human skin. Gabor filter is used for image enhancement for clear visualization of internal structure of vein structure. Development of fuzzy set rule for the purpose of edge detection on the bases of these rule edges is obtained. Detection of missing edges is obtained by applying Stephen Harris corner detection technique. The purpose worked shows the high accuracy and results as compare to the Laplacian Palm method, SIFT method, and canny edge method.

Keywords : Edge Detection, Fuzzy Logic, Harris Stephen, Gabor, Knn

I. INTRODUCTION

Palm vein recognition system is the biometric system used for person identification and verification. Large number of biometric system available in the market which distinguish person on the bases of different individuals like height, skin colour, texture, retina, voice etc. Palm vein biometric are superior because it has high level of efficiency reason behind is uniqueness and complex structure of blood vessel, which are present under the skin. The veins are present under the skin that is why not easy to forge. Palm vein recognition system is hygienic also because it is contactless. Benefits of palm biometric is internal structure of blood vessel remain same in person complete life span so no requirement of storing a database of person again and again. To acquire the internal structure of vein infrared light device is required as the experiment shows light of wavelength 700-1000nm can penetrate the human skin. Human palm skin is divided in three layers epidermis, dermis; and sub cutis. Different light wavelength will penetrate to different skin layers and illuminate in different spectra. To achieve the vein image it depends on two factors:1) the colour-absorptive and colour-reflective characteristics of human skin and 2) the light spectra to be used when acquiring images. The light of different wavelength give different contrast image but infra-red and NIR light(880–930 nm) give good contrast image of vein structure. Which is visible in the image for the further edge enhancement.

Basic Steps in Palm recognition System

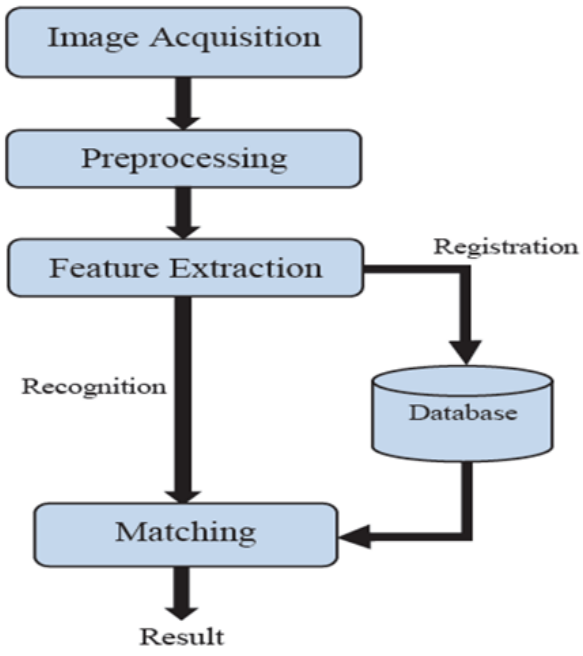

Figure 1: Basic Flow Diagram

General approach for any biometric system would be, start with image acquisition that is input image from the database, next is the pre-processing where image quality enhancement techniques are applied like gabor filter, next is the feature extraction on the bases of this information biometric system decide the authentication of person and final step is the matching where classifier is used for the matching purpose it match the training data with testing data.

Purposed Scheme

In purposed work is categorized in different step. These steps are
A.Input image from database
B.Apply Gabor filter to input image
C.Fuzzy logic for edge detection
D.Apply Harris Stephen Corner edge detection
E.K-nn classifier
F.Evaluation of parameters

A. Input image from database

In this work the image is taken from the database. These images in the database are captured with the help of near infra-red light (740-960nm wavelength).NIR radiation provides clear visualization of vein pattern. Multiple techniques are used to remove the noise from the background and improve the quality of captured image.

Figure 2: Human hand vein captured with a near infrared camera

B. Apply Gabor Filter to Input Image

Once the raw image is taken from the database it needs to apply pre-processing to enhance the quality of image and visibility of vein pattern. This is followed by the two steps

1. crop the region of interest(ROI)
2. apply the Gabor filter on cropped ROI

The Gabor filter can be defined as follows-

$$g(x,y,\lambda,\theta,\Psi,\sigma,\gamma) = \exp\left(-\frac{x'^2+y'^2\gamma^2}{2\sigma^2}\right)\cos\left(\frac{2\pi x'}{\lambda}+\Psi\right) \quad \ldots\ldots(1)$$

Where

$$x' = x\cos\theta + y\sin\theta \quad \ldots\ldots\ldots(2)$$
$$y' = -x\sin\theta + y\cos\theta \quad \ldots\ldots\ldots\ldots(3)$$

The ‘λ’ represent wavelength of the sinusoidal factor, ‘θ’ represents the orientation, and ‘Ψ’ is the phase offset, ‘σ’ is the standard deviation, ‘γ’ is the spatial ratio.

The threshold values are given to equation (1) for extraction of feature.

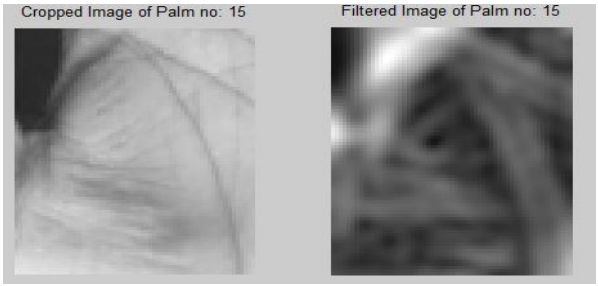

Figure 3: operation of Gabor filter on image

C. Fuzzy Logic For Edge Detection

Fuzzy logic is the set of rules on that bases it decide, whether it is edge class, background class and speckle class. Four set of rules are designed for edge class in different direction, one class for background and one class for speckle edge. A 3×3 mask is used which scan the complete image in step by step, where P5 is the pixel under testing whether it is edge or not ,it will decide with the help of the neighbourhood pixels(P1,P2,P3,P4,P6,P7,P8,P9).A feature vector is obtained bi-directional summed magnitude differences in gray level between P5 and its neighbours are

designated by dir1, dir2, dir3 and dir4 for Directions 1, 2, 3 and 4, respectively, and feature vector is obtained y=(dir1,dir2,dir3,dir4)

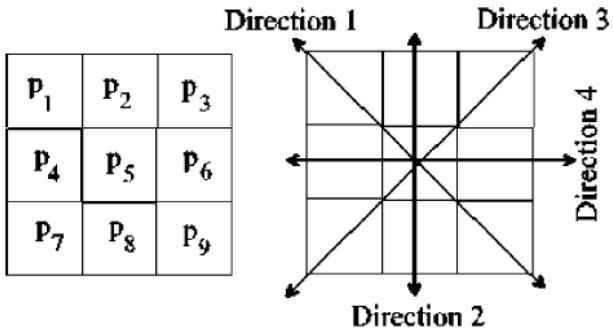

Figure 4: Pixels and directions in a 3 × 3 neighbourhood

$d1 = |p1 - p5| + |p9 - p5|$ (Direction 1)
$d2 = |p2 - p5| + |p8 - p5|$ (Direction 2)
$d3 = |p3 - p5| + |p7 - p5|$ (Direction 3)
$d4 = |p4 - p5| + |p6 - p5|$ (Direction 4)

D.Apply Harris Stephen Corner Edge Detection

Harris Stephen is the corner edge detection technique it is the modified Moravec's corner detector by considering the differential of the corner score with respect to direction directly, instead of using shifted patches. This corner detection technique is help in the detect the missing edges which are missed by fuzzy rule set and make system more accurate and sensible.

E.KNN (k nearest neighbour) classifier is a algorithm which is used to classifying the object to the closest training sample in the database. It is the simplest algorithm for classifying the object. If k=1 then the object is simply classify to the closest class. When k is greater than 1 then value of k must be odd because it make clear decision with majority of neighbour. Each query image Iq is examined based on the distance of its features from the features of other images in the training database. The nearest neighbour is the image which has the minimum distance from the query image in the feature space. The distance between two features can be measured based on one of the distance functions such as, city block distance d1, and Euclidean distance d2 or cosine distance d_{cos}.

$$d_1(x,y) = \sum_{i=1}^{N} |x_i - y_i|$$

$$d_2(x,y) = \sqrt{\sum_{i=1}^{N} |x_i - y_i|}$$

$$d_{cos}(x,y) = 1 - \frac{\vec{x}\vec{y}}{|x|.|y|}$$

K nearest neighbour algorithm uses K closest samples to the investigate the image. Each of these samples belongs to a known class Ci. The image which is under investigation is categorized to the class CM which has the majority of occurrences among the K samples. The performance of the kNN classifiers highly related to value of the k, the number of the samples and their topological distribution over the feature space.

II. COMPARISON OF RESULTS

The purpose worked shows the high accuracy and results as compare to the Laplacian Palm method, SIFT method, and canny edge method. The results of fuzzy rule set for edge detection are more accurate and sensitive. The scope of false rate in fuzzy logic is decrease as compare to the other technique and it shows the 96% of accuracy.

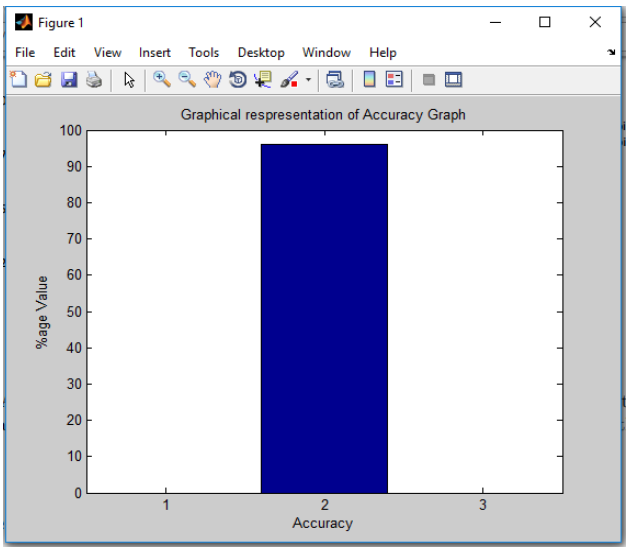

Figure 5 : The accuracy of the proposed work

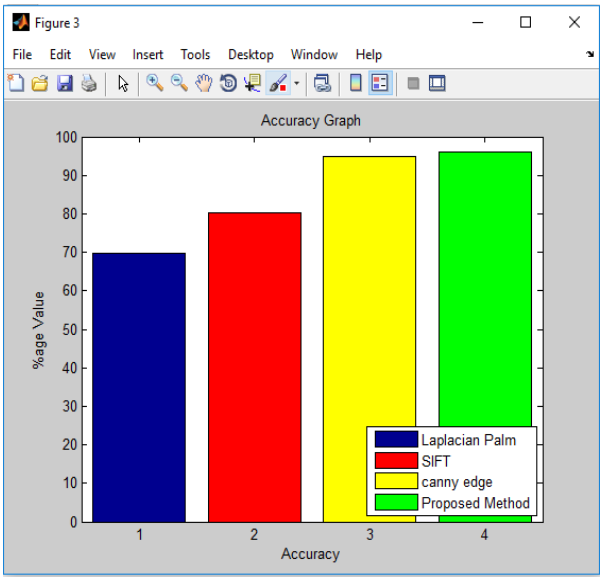

Figure 6 : comparison of result of fuzzy logic with other edge detection techniques

Method Applied	***Rate Achieved***
Laplacian Palm	69.81%
SIFT	80.37%
Canny edge	95.00%
Proposed work	96.00%

III. CONCLUSION

The Gabor filter and Effective fuzzy logic based edge detection has been presented in this work. This technique uses the edge strength information derived using three (3×3) masks to avoid detection of spurious edges corresponding to noise has extensively used to detect the edges of the blood vessel as palm vein pattern. The result of the filtered image gives fine extraction of the edge of blood vessel. The filtered image is processed under the Harris Stephens corner point detection algorithm that gives the green key points to form the feature vector. The purposed work obtained maximum information present in palm vein pattern and helps to build more secure biometric system. The palm vein authentication technology offers contactless authentication and provides a hygienic and non-invasive solution, thus promoting a high-level of user acceptance.

IV. FUTURE SCOPE

The proposed system can be applied to various parts of the human body where the veins are accessible(such as: Finger, wrist, and etc.). The quality of image data is vital for the applications; hence a lot of tasks need to be handled in the pre-processing stage. So, the current image enhancement methods can be improved to provide better enhancement results with lower complexity and less time consumption. The purposed work is based on fuzzy set rule, the better and less complex algorithm can be developed. Another matching method can be used instead of purposed, such as neural methods which may increase the discriminating power of the system and the matching time.

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