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Analysis of Palm Vein Recognition Technique using Binary Feature Extraction for Unique Identification

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Abstract:
Biometrics are used as one of the best alternatives in Recognition System. Palm vein recognition is an eminent and hoax-resistant means of biometric authentication. This paper aims a comparison between various matching algorithms to obtain a high accuracy and EER. The proposed algorithm are applied on a SIMULA data base containing 1200 samples and the method used for palm vein recognition is derived from local binary patterns(LBP).Firstly the palm vein images is enhanced by using CLAHE. After that, local binary patterns are to be extracted from the enhanced images. The computed palm vein feature vectors are represented in the form of series of binary pattern, therefore similarity check be computed efficiently.

Keywords: Palm vein, Local Binary Patterns, CLAHE, Manhattan, Ellucedian, D1, Canberra Similarity Measure, SIMULA Database.

I. INTRODUCTION

Palm Vein identification is the newest technique among all the available biometric recognition techniques. The basic idea is to capture the image, enhance it, extract relevant features from the image, and then compare it with the images in the database to finally recognize the individual. In todays scenario all automatic human df not visible through naked eyes. Palm veins are more secure and robust in comparison of other available identification technique like iris recognition, voice recognition, face gesture. Palm vein Recognition technique uses pattern-recognition method based on images of palm vein pattern which are present beneath the skin. Vein pattern is basically the network of blood vessels beneath person's skin. They are not affected by aging also. Veins are deep under the skin, thus this characteristic makes the systems highly secure, and they are not affected by the situation of the outer skin Vein patterns are different of every individual.[1].As the palm vein used for identification trait is little complicated due to the intricate network of the veins in the palm which make the system more robust , hard to fool and easier to operate. This increases the complexity of algorithm but result in better performance and reliability as there is more information to uniquely identify a sample from the large dataset. The Local Binary Pattern(LBP) is proposed by ojala in 1994,which is a texture recognition algorithm which they applied for extract the information based on distribution of edges that are encoded using two directions they are positive or negative.[2].This operator is based on grey level comparison of neighborhood pixel. The original operator is 3 by 3 neighborhood of 8 pixels around the center pixel. This neighborhood is threshold by the value of center pixel and the result obtained is a binary value. The LBP extraction are done in a circular or square neighborhood. A circular neighborhood is especially design for rotation-invariant operators. The main contribution of this paper is that it will introduces some new distance matching algorithm which are applied on Local Binary Pattern (LBP) to calculate the matching scores. The comparison between matching algorithm is done on the basis of different parameters. The uniform feature vector is formed that is able to overcome the irregularities in samples of databases. A local binary pattern is called uniform pattern if and only if its uniformity measure is at most 2. By selecting only the uniform patterns, one can reduce the size of the feature vector (LBP histogram) and improve classification performance. There are various advantages of using LBP as it gives invariance to Grey scale change, simplicity, high discriminative power and good performance. The rest of the paper is organized as follows. Section II describe the proposed model and discusses the uniform LBP in detail. The experimental results are discussed in section III. Conclusions and future scope are given in section IV.

II. PROPOSED MODEL

The block diagram used in the proposed method is shown in figure 3 and various blocked are explained in the following subsection.

A. Pre Prosseing Stage

The contrast of the image sample is enhanced by using the Contrast Limited Adaptive Histogram Equalization (CLAHE) [6].The adaptive histogram is used over conventional histogram as it reckon several histogram of distinct section of image and uses them to redistribute the value .CLAHE is an advance version of adaptive histogram equalization which overcome the disadvantage of noise amplification in homogeneous region of image.

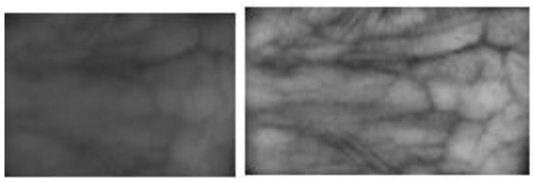


Figure.1.Resized Image: The origin nal sample is subjected to CLAHE and the image of is resized to appropriate dimensions for feature extraction

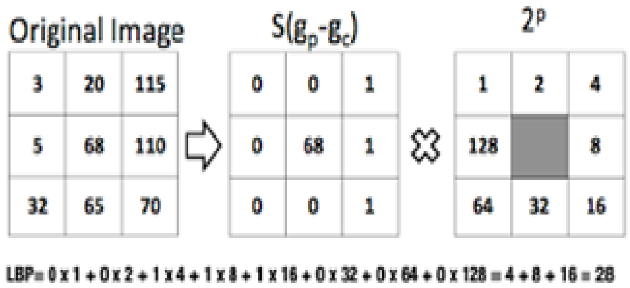
B. *Local Binary Patterns*

T.Ojala et al .[1] proposed the LBP, that describes the texture structure using the neighborhood of the center grey pixel, gr. Its operation is based on a grey level comparison of neighborhood of pixels. Given image I, the operator for this image is the 3 x 3 neighbourhood of 8 pixels around a centre pixel. This neighbourhood is thresholded by the value of the centre pixel and the result obtained is considered as a binary number which is represented in the below eq.

LBP_P, R (I c) = ∑s (z p − z r) * 2^(p−1) (1)

where s(u) = 1 if $u \geq 0$ and 0 otherwise. Each obtained decimal number is considered as a type of micro-pattern[3]. These micro-patterns are represented in histograms whose each bins contain one type of pattern.

The commutation of LBP is done in a following way:



The extention of LBP is uniform LBP. The original LBP is said to be uniform LBP if an only if there is a transition of two most bit. By using uniform LBP the size of feature vector is reduced and it also improves the classification accuracy of the system. There is a different labels of output for individual uniform pattern and only one label exist for obtaining the non uniform pattern. So for pattern maping of number of various output labels for P bits pattern is

$$P (P - 1) + 3 \qquad (2)$$

Patterns such as 00001100, 11000011, etc. are uniform patterns while 00010100, 0011001100, etc. are not uniform patterns. If (8,R) neighborhood is considered a total of 256 patterns generated out of which, 58 uniform, and 59 non uniform different labels. So by using uniform LBP more compact image representation is done.

P=8 R=1 P=16 R=2 P=16 R=7

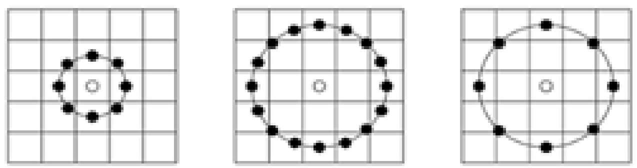


Figure.2.Different size of neighbourhood

Using (1) and (2) the 8-bit binary pattern for each center pixel is obtained. which are concatenated to form a global feature vector of the image.

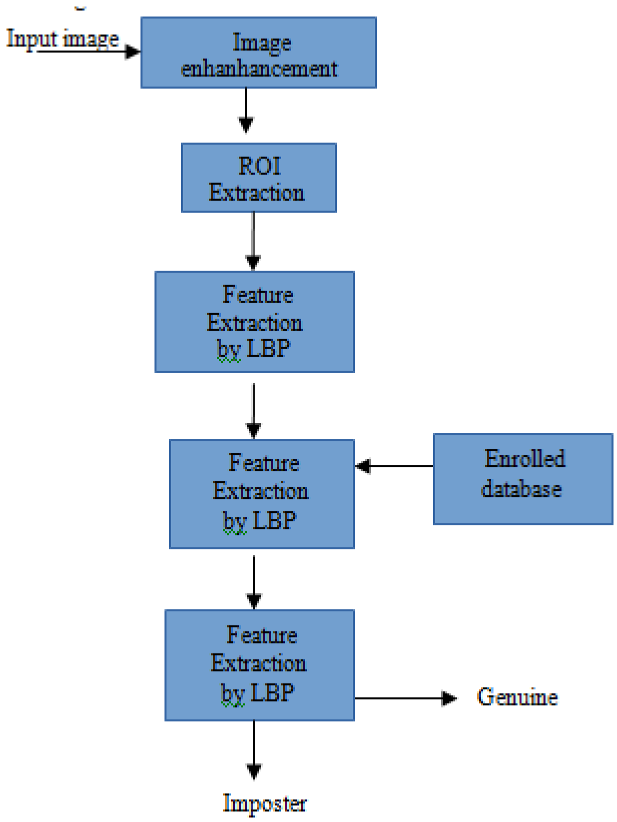


figure.3. Block Diagram

C. *Similarity Check*

The similarity between the image to be tested and enrolled images is determine by using four different similarity measures[5].
a) Manhattan distance measure.
b)Ellucedian distance.
c) D1 distance.
d) Canberra distance.
Manhattan distance is measure by using equation
M (a, b) = ∑ (X(i) – Y(i)) (3)
where i =1,2,........n; and X(i) and Y(i) are two point of image.
Ellucedian distance is given by
d(a, b) = √ (b(x) – a(x)) + (b(y) – a(y)) (4)
where a and b are two points between which distance is to be measured.
D1 distance is findout by using equations
d1 = ∑ (| x(i) - y(i) |) / (1 + | x(i) | + | y(i) |)
where i = 1 to n.
Canberra distance is defined as [6]
d_cad (x, y) = ∑ (| x (i) - y(i) |) / (| x(i) | + | y(i) |)
where i = 1 to n;d_cad is the canberra distance.

D. *Proposed Algorithm*

The datase has 100 subjects each subject having 12 palm vein image samples. The algorithm which is proposed for extraction of feature is mention in following steps.

- The sample image is enhanced and resized to desirable dimension.
- Extraction of feature vector is done by using Local Binary Pattern having a dimension of each image equivalent to 1 x 184600.
- The feature vectors of 12 samples of every subject are concatenate to form one feature vector for each subject, means 100 different feature vectors for 100 subjects.

- After that System performance characteristics, i.e. False Acceptance Rate (FAR) and False Rejection Rate (FRR) are calculated by comparing the individual samples with the global feature vectors which is generated for each individual.
- The curves plotted for FAR and FRR show a clear difference between the two characteristics which gives a different range to set a threshold for matching.

III. EXPERIMENT RESULT

The implementation of proposed method is done on a SIMULA database, which had 1200 samples of 50 candidates,12 samples of each hand taken in 3 series considering a difference of at least one week. The size of the images were 1024 x 768 pixels [4].The four samples belonging to same series of images of a palm are shown in fig 4.

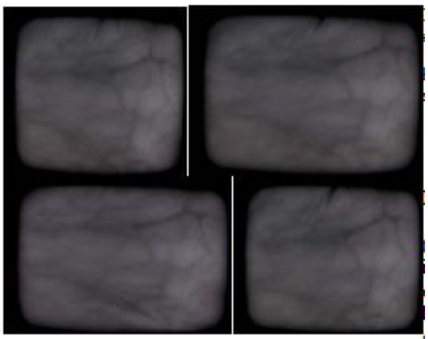


Figure.4.Vein Pattern samples belonging to same individual

The Region of Interest (ROI) of image was extracted by locating the center of gravity of the image. This is the point where most of the information was present. Images are resized to 142 x 100. By using Contrast Limited Adaptive Histogram Equalization (CLAHE) contrast of image sample is improved. The images which are enhanced were given as input to the LBP block to extract the features. Every image now be represented by 8 bit-binary patterns, which were then concatenated to form the feature vector of every image. The 12 different image samples obtained for every candidate show some random shifts and irregularities in achieving vein patterns which gives 12 different set of feature vectors for each candidate, then they were combined to form a single feature vector for all the images belonging to that set. Doing this help in improving the accuracy. The FAR vs. FRR graph, Fig. 5, is plotted to estimate the Equal Error Rate (EER), which comes out to be 20.14 for Canberra distance which is the best result in comparison of rest three distance measuring algorithm for A total of 1188x100 comparisons were performed in calculating the FAR and 12x100 comparisons were performed for FRR. There is a clear distinction between FAR and FRR plots which would help in defining a clear threshold value.

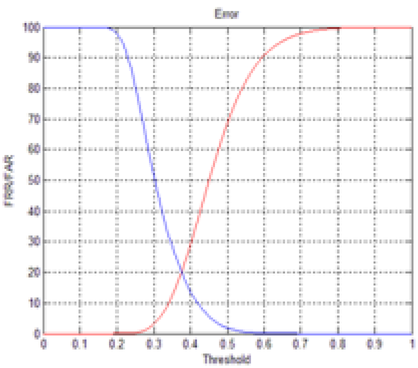


Figure .5 FAR vs threshold Graph for feature vector

The ROC curve is plotted in between the False Acceptance Rate and the False Rejection Rate at various threshold setting. By changing the threshold value FRR and FAR values can also be changed. For calculating the FRR value, the biometric reference is compared with all samples of the same individual. And for finding FAR value, the biometric reference of an individual is compared with all samples from different individuals. From the below graph it is cleared that as the value of FRR is increases the value of FAR decreases which is very necessary to make the system robust.

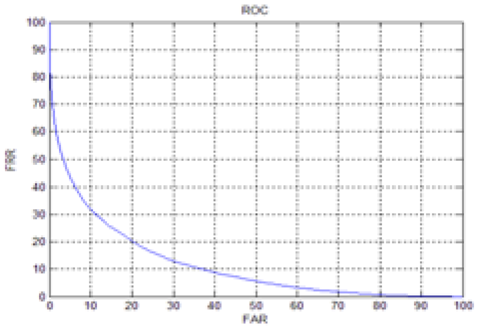


Figure .6.FAR vs FRR curve

The figure 7 shows a relationship graph between success rate and false acceptance rate .The graph states that as the accuracy for canberra distance reaches above 50% the FAR value is increased gradually. so the accuracy obtained for this matching algorithm is 52% as FAR should be kept minimum for more robust biometric system.

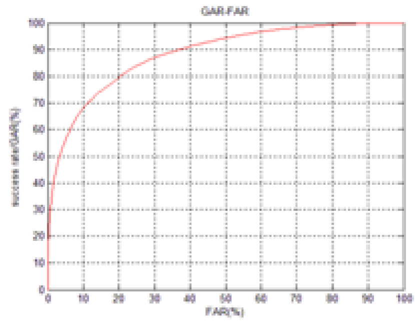


Figure.7.accuracy measure curve between GAR vs FAR

Table. 1comparison of eer for different matching algorithms

Type of distance	Manhattan distance	Ellucedian distance	D1 distance	Canberra distance
EER	22.4697	26.1212	20.1667	20.15
D_prime	1.6801e+03	1.6801e+03	1.6801e+03	1.6801e+03
Classification accuracy	46.33	42	52	52

IV. CONCLUSION

The proposed matching algorithm works efficiently on the chosen database giving a different EER value . It is concluded that out of four matching distance techniques canberra matching algorithm gives very impressive result on LBP (Local binary pattern). This technique can be applied on other such databases to check its performance and verify the claims. If the suggested method works well its performance can be enhanced by incorporating some changes like as combining more features, varying the length of feature vector, etc. Its future scope includes checking the system's performance on other higher derivatives and if the results are promising, doing a research to find a better accuracy.

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