Palmprint Identification Using Genetic Based Technique

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Abstract: Biometric verification is any means by which a person can be uniquely identified by evaluating one or more distinguishing biological traits. Unique identifiers include fingerprints, hand geometry, earlobe geometry, retina and iris patterns, voice waves;Gabor filters generate different frequencies and orientations which help it to extract useful features of an image. So, basically it helps to generate a threshold value of an image on the basis of which different and suitable frequencies and orientation points are generated. These generated points help in the image recognition process of an image. Also the technique of KNN in combination with Gabor filters and another approach of Gabor & WPLI help in the recognition process of a palmprint with better results and performance. Among all the best results is achieved using LLDP approach where verification results are 100%. In our experiments, we have implemented the improved LLDP (iLLDP) approach along with genetic algorithm to improve the Receiver Operating Characteristic curve (ROC), Correct Recognition Rate (CRR) and reduce the time complexity for the palmprint recognition technique. By improving these 3 parameters we have successfully attained better palmprint recognition as compared to the existing LLDP approach. With iLLDP approach we have achieved better recognition results along with verification of palmprint.

Keyterm:Palmprint,LLDP,iLLDP

I. INTRODUCTION

Biometrics is the known technique being used for identification, recognition and verification in various fields. It is the technique used to identify human beings when it comes to the surveillance and access control at various work places and organizational groups. The initial implementation of this was for research field and in forensics. The biometrics is classified on the basis of their physiological and behavioral characteristics. The various traits of biometrics used for security are fingerprint, palmprint, face recognition, iris, hand geometry, retina, etcetera are classified under physiological characteristics while others such as voice, gait, typing rhythm and many more under behavioral characteristics. Earlier methods used were token-based identification like passport and license and knowledge based identification such as password or personal identification number (PIN). Traditional methods were not very secured and could be easily forged by stealing and were not considered a reliable source for security. Biometrics is being widely used these days due to its uniqueness, universality, performance, acceptability and measurability worldwide. Palmprints has recently grabbed great attention of researchers due to its rich, stable and unique features like ridges, principal lines, wrinkles, minutiae, etc. The concept of hand geometry was initially introduced by Sir William Herschel in the year 1858, who has worked for Civil Services of India.

The palmprint is classified into 3 broad categories for verification and those are principal lines, texture formality and subspace learning. In this paper, we shall emphasize on palmprint verification and recognition approaches.

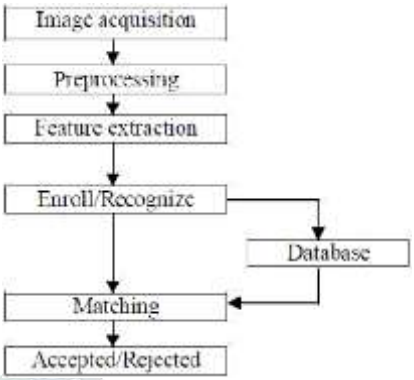

Fig.1. Palmprint Recognition steps

The above image shows the steps followed for the recognition of a palmprint. It is the general approach used in the field of palmprint recognition. The fig.2 describes the major traits of palmprint used for the palmprint recognition technique with different approaches.

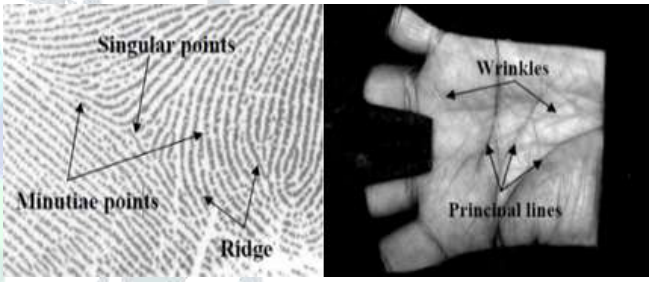

Fig.2. Representation of principal lines, winkles, minutiae points and ridges in a palmprint.

1.1 Gabor filter

Gabor filter is named after the scientist Dennis Gabor and is often used for texture analysis in image processing. It basically analysis if there is any specific frequency content in the image in specific location in the local region around the region of analyses. Gabor filters generate different frequencies and orientations which help it to extract useful features of an image. So, basically it helps to generate a threshold value of an image on the basis of which different and suitable frequencies and orientation points are generated. These generated points help in the image recognition process of an image. It generally works upon low scale image and help to extract those points that can be useful at the time when matching is performed. Gabor filters are mainly used for 2-D images, but these filters can be used in combination with various techniques to enhance the recognition performance and generate better and accurate results.

1.2 Genetic Algorithm

The genetic algorithm is search heuristic which is based upon Charles Darwin's theory of natural evolution. This algorithm depicts the natural selection process in which the fittest individuals are selected to produce an offspring of next generation. There are five main phases of genetic algorithm:-

Fig.3. Five phases of genetic algorithm

I. **Initial population:-**It is the set of individuals called population. Each individual present is the solution to the problem that we wish to resolve. An individual is characterized as set of variables called Genes.

II. **Fitness function:-**Fitness function determines how fit is the individual in comparison with that of other individuals. It generates a fitness score for all the individuals. The probability that an individual will be selected for reproduction depends upon its fitness score.

II. **Selection: -**The main purpose of selection is to select the fittest individual depending upon its fitness score. The two best individuals or parents are selected to generate better offspring. The individuals with highest fitness score has more probability of getting selected.

IV. **Crossover: -**Crossover is the most vital phase of genetic algorithm. For each pair to be mated, a crossover point is selected at random from within the genes. Generation of offspring occurs by the process of exchanging of genes of selected parents or individualsuntil the crossover point is reached. The generated new offspring is added to the population.

V. **Mutation: -**In some of the ne formed offspring's, some of their genes are subjected to mutation with low random probability. This means that some of the bits in the bit strings are flipped. Mutation occurs to maintain diversity among the population and to avoid the generation of underdeveloped offspring.

II. LITERATURE SURVEY

[Cenys et al.(2013)]Biometrics has been widely used to deal with authentication and identity management problems. These are unique in every individual or human being that makes it easy to differentiate all at individual basis. Palmprint is being used widely these days, while facial and fingerprint are more commonly used but are bit expensive to set up. This paper implements genetic based palmprint recognition approach that do not require and special equipment to set up and can be used at the places where fast recognition is required. The proposed method is compared with the existing one on the basis of method description, test results and evaluation.

[Younesi and Amirani (2017)] This paper proposes an efficient personal identification system based on palmprint recognition. Palmprint is more robust and after extracting ROI, the ROI is passed through Gabor Filters of different wavelength and orientation. The Binarized Statistical Image Features (BSIF) of phase outputs of Gabor Filters is obtained. Initially different BSIF codes are calculated and combined together and thereafter the histogram of final BSIF code is calculated. Then the efficient histograms are calculated and assigned to the k-nearest neighbour (KNN) classifier to perform personal identification. The experimental results performed depicts that the proposed resultsare better results than that of the existing one.

[Khangad, Luo and Kumar (2010)]This paper represents a new personal authentication system based upon 2D and 3D palmprint features that exploits concurrently. The main objective of the paper is to improve the robustness and accuracy of the existing palmprint identification system implementing 3D palmprint features. The proposed multilevel framework for personal recognition effectively utilizes its robustness against spoof attacks with 3D features of palmprint along with the discriminating power of 2D features. The method used to investigate 2D palmprint feature extractions is Gabor feature based competitive coding schemewhilst for 3D is surface curvature based method which is being implemented. A comparative analysis is performed regarding the representations of their individual performance and the attempt to improve performance using the proposed multilevel matcher that utilizes fixed score level combination to enhance the results. The experimental results approve the better performance with the 3D palmprint feature extractor as compared to that of with 2D palmprint extraction features. Moreover, the results also approve that the proposed authentication system build by this is extremely difficult to dodge, in contrast to the existing one in literature.

[Zhang et al. (2017)] Biometric recognition is an extremely important part of the in the field of biometric security. The pre-processing of an image is considered very important for the recognition of palmprint. On the other hand, many researchers believe that higher is the image sharpness, better will be the performance. However, it is clearly seen that better performance is attained by using a low resolution image for palmprint recognition. It is important for sharpness to lie under the specific range, also defined as the optimal range. Optimal range is defined by calculating the threshold value, below or higher this range the image is not considered apt for recognition of a palmprint. In this paper, the concept of palmprint image sharpness is introduced and it is proposed by evaluating the image sharpness between the specified optimal range. The performance is improved when the image used for recognition lies between the optimal range. The experiments are conducted on PolyU palmprint database and IIT Delhi palmprint database using CompCode and POC in order to validate proposed performance parameters of palmprint recognition when it lies under the optimal range. The overall performance is enhanced by 15% for palmprint recognition.

[Kalluri and Prasad (2016)] This paper proposes the implementation of palmprint recognition using Gabor filter & Gabor and Wide Principle Line Image (WPLI) features. Firstly, the images having fixed ROI (region of interest) are extracted. Further, ROI image is resized to the matrix of 64x64. The Gabor filters are implemented to extract features from ROI, whereas dissimilarity distance is required to measure the dissimilarity distance between the query palmprint with palmprint images present in the database. The experiments are conducted on PolyU Palmprint Database using Gabor and WPLI & Gabor features. Better experimental results are achieved with the proposed approach using the combination Gabor and WPLI features when compared to the existing method.

[Luo et al. (2016)]this paper describes the implementation of Local Binary Patter (LBP) which is descriptor that operates in the local-line geometry. So, it defines a new image descriptor known as Local Line Directional Pattern (LLDP). The main purpose of this paper is to work upon different implementations of LLDP descriptor to perform a competitive field of palmprint recognition. The developers of this paper implement and evaluate different variations to LLDP. Moreover, we know that palm-lines are considered dominant feature of palmprint, so when tested with

different descriptors,proposedLLDP descriptor was found more suitable for robust palmprint recognition. At last, the performance parameters of LBP and LLDP descriptors are compared where the LLDPs using directional indexing have better results as compared to that of bit string of Gabor filter using LLDs implementation. This proposed methodology results in number 1 rank by achieving identification rates of 100%. Further to enhance in performance in the field of recognition authors emphasize on developing new descriptor to have better discriminating power, less computational complexity and faster matching rate for palmprint recognition.

III. ALGORITHM

Population:- Population is consisting of the network solutions. Higher is the population size the higher is the accuracy of the genetic algorithm. Initial population is randomly selected.

Fitness Function:- Fitness value of each individual is calculated based on the fitness function. Various variable parameters are being used for the function. Like.

i. Energy (E).

ii. Concentration(Density)(D)

$$Fitness = E + N + Di/N$$

Selection:-Selecting the nodes from the current population to generate the new population. This selection size is

Crossover: - The crossover rate of 2 chromosomes is used with specific probability rate.

Mutation: - The mutation operator is applied on each bit of the chromosome with probability rate of mutation rate. Every bit while mutation will be 1 from 0 and from 0 to 1.

Flowchart

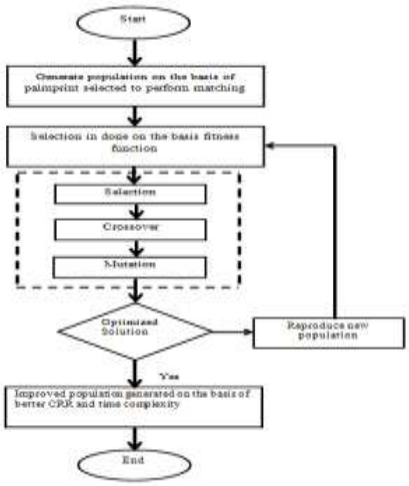

Fig.4. Flowchart of proposed iLLDP descriptor

V. PSEUDO CODE FOR ILLDP

Test case set S= θ
Identify the minutia points from the finger print image.
For each coverage C do
Find point Ns
Repeat
For (i=0;i<|Ns|/2;i++) do
Select two parents in the population
Generate two offspring by crossover operation between two parents
Insert two offspring into new generation list
If a new offspring satisfy the coverage, C then
S=S U (∑of the offspring)
Break
End if
End for
Mutate some offspring in the new generation List
Until satisfy C or reach maximum iteration
End for

VI. RESULTS AND DISCUSSSIONS

6.1 CRR(Correct Recognition Rate):

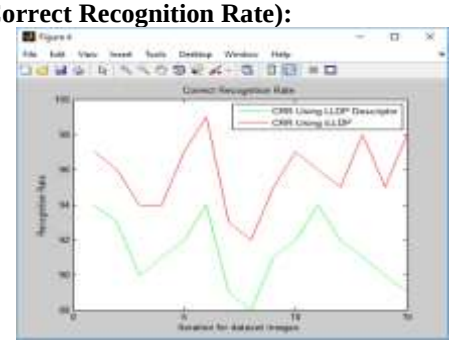

Fig.5. CRR comparison between LLDP and iLLDP

The above result shows the comparison of correct recognition rate (CRR) between existing LLDP descriptor and the proposed iLLDP descriptor. The experimental results verify that CRR of proposed methodology is better than that of existing methodology using IITDelhi palmprint database.

Table 1 values for LLDP and iLLDP

LLDP CRR Values	iLLDP CRR Values
94	97
93	96
90	94
91	94
92	97
94	99
89	93
88	92
91	95
92	97
94	96
92	95
91	98
90	95
89	98

6.2 Time for matching the image

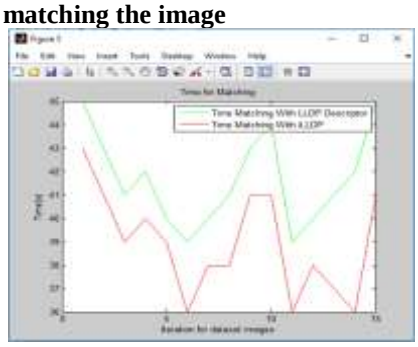

Fig.6. Time required for matching comparison between LLDP and iLLDP approach

The results verify that the time complexity is less in the case of proposed method using iLLDP descriptor as compared to that of existing results of LLDP descriptor. It proposed methodology proves the better results of palmprint recognition in terms of time complexity.

Table 2 Values or time for matching with LLDP and iLLDP

Time for matching with LLDP	Time for matching with iLLDP
45	43
43	41
41	39
42	40
40	39
39	36
40	38
41	38
43	41
44	41
39	36
40	38
41	37
42	36
45	41

a. ROC for LLDP and iLLDP

b.

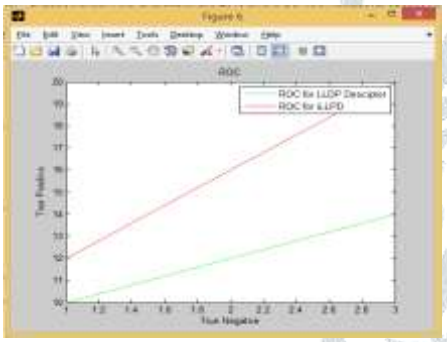

Fig.6. ROC for matching comparison between LLDP and iLLDP approach

The results verify that the ROC is more in the case of proposed method using iLLDP descriptor as compared to that of existing results of LLDP descriptor. It proposed methodology proves the better results of palmprint recognition in terms of ROC.

Table 4:- values for ROC with LLDP and iLLDP

ROC for matching with LLDP	ROC for matching with iLLDP
10	12
12	15
13	17
14	20

VII. CONCLUSION

Various techniques are implemented for palmprint recognition among which a technique of Gabor filters is present. In this technique, Gabor filter is applied using ROI of 64x64 where better recognition rates are achieved, while on the other side another approach of 2D and 3D palmprint feature extraction technique is implemented and the recognition system build using this technique extremely difficult to dodge. Another approach used for palmprint recognition is an optimized approach using image sharpness in which the threshold value is attained and an optimized range is specified in which the image sharpness must lie and has improved results of performance by 15%.

Also the technique of KNN in combination with Gabor filters and another approach of Gabor & WPLI help in the recognition process of a palmprint with better results and performance. Among all the best results is achieved using LLDP approach where verification results are 100%. In our experiments, we have implemented the improved LLDP (iLLDP) approach along with genetic algorithm to improve the Receiver Operating Characteristic curve (ROC), Correct Recognition Rate (CRR) and reduce the time complexity for the palmprint recognition technique. By improving these 3 parameters we have successfully attained better palmprint recognition as compared to the existing LLDP approach. With iLLDP approach we have achieved better recognition results along with verification of palmprint.

VIII. FUTURE WORK

Although, all techniques had implemented and shown better results than that of existing results, but we are looking forward to propose and implement an approach using new descriptor where we will focus to attain correct recognition rate, ROC and reducing its time complexity in more efficient manner. In future this Genetic technique can be enhanced by using various other parameters and their fuzzification.

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