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Optimized Palm Recognition Using Cuckoo Search Algorithm

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Abstract: Palm recognition system is used for segmented the images in order to improve the performance and reliability. For this palm recognition used some data sets. These data sets based upon the location of the friction ridge area. In this work we gather a database from 30 persons. Then it used active shape model algorithm after that cuckoo search algorithm is used for optimized result. In this proposed work, we used gabor filtration method. At the end trained coefficients are compared with the query coefficients and extract the matched image from trained dataset. It concludes that our proposed scheme which used active shape model, cuckoo search algorithm & Gabor filtration gives better results. The experimental results demonstrated that the proposed palm recognition system achieves a recognition accuracy of 98.4% and with false rejection rate (FRR) of = 0.77% & false acceptance rate (FAR) of = 0.77%.

Keywords: Biometrics, Palmprint, Cuckoo, False Acceptance Rate (FAR), False Rejection Rate (FRR).

I. INTRODUCTION

Palm recognition Some palm recognition systems scan the entire palm, while others allow the palm image to be segmented in order to improve performance and reliability. In general terms, reliability and accuracy is improved by searching smaller data sets. Palm systems categories data based upon the location of a friction ridge area.

Computer-aided personal recognition is becoming increasingly important in our information society, and in this field biometrics is one of the most important and reliable methods. A palm is the inner-surface of the hand between the wrist and the fingers. A palm print is defined as the prints on a palm, which are mainly composed of the palm lines and ridges.

Early works in automatic palm print recognition utilized palm print images obtained off line, while the newer systems typically obtain palm print image by using a scanner or a CCD camera. In general, approaches for palm print recognition can be divided into feature-based and appearance-based approaches. Feature-based approaches locate points of interest on the palm image or use other methods to locate and extract local features, where appearance-based approaches observe the entire palm image (previously normalized) as a feature vector.

Two approaches of Palm recognition:-

Feature-Based Approaches: **-** It can be extracted from palm print images and use for recognition. These features include:

- geometry features, such as palm width, height and surface,
- principal lines,
- wrinkles, which are smaller and less regular than principle lines,
- delta-points, defined as the centers of delta-like regions inside the palm,
- Minutiae, which are similar to the features typically extracted from fingerprints and require a high resolution input image to extract.

Appearance-Based approaches: **-** Appearance-based approaches observe the entire palm image as a vector (with pixel intensities as its components).This vector is usually subjected to different transformations in order to select a small feature set suitable for recognition. Earlier approaches usually used fixed transforms, such as Fourier transform, while the newer approaches tend to use transformations which maximize some criterion function on the training data in order to select the best features. These transformations include principal component analysis (PCA), linear discriminant analysis (LDA) and independent component analysis (ICA).

II. TECHNIQUES OF PALM RECOGNITION

Ridge based matching: **-** A matching using the ridge feature in form of finger code consists in computing the difference of two finger code vectors (query and reference). However, before applying the finger code it is important to align the fingerprint images, which is really a big problem, as in the case of other methods. In some case the singularity may be used for that purpose. A finger code also may be used as a complementary to minutiae based method in order to improve the overall matching accuracy. The original approach of this method used circular finger codes, considering as center the core point. The final

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results of the finger code difference are normalized and averaged using the 8 directions and obtained a value that varies from 0 to 1. The lower the score the more similar are the fingerprint. Some threshold value are used to decide whether there is matching or not.

Minutiae based matching: - This is the most popular and widely used in commercial applications, because of its good performance and low computation time, especially for good quality images. This method tries to align the minutiae of the input image (query template) and stored templates (reference template) and find the number of matched minutiae. After alignment, two minutiae are considered in matching if the spacial distance and direction difference between them are smaller than a given tolerance. A correct aligning of fingerprint is very important in order to maximize the number of matched minutiae; this requires the computing of the translation and rotation information, as well as other geometrical transformations such as scale and distortion. In order to compute efficiently aligning information there has been proposed many approaches. In this section we present a method that uses segments (formed by minutiae) instead of isolated minutiae. A segment is formed by two pair of minutiae of the same fingerprint, the way how the set of segments are constructed may vary (e.g., nearest neighbour, delaunay, etc). The figure below shows the segments constructed from the set of minutiae.

Correlation based matching: - Correlation based matching is used to match two palm prints. The palm print are aligned and computed the correlation for each corresponding pixel, however as the displacement and rotation are unknown it is necessary to apply the correlation for all possible alignments. The singularity information may be useful in order to find an approximated alignment.

The main drawback of this method is its computational complexity and less tolerance to non-linear distortion and contrast variation. There has been proposed some alternative that computes the correlation locally instead of globally, in which only interesting regions (e.g., minutia and singularity regions) are selected and matched.

Active shape model: - Active shape models (ASMs) are statistical models of the shape of objects which iteratively deform to fit to an example of the object in a new image, developed by Tim Coots and Chris Taylor in 1995. The shapes are constrained by the PDM (point distribution model). Statistical shape model to vary only ways seen in a training set of labeled examples. The shape of an object is represented by a set of points (controlled by the shape model). The ASM algorithm aims to match the model to a new image. It works by alternating the following steps:

- Look in the image around each point for a better position for that point
- Update the model parameters to best match to these new found positions

To locate a better position for each point one can look for strong edges, or a match to a statistical model of what is expected at the point. The original methodology suggests using to Mahalanobis distance detect a better position for each landmark point.

Phase based palm print recognition algorithm: - Palm print recognition algorithm using phase based image matching. The use of the phase components in 2D (two-dimensional) discrete Fourier transforms of palm print images makes possible to achieve highly robust palm print recognition. Experimental evaluation using palm print images clearly demonstrates an efficient matching performance of the proposed algorithm. The technique has been successfully applied to sub-pixel image registration tasks for computer vision applications.

Rotation and displacement alignment: - rotation and displacement between the registered image and the input image in order to perform the high-performance palm print matching. At first, we reduce the effect of background components in palm print images by applying 2D spatial window to the two image registered image and input image. The 2D Henning window is applied at the center of gravity of each palm print to align the two images registered image and input image correctly. The center of gravity of each palm print is detected by using $n1$-axis projection and $n2$-axis projection of pixel values. The palm print images, registered image and input image, after applying 2D Henning window.

Common region extraction: - To extract the overlapped region (intersection) of the two images. This process improves the accuracy of palm print matching, since the no overlapped areas of the two images become the uncorrelated noise components in the BLPOC function. In order to detect the effective palm print areas in the registered image and the input image, we examine the $n1$-axis projection and the $n2$-axis projection of pixel values. Only the common effective image areas, with the same size are extracted for the succeeding image matching step.

Palm print matching: - We calculate the BLPOC function between the two extracted images and evaluate the matching score. The matching score is the highest peak value of the BLPOC function.

Fuzzy clustering method: - Fuzzy clustering is a class of algorithms for cluster analysis in which the allocation of data points to clusters is not "hard" (all-or-nothing) but "fuzzy" in the same sense as fuzzy logic. In hard clustering, data is divided into distinct clusters, where each data element belongs to exactly one cluster. In fuzzy clustering (also referred to as soft clustering), data elements can belong to more than one cluster, and associated with each element is a set of membership levels. These indicate the strength of the association between that data element and a particular cluster. Fuzzy clustering is a process of assigning these membership

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levels, and then using them to assign data elements to one or more clusters.

Fuzzy c-means clustering: **-** In fuzzy clustering, each point has a degree of belonging to clusters, as in fuzzy logic, rather than belonging completely too just one cluster. Thus, points on the edge of a cluster may be in the cluster to a lesser degree than points in the center of cluster. An overview and comparison of different fuzzy clustering algorithms is available.

III. PROPOSED APPROACH USING CUCKOO

Biometric and biometric security systems will provide a greater understanding of the concept of network security. Biometrics is defined as the unique (personal) physical/logical characteristics or traits of human body. These characteristics and traits are used to identify each human. Any details of the human body which differs from one human to other will be used as unique biometric data to serve as that person's unique identification (ID), such as: retinal, iris, fingerprint, and palm print and DNA. Biometric is physiological and behavioural. Physiological has four steps: hand and palm recognition, head and face, physical characteristic and behavior characteristics. Palm recognition used the active shape model used for the shape of the objects which iteratively deform to fit to an example of the objects in a new image. Correlation based matching is used to match two palm prints. The palm prints are aligned and computed the correlation for each corresponding pixel. After matching phase based palm print recognition algorithm provides the phase information about the images. Phase based palm print algorithm followed some steps like: scale rotation and displacement alignment, common region extraction and palm print matching. Palm print matching is used for matching the new generated code of the images with the previous images. Cuckoo search algorithm is used in this proposed work which gives better results as compare to previous work.

3.1 Proposed Model

The proposed model focuses on the above objectives which are helpful in improving the results and are practically implemented using MATLAB 7.11.0 environment. In this proposed work, we used cuckoo search algorithm to optimize the results and to form a new technique for palmprint matching using Cuckoo algorithm. This algorithm provides better results as compare to previous techniques. The objectives of our proposed work are:

- Understanding of biometric security system.
- Implementation of correlation based matching.
- Implementation of cuckoo search algorithm for palm print recognition.

3.2 Basic Design

Biometric devices consist of 3 elements:

a) Scanner- captures the user's biometrics characteristics
b) Software-converts the data into digital form and compare it with the previously recorded data.
c) System database- stores the biometric data
Figure1 shows the proposed system at block design. Feature Vectors for all images in the database have been calculated in the feature extraction module, and stored in the form of a text file, called the system database. In the matching module feature vector has been calculated from the query image and compared with the system database. A decision for verification or recognition is taken as per the problem targeted. In the Image Acquisition setup featured a platen on which a person placed his/her hand and a webcam that captured the image of hand's top views. This setup is relatively inexpensive as compared to the fingerprint sensors. A database of 30 users has been prepared, taking image of the right hand for each user. The fingers must be clearly separated from each other in the image in order to obtain a complete hand shape. Background should be a dark one. The image acquisition setup does not employ any special illumination. Ideally, the placements of the hand on the platen at enrolment and verification need to be identical. Special markings are provided on the platen to position fingers. No pegs are used on the platen.

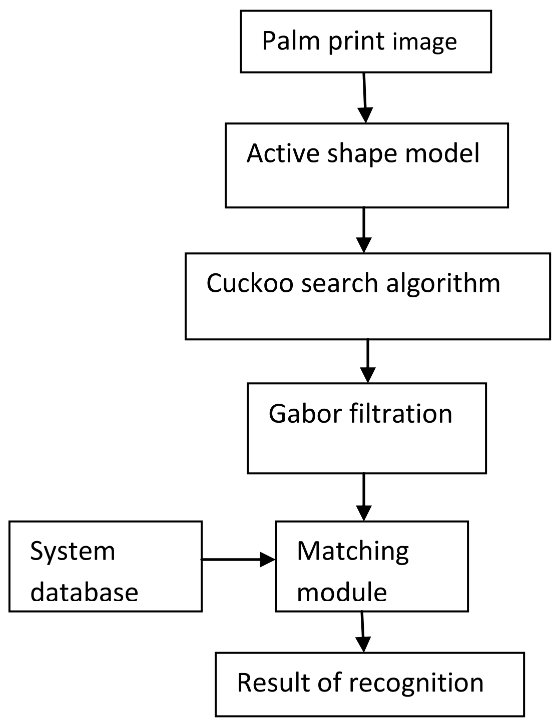

Fig 1: Basic Design of Palm Recognition System

3.3 Algorithm level Design

The algorithm design is shown in Fig 2, which involves:

Step 1: Image Acquisition.
Step 2: Apply active shape model method.

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Step 3: Apply Cuckoo search algorithm to get optimized results.

Woods knock = Number of points in Image

Step 4: Shortest path finder finds path for filtration.
Step 5: Now apply Gabor filtration.
Step 6: Applying SVM & Optimization w.r.t. contours points of coefficients.
Step 7: Comparing trained coefficients with query coefficients.
Step 8: Extract matched image from trained data set.

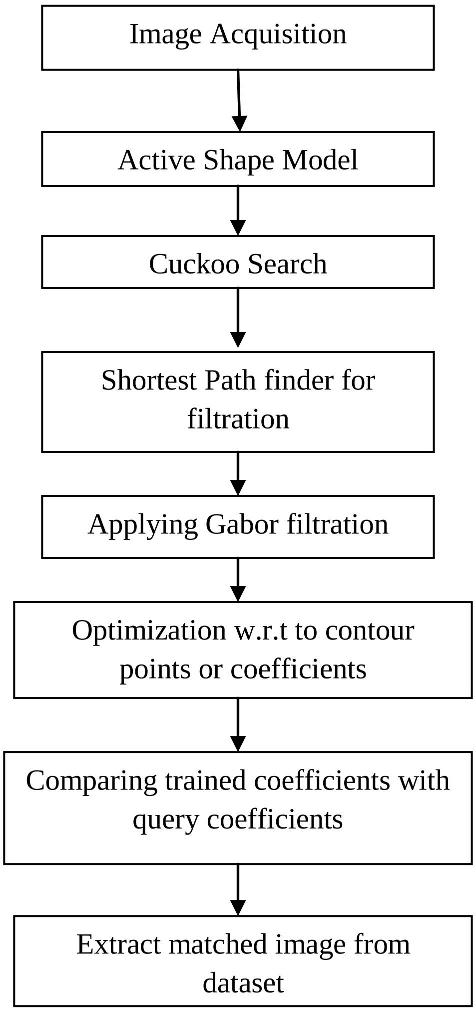

Fig 2: Algorithm level design of Palmprint recognition

Image Acquisition

In this proposed work, we used a sample of 30 palm print images. We collect all samples with the help of internet. All images are gray scaled and we converted all samples to same size (128×128). Figure 3.3 shows the original image samples.

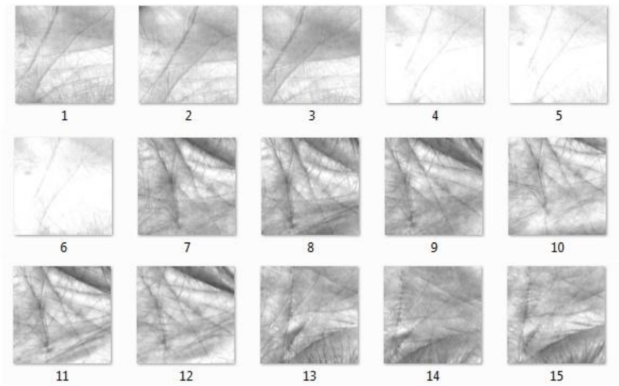

Fig 3: Sample Images (.bmp)

IV. RESULTS

A biometric recognition system can run in two different modes: identification or verification. Identification is the process of trying to find out a person's identity by examining a biometric pattern calculated from the person's biometric features. In the identification case, the system is trained with the patterns of several persons. For each of the persons, a biometric template is calculated in this training stage. A pattern that is going to be identified is matched against every known template, yielding either a score or a distance describing the similarity between the pattern and the template. The system assigns the pattern to the person with the most similar biometric template. To prevent impostor patterns (in this case all patterns of persons not known by the system) from being correctly identified, the similarity has to exceed a certain level. If this level is not reached, the pattern is rejected. In the verification case, a person's identity is claimed a priori. The pattern that is verified only is compared with the person's individual template. Similar to identification, it is checked whether the similarity between pattern and template is sufficient to provide access to the secured system or area. Performance of the biometric systems is measured by their accuracy in identification, which is calculated using false rejection rate and false acceptance rate. In this proposed work, a database of 60 images consisting of a **Training Set & Test Set** is used. Training Set consists of 30 genuine samples from known persons. Test Set consists of some genuine & some forged samples. For Palm print Samples:

Total Number of Samples in the database=30

Number of Sample that falsely accepted=7

$$FAR = \frac{\text{Total Number of Samples} - \text{Number of Samples that Falsely accepted}}{\text{Total Number of Samples}}$$

$$\text{So, } FAR = \frac{30-7}{30} = \frac{23}{30} = 0.77\%$$

Total Number of Samples in the database=30

Number of Sample that falsely rejected=7

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$$FRR = \frac{\text{Total Number of Samples} - \text{Number of Samples that Falsely rejected}}{\text{Total Number of Samples}}$$

$$\text{So, FRR} = \frac{30-7}{30} = \frac{23}{30} = 0.77\%$$

Tests are run on the dataset of 30 users. Results are reported in the form of FAR and FRR which are obtained for a different values of threshold. Accuracy is calculated for new proposed techniques.

$$\text{Accuracy} = 100 - (\text{FAR} + \text{FRR})\ \%$$

$$\text{Accuracy} = 100 - (0.77 + 0.77)\ \%$$

$$\text{Accuracy} = 98.4\ \%$$

Fig 4 shows the comparison of Previous & Proposed techniques which results that our proposed technique gives more accurate results than the previous. The accuracy of the system is approximately 98.4% which is better than the other Systems.

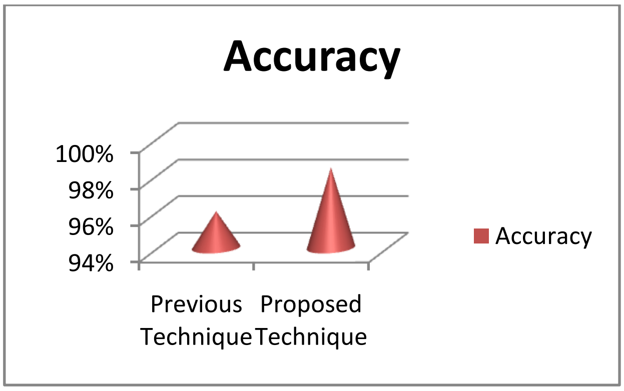

Fig 4: Comparison of Previous & Proposed Technique

V. Conclusion

Palm recognition system is used for segmented the images in order to improve the performance and reliability. For this palm recognition used some data sets. These data sets based upon the location of the friction ridge area. Palm recognition used two approaches: - (i) Feature based approach is used for locating points of interest on the palm image, whereas (ii) Appearance based approach is used for observing the entire palm image. For this purpose it used active shape model algorithm then we used cuckoo search algorithm for optimized results then in this proposed work, we used gabor filtration method. At the end trained coefficients are compared with the query coefficients and extract the matched image from trained dataset. It concludes that our proposed scheme which used active shape model, cuckoo search algorithm & Gabor filtration gives better results.

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