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Palm based Geometry for person identification and verification

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Abstract

In this biometric system, palm print, palm phalanges print which is existing and palm geometry is the new contribution in our work. In palm print and palm phalanges, the input image was taken and it is processed for verification. In Palm geometry, from the input image the features like palm height and width is taken. So that the storage space is reduced by taking data related information. Here, computational time is also reduced. The input images are taken with high resolution camera device. At last, we use random forest to validate the matching stage. The results proved the validity of our proposed modality.

Keywords—Palm Print (PP), Palm Phalanges Print(PPP), Palm Geometry(PG), Person Identification and Verification.

I. INTRODUCTION

The role of personal identification and verification becomes increasingly important in our society. With the onslaught of improved forgery and identity impersonation methods, previous ways of correct authentication are not sufficient. Therefore, new ways of efficiently proving the authenticity of an identity at a low cost are greatly needed. Various avenues have been explored to provide a solution and biometric-based identification is proved to be an accurate and efficient answer to the problem[4]. Biometrics has been an emerging field of research in the recent years and is devoted to identification of individuals using physical traits, such as those based on iris or retinal scanning, face recognition[9], fingerprints, or voices. As unauthorized users are not able to display the same unique physical properties to have a positive authentication, reliability will be ensured. This is much better than the current methods of using passwords, tokens or personal identification number (pins) at the same time provides a cost effective convenience way of having nothing to carry[4]. The proposed Palm geometry has many features like palm length, palm width in unimodal biometric system. Camera with high resolution and pixel in mobile is used as an input device. Hence it reduces the cost and it is effective. Palm geometry can reduce the space and time complexity as the features are of data values.

II. LITERATURE SURVEY

Recent study from the existing papers are analyzed with the attributes namely algorithm, data set used, features used, parameter used for analysis, results of recognition rate, limitations and advantages. From the analysis of the paper named, Multimodal Fusion of PPP with PP and DHV[1], it was shown that KNN, SVM, RF algorithm were used, Features like GMF, AAD were used. GAR, FAR, AUC were identified. In [2], A survey of biometric technology based on hand shape, SVM algorithm was used and features Average feature vectors and Raw feature vectors were used.

III. PALM BASED BIOMETRICS

A. *Palm Phalanges Print (PPP)*

Human hand with its two dorsal and anterior sides consist of phalanges joint, due to its unique pattern can be claimed to be used in personal identification. In its physical anatomy, four fingers, i.e. little, ring, middle and index, slightly differ from thumb. In palmer side of fingers, the skin folding is known as phalanges. The pattern in the skin folding of phalanges joint contains broad area with parallel lines showing the unique information about the individual. This joint can be used as biometric modality and termed as palm-phalanges print.

B. *Palm Print (PP)*

The print that is taken from the interior part of the palm is so called PP. The palm itself consists of principal lines, wrinkles (secondary lines), and epidermal ridges. The input image was

taken, then it went to series of steps like pre-processing, feature extraction, matching which was explained in the later section 3.1.

C. *Palm Geometry (PG)*

PG is the new proposal of our work. Here the geometrical shape of palm is taken and features like height and width was extracted and those data values are stored in the database. Thus it reduces time and space complexity. Recognition rate was much less when compared to PPP and PP. But it may be very useful when it combines with any other biometric system.

D. *Modules and their functionalities*

1) *Image Acquisition:* First, we have created a new anterior hand database of individuals by using camera device or mobile. Then, this database is used to extract Region Of Interest (ROI) from anterior hand images. In acquired database, fingers are not touching each other but all sample positions are kept varying so as to make the system position invariant and hence optimizing the practicality of the system as shown in Fig 1.

2) *Pre-processing:* During pre-processing phase, the RGB image is converted into gray scale image and then noises are removed and smoothed by using appropriate filter. Because of the black background, there is a clear difference in intensity between the hand and the background. Therefore, the histogram of the image is bimodal. The image can be easily converted to a binary image by thresholding. Then the boundary of the image is extracted as shown in Fig 2 and Fig 3.

Region of Interest (ROI) of the image is localized by using the boundaries and cropped. This image is then resized to the same format as that of the entries in database to match [1].

3) *Feature Extraction:* Images are enhanced using Adaptive histogram equalization. Then it is partitioned into non overlapping windows of size (9*9). Thus a total of 81 windows are created from each ROI. Then the Gaussian Membership Function based feature of palm print, palm-phalanges is extracted from each window for feature extraction. Then the Gaussian membership function is used to extract the features from each window because of its robustness and property of providing system with less degree of freedom. Along with GMF, the features based on statistical mean and average absolute deviation (AAD) for feature extraction are also extracted. Classification is performed using Random forest. Calculate scores and obtain ROC for individual modality[1][4].

4) *Matching:* The features of the input images are compared with the database features [1][2]. If any of the features matched with the input features then the person will be identified. Otherwise the person can be verified with only one record in the database. If the input feature is not matched with any of the database features then that person will not be recognized.

5) *Normalization:* Calculate scores and obtain ROC for individual modality [1][4].

IV. EXPERIMENTAL ANALYSIS

A. Experimental set up

The two varying images per person of 50 persons are taken, so initially there are totally 100 images. Testing was performed on certain set of images [1]. The experiment was done by using high resolution camera of 16 MP with laser focus. So, it can be used for web application.

B. Data set description (with illustrations)

The acquired images were stored in the database and it is named as PEC palm print database. The image is selected and it undergoes for the authentication purpose. If the image is stored in the database, it reports that the *image is identified*. If not present in the database means, it reports that the *image is not identified*. If the specified image is matched with many images stored in the database it reports that, the *image is matched with many images*.

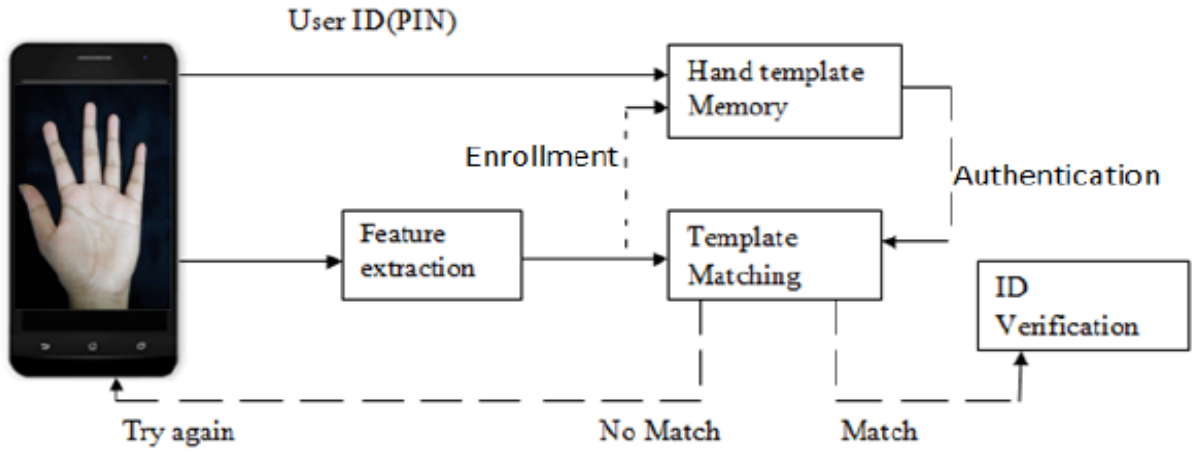

Fig. 1. Overall system architecture

C. Hardware / Software / tools or equivalent Requirement

- System with speed of 2.16GHz
- System type: 64-bit Operating System, x64- based processor
- MATLAB R2010a

D. Assumptions / constraints considered in the experiment

The hand is kept with black background facing upward, the fingers are separated. The palm is captured with high resolution camera[1].

E. Parameters used for assessing your work and to compare with the existing

- False Rejection Rate
- False Acceptance Rate
- Execution time
- Space required
- Recognition Rate
- Intra user variability
- Inter user similarity
- Genuine acceptance rate
- Failure to enroll and Failure to capture
- Match score

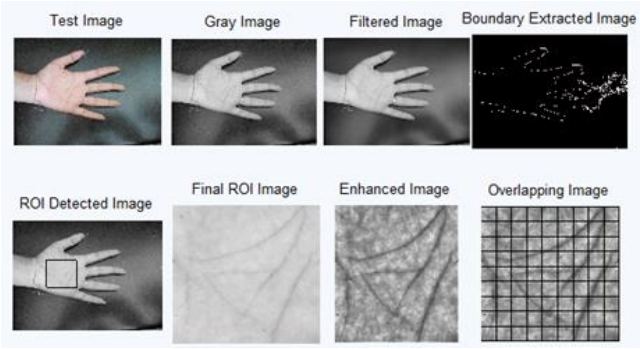

Fig. 2. Palm print modality

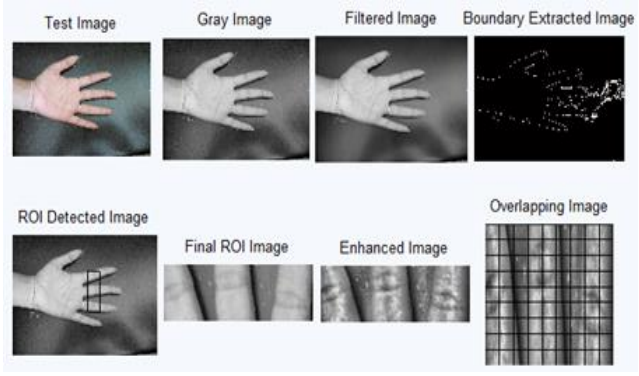

Fig. 3. Palm phalanges modality

PERFORMANCE EVALUATION IN PERCENTAGE FOR
PALM PRINT PATTERN BASED

ON RANDOM FOREST CLASSIFICATION

FAR %	0
FRR %	4.4
Execution time (seconds)	15.45
Space required (MB)	78.2
Recognition rate %	95.6
Intra user variation %	0
Inter user similarity %	0
GAR (1-FRR)	0.56

TABLE I PERFORMANCE EVALUATION IN PERCENTAGE FOR PALM PHALANGES PRINT PATTERN BASED ON RANDOM FOREST CLASSIFICATION

FAR %	0
FRR %	18.18
Execution time (seconds)	16.14
Space required (MB)	44.6
Recognition rate %	87.5
Intra user variation %	0
Inter user similarity %	28.57
GAR (1-FRR)	0.818

V. PROPOSED WORK

As given in the above sections, we discussed about existing module palm phalanges print [1] and the result of parameters are concluded. In the upcoming section we discuss about the proposed work such as palm geometry. We prefer to the use of palm geometry because the features are very less like width, height of the palm. So the space allocated to them was much reduced[2]. As this is of data value, even time also minimized. It will be cost effective also[8].

A. Modules in our proposed work and their functionalities

As done in palm phalanges, same procedure are used in palm geometry modality.

- Image Acquisition
- Pre-processing
- Feature Extraction
- Matching

In feature extraction, features like width and height of the palm are extracted and stored in the database. During matching stage, the features of the person is compared with the already enrolled database features. If the features are matched, then the person will be authenticated.

VI. SIMULATION RESULTS

Fig. 4. Palm Geometry modality

TABLE II PERFORMANCE EVALUATION IN PERCENTAGE FOR PALM GEOMETRY PATTERN BASED ON RANDOM FOREST CLASSIFICATION

FAR %	0
FRR %	0
Execution time (seconds)	15.20
Space required (MB)	44.6
Recognition rate %	97.5
Intra user variation %	0
Inter user similarity %	0
GAR (1-FRR)	1

VII. CONCLUSION

In this paper, a palm based biometric system has been proposed. Along with palm print and palm-phalanges print, a novel biometric modality "palm geometry" has been proposed. To further improve the performance of unimodal biometric system, palm geometry is implemented. The system has been implemented using real images from databases. The pre-processing phase was based on the Gaussian filter. Using cost effective device proved to be very efficient and effective to the users as well as to the recognition system. The mean feature also extracted as shown in Fig 2 and Fig 3. Classification is performed using Random forest. For hand geometry, the geometric features are extracted. Thus the accuracy of Palm Geometry (PG) as shown in Table 3 is higher than Palm phalanges print (PPP).

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