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Palm Print Texture Recognition Using Connected-Section Morphological Segmentation

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Abstract: Biometric Recognition Method provides a greater recognition rate, superior effectiveness and makes the user operating more comfortable. Palm print recognition is considered the most feasible and consistent biometric recognition technique remaining to its merits such as low cost, user sociability with high speed and high accuracy. Advanced and fast correlation based feature for palm print recognition based on modified correlation filter classifier with spatial entities identifies more line features of the palm print very efficiently and in a stochastic manner but fails to adapt the texture variance. To overcome the above issue to implement a new technique termed Palm print Texture Recognition using the Connected-section Morphological Segmentation (PTR-CMS) for effective adaptation of texture variance and to remove the noise from palm print recognition. PTR-CMS technique is to reliably segment the images to smaller regions from the captured images. The proposed scheme is evaluated in terms of segmented regional texture variance based on the partition size and average equal error rate. Connected-section morphological segmentation (PTR-CMS) technique considers the problem of which fails to provide texture variance. An analytical and empirical result shows the lesser false acceptance rate with the efficient adaptation of the texture variance of our proposed scheme.

Key words: Biometrics, palm print recognition, morphological segmentation, connected section, texture variance

INTRODUCTION

The fast growth in the world's economy causes the huge destruction and violence's around the world with the decline in social orders. The importances of security are raised and demand rose to the automatic identification systems. Alternatively, numerous techniques are used in the automatic identification systems. Usually, the person uses the passwords, encrypted and decryption key to access the confidential data in the society. But the password may be forgotten or misused by some other users who are authenticated to the owner. The key can be lost by the user or by antiauthority copied by others.

Consequently, people require an identification system to recognize the user's identity without above disadvantages which is called as the biometric identification. Biometric Identification System has high effectiveness, high recognition rate and comfortable to the user's individual operations. The individuals' physiological individuality include DNA, face, ear, fingerprint, gait, iris, palm prints and voice. A biometric identification system ought to convene accuracy, speed and resource requirement. A palm print pattern is so unique that even twins have different palm print patterns, the pattern remains stable and fixed all through one's life. Compared to other physiological characteristics, palm print recognition is considered the most viable and reliable biometric recognition technique owing to its merits such as low cost, consumer sociability, high speed and high accuracy. Similar to other biometric systems, a Palm Print Identification System using the improved morphological segmentation includes five stages such as palm print augmentation stage, palm print threshold stage, de-noising palm print stage and the boundary detection stage and connected-section morphological approach for boundary detection (Fig. 1).

Enhanced morphological segmentation of palm print is to mechanically and reliably segment a small region from the confine palm print image and palm print extraction is to extract the palm print from a morphological image. This is considered one of important stages from all these stages because it greatly influences the overall identification accuracy and processing speed of the whole system. It is very important that to take the enhanced morphological connected-section segmentation for different palm print images to guarantee the stability of the segmented palm print features to provide consistent recognition rate and speedy processing speed. In reality, a palm print is frequently bounded by noise. So, a novel

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Fig. 1: Palm print for biometric verification

palm print segmentation scheme must extract the palm print by removing all of these “noise” textures and form a de-noise palm print image.

This technique uses the morphological expansion and corrosion to remove the noises and detect the boundary of the palm. The morphological gap operation is combined with the morphological expansion and the corrosion operations. Where corrosion operation is applied to “contract” or “tightening” the objects and expansion operation is utilized to “expand” or “tightening” the objects.

Literature review: Palm print recognition has emerged as one of the well-liked and hopeful biometric modalities for forensic and commercial applications. In recent years, the contact less system emerges as a feasible option to tackle hygienic issues and get better the user acceptance. Therefore the practice of traditional palm print feature extraction methods on contact less imaging schemes remains questionable and hence all/popular palm print feature extraction methods may not be helpful in contact less frameworks by Morales *et al*. (2010).

A new face detection technique is proposed by Nallaperumall *et al*. (2008) which uses mixed Gaussian Color Model, adaptive threshold and template matching techniques. Face detection provides a content-based representation of the image where it can be used for encoding, manipulation, enhancement, indexing, modeling, pattern recognition and object tracking purposes. Katsuki *et al*. (2012), propose a Bayesian image Super-Resolution (SR) Method with a causal Gaussian Markov Random Field (MRF) prior. SR is a system to guess a spatially high-resolution image from given numerous low-resolution images. Nakhmani and Tannenbaum (2012) offer algorithms for locating crossings by angle considerations and by plotting the 4-connected lines between the separate contour points and solves the topological problems. Stamm and Liu (2011) framework operates by estimating the sharing of an image’s transform coefficients before compression then adding up anti-forensic dither to the transform coefficients of a opaque image so that their distribution matches the predictable one but lacks in pairing the images. Thirumalai and Frossard (2012) suggest a geometry-based correlation model in order to clarify the frequent information in pairs of images.

Dhore *et al*. (2011) uses a morphological approach for segmentation of a document image. The morphological approach quantitatively describes operations effectual for the form of objects in an image. The mathematical morphology describes such operations by combinations of essential set operations between an image and a small object called a structuring element. Ponraj *et al*. (2012) uses the morphological operations to improve the contrast of the mammogram image. Morphology has a variety of operations when sensible to a mammogram produces a high contrast image.

A video copy detection system that is based on content fingerprinting and can be used for video indexing and copyright applications is proposed by Esmaeili *et al*. (2011). The scheme relies on a fingerprint extraction algorithm followed by a fast approximate search algorithm. Poon *et al*. (2010) model uses overlapping features such as morphemes and their contexts and incorporates exponential priors inspired by the smallest amount description length (MDL) principle.

Simoens *et al*. (2012) objective is to highlight that when going beyond the usual honest-but-curious assumption much more complex attacks can influence the isolation of data and users. On the one hand, researchers bring in a new comprehensive framework that encompasses the different schemes they want to look at. It presents a system model in which each interior entity or combination of entities is a probable attacker. Gueguen *et al*. (2010) suggest a novel approach for breaking up an image into multi-scale overlapping objects. The image is decaying by differential morphological pyramid, resulting in a discrete scale-space representation. To adapt the texture variance in the palm print recognition, researchers devise a new technique named as a Palm print Texture Recognition using the Connected-section Morphological Segmentation (PTR-CMS) scheme is presented.

MATERIALS AND METHODS

Palm print texture recognition using connected-section morphological segmentation: The palm print texture recognition contains the following steps as shown in

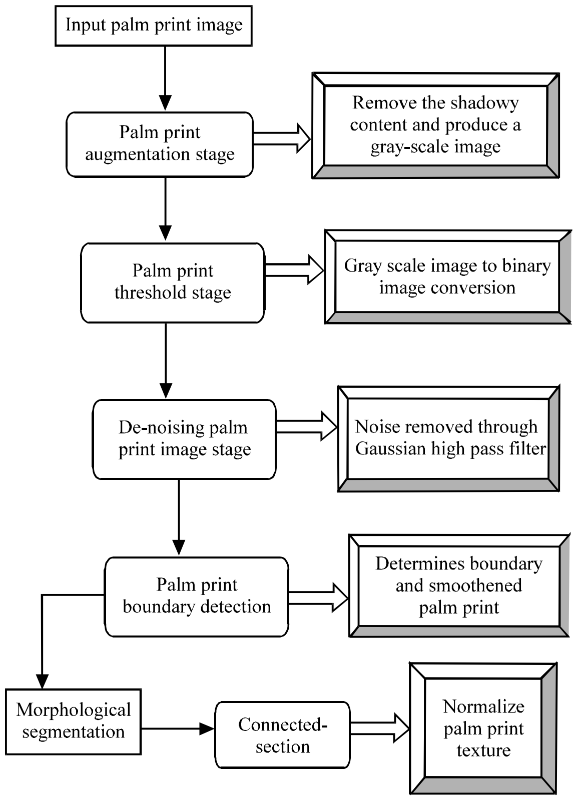

Fig. 2: Steps of palm print texture recognition

Fig. 2. Figure 2 describes the palm print texture recognition using the connected-section morphological segmentation. It takes the palm print image as an input for the adaptation of texture variance by go-thronging of all the stages. Palm print Texture Recognition using the Connected-section Morphological Segmentation (PTR-CMS) for effective adaptation of texture variance and to remove the noise from palm print recognition. The connected-section technique is used for performing the morphological segmentation of palm print images.

Morphological segmentation procedure: The morphological segmentation procedure contains the following stages namely palm print augmentation stage, palm print threshold stage, de-noising palm print stage and the palm print boundary detection stage and morphological approach for boundary detection.

Palm print augmentation stage: The main objective of the palm print augmentation stage is through altering the intensity functions, palm print shadowy content and a combination of these functions. It is used to improve the awareness and effectiveness to the palm print image. The shadow and noise are removed by rising dissimilarity and enlightening details are examples of palm print augmentation operations. The augmentation of a palm print image gives the frequency of amount of the gray levels.

Procedure to perform augmentation equalization:

- Step 1: find the running sum of the line graph values
- Step 2: regularize the values from step 1 by separating by the total number of pixels
- Step 3: multiply the values from step 2 by finding the highest gray-level value and round
- Step 4: mach the gray level values to the results from step 3 using a one to one correspondence

In normal threshold, pixels having intensity lower than the threshold H are set to zero and the pixels having intensity greater than the threshold are set to left at their creative intensity depending on the effect that is required. This type of normal threshold allows us to obtain a binary image from a grayscale palm print image. The mathematical expressions are: the derivation of the region functions for an object whose boundary is defined by palm print threshold:

$$T(G) = \frac{-g}{g} TR(G) \quad (1)$$

Where:

G = Gray level
R(G) = Region of the object at gray level G
T(G) = Bar graph

De-noising palm print image stage: A palm print image is often corrupted by noise in its acquirement or broadcasting. Noise is any undesired information that contaminates a palm print image. Noise appears in palm print images from a variety of sources. The objective of the de-noising is to remove the noise while maintaining as much as possible the important signal features. De-noising can be done through filtering. Filters concept reduce noise in the palm print images. Enhanced Gaussian high pass filter helps to reduce a noise:

$$T_{ghf}(v,w) = c + d_{Tgp}(v,w) \quad (2)$$

Where:

C = Offset
d = Multiplier
$T_{gp}(v, w)$ = The relocate function of the Gaussian high pass filter

Palm print boundary detection stage: This palm print boundary detection stage defines boundaries as zero-crossings of subsequent derivatives in the course of the greatest first derivate. This works in multiple stage process:

- Palm print image is smoothed by enhanced Gaussian difficulty
- Initial derivate operator is applied to the smoothed palm print image to highlight region of the image with high spatial derivatives

The efficiency of this method is resolute by three parameters:

- Width of the enhanced Gaussian kernel
- Upper threshold
- Lower threshold used by follower

$$(p, q) = \text{boundary}\ (\text{filter}, \text{'X'}, Q, \Sigma) \tag{3}$$

Where:
Q = Vector
Q = [q1, q2], containing the two thresholds
X = Boundary value
Σ = Standard deviation of the smoothening filter

Morphological operations for boundary discovery: Morphological operations are very effective in the detection of boundaries in a binary image P. The following boundary detectors are widely used:

$$Q = (P\text{-}\theta Q) \tag{4}$$

$$Q = (P \oplus X) = P \quad \text{or} \quad Q = (P \oplus X)\text{-}(P\theta X) \tag{5}$$

Where:
Q = Boundary image
θ = Corrosion operator
⊕ = Expansion operator
\- = Set theoretical subtraction

Connected section morphological palm print segmentation: In a palm print images the palm's position, direction, rotation angle and degree of stretch will influence the connected-section segmentation to trouble the feature extraction of the palm print. Palm alignment is a necessary and dangerous step for aligning palm poses to a characteristic pose to diminish the disturbing of nonlinear factors such as rotation, translation and deformation in sampling process to enhance the robustness of palm print connected-oriented segmentation. The palm alignment is to discover appropriate input points from the palm to normalize the position of the palm print image. The palm position and connected-section removal are performed by palm curve detection in the contract region of palm, orientation line construction and palm normalization steps described in the study.

Palm curve discovery on the contract region of palm print image: To reduce the region of operation is necessary for accelerating the processing speed. The contract region is a rectangular region bounded by four line segments. The upper-bound line is the most upper row whose white pixels is no <250, the lower-bound line is the lowest row whose white pixels is no <250, the right-bound line is the rightist column whose white pixels is no <100 pixels and the left-bound line is the most left column whose white pixels is no <100 pixels. For obtaining better input points there is a need to construct the orientation line for efficiently aligning the palm in a palm images.

Orientation points and location line construction: For extracting the central parts of the palm print images, this step detects the three orientation points between fingers. Two of them are used to build a location line segment for alignment of the different palm print images and an additional one is used to decide the central position of the connected-section.

Palm print normalization: Once the orientation points and location line are defined, the proposed method normalizes the palm print's pose by taking the middle point as the center of revolution to rotate the palm print counterclockwise with an angle evaluated.

Experimental evaluation: Connected-section Morphological Segmentation were implemented for palm-print recognition by improving the accuracy an adapting the texture variance. It is implemented using MATLAB. In addition to noise removal, the proposed model also present qualitative results for the adapting texture extraction of the palm print images. Researchers have analyzed the performance of proposed PTR-CMS, using CASIA Palm-print image database and Skin segmentation UCI repository dataset.

The training sample for CASIA database consists of 5,502 palm-print images captured from 312 users. It collects palm print images from both left and right palms all palm-print images are 8 bit gray level JPEG files by providing the images of palm-print using the database CASIA. It has also developed real-time palm print recognition systems working on PDA and common PC (Fig. 3).

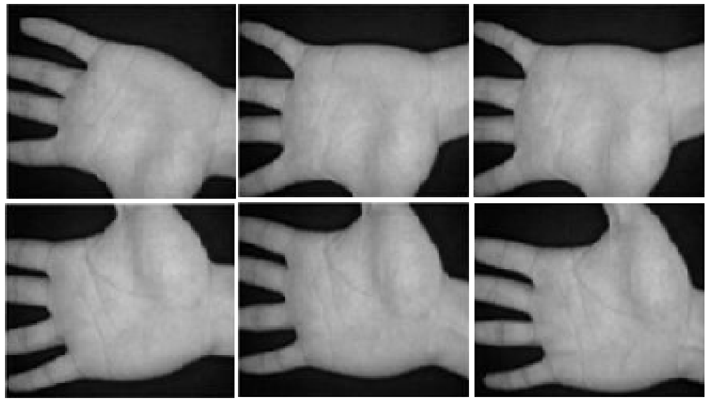

Fig. 3: Six typical palm prints in CASIA database

The skin dataset is collected by randomly sampling B, G and R values from images of various age groups (young, middle and old), race groups (white, black and asian) and genders obtained from FERET database and PAL database. Total learning sample size is 245057; out of which 50859 is the skin samples and 194198 are non-skin samples. The performance of the proposed Palm print Texture Recognition using the Connected-section Morphological Segmentation (PTR-CMS) is measured in terms of:

- Segmented regional texture variance
- False acceptance rate
- Average equal error rate

RESULTS AND DISCUSSION

In this research, researchers efficiently evaluated the texture extraction for the palm print using the connected-section morphological segmentation. Figure 4 describes the performance of the proposed Palm print Texture Recognition using the Connected-section Morphological Segmentation (PTR-CMS) scheme compared with an Advanced and Fast Correlation Based Feature for Palm print Recognition (AFCBF) and Human Identification using Palm Vein images (HI-PV).

Segmented regional texture variance: The segmented region in the palm print texture recognition using the connected-section morphological segmentation identifies the texture variance of the system.

The palm prints are portioned based on the size of the each palm print by implementing the proposed Palm print Texture Recognition using the Connected-section Morphological Segmentation (PTR-CMS) scheme. Figure 4 describes the partition size based on the segmented regional texture variance.

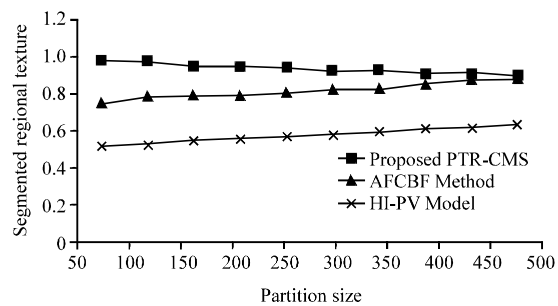

Fig. 4: Partition size vs. segmented regional texture variance

Figure 4 describes the partition size based on the textures variance created. The proposed Palm print Texture Recognition using the Connected-section Morphological Segmentation (PTR-CMS) efficiently identified the texture variance in the segmented part by adapting the pseudo implications of equivalences from a given skin data set. In the proposed PTR-CMS scheme, the texture variance are normalized based on the connected-section methodology.

The outcome of the proposed Palm print Texture Recognition using the Connected-section Morphological Segmentation is compared with the Advanced and Fast Correlation Based Feature for Palm-print Recognition (AFCBF) and Human Identification using Palm Vein images (HI-PV). In other words, the additional training sample does not bring useful information and thus the resulting performance improvement is much smaller. On the contrary, the misplaced samples in SPATIA database can indeed deteriorate the performance by Zhou and Kumar (2011). The variance in segmented regional texture generation is approximately 30-40% high in the proposed PTR-CMS.

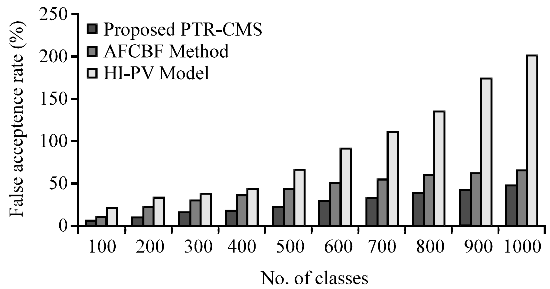

Fig. 5: No. of classes vs. false acceptance rate

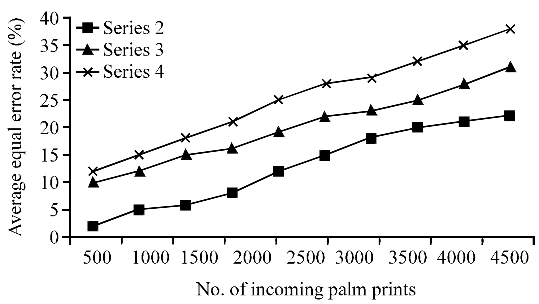

Fig. 6: No. of incoming palm prints vs. average equal error rate

False acceptance rate: It is defined as a rate at which the unauthenticated palm prints are not accepted by the PTR-CMS. It is called the false acceptance rate. It is measured in terms of percentage.

Figure 5 described the false acceptance from the set of classes. In the proposed PTR-CMS scheme, the process of acceptance rate is higher in the proposed scheme but lacks in the accepting the unauthenticated persons. The outcome of the proposed Palm print Texture Recognition using the Connected-section Morphological Segmentation (PTR-CMS) for false acceptance rate is shown.

Figure 5 describes the false acceptance rate from the set of classes. As it is experimental using the CASIA database showing that the false rate is lower in the proposed PTR-CMS. The observed performance from the morphological segmentation palm approach on the CASIA database is higher and this may be due to the fact that it does focus on extracting and matching the textured information and produce strong mechanism to accommodate potentially large variations which are more likely to exist in the contact less database. So, the existing model accepts the more false rate from the set of classes thus showing that the quality less palm print recognition. The variance in false acceptance rate is approximately 15-20% less in the proposed PTR-CMS.

Average equal error rate: The error rate of the proposed PTR-CMS is examined and output is shown with a minimum average error. It is called an average equal error rate.

Figure 6 described the average error rate from the incoming palm prints. In the proposed Palm print Texture Recognition using the Connected-section Morphological Segmentation (PTR-CMS) scheme; it produces the lesser error rate to identify the palm print efficiently. Comparison result of PTR-CMS with an Advanced and Fast Correlation Based Feature for Palm print Recognition (AFCBF) and Human Identification using Palm Vein images (HI-PV) for error rate calculation is measured in terms of percentage.

The performance graph of the proposed Palm print Texture Recognition using the Connected-section Morphological Segmentation (PTR-CMS) scheme for average equal error rate is shown in the Fig. 6. The connected section in the morphological segmentation will identify and apply the rules between the derivations this approach uses the morphological operations and makes the lesser error rate when compared to the AFCBF and HI-PV technique. The variance in the error rate in the both dataset evaluation would be approximately 40-50% low in the proposed Palm print Texture Recognition using the Connected-section Morphological Segmentation (PTR-CMS) scheme. Finally, it is being observed that the proposed PTR-CMS eradicates the noise occurring in the palm print recognition and suitably adapt to the texture variance. The proposed Palm print Texture Recognition using the Connected-section Morphological Segmentation (PTR-CMS) Method is analyzed though CASIA database and skin dataset.

CONCLUSION

In this research, researchers efficiently performed the biometric palm print recognition using the Connected-section Morphological Segmentation (PTR-CMS) for effective adaptation of texture variance and to remove the noise from palm print recognition. Improved morphological segmentation of palm print is to automatically and consistently segment a small region from the confine palm print image and palm print extraction is to extract the palm print from a morphological image depending on the texture variance. Performance of Connected-section Morphological Segmentation (PTR-CMS) technique is to reliably segment the images to smaller regions from the captured images. The proposed scheme is evaluated in terms of segmented regional texture variance based on the partition size, false acceptance rate and average equal error rate. Thus, Connected-section Morphological Segmentation (PTR-CMS) technique considers the problem of texture variance. An analytical and empirical result shows the approximately 20-30% lesser false acceptance rate with the efficient adaptation of the texture variance of the proposed scheme.

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