Multi-Modal Palm Print and Finger Dorsal Biometric Authentication System using C2- based Fusion Algorithm

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Abstract - *In this paper, we have proposed a multi-modal personal identification system that fuses palm print and finger dorsal images at feature level. In a company and enterprise world Biometric based authentication system is a most wanted activity. Legitimacy, safety and protection are the most common traits of authentication system. Such that we've got proposed C2-based fusion algorithm for combining the two distinctive, intricate, precise specific detailed Palm print and Finger dorsal images for extracting a feature data from the acquired information, and comparing this feature with the template set stored in database. The combined method is carried out for data units for verification and gives better performance.*

Key Words: Personal identification - Comparative competitive code (C2 code) – Gabor filter - Magnitude code (Magcode) - Orientation code (Oricode)

1. INTRODUCTION

In today's world crucial to discover a user in many applications such as personnel security, finance, airport, health center and other critical areas [9] Human identification,verification has been usually executed through the use of a password or ID Cards. Biometric based authentication system plays an vital function to reduce the fraudulent use of identification and to growth an accuracy, authenticity, safety and security [8] Biometric means: "To figuring out an person based on identifiable traits"[11] or "Application of modern statistical approach to measure biological objects"[7] The Term biometric represents the particular behavioral and physiological characteristics of someone for authentication [4] Physiological Biometrics are the direct measurements of a part of the human body (i.e.) iris, face, fingerprint and hand scan reputation and Behavioral Biometrics are the measurements and statistics derived from an action completed by way of the user, and its indirectly measures some traits of the human body (i.e.) Signature, gait, gesture, and key stroking reputation. [10] These structures operates by using obtaining biometric facts from an character person, extracting a characteristic set from the processed data, and then comparing this against the template set stored in the database. The major gain of biometric generation is that it is more safe and snug then traditional systems. The combination of finger vein and iris is utilized in [1] which makes use of the specific 2D Gabor filter out for extracting the functions of this combination. In this paper Palm print and Finger Dorsal combination is proposed, [12] The dorsal veins and palm are taken into consideration as samples being extracted from the user's hand image.

1.1 PALMPRINT

Palm print is the central location of hand that lies between the wrist and fingers. Currently Palm print based authentication system (a way of a well known fingerprint - based identification) is a capacity opportunity to become aware of a human. Since palm is bigger than a finger, palm print is anticipated to be even more reliable than finger print.Palm print includes many lines with unique sizes and directions [3] and extraordinary patterns are identified. Palm prints are stable and it provides high accuracy in representing each individual's identity wrinkles and texture can be used for personal verification to authenticate the user [13] By combining lines and patterns of palm print, it produce a unique feature records which may be used for authenticate the person.

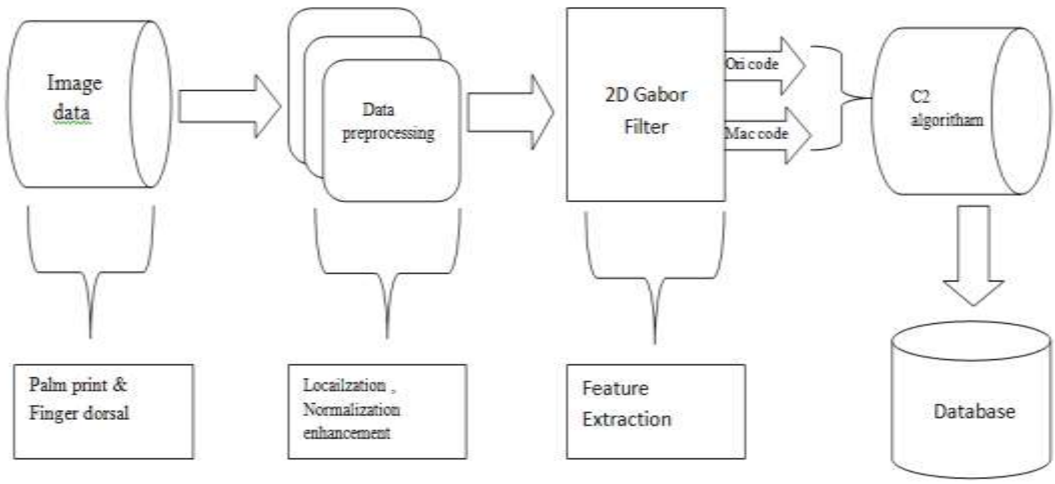
1.2 FINGER DORSAL

The physiological features characterize the dorsal venous community of the hand are single to each character and it is able to be used as a biometric person for individual identification. The extraction of the dorsal veins from the images that were acquired via an infrared device. For each identification we want the representation of the veins in the form of shape descriptors, that are invariant to translation, rotation and scaling ; This extracted descriptor vector is the input of the matching step. Many works was made for this feature extraction. Especially, [14] who used single triangulation of hand vein images and simultaneous extraction of knuckle form information.

2. PROPOSED WORK

An outline of the model is stated in Figure.1 which uses multi-modal palm print and finger dorsal as input and extract reduced feature vectors from C2 code for user authentication. The raw images have noises and unnecessary objects which are pre-processed and given to 2D Gabor filter to sort out magnitude and orientation data. The combination of data from 2D Gabor filter is used for deriving the C2 coding model.

Figure -1: Proposed C2 coding scheme for feature vector extraction



2.1. PRE-PROCESSING OF PALM PRINT AND FINGER DORSAL IMAGE:

The obtained palm print and finger dorsal are noisy with rotational and translational variations gathered from unconstrained imaging. These resultant images are first subjected to pre-processing steps, which automatically extract the region-of-interest (ROI) images to reduce the translational and rotational variations. The ROI segmentation for palm print is followed by reducing the translational or orientation error. This is necessary in palm print as the image from the subject may get rotated and correct fusion of both palm print and finger dorsal may be missed. Finally, the corrected palm print is enhanced to extract the pattern with stability.The dorsal is the upper part of finger, however the raw image of dorsal contain irrelevant parts such as knuckles, lunula, finger nail etc., There are some problems in varying distance of dorsal to camera and non-uniform brightness while capturing dorsal image. Localization of dorsal is the first step which eliminates unwanted portion of dorsal and fixing the dorsal boundary. The second step is to unwrap localized dorsal to a fixed rectangular mask in order to reduce deformation. To perform the normalization in dorsal image that provides correction in lighting.

2.1.1.PALM PRINT IMAGE LOCALIZATION, NORMALIZATION AND ENHANCEMENT :

The aim of this project is to develop a palm print based authentication system, which gets an raw image as input in Figure-2. The application ought to be capable of section the person's hand from this image, localize the palm area (ROI) to do away with the unwanted part of the image. The system has three main elements. The first element is the pre-processing module, which task's is to segment the hand,discover the key points,and based on those key points setup a coordinate system and lastly, extract the palm area. The next element's is to extract the functions from the previously stated palm area, and encode them. The third element is the matching module, which compares and gives similarity rate of samples. feature extraction method uses a 2-dimensional Gabor filter. The convolution with this filter results an image that includes the different texture additives of the palm. Using this method, the matching between two functions can be computed through the Hamming distance. At the cease of identification process, the system accepts the person if the distance among the currently extracted characteristic and any of the stored features is less than a designated threshold value, in any other case rejects it. To limit these types of little important information, ROI segmentation of Palm print is performed by using mean and variance algorithm its given below.

ALGORITHM BASED ON MEAN AND VARIANCE:

1. With dividing the palm print I into non over lapping blocks of size M*N.

2. Calculate the mean value

$$mean = \frac{\sum_{i=1}^{M}\sum_{j=1}^{N} I(i,j)}{M*N}$$

Where I(i, j) is the pixel gray value of i^{th} row and j^{th} column.

3. Mean value is used to derive the variance value

$$\text{var}\,ience = \frac{\sum_{i=1}^{M}\sum_{j=1}^{N}[(i,j)-mean]^\wedge 2}{M*N}$$

4. Choose a common threshold value that works on all the different images. If the threshold value is less than the variance the block is considered as foreground otherwise it is assumed to be background.

The ROI segmented palm print is shown in Figure-3.

Figure -2 : Palm print image before preprocessing

Figure -3: Palm print image after preprocessing

2.1.2. FINGER DORSAL IMAGE LOCALIZATION,

NORMALIZATION AND ENHANCEMENT:

Localization is used to process the dorsal image and it removes the irrelevant portion of image. The specific region of the image cropped from a well-defined rectangular window with specific value of x, y in the image plane. The dorsal pattern appearance may differ for the same person due to, illumination position of finger and image quality. So the images are resized to the size of 200 *100 aspects. Using near-Infrared (NIR) camera to capture the finger dorsal images are shown in Figure-4.

Non-uniform illumination may affect the quality of the finger dorsal image, and this leads to poor contrast in dorsal images. The contrast adjustment is done through finger dorsal normalization which improves the contrast of the finger dorsal image. A 3*3 image mask known as median filter is used to reduce the noises generated by image operation [2].Figure-5 shows the final form of segmented finger dorsal image is known as sub-images.

Figure -4 : Finger Dorsal image before preprocessing

Figure -5 : Finger Dorsal image after preprocessing

2.2. DESIGN OF 2-D GABOR FILTER FOR FEATURE EXTRACTION:

In 2D domain Gabor filters are popularly used for texture analysis of images such as finger print, palm print, finger dorsal, finger vein and iris. These images are having rich number of curvatures and ridges . Gabor filter is resolved into two components known as odd symmetric and even symmetric .Gabor filter which are used to find ridge and edge detection, respectively.

The 2D Gabor filter is defined as

$$\varphi(x, y, x_0, y_0, \omega, \theta, k) = \frac{-\omega}{k\sqrt{2\pi}} e^{\frac{-\omega^2}{8k^2}(4x'^2 + y'^2)} (\cos \omega x' - e^{\frac{-k^2}{2}})$$

Where,

$$x' = (x - x_0) \cos\theta + (x - x_0) \sin\theta$$

$y' = -(x - x_0) \sin\theta + (x - x_0) \cos\theta$ $(x_0 - y_0)$ represents centre of the function,

$\omega$is a radial frequency in radians per unit length and

θ is the orientation of Gabor functions in radians.

The k is defined by $k = \sqrt{2 \ln 2} \left(\frac{2^{\delta}+1}{2^{\delta}-1} \right)$

Where δ is the half amplitude bandwidth of the frequency response.

The ωcan be derived from $\omega = \frac{k}{\sigma}$, while $\sigma$and δ are fixed.

These equation are the Gabor functions [6]. which gives the orientation code and magnitude code for any texture-based image analysis.

3. CODING SCHEME:

The orientation information extracted from palm print and finger dorsal is useful for multimodal biometric authentication system. The orientation scheme of three methods filtering, devising suitable code and matching score values. The C2 coding (Comparative competitive coding) is developed as a extension of orientation scheme by [6]. The orientation information have a even and symmetric coefficient from a Gabor function. The C2 code scheme comes up with a bitwise feature representation with angular distance. The preprocessed Gabor filtered palm print and finger dorsal are shown in figures as 6,7,8,9 respectively.

3.1. COMPETITIVE CODE:

Competitive coding widely known as C2code/Compcode produces an intended result for extracting and representing biometric orientation information .Lee et al. have elaborated 2D Gabor filter for palm print image analysis and its negative real part of Gabor function is used; after, its applied to finger print, finger vein and iris images The Gabor filter function is shown in Equation.1

The C2 code was obtained from six 2D Gabor filter coefficients $\theta_p = \frac{p\pi}{6}$, p = $\{0,1,2,\dots,5\}$ which produce bitwise palm print orientation. The convolution is taken between palm print or finger dorsal or multimodal image $I(x,y)$ and Gabor filter $\varphi(x,y,\theta)$ with θ orientation.

The competitive rule is defined as [2,5,6] $j = \arg\min\{I(x,y) * \varphi(x,y,\theta)$

where * denotes the convolution operator with j as winning index is encoded 3 bits for efficient palm print or finger dorsal representation. The $I^k(x,y,\theta_j)$ the pixel of convolves with Gabor filter $G^k(x,y,\theta_j)$ and the minimum of its response is known as trends of the line known as $Oricode^k$ [2,5]

$$Oricode^k(x,y) = \arg\min_j\{I^k(x,y) * G^k(x,y,\theta_j)\}$$

Set $C2Code(x,y) = Oricode^v(x,y)$ if Case 1 and Case 2 represent the same pixels of various images with principal orientation . The junction point of palm print and finger dorsal is represented by the pixels of Case 3. These pixels are selective parameter for person identification and Set $C2Code(x,y)$ = J This is not common in ordinary C2code feature mapping. Case 4 is also used as junction point for poor quality images which in turn it produces $Oricode^k$ of Gabor function J and set lower $Magcode(x,y)$ that are equivalent to $Oricode(x,y)$ These fusion strategy is named as Comparative Competitive Code (C2 code) as shown in figure.

Case 3 represents the pixels that lie on the junction formed by palm print and finger dorsal. These Junction points are more discriminating for person identification and let$C2Code(x,y)$ = J which is not found in ordinary C2code feature maps. Case 4 may depends on junction point but poor quality of image does not vary much. This

$$OPcode(x,y) = ODcode(x,y) \& MPcode(x,y) = MDcode(x,y)$$

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Leads to $Oricode^k$ of Gabor filter response of J and let lower $Magcode(x,y)$ that corresponds to the $Oricode(x,y)$ These fusion map is termed as Comparative Competitive Code (C2 code).

Gabor Filter gives two components as even symmetric coefficient produces magnitude information of feature vector and odd symmetric coefficient produces orientation information of images. The Oricode of Palm print images shown in Figure.6, which corresponds to the sample image given in Figure.4, and Oricode of Finger dorsal are shown in Figure.7, which corresponds to the sample Finger dorsal image given in Figure.2. The Magcode information of Palm print and Finger dorsal images is given in Figure.8,9 respectively. C2 code is obtained from both Oricode and Magcode information, which optimize memory requirements and reduces the size of feature vector.

Figure.10 are represented the minute details present in both Palm print and Finger dorsal and the accuracy of C2 code is apparent.

Figure -6 : Oricode image of Palm print

Figure -7 : Oricode image of Finger Dorsal

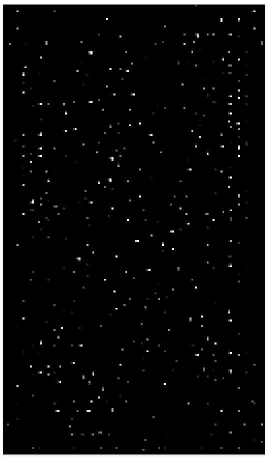


Figure -8: Magcode image of Palm print

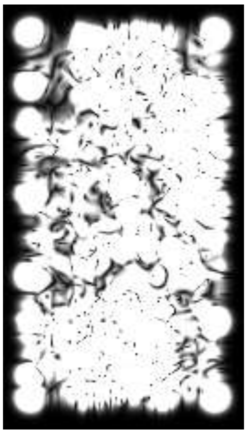


Figure -9 : Magcode image of Finger Dorsal

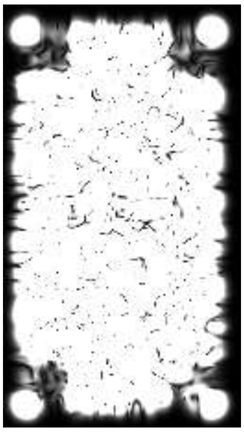
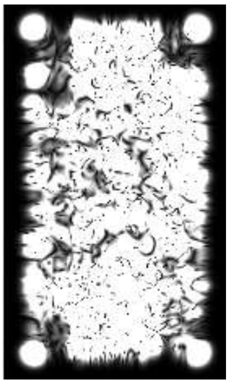


Figure -10 : C2 code output of palm print and finger dorsal



4. CONCLUSIONS

In the process of accuracy matching, the quality of Biometric traits plays a major role where the poor quality of inputs leads to incorrect matching result this happens because of sample features extracted are not accurate. The proposed score-level fusion of Finger dorsal and Palm print C2 algorithm is carried out to extract to reduced number of feature vectors which in turn increased processing speed and reduced the memory allocation. The project results have proved the performance improvement of the process. it is shown they the proposed algorithm is giving high performance with R2 value of 0.992 and the validation obtained with an error rate.

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