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RESEARCH ARTICLE

FINGERPRINT MATCHING BASED ON STATISTICAL TEXTURE FEATURES

K. PHALGUNA RAO[1], M.CHARAN KUMAR[2]
[1]Professor, Dept. of CSE, ASIT, Gudur, India
[2]M.Tech 2nd year, Dept. of CSE, ASIT, Gudur, India
[1] kprao21@gmail.com; [2] cherry.abu@gmail.com

Abstract: Fingerprint is a reliable biometric which is used for personal verification. Three arithmetical features are extracted from fingerprint images and represented using a mathematical reproduction. These features are (1) an entropy coefficient, computed from the intensity histogram of the image, (2) a relationship coefficient, computed by correlation operation between the novel image and a filtered version of the image obtained using a 2D wiener filter, and (3) an energy coefficient, obtained by first subjecting the image to a 5-level wavelet decomposition and thereafter computing the proportion energy of the approximation coefficient obtained after the 5th level decomposition. Results show that fingerprint texture feature can be convincingly used for discrimination and for personal verification.

Index Terms:- fingerprint texture, entropy, correlation, wavelet energy

INTRODUCTION

Biometrics, which refers to identifying a person based on his or her physiological or behavioral characteristics, has the ability to reliably distinguish between an authorized person and an imposter. Finger print technology used in forensic and law enforcement agencies [1]. To identify the suspects in the crime sciences based on impressions of fingers [2]. Nowadays, automated fingerprint identification system (AFIS) has become an indispensable tool for law enforcement agencies. In law enforcement applications, three types of finger prints used [3].

(a) (b) (c)

Fig. 1.Three types of fingerprint suspicion. Rolled and ordinary fingerprints are also called full fingerprints. (a) Rolled; (b) plain; (c) latent.

These are:

- Rolled, secure by turning over and over the finger from "nail to nail".
- Plain, obtained by placing the finger on a plain paper.
- Latent, Lifted from surfaces of objects that handled by a person typically at crime scenes.

EXISTING SYSTEM

A. Fingerprint Recognition

The existing algorithm uses a robust alignment algorithm (descriptor-based Hough transform) to align fingerprints and measures similarity between fingerprints by considering both minutiae and orientation field data [4]. To be consistent with the common Implementation in latent matching (i.e., only minutiae are marked by latent examiners), the orientation field is reconstructed from minutiae [5]. Since the proposed algorithm relies only on manually marked minutiae, it can be easily used in law enforcement applications. Experimental results on two different latent databases show that the proposed algorithm outperforms two well optimized commercial fingerprint matchers.

Fingerprint recognition (also known as Dactyloscopy) is the process of comparing known fingerprint against another or template fingerprint to determine if the impressions are from the same finger or not. It includes two sub-domains: one is fingerprint verification and the other is finger print identification [6]. Verification specify an individual fingerprint by comparing only one fingerprint template stored in the database, while identification specify comparing all the fingerprints stored in the database. Verification is one to one matching and identification is one to N (number of fingerprint templates available in database) matching. Verification is a fast processes compared to identification.

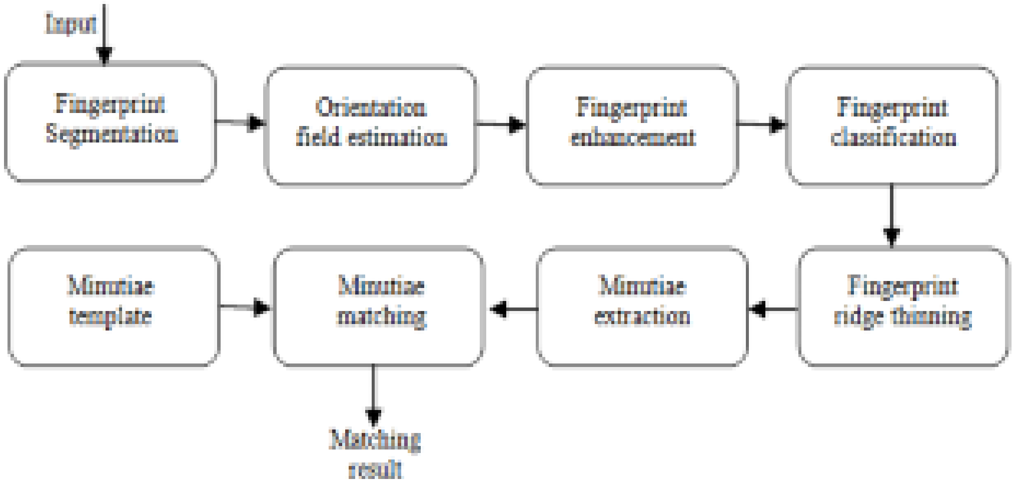

Fig.2. Fingerprint Recognition System

First of all we take a fingerprint image. After taking an input image we can apply fingerprint segmentation technique. Segmentation is separation of the input data into foreground (object of interest) and background (irrelevant information). Before extracting the feature of a fingerprint it is important to separate the fingerprint regions (presence of ridges) from the background [7]. This is very useful for recovering false feature extraction. In some cases, a correct segmentation is very difficult, especially in poor quality fingerprint image or noisy images. Orientation field plays an important role in fingerprint recognition system. Orientation field consist of four major steps (1) pre-processing fingerprint image (2) determining the primary ridges of fingerprint block (3) estimating block direction by projective distance variance of such a ridge (4) correcting the estimated orientation field [8]. Image enhancement is use to improve significantly the image quality by applying some image enhancement technique.

The main purpose of such procedure is to enhance the image by improving the clarity of ridge structure or increasing the consistency of the fridge orientation. Fingerprint classification is used to check the fingerprint pattern type. After classification of fingerprint. We can apply fingerprint ridge thinning which is also called block filtering; it is used to reduce the thickness of all ridges lines to a single pixel width. Thinning does not change the location and orientation of minutiae points compared to original fingerprint which ensures accurate estimation of minutiae points. Then we can extract minutiae points and generate data matrix. Finally we can use minutiae matching to compare the input fingerprint data with the template data and give the result.

B. Fingerprint Matching Techniques

There are many Fingerprint Matching Techniques. Most widely used matching techniques are these:

• ***Correlation-based matching***:

In correlation based matching the two fingerprint images are matched through corresponding pixels which is computed for different alignments and rotations. The main disadvantage of correlation based matching is its computational complexity.

• **Minutiae-based matching**:

This is the most popular and widely used technique, for fingerprint comparison. In minutiae-based techniques first of all we find minutiae points on which we have to do mapping. However, there are some difficulties when using this approach. It is difficult to identify the minutiae points accurately when the fingerprint is of low quality.

• **Pattern-based (or image-based) matching:**

Pattern based technique compare the basic fingerprint patterns (arch, whorl, and loop) between a previously stored template and a candidate fingerprint. This requires that the images be aligned in the same orientation. In a pattern-based algorithm, the template contains the type, size, and orientation of patterns within the aligned fingerprint image [9].

The candidate fingerprint image is graphically compared with the template to determine the degree to which they match.

PROPOSED SYSTEM

Here we calculate textural statistical features for fingerprint feature extraction and matching purpose. These features are (1) an entropy coefficient, computed from the intensity histogram of the image, (2) a more coefficient, computed by correlation action between the original image and a filtered version of the image obtained using a 2D wiener filter, and (3) an energy coefficient, obtained by first subjecting the image to a 5-level wavelet decomposition and thereafter computing the percentage energy of the approximation coefficient obtained after the 5th level putrefaction [10]. The perspective is tested over a dataset of 80 images divided into 10 classes and is seen to provide accurate recognition results.

Entropy:

Entropy is a statistical measure of randomness that can be used to characterize the texture of an image. It is defined in equation (1) below, where p_i is the i^{th} frequency valve generated from a k-bin normalized intensity histogram of the image.

$$\boldsymbol{E_n = -\sum_{i-1}^{k} p_{i \log 2 p_i}} \qquad \textbf{(1)}$$

The standard values are computed by dividing each frequency count by sum of pixels in the images, as given in equation (2) where f_i is the i-th frequency value of the histogram and N the total number of pixels.

$$\boldsymbol{p_i = f_{i/N}} \qquad \textbf{(2)}$$

Correlation:

The image is first subjected to a 2-D wiener filter using a 3 x 3 locality. The correlation coefficient is calculate using equation (3), where I_{mn} is the original images of dimensions m x n and J_{mn} is the filtered version of the same, and $\bar{\imath}$ and $\bar{\jmath}$ denote the mean pixels values of the corresponding images [11].

$$\boldsymbol{C}_{c=\frac{A}{B}}\text{ , where}$$

$$\boldsymbol{A} = \sum_m \sum_n (\boldsymbol{I}_{mn-\bar{I}})(\boldsymbol{j}_{mn-\bar{j}})$$

$$\mathbf{B} = \sqrt{\{\sum_m \sum_n (\boldsymbol{I}_{mn}-\bar{\boldsymbol{I}})^2\ \{\sum_m \sum_n (\boldsymbol{j}_{mn} - \bar{\boldsymbol{j}})^2\}} \quad \mathbf{(3)}$$

Energy:

For calculating the energy coefficient, the image I is subjected to a wavelet decomposition using the Daubechies wavelet for up to 5 levels. The wavelet decomposition involves convolving the image with a low-pass filter for generating the approximation coefficients (A) and a high-pass filter for generating the detail coefficients (D) followed by a down-sampling. The data image for each level is taken as the approximation image for the previous level. The decomposition operation generates the approximation coefficients A_5 and detailed coefficients D_5, D_4, D_3, D_2, D_1 as shown in below fig.2 [12].

The percentage of the energy comparable to the approximation coefficient is subsequently computed as given below;

$$\boldsymbol{E_a} = \sum (\boldsymbol{A_5}) / \sum (\boldsymbol{A_5}+\boldsymbol{D_5}+\boldsymbol{D_4}+\boldsymbol{D_3}+\boldsymbol{D_2}+\boldsymbol{D_1}+) \quad \mathbf{(4)}$$

The final feature vector is taken as the composite formed of the above three components viz.

$$\mathbf{F} = \{\boldsymbol{C_c}, \boldsymbol{E_n}, \boldsymbol{E_a}\} \quad \mathbf{(5)}$$

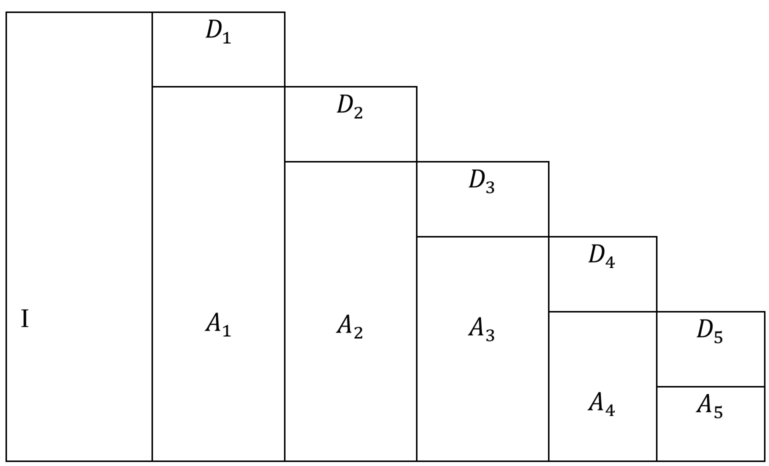

Figure2: Wavelet decomposition of an image I

Classification is done by mapping the feature vectors of a training set and a testing set into appropriate feature spaces and calculating differences using Manhattan distance [13]. The Manhattan distance metric (d) of two n-dimensional vectors T= $\{T_1, T_2, T_3, \ldots\ldots, T_n\}$ and S= $\{S_1, S_2, S_3, \ldots.., S_n\}$ is given by

$$\mathbf{D} = \sum_{i=1}^{n} |\, \boldsymbol{T_i} - \boldsymbol{S_i} \,| \quad \mathbf{(6)}$$

<u>Algorithm for calculating statistical texture features</u>

Input: Query image for which statistical features has been computed.

Output: feature vector

1. Calculate Entropy for query image (En) using -sum (p.*log2 (p)) formula

2. Apply wiener filter for query image and then calculate correlation coefficient (CC) for query image and filtered Image.

3. Apply 5 level decomposition for input query image and calculate energy for coefficients (Ea)

4. Calculate feature vector F for query image by using En, Ea, and CC.

Then compare feature vector F of query image with the database image and if features are equal then the image is matched.

EXPERIMENTAL RESULTS

In my experimental results by using 2 data classes, they are train data base and test data base.

1st Class

2nd Class

CONCLUSION

This paper has proposed a quick and efficient technique of fingerprint recognition using a set of texture statistical based features [14]. The features are derived from a correlation coefficient, an entropy coefficient and an energy coefficient. The features can be calculated by using fingerprint miniature points. Moreover such texture based by using color finger print images [15]. The fingerprint images may be divided in to separation of red, green and blue components. And output part combine true color components. Future work would involve combining color and shape based techniques to study whether these can be used to improve recognition rates.

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AUTHORS

K.Phalguna Rao, completed M.Tech information technology from Andhra University presently Pursuing PhD. Life member of ISTE. He is working as Professor in the Dept of CSE Published several papers in the International Journals and International and national conferences. Attended several International and national workshops. Research Interest areas are Data Base Systems, Network Security, cloud Computing, Bioinformatics.

M.Charan Kumar received sree kalahasthi institute of technology degree in computer science engineering from the Jawaharlal Nehru technology university Anantapur, in 2010, and received the Audisankara institute of technology M.Tech degree in computer science engineering from the Jawaharlal Nehru technology Ananthapur in 2014, respectively. He published one national journal and participated three national conferences. He worked as communication faculty for 3 years in Kerala and Karnataka.