A NOVAL APPROACH FOR VERIFICATION OF IDENTITY USING HT BASED DESCRIPTOR OPERATOR

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Abstract - The biometry or biometrics refers to the automatic identification (or verification) of an individual (or a claimed identity) by using certain physiological or behavioral traits associated with the person. Traditionally, passwords (knowledge-based security) and ID cards (token-based security) have been used to moderate access to restricted systems. However, security can be easily breached in these systems when a password is divulged to an unauthorized user or an impostor steals a card. Identifying suspects based on impressions of fingers lifted from crime scenes (latent prints) is extremely important to law enforcement agencies. Latents are usually partial fingerprints with small area, contain nonlinear distortion, and are usually smudgy and blurred. Due to some of these characteristics, they have a significantly smaller number of minutiae points (one of the most important features in fingerprint matching) and therefore it can be extremely difficult to automatically match latents to plain or rolled fingerprints that are stored in law enforcement databases. Our goal is to develop a latent matching algorithm that uses only minutiae information. The proposed approach consists of following three modules: (i) align two sets of minutiae by using a descriptor-based Hough Transform; (ii) establish the correspondences between minutiae; and (iii) compute a similarity score.

***Key Words*:** false accept rate, false rejection rate, signal to noise ratio, decibel, noise.

1. INTRODUCTION

Fingerprint-based identification is one of the most important biometric technologies which have drawn a substantial amount of attention recently. Humans have used fingerprints for personal identification for centuries and the validity of fingerprint identification has been well established. In fact, fingerprint technology is so common in personal identification that it has almost become the synonym of biometrics. Fingerprints are believed to be unique across individuals and across fingers of same individual. Even identical twins having similar DNA, are believed to have different fingerprints. These observations have led to the increased use of automatic fingerprint based identification in both civilian and law-enforcement applications. A fingerprint is the pattern of ridges and furrows on the surface of a fingertip [3]. Ridges and valleys are often run in parallel and sometimes they bifurcate and sometimes they terminate. When fingerprint image is analyzed at global level, the fingerprint pattern exhibits one or more regions where ridge lines assume distinctive shapes. These shapes are characterized by high curvature, terminations, bifurcations, cross-over etc. These regions are called singular regions or singularities. These singularities may be classified into three topologies; loop, delta and whorl. At local level, there are other important features known as minutiae can be found in the fingerprint patterns. A minutia means small details and this refers to the various ways that the ridges can be discontinuous [4]. A ridge can suddenly come to an end which is called termination or it can divide into two ridges which is called bifurcations (Figure 1). Figure 1: Ridge ending, core point and ridge bifurcation is shown.

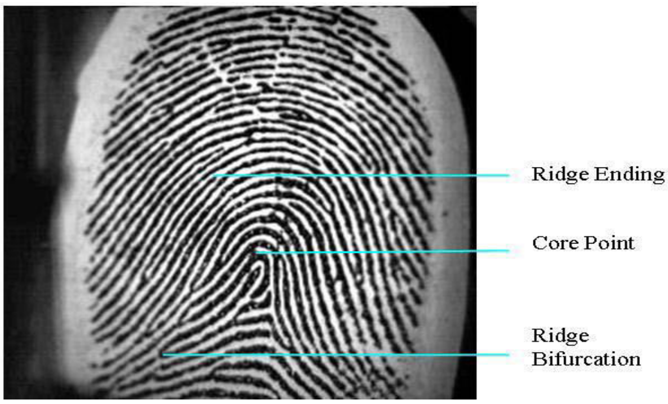


Fig 1 : Ridge ending, core point and ridge bifurcation

2. FINGERPRINTS AS BIOMETRIC

Fingerprints were accepted formally as valid personal identifier in the early twentieth century and have since then become a de-facto authentication technique in law-enforcement agencies worldwide. The FBI currently maintains more than 400 million fingerprint records on file. Finger prints have several advantages over other biometrics, such as the following:

High universality: A large majority of the human population has legible fingerprints and can therefore be easily authenticated. This exceeds the extent of the population who possess passports, ID cards or any other form of tokens.

High distinctiveness: Even identical twins who share the same DNA have been shown to have different fingerprints, since the ridge structure on the finger is not encoded in the genes of an individual. Thus, fingerprints represent a stronger authentication mechanism than DNA. Furthermore, there has been no evidence of identical fingerprints in more than a century of forensic practice. There are also mathematical models [3] that justify the high distinctiveness of fingerprint patterns.

High permanence: The ridge patterns on the surface of the finger are formed in the womb and remain invariant until death except in the case of severe burns or deep physical injuries.

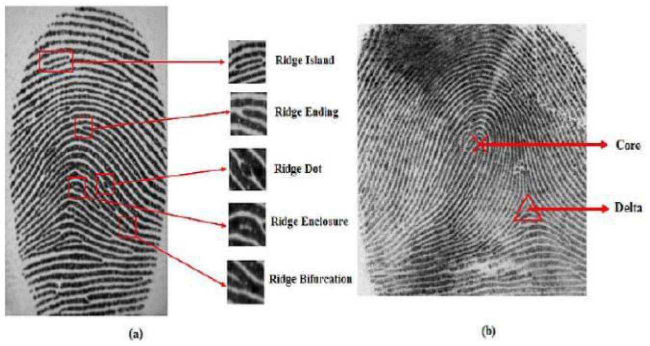


Fig 2 : (a) Local features: minutiae (b) global features: core and delta

Easy collectability: The process of collecting fingerprints has become very easy with the advent of online sensors. These sensors are capable of capturing high resolution images of the finger surface within a matter of seconds [2]. This process requires minimal or no user training and can be collected easily from co-operative or non co-operative users. In contrast, other accurate modalities like iris recognition require very co-operative users and have considerable learning curve in using the identification system.

High performance: Fingerprints remain one of the most accurate biometric modalities available to date with jointly optimal FAR (false accept rate) and FRR (false reject rate). Forensic systems are currently capable of achieving FAR of less than 10-4

Wide acceptability: While a minority of the user population is reluctant to give their fingerprints due to the association with criminal and forensic fingerprint databases, it is by far the most widely used modality for biometric authentication.

3. HIERARCHICAL HOUGH TRANSFORMS

I mentioned earlier that the choice of quantization is a big problem. One way round that is to start by doing a Hough transform with a very coarse quantization of parameter space. You then subdivide those bins with lots of votes, and do another transform into just these parts of parameter space, with the finer quantization. The process is repeated until the bins are as small as necessary. This method has been used successfully, but may be delicate: a lot of small peaks in one part of parameter space will stop you seeing a single larger peak in another part.

4. HOUGH TRANSFORMS FOR OTHER SHAPES

The Hough transform is not restricted to detecting straight lines, though that is a common use. Other geometrical shapes that can be described with a few parameters are also well suited to it. For example, a circle is specified with three numbers: the X and Y coordinate of its centre, and R, its radius. To find circles using a Hough transform, you need a three-dimensional accumulator array. Each edge element votes for all the circles that it could lie on, and the 3-D array is searched for peaks that give circle positions and radii. More complicated shapes can be found - a general ellipse, for example, needs a 5-D parameter space. Hough transforms have also been used for finding vanishing points - the points to which the images of parallel sets of lines appear to converge. Finally, the method can be generalized to detecting any shape that can be represented by a finite number of line segments, but which may appear at any orientation, scale and position in the image [6].

Some steps for Hough transform:

1. Find edges in the image by using any edge detection operator.
2. Compute the Hough transforms.
3. Display the Hough transform.
4. Find peaks in the Hough transform.
5. Superimpose a plot on the image that identifies the peaks.
6. Find lines in the images.
7. Create a plot that superimposes the lines on the original image.

5. METHODOLOGY

Steps for methodology are:

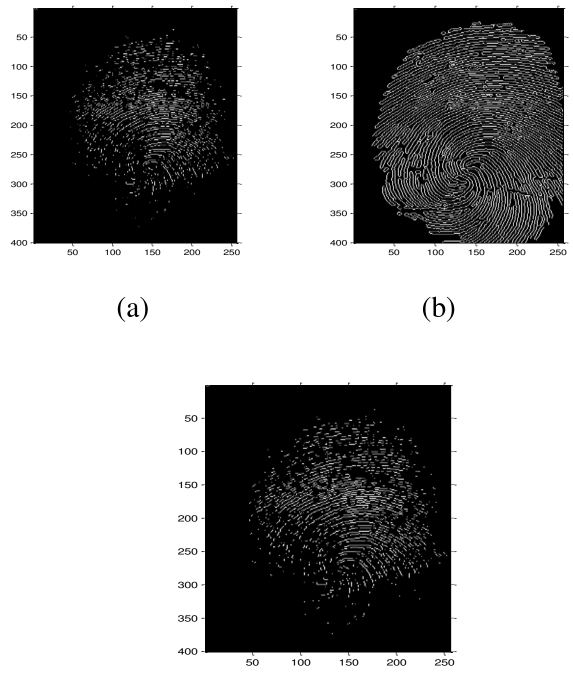
1. Consider two sets of fingerprint images.
2. Apply the Hough transform in the two sets of fingerprint images to find the longest line in the image i.e. in the Hough transform different steps is involve and then find the longest line in the fingerprint image with using different edge detection operator .
3. Output of above step can be taken as input for next step i.e. for the calculation of total matched percentage in this different step is involved.
4. Apply different edge detection operator in the output of Hough transform.
5. With help of output of different edge detection operator i.e. after obtaining the black and white points.
6. Matching of white point is done in the two set of fingerprint images.
7. Calculating the total matched percentage on the basis of different edge detection operator.
8. Finally the decision making of matching is performed on the basis i.e. if the two set of fingerprint is matched if matching is more than 90% and if two set of fingerprint is mismatched if matching is less than 90%.
9. Comparison is done on the basis of percentage matching by different edge detection operator and selects the output edge detection which gives more percentage of matching.
10. Finally we get the conclusion that this project gives best result of fingerprint matching by Hough transform and prewitt edge detection operator.

Regarding this, Zhao et al proposed a Dynamic Anisotropic Pore Model (DAPM), which has two parameters to adjust: scale and orientation. These two parameters are adaptively determined according to the ridge frequency and orientation, respectively. The DAPM is defined as:

$$\begin{cases} P_0(i,j) = e^{(-j^2/2\sigma^2)} cos\left(\frac{\pi}{3\sigma} i\right) \\ -3\sigma \leq i, j \leq 3\sigma \end{cases}$$

$$\begin{cases} P_\theta(i,j) = Rot(P_0, \theta) = e^{(-\hat{j}^2/2\sigma^2)} cos\left(\frac{\pi}{3\sigma} \hat{i}\right) \\ \hat{i} = icos(\theta) - jsen(\theta), \hat{j} = isen(\theta) + jcos(\theta) \\ -3\sigma \leq i, j \leq 3\sigma \end{cases}$$

6. RESULT AND DISCUSSION



(a) (b)

(c)

Fig 3: Output of edge detection of first fingerprints image (a) prewitt edge detection (b) canny edge detection (c) sobel edge detection

7. CONCLUSION

fingerprint matching is performed with the help of different edge detection operators and Hough transform. In decision making algorithm matching is performed. Prewitt, sobel and canny edge detector operators are used in first algorithm and percentage of matching is 8.9, 16.9 and 9.0 respectively. When same operator is used in second algorithm with Hough transform the percentage of matching is 40.6, 32.9 and 39.9 respectively. So on the basis of decision making algorithm it may be concluded that Prewitt edge detection operator with Hough transform gives the better agreement of matching.

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