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A SURVEY OF MINUTIAE EXTRACITION FROM NOISY FINGERPRINT IMAGES

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Abstract

Fingerprint recognition derived from physiological characteristics of biometric system. It's an oldest and broadly used technique of biometric system owing to its trustworthiness and individuality. A big issue in fingerprint recognition is sensitiveness with the noise. During this paper we've got mentioned regarding completely different techniques for minutiae extraction and their processing time analysis with the noisy image. Noisy image needs numerous image processing steps to boost the image to reduce noise. This will increases processing time for extraction of minutiae.

Keywords: fingerprint images, minutiae extraction, ridge endings, ridge bifurcation, fingerprint recognition.

Introduction

Humans identify each other according to their various characteristics for ages. We have a tendency to acknowledge others by their face when we meet them and by their voice as we speak to them. PC systems verify the authentication by someone having key, some information chip or one knows password, identity number. Things like keys or chips, however, tend to get stolen or lost and passwords are typically forgotten or disclosed [1].

To achieve more reliable verification or identification we must always use one thing that basically characterizes the given person. Biometrics offer automated methods of identity verification or identification on the principle of measurable physiological or behavioral characteristics like a fingerprint or a voice sample. The characteristics are measurable and distinctive.

A number of biometric characteristics exist and are in use in numerous applications. Every biometric has its strengths and weaknesses, and the selection depends on the applying. No single biometric is predicted to effectively meet the requirements of all the applications. The match between a particular biometric and an application is decided depending upon the operational mode of the application and the properties of the biometric characteristic.

Fingerprint

Fingerprint identification is a physiological characteristics primarily based technique used for biometric system. Fingerprint identification is that the oldest technique which is widely exploitation in biometric system for various security purpose. Fingerprints contain an oversized quantity of information. Because of the high level of data within the image, it's possible to eliminate false matches and scale back the number of possible matches to a small fraction. This implies that the fingerprint technology may be used for identification even within massive databases. Fingerprint matching techniques may be placed into two categories: minutiae-based and correlation based. Minutiae-based techniques realize the minutiae points first and then map their relative placement on the finger [2].

Uniqueness and durability are the features made the fingerprint most popular and extremely used technique for identification system. Fingerprint has helpful data with in the form of line structure. This line structure has black and white lines. Black line is understood as ridges that have high gray scale values and white lines are understood as valleys that have low grayscale values. Fingerprint information has been classified by completely different features which are known as minutiae (trivialities). Most automatic systems for fingerprint comparison are supported on minutiae matching; minutiae are local discontinuities in the fingerprint pattern. A total of hundred and fifty completely different minutiae varieties are known. In practice only ridge ending and ridge bifurcation minutiae varieties are employed in fingerprint recognition. Sample of trivialities are given in (Figure 1).

Figure 1 Minutiae in the fingerprint image

Literature survey

Conventional approaches are proposed in [3], incorporates a series of processing operation for extraction of minutiae from the fingerprint: preprocessing, binarization, thinning, minutiae extraction and post-processing. A crucial step in finding out the statistics of fingerprint minutiae is to reliably extract minutiae from the fingerprint images. However, fingerprint images are seldom of excellent quality. They'll be degraded and corrupted owing to variations in skin and impression conditions. Thus, image enhancement techniques are utilized before to minutiae extraction to get an additional reliable estimation of minutiae locations.

Salil Prabhakar, 2003, [4] has proposed a feed forward of the original grayscale image information to a feature (minutiae) verification stage within the context of a minutiae-based Fingerprint verification system. This minutiae verification stage is predicated on reexamining the grayscale profile in a detected minutia's spatial neighborhood within the detected image. This approach improved the matching accuracy ~3:2%.

Asker M. Bazen and Sabih H. Gerez, 2001, [5] have proposed an algorithm for the segmentation. A very important step in an automatic fingerprint recognition system is that the segmentation of fingerprint pictures. The task of a fingerprint segmentation algorithm is to choose which part of the image belongs to the foreground, originating from the contact of a fingertip with the detector, and which part to the background, which is the noisy area at the borders of the image. Planned methodology uses three constituent options, being the coherence, the mean and the variance. An optimal linear classifier is trained for the classification per pixel, whereas morphology is applied as post processing to get compact clusters and to cut back the quantity of classification errors.

Raymond Thai, 2003, [6] increased the fingerprint image by taking a mix of each synthetic test images and real fingerprint images. The use of synthetic images has provided a more quantitative and accurate measure of the performance. Whereas real images rely on qualitative measures of inspection, however will offer an additional realistic analysis as they provide a natural illustration of fingerprint imperfections like noise and corrupted components. Raymond Thai offer, segmentation, binarization, and cutting extra steps to boost the fingerprint image.

Dario Maio and DavideMaltoni, 1997, [7] have proposed a way where the minutiae are extracted directly from the grayscale images. This system is predicated on ridge line following algorithm that follows the image ridge lines till a termination or bifurcation occur. Results of this approach are higher as compare to the approaches in which binarization concerned in terms of potency and lustiness.

A.M. Bazen, and S.H. Gerez, 2001, [8] given an environment for using genetic programming, it applied on image process issue like fingerprint recognition. The environment performs tasks like: population management, genetic operators and distributed parallel evaluation of the programs.

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Furthermore, it provides a framework for implementation of the problem specific part. Using object-oriented ways, the environment is designed to offer a high degree of flexibility and easy use.

Asker M. Bazen and Martijn van Otterlo, 2001, [9] have proposed an agent primarily based approach on SARSA learning technique in which an autonomous agent walks around on the fingerprint images and learns how to follow ridges in the fingerprint and how to recognize minutiae further. During this planned theme agent is located in the environment, the fingerprint, and uses reinforcement learning to get an optimum policy. Multilayer perceptions are used for overcoming the difficulties of the large state area. By selected the correct reward structure and learning environment, the agent is ready to find out the task.

One drawback with SARSA approach is that it needs exploring the policy that will increase the convergence speed. Sandeep Tiwari and Neha Sharma 2012, [2] have proposed a Q-learning approach that is insensitive to the policy of exploration. Agent learns by observing the relation between neighborhood grayscale values of ridges and find original minutiae. The proposed approach considerably reduces convergence speed owing to insensitiveness to the policy exploration.

Methodology

Preprocessing

One of the foremost widely used fingerprint preprocessing techniques is the method employed that is predicated on the convolution of the image with Gabor filters tuned to the local ridge orientation and ridge frequency. The main stages of this algorithmic program include normalization, ridge orientation estimation, ridge frequency estimation and filtering.

The first step in this approach involves the normalization of the finger print image so that it has a pre specified mean and variance. Normalization is employed to cut back the results of these variations, which facilitates the next image improvement steps. An orientation image is then calculated, that could be a matrix of direction vectors representing the ridge orientation at every location in the image. The next step in the image enhancement method is the estimation of the ridge frequency image. The frequency image defines the local frequency of the ridges contained in the fingerprint. Firstly, the image is split into square blocks and an oriented window is calculated for every block. For each block, an x-signature signal is built using the ridges and valleys in the oriented window. The x-signatureis the projection of all the grey level values in the oriented window along a direction orthogonal to the ridge orientation. Fin-

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gerprint enhancement methods supported the Gabor filter are widely used to facilitate numerous fingerprint applications like fingerprint matching

CN	Property
0	Isolated point
1	Ridge ending point
2	Continuing ridge point
3	Bifurcation point
4	Crossing point

and fingerprint classification. Gabor filters are band pass filters that have both frequency-selective and orientation-selective properties which imply the filters may be effectively tuned to specific frequency and orientation values.

In addition to those four stages, there are three extra stages of fingerprint preprocessing techniques that include: segmentation, binarisation, and thinning.

Feature extraction

After a fingerprint image has been increased, following step is to extract the minutiae from the enhanced image. The most unremarkably utilized methodology of minutiae extraction is the Crossing Number (CN) concept. This methodology involves the use of the skeleton image wherever ridge flow pattern is eight-connected. The minutiae are extracted by scanning the local neighborhood of every ridge pixel in the image employing a 3×3 window. The CN value is then calculated, that is outlined as 0.5 the total of the differences between pairs of adjacent pixels in the eight-neighborhood. Using the properties of the CN as shown in Table 1.1, the ridge pixel will be classified as a ridge ending, bifurcation or non-minutiae point. For example, a ridge pixel with a CN of one corresponds to a ridge ending, and a CN of three corresponds to a bifurcation.

Table 1.1: Properties of the Crossing Number.

Some authors have conjointly performed minutiae extraction using the skeleton image. Their approach involves using a3×3 window to look at the local neighborhood of every ridge pixel in the image. A pixel is then classified as a ridge ending if it has only one neighboring ridge pixel in the window, and classified as a bifurcation if it has three neighboring ridge pixels. Consequently, it may be seen that this approach is incredibly similar to the Crossing Number methodology.

Post processing

False minutiae is also introduce into the image owing to factors like noisy images, and image artifacts created by the thinning process. Hence, once the minutiae are extracted, it’s necessary to use a post processing stage in order to validate the minutiae.

The majority of these proposed approaches for image post processing in literature are based on a series of structural rules used to eliminate spurious minutiae. One alternative approach is that performs the validation of minutiae based on a collection of heuristic rules. For instance, a ridge ending point that's connected to a bifurcation point, and is below a certain threshold distance is eliminated. This heuristic program corresponds to removal of the spike structure. Extra heuristic rules are then used to eliminate other types of false minutiae. Furthermore, a boundary effect treatment is applied wherever the minutiae below a definite distance from the boundary of the foreground region are deleted. [10]

Conclusion

Most of the existing automatic fingerprint verification systems are supported on minutiae features. Such systems first find the minutiae grayscale values on a direction normal to the local ridge direction. These Classical approaches use a series of image processing steps for this task, but lack robustness because they're highly sensitive to noise and image quality. This has been improved by using agent based approach known as reinforcement learning. In which agent is located in the fingerprint environment, and uses reinforcement learning to get an optimum policy. Asker M. Bazen and Martijn van Otterlo has proposed a SARSA approach of reinforcement learning .Problem with the SARSA technique is it needs to explore the policy . A Q-learning approach significantly reduces convergence speed owing to insensitiveness to the policy exploration.

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