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Literature Survey On Fingerprint Recognition Using Level 3 Feature Extraction Method

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ABSTRACT : To design Level 3 fingerprint feature extraction method and match using SIFT algorithm. First of all fingerprint of good quality are acquired by using optical scanner. Normalization of image is done using Gaussian blurring and sliding window contrast adjustment. Pores are extracted and estimated. These estimated pores, are used to match from template database to stored database using SIFT algorithm. Scale Invariant Features Transform (SIFT) is an algorithm in computer vision to detect and describe local features in images. The features are invariant to image scaling and rotation. They are well localized in both the spatial and frequency domains. The features are highly distinctive, which allows a single feature to be correctly matched with high probability against a large database of features, providing a basis for object and scene recognition.

Keywords - Fingerprint recognition, pores, SIFT technique, pores matching

INTRODUCTION

Fingerprint recognition is a complex pattern recognition problem. It is difficult to design accurate algorithms capable of extracting salient features and matching them in a robust way, especially in poor quality fingerprint images and when low-cost acquisition devices with small area are adopted. There is a popular misconception that automatic fingerprint recognition is a fully solved problem since it was one of the first applications of machine pattern recognition. On the contrary, fingerprint recognition is still a challenging and important pattern recognition problem

LITERATURE SURVEY

This chapter presents the work done by other researcher related to fingerprint verification system, pores extraction and matching system. In this chapter description about all reference papers are summarized.

1.) Qijun Zhao et al. [6] proposed an adaptive pore model for fingerprint pore extraction. Sweat pores have been recently employed for automated fingerprint recognition, in which the pores are usually extracted by using a computationally expensive skeletonization method or a unitary scale isotropic pore model. In this paper, however, author shows that real pores are not always isotropic. To accurately and robustly extract pores, they propose an adaptive anisotropic pore model, whose parameters are adjusted adaptively according to the fingerprint ridge direction and period. The fingerprint image is partitioned into blocks and a local pore model is determined for each block. With the local pore model, a matched filter is used to extract the pores within each block. Experiments on a high resolution (1200dpi) fingerprint dataset are performed and the results demonstrate that the proposed pore model and pore extraction method can locate pores more accurately and robustly in comparison with other state-of- the-art pore extractors.

2.) Moheb R. et al. [7] proposed an approach to image extraction and accurate skin detection from web pages. This paper proposes a system to extract images from web pages and then detect the skin color regions of these images. As part of the proposed system, using BandObject control, they build a

Tool bar named "Filter Tool Bar (FTB)" by modifying the Pavel Zolnikov implementation. In the proposed system, they introduce three new methods for extracting images from the web pages (after loading the web page by using the proposed FTB, before loading the web page physically from the local host, and before loading the web page from any server). These methods overcome the drawback of the regular expressions method for extracting images suggested by Ilan Assayag. The second part of the proposed system is concerned with the detection of the skin color regions of the extracted images. So, they studied two famous skin color detection techniques. The first technique is based on the RGB color space and the second technique is based on YUV and YIQ color spaces. They modified the second technique to overcome the failure of detecting complex image's background by using the saturation parameter to obtain an accurate skin detection results. The performance evaluation of the efficiency of the proposed system in extracting images before and after loading the web page from local host or any server in terms of the number of extracted images is presented. Finally, the results of comparing the two skin detection techniques in terms of the number of pixels detected are presented.

3.) Manvjeet Kaur et al. [8] proposed a fingerprint verification system using minutiae extraction technique. Most fingerprint recognition techniques are based on minutiae matching and have been well studied. However, this technology still suffers from problems associated with the handling of poor quality impressions. One problem besetting fingerprint matching is distortion. Distortion changes both geometric position and orientation, and leads to difficulties in establishing a match among multiple impressions acquired from the same finger tip. Marking all the minutiae accurately as well as rejecting false minutiae is another issue still under research. Our work has combined many methods to build a minutia extractor and a minutia matcher. The combination of multiple methods comes from a wide investigation into research papers. Also some novel changes like segmentation using morphological operations, improved thinning, false minutiae removal methods, minutia marking with special considering the triple branch counting, minutia unification by decomposing a branch into three terminations, and matching in the unified x-y coordinate system after a two-step transformation are used in the work.

4.) Hoi Le et al. [9] proposed online fingerprint identification with a fast and distortion tolerant hashing method. National ID card, electronic commerce, and access to computer networks are some scenarios where reliable identification is a must. Existing authentication systems relying on knowledge-based approaches like passwords or token-based such as magnetic cards and passports contain serious security risks due to the vulnerability to engineering-social attacks and the easiness of sharing or compromising passwords and PINs. Biometrics such as fingerprint, face, eye retina, and voice offer a more reliable means for authentication. However, due to large biometric database and complicated biometric measures, it is difficult to design both an accurate and fast biometric recognition. Particularly, fast fingerprint indexing is one of the most challenging problems faced in fingerprint authentication system. In this paper, they present a specific contribution by introducing a new robust indexing scheme that is able not only to fasten the fingerprint recognition process but also improve the accuracy of the system.

5.) Ratha et al. [30] proposed an adaptive flow orientation based segmentation or binarization algorithm. In this approach the orientation field is computed to obtain the ridge directions at each point in the image. To segment the ridges, a 16x16 window oriented along the ridge direction is considered around each pixel. The projection sum along the ridge direction is computed. The centers of the ridges appear as peak points in the projection. The ridge skeleton thus obtained is smoothened by morphological operation. Finally minutiae are detected by locating end points and bifurcations in the thinned binary image.

6.) Anil Jain et al. [10] proposed a Pores and Ridges: Fingerprint Matching Using Level 3 Features. Fingerprint friction ridge details are generally described in a hierarchical order at three levels, namely, Level 1 (pattern), Level 2

(minutiae points) and Level 3 (pores and ridge shape). Although high resolution sensors (~1000dpi) have become commercially available and have made it possible to reliably extract Level 3 features, most Automated Fingerprint Identification Systems (AFIS) employ only Level 1 and Level 2 features. As a result, increasing the scan resolution does not provide any matching performance improvement [17]. They develop a matcher that utilizes Level 3 features, including pores and ridge contours, for 1000dpi fingerprint matching. Level 3 features are automatically extracted using wavelet transform and Gabor filters and are locally matched using the ICP algorithm. Our experiments on a median-sized database show that Level 3 features carry significant discriminatory information. EER values are reduced (relatively ~20%) when Level 3 features are employed in combination with Level 1 and 2 features.

7.) Mayank Vatsa et al. [11] proposed an combining pores and ridges with minutiae for improved fingerprint verification. This paper presents a fast fingerprint verification algorithm using level-2 minutiae and level-3 pore and ridge features. The proposed algorithm uses a two-stage process to register fingerprint images. In the first stage, Taylor series based image transformation is used to perform coarse registration, while in the second stage, thin plate spline transformation is used for fine registration. A fast feature extraction algorithm is proposed using the Mumford–Shah functional curve evolution to efficiently segment contours and extracts the intricate level-3 pore and ridge features. Further, Delaunay triangulation based fusion algorithm is proposed to combine level-2 and level-3 information that provides structural stability and robustness to small changes caused due to extraneous noise or non-linear deformation during image capture. They defines eight quantitative measures using level-2 and level-3 topological characteristics to form a feature super vector. A 2n-support vector machine performs the final classification of genuine or impostor cases using the feature super vectors. Experimental results and statistical evaluation show that the feature super vector yields discriminatory information and higher accuracy compared to existing recognition and fusion algorithms.

8.) Umut Uludaga et al. [14] proposed a Biometric template selection and update: a case study in fingerprints. Sweat pores have been recently employed for automated fingerprint recognition, in which the pores are usually extracted by using a computationally expensive skeletonization method or a unitary scale isotropic pore model. In this paper, however, real pores are not always isotropic. To accurately and robustly extract pores, they propose an adaptive anisotropic pore model, whose parameters are adjusted adaptively according to the fingerprint ridge direction and period. The fingerprint image is partitioned into blocks and a local pore model is determined for each block. With the local pore model, a matched filter is used to extract the pores within each block. Experiments on a high resolution (1200dpi) fingerprint dataset are performed and the results demonstrate that the proposed pore model and pore extraction method can locate pores more accurately and robustly in comparison with other state-of-the-art pore extractors.

9.) Coetzee and Botha [31] proposed a binarization technique based on the use of edges extracted using Marr-Hilderith operator. The resulting edge image is used in conjunction with the original gray scale image to obtain the binarized image. This is based on the recursive approach of line following and line thinning. Two adaptive windows, the edge window and the gray-scale window are used in each step of the recursive process. To begin with, the pixel with the lowest gray-scale value is chosen and a window is centered on it. The boundary of the window is then examined to determine the next position of the window. The window is successively position to trace the ridge boundary and the recursive process terminates when all the ridge pixels have been followed to their respective ends.

10.) Ruud M. Bolle et al. [33] proposed the evaluation techniques for biometrics-based authentication systems (FRR). Biometrics-based authentication is becoming popular because of increasing ease-of-use and reliability. Performance evaluation of such systems is an important issue. They endeavor to address two aspects of performance evaluation that have been conventionally neglected. First, the "difficulty"

of the data that is used in a study influences the evaluation results. They propose some measures to characterize the data set so that the performance of a given system on different data sets can be compared. Second, conventional studies often have reported the false reject and false accept rates in the form of match score distributions. However, no confidence intervals are computed for these distributions, hence no indication of the significance of the estimates is given. In this paper, they compare the parametric and nonparametric (bootstrap) methods for measuring confidence intervals. They give special attention to false reject rate estimates.

11.) Wang Yuan et al. [36] proposed a real time fingerprint recognition system based on novel fingerprint matching strategy. In this paper they present a real time fingerprint recognition system based on a novel fingerprint minutiae matching algorithm. The system is developed to be applicable to today's embedded systems for fingerprint authentication, in which small area sensors are employed. The system is comprised of fingerprint enhancement and quality control, fingerprint feature extraction, fingerprint matching using a novel matching algorithm, and connection with other identification system. Here they describe their way to design a more reliable and fast fingerprint recognition system which is based on today's embedded systems in which small area fingerprint sensors are used. Experiment on FVC database show our system has a better performance than compared. And for the image enhancement and matching techniques they use high efficiency, it can also give a real time identification result with high reliability.

12.) Wei Cui et al. [37] proposed the research of edge detection algorithm for fingerprint images. This paper introduces some edge detection operators and compares their characteristics and performances. At last the experiment show that each algorithm has its advantages and disadvantages, and the suitable algorithm should be selected according the characteristic of the images detected, so that it can perform perfectly. The Canny Operator is not susceptible to the noise interference; it can detect the real weak edge. The advantage is that it uses two different thresholds to detect the strong edge and the weak edge, and the weak edge will be include in the output image only when the weak edge is connected to the strong edge. The Sobel Operator has a good performance on the images with gray gradient and high noise, but the location of edges is not very accurate, the edges of the image have more than one pixel. The Binary Image Edge Detection Algorithm is simple, but it can detect the edge of the image accurately, and the processed images are not need to be thinned, it particularly adapts to process various binary images with no noise. So each algorithm has its advantages and disadvantages, and the suitable algorithm should be selected according to the characters of the images been detected, then it can performance perfectly.

13.) Shunshan li et al. [38] proposed the Image Enhancement Method for Fingerprint Recognition System. In this paper fingerprint image enhancement method, a refined Gabor filter, is presented. This enhancement method can connect the ridge breaks, ensures the maximal gray values located at the ridge center and has the ability to compensate for the nonlinear deformations. it includes ridge orientation estimation, a Gabor filter processing and a refined Gabor filter processing. The first Gabor filter reduces the noise, provides more accurate distance between the two ridges for the next filter and gets a rough ridge orientation map while the refined Gabor filter with the adjustment parameters significantly enhances the ridge, connects the ridge breaks and ensures the maximal gray values of the image being located at the ridge center. In addition, the algorithm has the ability to compensate for the nonlinear deformations. Furthermore, this method does not result in any spurious ridge structure, which avoids undesired side effects for the subsequent processing and provides a reliable fingerprint image processing for Fingerprint Recognition System. In a word, a refined Gabor filter is applied in fingerprint image processing, then a good quality fingerprint image is achieved, and the performance of Fingerprint Recognition System has been improved.

14.) S. Mil'shtein et al. [39] proposed a fingerprint recognition algorithm for partial and full fingerprints. In this study, they

propose two new algorithms. The first algorithm, called the Spaced Frequency Transformation Algorithm (SFTA), is based on taking the Fast Fourier Transform of the images. The second algorithm, called the Line Scan Algorithm (LSA), was developed to compare partial fingerprints and reduce the time taken to compare full fingerprints. A combination of SFTA and LSA provides a very efficient recognition technique. The most notable advantages of these algorithms are the high accuracy in the case of partial fingerprints. At this time, the major drawback of developed algorithms is lack of pre-classification of examined fingers. Thus, they use minutiae classification scheme to reduce the reference base for given tested finger. When the reference base had shrunk, they apply the LSA and SFTA.

15.) Another paper proposed a novel approaches for minutiae filtering in fingerprint images. Existing structural approaches for minutiae filtering use heuristics and adhoc rules to eliminate such false positives, where as gray level approach is based on using raw pixel values and a super-vised classifier such as neural networks. They proposed two new techniques for minutiae verification based on non-trivial gray level features. The proposed features intuitively represent the structural properties of the minutiae neighborhood leading to better classification. They use directionally selective steerable wedge filters to differentiate between minutiae and non-minutiae neighborhoods with reasonable accuracy. They also propose a second technique based on Gabor expansions that result in even better discrimination. They present an objective evaluation of both the algorithms. Apart from minutiae verification, the feature description can also be used for minutiae detection and minutiae quality assessment.

16.) Deepak Kumar Karna et al. [41] proposed normalized cross-correlation based fingerprint matching. To perform fingerprint matching based on the number of corresponding minutia pairings, has been in use for quite some time. But this technique is not very efficient for recognizing the low quality fingerprints. To overcome this problem, some researchers suggest the correlation technique which provides better result. Use of correlation-based methods is increasing day-by-day in the field of biometrics as it provides better results. In this paper, they propose normalized cross-correlation technique for fingerprint matching to minimize error rate as well as reduce the computational effort than the minutiae matching method. The EER (Equal Error Rate) obtained from result till now with minutiae matching method is 3%, while that obtained for the method proposed in this paper is approx 2% for all types of fingerprints in combined form.

17.) Asker M. Bazen et al. [42] proposed a correlation-based fingerprint verification system. In this paper, a correlation-based fingerprint verification system is presented. Unlike the traditional minutiae-based systems, this system directly uses the richer gray-scale information of the fingerprints. The correlation-based fingerprint verification system first selects appropriate templates in the primary fingerprint, uses template matching to locate them in the secondary print, and compares the template positions of both fingerprints. Unlike minutiae-based systems, the correlation-based fingerprint verification system is capable of dealing with bad-quality images from which no minutiae can be extracted reliably and with fingerprints that suffer from non-uniform shape distortions. Experiments have shown that the performance of this system at the moment is comparable to the performance of many other fingerprint verification systems.

18.) David G. Lowe [43] proposed an approach to distinctive image features from scale-invariant keypoints. This paper presents a method for extracting distinctive invariant features from images that can be used to perform reliable matching between different views of an object or scene. The features are invariant to image scale and rotation, and are shown to provide robust matching across a substantial range of affine distortion, change in 3D viewpoint, addition of noise, and change in illumination. The features are highly distinctive, in the sense that a single feature can be correctly matched with high probability against a large database of features from many images. This paper also describes an approach to using these features for object recognition. The recognition proceeds by matching individual features to a database of features from

known objects using a fast nearest-neighbor algorithm, followed by a Hough transformation to identify clusters belonging to a single object, and finally performing verification through least-squares solution for consistent pores parameters. This approach to recognition can robustly identify objects among clutter and occlusion while achieving near real-time performance.

I. CONCLUSION

This chapter presents the work done by other researcher related to fingerprint verification system, pores extraction and matching system. In this chapter description about all reference papers are summarized. This paper presents a brief survey of fingerprint level 3 features extraction and matching approach which is a novel approach, its characteristics, design issues and applications. It also describes an overview of Level 1 and level 2 features, in the literature and their functionalities. Along with that, it has through discussion of SIFT algorithm. Finally, it presents an novel approach for level 3 feature extraction and matching algorithm. Since the technology is going to its zenith, the way of its journey is not smooth and many loopholes are there.

The proposed work is an attempt to overcome some weakness regarding security concern of the system. The experimental results demonstrate that the proposed approach and its associated pore extraction method can detect pores more accurately and robustly, and can help to improve the verification accuracy of pore based fingerprint recognition systems. There are many method exists to make it unextractable by adversaries, like one is to use multi-biometric traits under a single process, but it need extra sensors setup for each kind of traits, the proposed technique gives an extra edge to such systems which use single type of sensor and give more security.

This approach will give the technology new amplitude in order to provide a secure way of authentication, in which the pores are logically extracted. The proposed algorithm performs better than existing recognition algorithms and fusion algorithms. Along with other advantages, in all biometric systems fingerprint based systems are more efficient than other multimodal system, so it minimizes FAR and FRR.

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