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A Survey Paper on Fingerprint Recognition and Cross Matching

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Abstract: ***As common as largely used various technical methods, identification of fingerprint is presently growing as a very popular biometric recognition approach, primarily due to its uniqueness. Process of performing a sharp observation and thereby finding out the most appropriate fingerprint match from the given set of data is what actually meant by the term fingerprint recognition. For getting the proper match output using fingerprint recognition systems, a wide variety of theoretical methods and algorithms were proposed and are quite common for last long years. Each system use minutia feature as the key feature for similarity identification because of its accuracy. Some researchers used features like ridge map, core point feature other than the minutia to get better performance and accuracy. Nowadays cross matching of fingerprint from different sensors are also a research topic due to the emergence of new contactless sensors. This survey paper includes the discussion about fingerprint recognition and cross matching techniques. Here different approaches are studied in terms of accuracy and performance.***
Keywords: Minutia, Ridge map, Sensor interoperability, Gabor-HoG, BGP

I. INTRODUCTION

Fingerprint is a key marker, which plays a major role in proving the identity of a human, because of its constant and unique features. Biologically, fingerprints can be defined as a unique skin pattern that remains as a printed identification form in palm of every human. There will not happen any change in pattern and structure of fingerprint while aging. Due to all these reasons, fingerprint recognition technologies taken as an important human identification method. Applications like law enforcement and e-business takes advantages of this technique.

Nowadays different types of fingerprint sensors are available with different industries. So the fingerprint interoperability is very important. Fingerprint interoperability means the ability to check the cross match of fingerprint from two different sensors. Proper examination and gaining a wide knowledge about different steps and algorithms used in Fingerprint Recognition techniques is the goal of this paper. Clear study on different fingerprint recognition and matching methods are discussed through this survey. The key feature used for these type of methods are minutia feature because of its accuracy. Nowadays we need to match the fingerprint from different types of sensors, so more sophisticated methods are needed. This paper shows important methods from old to now.

II. LITERATURE SURVEY

This paper [1] introduced, first automatic fingerprint identification system. This automated fingerprint identification system operates in two stages: minutia extraction and minutia matching. The extraction of minutia features are done by using an improved version algorithm proposed by Ratha et al. This extraction step includes some steps, first do the smoothing on input image. Then it estimates orientation field as well as region location. Finally, ridge extraction and thinning of image will done for the minutia feature extraction. Matching of these features are done by an alignment-based elastic matching algorithm. These two algorithm gave high accuracy and performance. The disadvantage with which is that, time consuming.

This paper [2] present an unconstrained recognition device for fingerprints of human by considering models, which are in fully touchless 3-D form with different moves as key point. Such mechanism does not require contact with any outer space or certain instructions regarding where to place fingerprint, but will catch many number of images at a time where the movement of finger is going on. The author present a novel algorithm for construction of 3-D model and an advanced procedure which includes evaluating numerous touch-compatible pictures for matching fingerprint. Finally, the matching score will be calculated from both test image and image from database. The advantage of this method is that, evaluate different aspect of biometric system like robustness to environmental conditions, recognition performance and interoperability with touch-based technologies.

Paper [3] discussing about biometric sensor interoperability and recognition. Sensor interoperability is the process of matching fingerprints collected from different sensors. Different biometric domains including fingerprint, face, iris, and speech reports poor inter-sensor performance. In this paper [3], author proposed a Thin-Plate Spline (TPS) model, it used a nonlinear calibration scheme.

It is used to register a pair of fingerprint sensors. The TPS model defines the spatial relationship between the two sensors. This model introduced between minutia extraction and minutia matching, which helps to handle the inter-sensor distortion. This will improve the accuracy of fingerprint cross matching. This paper [4] introduces a non-contact based fingerprint acquisition and mosaicking system which can be presented in a multi viewing form. Such system mainly consider three unique fingerprint angles simultaneously, which are calculated from the given images. Here, a state-of-art technique related to doing mosaicking operation on fingerprint is done for splicing the acquired pictures of identical finger altogether, in order to create another image with much large field area. This image mosaicking includes four steps: initial correspondences establishment, transformation estimation, mosaic region selection and post-processing. The first step is extraction of segmented SIFT feature and finding out the match between them. For measuring certain parameters in the method for estimation of transform, RANSAC technique is very much useful. Stitching line selection is used to find the mosaic region. Finally post-processing step generate the mosaic image. For evaluating and proving the efficiency of the system, deep comparison between images that are mosaicked and also related to contact based fingerprint is to be done. This paper [5], discussed about two topics, sensor interoperability and fusion. Normally the performance of matching images from different sensors are very less. So, here the authors used fused score from different sensors. The basic architecture of proposed fingerprint verification system includes, pre-processing, feature extraction, similarity checking between test image and enrolled templates, score normalisation and decision threshold calculation. Finally, this paper find out that fusing scores from different sensors results better performance than fusing different instances from the same sensor.

In this paper [6], authors investigates a problem with the cross matching of contactless fingerprints with contact based fingerprints. And also develops a new model named deformation correction model (DCM) for getting a correct match of a fingerprint from the input. Robust thin-plate spline (RTPS) is the main base method for DCM, proposed for understanding and acquiring the exact elastic deformation of fingerprint with the use of splines. By the usage of DCM, aligning process of contact and non-contact based minutiae features can be easily performed. Moreover, specific fingerprint ridge maps in relation with minutia features are included for further improvement in such cross-matching performance. Finally they calculated matching score to take a decision regarding genuinity.

There are different types of sensors for collecting fingerprints. So, these fingerprints from different sensors vary differently. This paper [7] proposes an algorithm to match fingerprint images from various sensors. Fingerprint core detection method is used to find core point or registration point. Then, it is used to find out ridge. Then the fingerprint is normalized in image space as well as feature space. Finally, adjustable bounding box method is used for minutia matching.

This paper [8] proposes a pre-processing step for minutia based fingerprint cross matching. First, the image is enhanced using Gabor filter. Then, core point localization is used to find out ROI. Normalized cross-correlation is used for finding the similarity between testing image and ROI. Then a checking is performed to find out whether there is a need for distortion correction. For this, thresholding approach is used. If distortion correction is needed, it is performed before minutia extraction. Otherwise, directly perform minutia extraction without distortion correction. Then minutia matching is performed for identification.

This paper [9] proposes an automatic fingerprint verification system. First the fingerprint image is enhanced. Then its minutia features along with three descriptors namely Gabor-HOG, BGP and orientation are computed. These information are stored in a template database. While fingerprint matching, minutia feature extraction and three descriptor computations are performed for the test image. The three descriptors are separately matched to compute some scores. At last, these scores are fused to find out the final score. This paper [10] proposes a field orientation based cross correlation approach. First, the image is smoothed to remove noise. Then edge is detected using canny filter. Then field orientation is computed for template image and input test image. Then a cross correlation score is computed to find the similarity.

III.CONCLUSIONS

Fingerprint recognition system is widely used in different forensic applications and other security issues. Because it is considered as convenient personal identification system. Eventually, due to security and reliability of fingerprint recognition systems lot of businesses in the industrial sector, including the personal devices and financial industry are using it. Now Fingerprint Recognition System is using different type of sensors, so the cross matching of fingerprint from multiple sensors are important. This paper discussed about various fingerprint recognition and cross matching techniques. Basic step of each method is minutia similarity checking, because it considered as unique one. Each paper proposed different methods, which are better than other. This paper explain various advantages as well as disadvantages of these approaches.

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