A Review Of Rotational Invariance Technique In Fingerprint Recognition

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Abstract

In the image processing systems, the input image is first preprocessed, which may involve restoration, enhancement, or just proper representation of the data. The most significant problem in image analysis is the detection of presence of an object within a given scene or an image. Such problem occurs in trademarks classification and other areas like remote sensing for monitoring growth patterns within urban areas, weather prediction from satellite, target detection from radar or from the fighter plane, etc. For this purpose, template matching or template detection is the most commonly used technique. Using rotation invariant template matching the object of interest can be easily searched even if it is rotated at any angle within the query image. Rotation invariant template matching is used in many applications like, trademark detection, character recognition, fingerprint identification, biomedical imaging, remote sensing and feature tracking.

Keywords: Fingerprint recognition, Biometrics, Rotation Invariance

I. Introduction

Biometric system is an imperative area of research in recent years. Biometrics refers to the use of distinct physiological and behavioral characteristics to identify individuals automatically and has the ability to distinguish between an authorized person and imposter. Physiological characteristics include fingerprint, face, retina iris etc. and these characteristics are unique to every person [1]. Among all biometrics (e.g., face, fingerprint, hand geometry, iris, retina, signature, voice print, facial thermo gram, hand vein, gait, ear, odor, keystroke dynamics, etc.), fingerprint-based identification is one of the most mature and proven technique.

Nowadays, fingerprint recognition is one of the most important biometric technologies based on fingerprint distinctiveness, persistence and ease of acquisition. Although there are many real applications using this technology, its problems are still not fully solved, especially in poor quality fingerprint images and when low-cost acquisition devices with a small area are adopted. In fingerprint recognition process, the important step which affects on system accuracy is matching between template and query fingerprint.

II. Fingerprint Recognition System

The block diagram of Finger Recognition System is as shown in Figure 1. First, Input step takes on-line form the fingerprint scanner or off-line input image from database. Second, the input is passed through a number of preprocessing steps such as gray scale converting, noise reduction, binarization, and

thinning.[2]. All these steps use the built-in functions of Matlab. Third, fingerprint recognition system is started to run. It is considered by statistics of geometry approaches. Finally, decision will be made

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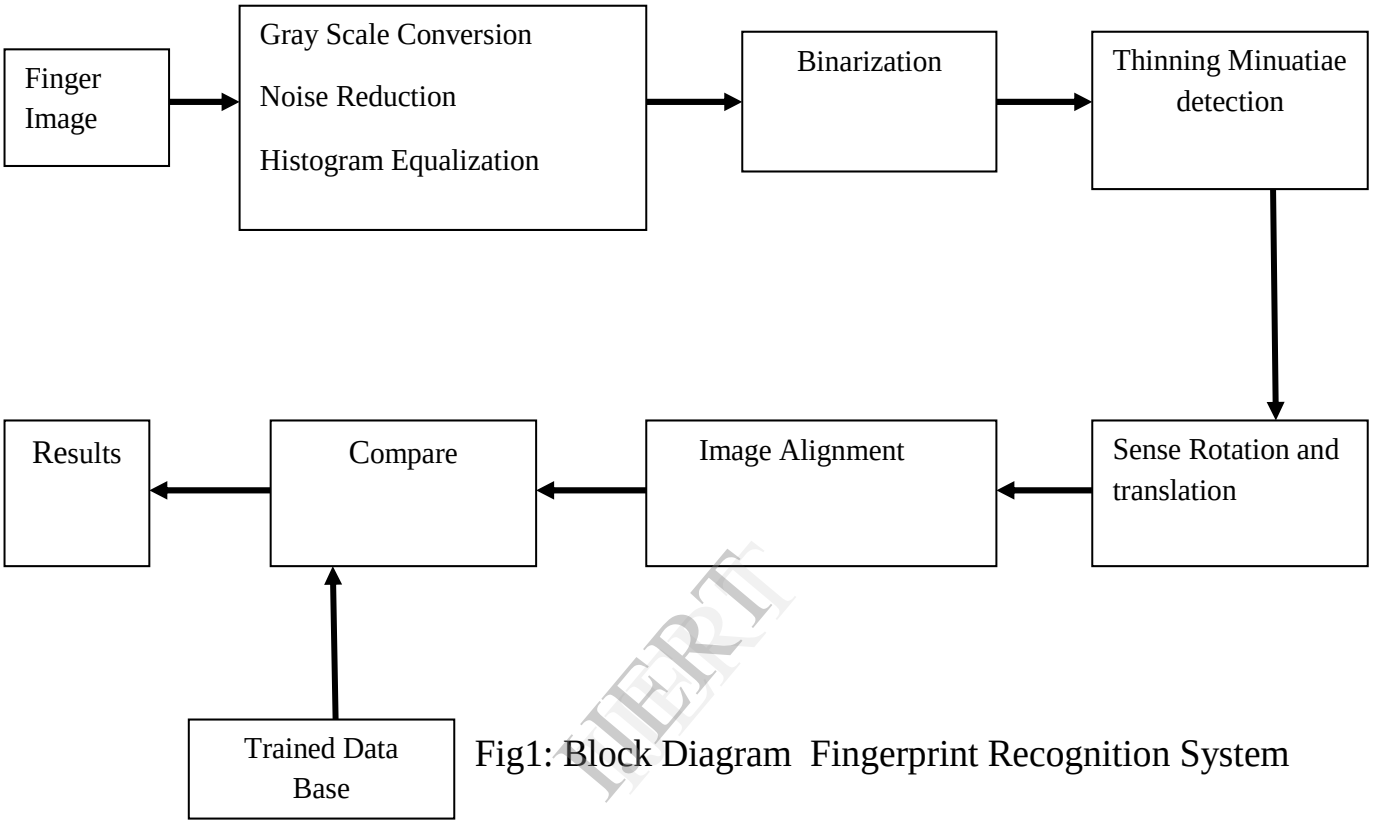

Fig1: Block Diagram Fingerprint Recognition System

A. Preprocessing Steps

The performance of feature extraction for image depends on the quality of input image. To obtain the higher accuracy performance, the input image needs to undergo several image enhancement techniques. In this system, Pre-processing steps are the most important than the other recognition system.

B. Image Enhancement

Image enhancement is the process improving the quality of a digitally stored image by manipulating the image with software. It is quite easy, for example, to make an image lighter or darker, or to increase or decrease contrast. The first step in image enhancement is to convert the input image into gray scale image. This is necessary because though it image appears black and white there are 3 dimensions which are present in the normal color image. Then next step is noise reduction. For this purpose median filter is used. Median filter is useful salt and paper noise which is usually present in the fingerprint image [3]. Then next step is binarization. Binarization is the process which transforms the 8 bit gray image to a one bit image. After the binarization image contains 0 values for ridges and 1 value for furrows. The next step is fingerprint image thinning. In this process the redundant pixels of ridges are just

one pixel wide[4]. This is done using MATLAB‟s built in morphological thinning function.

III. Literature Review

Kim H. Y. et al. [7] considered the grayscale template matching problem, invariant to rotation, scale, translation, brightness and contrast. They proposed a technique that substantially accelerates this searching while obtaining the same results as the original brute force algorithm. Their algorithm consists of three cascade filters. Lin Y-H. et al. [8] proposed a new method for template matching, invariant to image translation, rotation and scaling. In the first step of the approach, the ring-projection transform (RPT) process is used to convert the 2D template in a circular region into a 1D gray-level signal as a function of radius. Then, the template matching is performed by constructing a parametric template vector (PTV) of the 1D gray-level signal with differently scaled templates of the object.

W-C. et al. [9] proposed an algorithm for rotation invariant template matching method. The algorithm consists of two stages process. In the first stage, the scene image and template are reduced in resolution. Then the features from the sub image covered by the template are extracted using RPT method. The normalized correlation formula is used to select the matching candidates in the coarse search stage. These candidates will be recovered to original position and determine the searching range. In the second-stage process, Zernike moments based on the matching candidates are used to determine the optimal matching point.

Ullah F. et al. [10] proposed a new method for rotation-invariant template matching in gray scale images. It is based on the utilization of gradient information in the form of orientation codes as the feature for approximating the rotation angle as well as for matching. Orientation codes-based matching is robust for searching objects in cluttered environments even in the cases of illumination fluctuations resulting from shadowing or highlighting, etc. Zhonghai L.I. et al. [11] present the concept of relative orientation code, and designed a template matching method based on relative orientation code in order to improve accuracy and real time ability. This method first selects candidate target points using relative orientation codes histogram matching, then calculates the rotation angle of candidate sub image and rotates the sub image, finally match the relative orientation codes in the sub image. Their results show that this method is robust when the image is rotated by any angle, and the candidate points are selected and matched accurately, and the computing time is less than original method. Urano et al. [12] proposed a fast and rotation invariant template matching using an orientation code difference histogram (OCDH). The method is effective in presence of some irregularities like shading, highlighting, occlusion or their combination. This method is based on Orientation code matching (OCM) and orientation code histogram.

Pew-Than Yap et al. [13] introduces a set of 2D transforms, based on a set of orthogonal projection bases, to generate a set of features which are invariant to rotation. R M Mandi et al.[14] uses an algorithm for recovering translation parameters from two fingerprint images of the same individual that differ by Scaling, Rotation, and Transformation also known as similarity transformation or Rotation-scale-

Translation (RST) Transformation.The algorithm uses minutiae based matching to compare input fingerprint image with the template fingerprint image stored in the database. The algorithm uses various standard preprocessing steps. It includes all the stages to extract the minutiae.

IV. Comparative Analysis

Year Of Publication	Author Name	Technique / Method Used	Pros	Cons
2007	H. Y. Kim and S. A. Araujo [7]	Grayscale template matching using rotation invariance.	Obtains the same results as the origina	
2008	Yi-Hsien Lin, Chin-Hsing Chen [8]	Template matching using the parametric template vector with translation, rotation and scale invariance	Conversion Of 2D images is easy and simple	
2009	Wen-Chia Lee, Chin-Hsing Chen [9]	Template Matching Method for Rotation Invariance	Zerkine moments are used to determine matching point	
2004	Farhan Ullah, Shun'ichi Kaneko	Orientation codes for rotation-invariant template matching	Uses Gradient information	
2011	LI Zhonghai, LIU Chunyu, CUI Jianguo, SHEN Weifeng, [11]	Improved Rotation Invariant Template Matching Method Using Relative Orientation Codes	Uses histogram matching to find orientation codes.	
2005	Takahiro Urano, Shun'ichi Kaneko, Takayuki Tanaka, Munatoshi Imada [12]	Using Orientation Code Difference Histogram (OCDH) for Robust Rotation-invariant	Effective in Presence of irregularities as well.	

2010	Pew-Thian Yap, Xudong Jiang, Alex Chichung Kot [13]	2D transforms, based on a set of orthogonal projection bases to generate a set of features which are invariant to rotation	PHTs encompass the orthogonality and invariance advantages of Zernike and pseudo-Zernike moments	Free from Zerkine inherent limitations
2012	R. M.Mandi S. S. Lokhande [14]	Uses an algorithm for recovering translation parameters from two fingerprint images of the same individual that differ by Scaling, Rotation, and Transformation also known as similarity transformation or Rotation-scale-Translation (RST) Transformation	Useful to identify two fingerprint images of the same individual which are misaligned by small transformations.	Tested on the pilot database

V. Refrences

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