European Journal of Molecular & Clinical Medicine
ISSN 2515-8260 Volume 7, Issue 10, 2020

IMPROVED AUTOMATED FINGERPRINT IDENTIFICATION SYSTEM USING IMPROVISED GABOR FILTERS ALGORITHM

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Abstract

Automated fingerprint identificationprocess takes many steps and may leads to accessibility problem. Image processing techniques can be implemented in automatic fingerprint identification system for better recognition. The image processing improver's accuracy of the identification process without damaging the real quality of the fingerprint images. The basic enhancement, resizing and contest improvement are followed as the basic steps of the image processing techniques before using the gray scale conversion process. The dry finger print and wet fingerprint images should be automatically determined with the defined parameter settings. The image processing technique of classification and automatic parameter selection are used for better fingerprint enhancement procedure, which is one of the novel method followed in this research work.

The process carried out in enhancement procedure produces best result in evaluation and identification process of the fingerprint using fingerprint sensors without damaging the quality of the images. The image enhancement process also improves the quality of the database and easy acceptability of evaluation process. Uchida method used in previous fingerprint identification process only uses the particular segment of fingerprint rather using full finger print. The finger print patterns are the most significant factors in identification process.

The gray scale conversion process of the image processing techniques is one of the important technique used in the pattern recognition process. The image enhancement techniques usually follows frequency domain and spatial domain which has some practical difficulties in matching process. The discussed problem can be solved withproposed FFT-Based Signal Analysis and Measurement techniques inglobal features but do not compensate for the effect of image-to-image brightness variations. The proposed Gabor Filters Algorithm using FFT based signal analyzing

process makes best drop down in Equal error rate (EER) 1.82% to 1.22%.

Keyword: Image processing, Image Classification, Gabor Filters

1. INTRODUCTION

The security plays a major role in modern internet era. Many hackers significantly uses many strategical approach in breaking unique security process. Organizations uses many security measures to overcome unauthorized users entry. Even though there is lot of security measures are available, the researchers and organizations finds very difficult to overtake hackers attack. Biometric way of giving security is evolved in recent years to acquire a better position improving security. Fingerprint recognition is one of the identification process given as an additional support in improving security. Image processing is the most common technology used in biometric identification process used in providing security.

The features of fingerprint has various levels starts from level 1 to 3. The ridge flow shape are clearly visible in level 1, minutiae point in fingerprint are identified in level 2 and finally the uniqueness of level 2 is enhanced in level 3.

1.1.Global Ridge Pattern

The identified fingerprint images has two different skin tones they are concave and convex. The line of shapes patterns with convex are known to be ridged and spiral curve line shape identified in finger print are known to be valleys (Fig 1). Further the types are divided into two ridge flows, they are pseudo parallel ridge and high curvature ridge which are present in the center point and valley point respectively. The representation relies on the global landmarks, ridge structure and ridge pattern characteristics. The features listed below which are commonly used in global fingerprint.

Fig 1: Global Fingerprint Ridge Flow Patterns.

The uniqueness in fingerprints are seen in singular point junction were the lines join together with the center point of the fingerprint with edge point. Usvally the junction consist of three different point, which will be different from person to person. The point junctions are taken for fingerprint registration process before taking into classification

process. The ridge valley point structure are taken for orientation map in classification stage. The part is also considered for image enhancement, filtering and feature verification process in image processing. The contextual filtering techniques used in fingerprint images are extensively used for formal defining the shape of the ridge frequency mapping. This sensitive representation needed in fingerprint images for quality identification. However, this facilities are limited in many fingerprint identification systems.

1.2.Local Ridge Detail

Local ridge detailed figure print patterns are the most commonly used fingerprint representations. Usvally Local ridge detailed figure print patterns are structured referred to level 2 valley patterns in fingerprint. The phenomena was observed by the researcher Francis Galton, who have structured and permanence the minutiae. The observation gathered makes an impact for forensic experts in matching different types of fingerprints.

Based on the categorization, minutiae are mostly 150 different types, which are likely to be used by forensic experts in crimes. Ridge ending and Ridge bifurcation are the most usual minutia used because other type of minutiae considered to be a combination of these both Ridge ending and Ridge bifurcation fig 2.

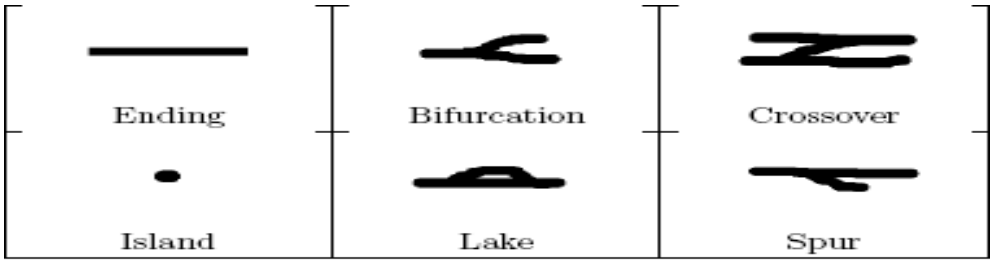

Fig 2: Common minutiae types

1.3.Intra-ridge Detail

Each and every ridge points have many tiny sweat pores and other permanent details which allows easy identification process in classification fig 3 and fig 4. Pores are considered to be highly characteristic in terms of their position,shape andnumbers. These identification techniques are only possible in high quality fingerprint images [4]. Hence this representation are not available in automatic fingerprint identification systems.

Identification process is very difficult, when the sensing area is very tiny for identification and the finger sensor mounting problem (which makes the center point very

small). The addressed problem makes the significant changesin taking the identification process into next level and detecting minutiae. The error rate can be minimized for the better result only if the level 3 features are increased and capacity of the level 2 are also increased[5]. The feature based fingerprint recognition system combines both the level 1 and 2 features together to solve such problems.

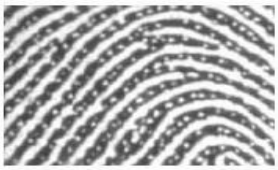

Fig 3: Sweat pores

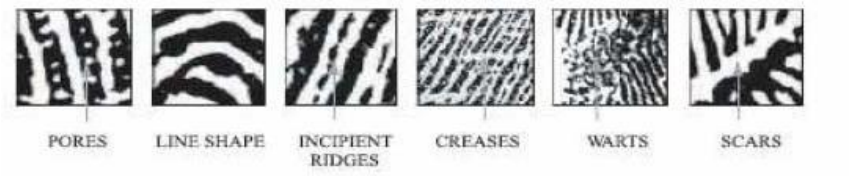

Fig 4: Global fingerprint ridge flow patterns

1.4. Gabor Feature and FFT phase feature

Gabor features is one of the texture features applied in fingerprint classification, attaching and segmentation. The images of the fingerprint are resized into 16 X 16 as the basic step of every image processing approach. After resizing, a bank of Gabor filters are inserted into each and every cells for identifying the feature vector. The variation in each and every Gabor filtering directions are considered for such action.

The noise detection techniques used in image processing frequently balance the translated fingerprint images and changes illuminated after each and every iterations. The quality of the fingerprint images are improved after each and every successful completion of noise detection and removal techniques.

2. LITERATUREREVIEW

The stage one filtering technique used in every contextual filtering stars with Gabor filtering approach. The fingerprint image enhancement technique was discussed clearly shows the consistency and importance of the Gabor filtering approach. The filtering parameters used in fingerprint image processing determines the local ridge orientation frequency, reliability and ridge frequency, which are most needed in identification process[2]. The frequent domain is another filtering process used apart

from these frequencies. The bank division in Gabor filtering technique is implemented in many of researches for analyzing the difference in particular part of the fingerprint [3]. The algorithm involved in filtering process as evolved this recent decade and became very efficient on detection process.

This research work focus on analyzing the types in orientation field patterns identified in fingerprint. The process is evaluated with neural network instead of specifying in different model [14].Two different Boltzmann mechanism was used for the Gabor filtering identification techniques, which is very useful in enhancement of fingerprint images. The iterations are carried out with unsupervised manner at the early stage and the process is carried out with backpropagation learning with increased weightage in matrices. The noises in fingerprint images are removed using various filtering techniques.

3. PROPOSED METHOD

The research work focuses on detecting image of fingerprint using Gabor filtering techniques. The previous identification process starts with resizing and segmentation [6]. The size of the finger print images are resized into 16 X 16 DPI, then taken for the segmentation process. There the image processing techniques such as gray scale conversion and filtering techniques are applied.

3.1.Segmentation

The foreground and background objects are to be identified in the segmentation process. This process is one of the basic steps of every image processing techniques [15]. The noise form the fingerprint images are cleared with the technique before taking into the next step[7]. The enhancement, feature extraction and matching performance are followed.

3.2.Image Quality Assessment

Objective estimation of fingerprint image quality is a nontrivial technical problem. The commonly used features for fingerprint image quality are Fourier spectrum energy, Gabor filter energy, and local orientation certainty level [13]. However, there is no systematic method to combine the texture features in the frequency domain and spatial domain. Combining the metrics in the frequency domain and the spatial domain is a classification problem, which must be solved to select appropriate preprocessing and

enhancement parameters.

3.3.Enhancement

For good quality fingerprint images, most AFISs can accurately extract minutiae points in the well-defined ridge-valley regions of a fingerprint image where the ridge orientation changes slowly, but cannot get satisfactory results in the high- curvature regions [8]. Gabor filter has been used extensively to enhance fingerprint images, and local ridge orientation and ridge frequency are critical parameters for high performance[9]. However, researchers have only used a single low-pass filter with the size of 5×5 with the assumption that there is slow orientation change in local ridges. Noisy regions like creases cannot be smoothed successfully with a Gaussian kernel of that size. The inherent relationship between ridge topology and filter window size must be studied.

3.4.Feature Detection Accuracy

Although there are several methods available for detecting minutiae, the technical problems related to the improvement of feature extraction are still active fields of research. All existing minutiae extraction methods need their corresponding feature verification and filtering procedure[10]. The research work proposes a chain-coded contour tracing method for minutiae detection, and explore several heuristic rules for spurious minutiae filtering associated with this thinning-freemethod.

Database Name	Sensor Type	Image Size	Resolution (dpi)
2000 DB1	Low-cost Optical Sensor	300 X 300	500
2000 DB2	Low-cost Capacitive Sensor	256 X 364	500
2000 DB3	Optical Sensor	448 X 478	500
2002 DB 1	Optical Sensor	388 X 374	500
2002 DB 2	Optical Sensor	296 X 560	569
2004 DB 1	Capacitive Sensor	300 X 300	500
2004 DB 1	Optical Sensor	640 X 480	500
2004 DB 2	Optical Sensor	328 X 364	500
2004 DB 3	Thermal Sweeping Sensor	300 X 480	500

Table 1: Parameters of the chosen database.

4. EXPERIMENTS AND DISCUSSION

Our methodology has been tested on FVC2002 DB1, which consists of 800 fingerprint images (100 distinct fingers, 8 impressions each). Image size is 374 × 388 and the resolution is 500 dpi. To evaluate the methodology of correlating preprocessing parameter selections to the fingerprint image characteristic features, we modified the

Gabor-based fingerprint enhancement algorithm [1] with adaptive enhancement of high-curvature regions. Minutiae are detected using chaincode-based contour tracing. In Figure 3.4, enhanced image of low quality image shown in Figure 5. (b)

(a) (b)

Fig 5: a) Enhancement and feature detection for the fingerprint of Fig 5: d) shows that the proposed method can enhance fingerprint ridges and reduce block and boundary artifacts simultaneously.

Figure 5 shows results of utilizing the selective method of image enhancement on the fingerprint verification. The fingerprint matcher developed at the Center for Unified Biometrics and Sensors (CUBS) [16]. The automatic method selects clip limit in CLAHE algorithm depending on the image quality level in section 3.2. The non-automatic method uses the same clip limit for all images. The minimum total error rate (TER) of 2.29% (with FAR at 0.79% and FRR at 1.5%) and the equal error rate (EER) of 1.22% are achieved for the automatic method, compared with TER of 3.23% (with FARat 1.05% and FRR at 2.18%) and ERR of 1.82% for the non-automatic enhancement parameter selection system. Note that the improvement is caused by only applying 5 different clip limit parameters to predetermined 5 image quality classes [11]. The results confirm that image quality classification as described is indeed useful in image quality enhancement.

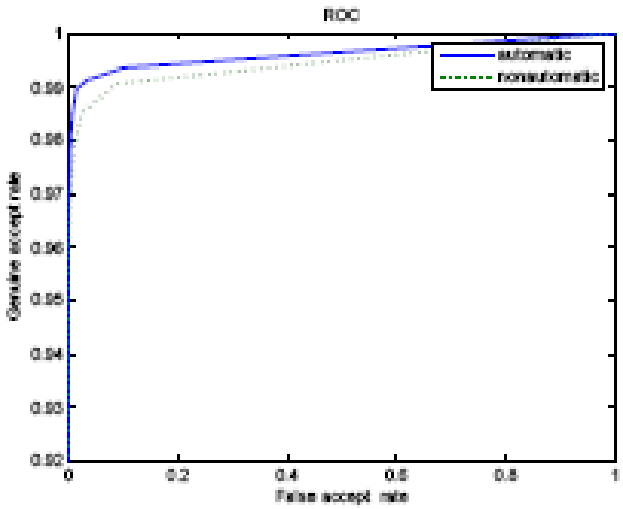

Figure 6: A comparison of ROC curves for system testing's on DB1 ofVC2002.

5. CONCLUTION

Fingerprint ridge flow patterns can be categorized into two types: pseudo- parallel ridges and high-curvature ridges surrounding singular points. Enhancement filters should follow the ridge topological patterns, and filter window size in the regions of different ridge patterns should be dynamically adjusted to local ridge flow. In order to repair broken ridges, clean noise in the valley, and retain local ridge flow shapes, accurate ridge orientation estimation is critical. In order to deal with the problem of ambiguous ridge orientations at singular points like minutiae or cores and deltas, some models have been proposed which allow the co-existence of multiple ridge orientations at a single point.

However, it is then difficult to perform enhancement if there is no local dominant ridge direction. Research work introduces the coherence map to locate high-curvature regions. Local ridge direction is filtered with Gaussian kernel size adapted to the local ridge topology. Furthermore, local statistical texture features are used to distinguish singular regions with noisy smudge regions, even though the coherence values in the two regions are similar.

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