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# Fingerprint Image Enhancement Based on Various Techniques, Feature Extraction and Matching-Review Paper

Usha Rani[1]
*Student[1], Department of Electronics and Communication Engineering, BPSMV, Khanpur Kalan, Gohana, Sonepat, Haryana, India*

***Abstract*** *-Fingerprints are the oldest and most widely used form of biometric identification. Everyone is known to have unique, immutable fingerprints. As most Automatic Fingerprint Recognition Systems are based on local ridge features known as minutiae, marking minutiae accurately and rejecting false ones is very important. However, fingerprint images get degraded and corrupted due to variations in skin and impression conditions. Thus, image enhancement techniques are employed prior to minutiae extraction. A critical step in automatic fingerprint matching is to reliably extract minutiae from the input fingerprint images. This paper presents a review of a large number of techniques present in the literature for extracting fingerprint minutiae. The techniques are broadly classified as those working on binarized images and those that work on gray scale images directly.*

***Keywords: Fingerprinting, pattern recognition, feature extraction, image enhancement, fingerprints minutia.***

## 1. INTRODUCTION

Because of their uniqueness properties fingerprints have been used for personal identification and criminal investigations because the starting of the 20th century. Minutiae, which consist of points of discontinuity of the papilla's ridges that form the fingerprint, are the largest type of feature used on the fingerprint recognition world. Most recently, when digital computers emerged, fingerprint manipulation became a challenge for automation. Researchers, since then, have been proposing different algorithms and approaches for the processes of segmentation, minutiae extraction and fingerprint automatic classification [1].

## 2. Related Work

**[1]Josef StrömBartunet. al (2013)** proposed several improvements to an adaptive fingerprint enhancement technique that was based on contextual filtering. The term adaptive imply that parameters of the technique were automatically familiar based on the input fingerprint image. Five processing blocks comprised the adaptive fingerprint enhancement method, where four of these blocks were updated in our proposed system. Hence, the proposed overall system is novel. The four updated processing blocks were: 1) preprocessing; 2) global analysis; 3) local analysis; and 4) matched filtering. In the preprocessing and local analysis blocks, a non-linear dynamic range adjustment method was used. In matched filtering blocks and the global analysis different forms of order arithmetical filters were applied. These processing blocks enhanced and latest adaptive fingerprint image processing method [2].

**[2]Madhuriet. al. (2012)** proposed that there exist many human recognition techniques which were based on fingerprints. Most of these techniques used minutiae points for fingerprint illustration and matching. on the other hand, these techniques were not rotation invariant and fail when enrolled image of a person was matched with a rotated test image. Moreover, such techniques failed when partial fingerprint images are matched. This paper proposed a fingerprint recognition technique which uses limited robust features for fingerprint representation and matching. Experiments were performed using a file of 200 images collected from 100 subjects, 2 images per subject. The technique had produced a recognition accuracy of 99.46% with an equivalent error rate of 0.54% [3].

**[3]NasibeAkbariet. al. (2012)** proposed that automated recognition of a person was one of the most critical issues in the modern society. General biometric systems rely on the plane topography of an article and, thus, are potentially exposed for spoofing. Optical coherence tomography was a technology that has the capability to probe the interior construction of meaningful tissues. The paper described an algorithm for computerization fingerprint recognition that the algorithm was applied on the OCT fingerprint images. This algorithm was based on scanning of the enhanced and segmented OCT images [4].

**[4]D. Ashok Kumar et. al. (2011)** proposed that the heart of democracy was voting. The heart of voting was trust that each vote was recorded and tallied with accuracy and impartiality. The accuracy and impartiality were tallied in high rate with biometric system. With these biometric signs, fingerprint had been researched the longest period of time, and showed the most capable future in real-world applications. Because of their consistency over time and uniqueness, fingerprints had been used for identification over time. However, because of the difficult distortions among the different impression of the similar finger in real life, fingerprint detection is still a challenging problem. Hence in this study, the authors were interested in analyzing and designing the Electronic Voting System based on the fingerprint minutiae which was the core in current modern approach for fingerprint study [5].

**[5]Shashi Kumar D R et. al. (2011)** investigated that forensic applications like terrorist identification, criminal investigations, and National security issues required a capable identification system and tough fingerprint data base. In this paper they proposed DWT based Fingerprint Recognition using Non Minutiae (DWTFR) algorithm. Fingerprint image was decomposed into multi resolution sub bands of LL, LH, HL and HH by apply 3 levels DWT. The Dominant local orientation angle θ and Coherence were computed on LL band only. The Centre Area Features and Edge Parameters were determined on each DWT level by allowing for all four sub bands. The contrast of test fingerprint with database fingerprint was determined based on the Euclidean space of all the features. It was observed that the values of FAR, FRR

and TSR were improved compared to the existing algorithm [6].

**[6]HasanFleyehet. al. (2010)** presented a new algorithm to segment fingerprint images. The algorithm used four features, the local mean, the global mean, coherence, and variance of the image to achieve the fingerprint segmentation. Using these features, a rule base structure is built to segment the image. The future algorithm is implemented in three stages; segmentation, pre-processing and post-processing. Gaussian filter and histogram equalization are useful in the pre-processing step. Segmentation is useful by the local features. Finally, fill the gaps algorithm and a modified description of Otsu thresholding are invoked in the post-processing stage [7].

**[7]Mohammed S. Khalil et. al. (2010)** proposed that biometric-fingerprint images for individual identification. A sub-image of 129 x 129 was extracted as of the unique image and changed into a co-occurrence matrix. Four dissimilar kind of family member location distances were used to produce the matrices. The outcomes have been analyzed by the Program for Rate Estimation and Statistical Summaries (PRESS). The effectiveness of the future method has been recognized by the original outcome and that the additional the distances of the virtual position the lower the error equal rate [8].

**[8]Airam Carlos et. al. (2006)** investigated computational segmentation method, applied to the recognition of the region of interest on fingerprint images is planned. The technique is based on the hypothesis that a little fingerprint part resembles a two-dimension sinusoid function. So, its Fourier spectrum has to present an understandable sample. Since neural networks are extremely appropriate for solving pattern detection problems, an MLP network is used to differentiate the regions containing fingerprint remains from the break of the image. The planned model is qualified above fingerprint images obtained from the NIST particular record 27, and the obtained results demonstrate that the approach woks logically well for images with different noise and contrast levels [9].

**[9]Anil Jain et. al. (2006)** proposed that fingerprint friction ridge details are usually described in a hierarchical categorize at three levels, namely, Level 1- minutiae points Level 2- pattern, and Level 3- ridge and pores figure. even though elevated resolution sensors (~1000dpi) have develop into commercially presented and have complete it achievable to dependably extract Level 3 features, most Automated Fingerprint Identification Systems (AFIS) utilize only Level 1 and Level 2 features. As a result, increasing the scan resolution does not give any matching presentation enhancement .We expand a matcher that utilizes Level 3 features, in addition to pores and edge contours, for 1000dpi fingerprint same. Level 3 facial appearances are by design extracted using Gabor filters and wavelet transform are close by matched using the ICP algorithm. Our experiments on a median-sized record show that Level 3 features carry important unfair information. EER values are reduced (relatively ~20%) when

Level 3 features are working in combination with Level 1 and 2 features [10].

**[10]GeppyParzialeet. al. (2005)** proposed that the Surround Image, an innovative multi-camera touch less device able to capture rolled-equivalent fingerprints, is here available for the first time. Due to the necessitate of make contact with among the flexible skin of the finger and some inflexible surface, the acquired images present no bend. The multi-camera method acquires singular finger views that are joint together to provide a 3D representation of the fingerprint. This original symbol leads to a new description of minutiae bring new challenges in the field of fingerprint recognition [11].

## 3. Methodology

### 3.1 Finger-prints System Design

A finger-prints recognition system consists of finger-prints device, minutia extractor and minutia matching. For finger-prints acquisition, optical or semi-conduct sensors are extensively used. They have large efficiency and suitable accuracy except for various cases that user's finger is also dirty or dry [12] .Finger-prints technique is one of the mainly admired applications in classification and verification as it develops a low-cost fast computing system. Applications have accessing buildings or facilities withdrawing money or using a credit card, gaining access to electronic in sequence on a confined computer or over the internet [13].

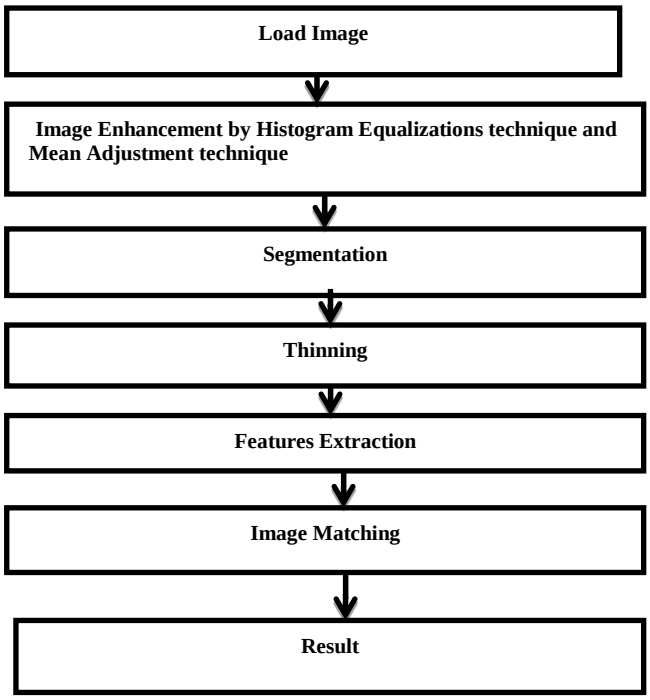


**Figure2: Functional Block Diagram of Fingerprinting Recognition Approach [13]**

### 3.3 Finger-prints Image Enhancement

Image enhancement means getting a clearer image. Image enhancement can be treated as transforming one image to another so that the look and feel of an image can be improved or machine analysis or visual perception of human beings [14].

### 3.4Image Segmentation

The process of partitioning a digital image into multiple regions (set of pixel) is called image segmentation. Segmentation of an image involves the division or separation of the image into regions of similar attribute [15].

### 3.5 Thinning of Image

Thinning is a morphological operation that is used to eliminate selected pixels from foreground from binary images. It is used to eliminate redundant

pixels of long narrow lines till long narrow lines are just one pixel wide [16].

**3.6 Minutiae Extraction**

After enhancement of the finger-prints image, image is complete prepared for minutiae extraction. For proper extraction, conversely an algorithm namely thinning algorithm is applied to enhanced image. It gives a skeletonised representation of image [17].

**3.7 Minutiae Matching**

The minutiae based techniques usually match the two minutiae sets from two prints of fingers by first aligning the two sets and then including the number of minutiae that match [18].

**3.8 Result**

If both are matched, then dissimilarity image shows no error. But if both are dissimilar, then it shows error image [19].

**4. Conclusions**

Image quality is related directly to the ultimate performance of automatic fingerprint authentication systems. Good quality fingerprint images need only minor preprocessing and enhancement for accurate feature detection algorithm. This paper reviewed a large number of techniques described in the literature to extract minutiae from fingerprint images. The approaches are distinguished on the basis of several factors like: the kind of input images they handle i.e. whether binary or gray scale, techniques of binarization and segmentation involved, whether thinning is required or not and the amount of effort required in the post processing stage, if exists. But low quality fingerprint images need preprocessing to increase contrast, and reduce different types of noises.

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