Comparative Study on Fingerprint Recognition System

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ABSTRACT: Biometric is a technique or a technology, which can be used to identify a person based on behavioural and physiological characteristics. Different biometric techniques are Fingerprint Recognition; Palm Recognition; Face Recognition; Iris; voice Signature; User-Ids and Passwords. But fingerprint is one of the most popular biometric techniques and identification of fingerprint recognition has been done by considering its unique characteristics like: core point, delta points, and bifurcation points. The purpose of this paper is to perform comparative study on various fingerprint recognition methods such as correlation based, minutiae based and other local, global methods.

KEYWORDS: Fingerprint Recognition, Authentication, Biometric Features, Enhancement and Segmentation.

I. INTRODUCTION

Biometrics or biometric based recognition is the science of verifying, or identifying the identity of a person based on behavioural and/or physiological characteristics [1]. According to the A.K. Jain, the term biometrics is defined as "Automated methods of authenticating a person based on behavioural or physiological characteristics" [2].

Basically, biometric features are Anatomy based such as fingerprints, palm, face, iris etc. and behaviour based such as voice, heart-beat etc. Most of the biometric identifiers is combination of behavioural and physiological characteristics of a person. For example, fingerprints may be physiological in nature but the usage of the input device (how user places a finger over the fingerprint scanner etc.) depends on the person's behaviour[3]. And fingerprint is the most popular technique for fingerprint recognition system.

Various approaches have used by the researchers over the years for fingerprint recognition by using minutiae points, ridges, valleys etc [4]. Such as correlation based, counting number of minutiae points, phase based, DSP based and based on Euclidian distance between core and minutiae points.
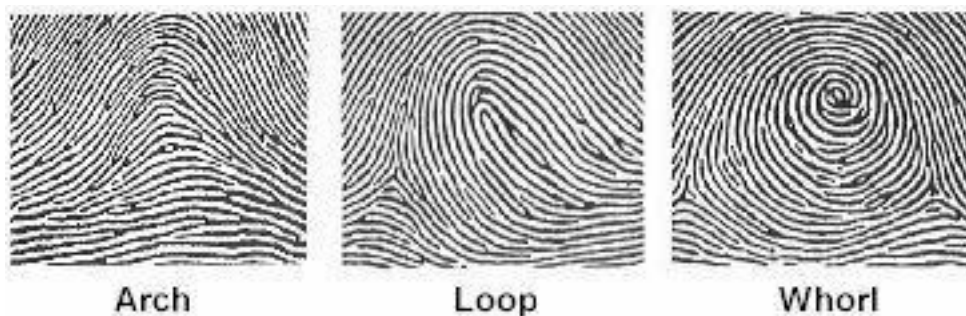

Figure 1 : Types of Fingerprint [5]

There are mainly 3 classes of fingerprints: Loop, Whorl and Arch i.e. shown in figure 1. 60-65% of the population has loop type fingerprint, 30-35% of the population have whorl type fingerprint but only 5% of the population have Arch type fingerprints [6].

II. PREVIOUS WORK

Different techniques have been used to recognize the Fingerprints. These techniques are broadly classified as:

Minutiae Based: This approach is most widely used by Human experts and machines. According to the study, two individuals can not have more than seven common minutiae points. Minutiae points are of 2 types: Ridge Ending and Ridge Bifurcation Points. Ridge Ending are the points where the ridge curve terminates and Ridge Bifurcation are the points where ridge curve splits from a single path to double path called as Y- Junction Shown in figure [4].
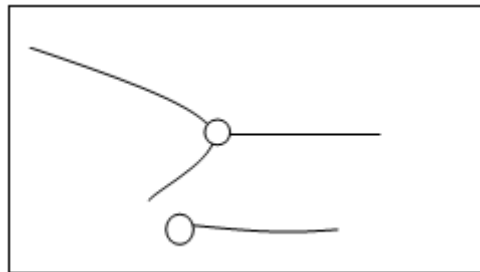

Fig.2 Minutiae Points: (a) Ridge Bifurcation   (b) Ridge Ending

Pattern Based Approach: The overall fingerprint characteristics have been considered. For this approach, size must be larger than Minutiae based approach as in this authentication system fingerprint image consider itself as a template.
Neural Network Based Approach: This approach gives good results as neural network can easily recognize poor quality images as well as avoids inheritance problem**.**
Gabor Based Technique: Gabor filter has been used to enhance and remove noise from an image whenever quality of image is not so good.
Wavelet- Based Features: Fast Fourier Transform (FFT) has been used to recognize the fingerprint with the 90% precision rate.
Euclidian Distance Technique: The Euclidian distance has been determined between core point and their nearest neighbour bifurcation points.
Novel Approach: The Novel approach has been used to determine the core points of fingerprints that have no centre point i.e. Arch Type Fingerprint.
Digital Signal Processor: DSP is the nucleus of this embedded recognition system. The System can run independently without personal computer. This software is developed on the basis of Visual DSP++ project management tool using C language.

III. LITERATURE REVIEW

Fingerprint identification is based on the unique and invariant features of fingerprints like ridges and valleys. Ridges are the combination of minutiae points and core point. These Minutiae points consists of minutiae endings and minutiae bifurcation points. Minutiae points have been detected by using minutiae detection algorithm by Virgina [7] and Kuntal [8]. Core point has been detected by using singular point detection method by Ali[9]. Hemlata[10] and Wen[11] proposed a technique in which recognition has been done by counting number of minutiae points using minutiae matching algorithm.

Ala Batli [12] proposed the system that determines the Euclidian distance between core point and neighbour bifurcation points and the results has been evaluated using back propagation neural network. Avinash[13] and Adrian[14] followed Winner Takes All Technique and Neural Network for classification.
Guoqiang[15] and Navrit[16] gives Novel Approach for centre point detection by using a set of isosceles triangle. Wang Yongxu[17] concentrates on two approaches i.e. Principal Component Analysis (PCA) for extracting Statistical features and Novel Approach for dividing the Region Of Interest (ROI).

Wahab[18] proposed a methodology that defines two stages for matching the fingerprints i.e. correlation using local features and correlation using global features. Asif Iqbal[19] proposed a technique for filtering out false minutiae points and preserves true ones. R. Priya[20] employed these techniques for Secure Internet Banking.

Another approaches are Digital Signal processor proposed by Maddu[21] and combination of Fast Fourier Transformation(FFT) and Gabor filters proposed by Gualberto[22] .Koichi[23] proposed Phase-based matching approach based on 2D Discrete Fourier Transformation. Kaisheng[24] employed Automatic Fingerprint Recognition System (AFRS) technique for fingerprint recognition.

IV. **COMPARATIVE STUDY**

Sr. No.	Paper Name	Enhancement	Segmentation	Feature Extraction	Classification
1	An Embedded Algorithm of Fingerprint Recognition System Using Novel Approach Based on Euclidian Distance [25]	Hong's Algorithm and Histogram Equalization	Otsu Segmentation Algorithm	Determine Euclidian distance between core and minutiae points	Neural Network
2.	Fingerprint Identification & Recognition Using Back-Propagation Neural Network [14]	Grey-Level Enhancement	Adaptive thresholding methods	Edges are detected by using "Sobel Edge Detection Method" which are existing inside the fingerprint images.	Back-propagation Neural Network
3.	Fingerprint Verification Based on Back-Propagation Neural Network [12]	Hong's Gabor Filter		Detect Core point using Complex Filters	Neural Network
4.	Strategy to Extract Reliable Minutia Points For Fingerprint Recognition [19]	Using function histeq()		Extract ROI using two Morphological operations called OPEN and CLOSE	
5.	A Neural Network Based Approach for fingerprint recognition System [13]				
6.	Fingerprint Recognition By Euclidian Distance [26]			Determine Core Point by using Average Squared Directional Field (ASDF) and Bifurcation Point using 3x3 pixel mask & 52 possible patterns	
	Fingerprint	Combination of		Minutiae Detection	

7.	Recognition [22]	Fourier Transformation and Gabor Filtering		Algorithm is used by estimating the number of pixels that cross the PixelCenter(PC)	
8.	A Novel Approach used for measuring fingerprint orientation of arch fingerprint [15]				
9.	Study on the Embedded Fingerprint Image Recognition System [24]	The common method of enhancement is to calculate the every part of image's local feature, like directional and rates, then use texture filter to filter every part	The local Variance segmentation method is through using fingerprint image's local gray scale variance	Extract Local and Global Features. Global Feature reflect overall shaper of fingerprint & Local feature can reflect minutiae of fingerprint	
10.	A Fingerprint Recognition Algorithm using Phase-Based Image Matching for Low-Quality Fingerprints [23]			The Poincare Index method is used to detect the core point of an image	
11.	DSP based Embedded Fingerprint Recognition System [21]	Gabor Filter	Image is segmented for the purpose of separating the foreground and background regions	Crossing Number(CN) is used for extracting the minutiae points	
12.	Minutiae Detection Algorithm for Fingerprint Recognition [7]	Directional Filters	"Otsu Method" to obtain best performance threshold	Template is formed by making a list of minutiae and number of ridges between each pair of minutiae.	
13.	A Fingerprint Recognition Algorithm Based on Principal Component Analysis [17]			Use Poincare Index to detect Singular point.	

V. CONCLUSION

Biometric system is used for security purpose and Fingerprint Recognition is one of the most simplest and successful biometric method for authentication. Various researchers gave different conclusion based on their research. Results of minutiae matching technique calculated by counting number of minutiae points has not been satisfactory as two different persons can have same number of minutiae points. Euclidian distance approach gives good result but the results are still not satisfactory for poor quality image.

An Embedded algorithm of fingerprint recognition using novel approach based on Euclidian distance gives satisfactory result [25]. This network was trained by neural network.

There are various approaches described in this paper. But a lot of work is still required to solve the problems regarding fingerprint recognition. Most common problem is the average quality of an image (like Age Group, Skin Condition, Ridge Distortion and Cut in Ridges and Spikes) which creates difficulty in recognizing the image. Different types of Enhancement and Segmentation techniques can be apply for recognizing the fingerprint.

The simulation studies involve the deterministic small network topology with 5 nodes as shown in Fig.1. The proposed energy efficient algorithm is implemented with MATLAB. We transmitted same size of data packets through source node 1 to destination node 5. Proposed algorithm is compared between two metrics Total Transmission Energy and Maximum Number of Hops on the basis of total number of packets transmitted, network lifetime and energy consumed by each node. We considered the simulation time as a network lifetime and network lifetime is a time when no route is available to transmit the packet. Simulation time is calculated through the CPUTIME function of MATLAB. Our results shows that the metric total transmission energy performs better than the maximum number of hops in terms of network lifetime, energy consumption and total number of packets transmitted through the network.

The network showed in Fig. 1 is able to transmit 22 packets if total transmission energy metric is used and 17 packets if used maximum number of hops metric. And the network lifetime is also more for total transmission energy. It clearly shows in Fig. 2 that the metric total transmission energy consumes less energy than maximum number of hops. As the network is MANET means nodes are mobile and they change their locations. After nodes have changed their location the new topology is shown in Fig .3 and energy consumption of each node is shown in Fig. 4. Our results shows that the metric total transmission energy performs better than the maximum number of hops in terms of network lifetime, energy consumption and total number of packets transmitted through the network.

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