



## A Full Analytical Review of Fingerprint Matching Mechanism

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**ABSTRACT** This paper focuses on the various semblance of the fingerprint(s). Fingerprint matching refers to match of stored set of patterns from the database using uploaded views of the fingerprint(s). The images so called as a class used as identification. Here we are proposing a database handling system using classifiers with added soft computing features

**KEYWORDS**-Classifiers, Gabor filter, Gaussian Filter, Neural Networks, Soft Computing.

### I. INTRODUCTION

A fingerprint is the strong and unique evidence of one's self identity. It is must to keep every person's fingerprints for civilian applications like, adhar card, and cellular phones. Biometric refers to identify an identity using biological or behavioural characteristics [1]. A biometric system has two modes-Identification mode and Verification mode. In the identification, system compares the input biometric against the templates stored of all the users. In verification, it accepts or rejects according to the matches found that were used for verifying a decorous identity.

A fingerprint appears as series of dark and whites lines of a person's skin. The dark lines are the high peak-ridges. The white spaces between the ridges are low shallow-valleys. Often, both run parallel or bifurcate or cross-over. Normally, images captured by fingerprint scanner are different it belongs to a single person prints. To verify, minutiae matching invariant to rotation, translation, scaling is performed.

The images are to be processed in order to retrieve statistics. In this paper, image pre-processing steps are adaptive thresholding, dilation, erosion, thinning and Gaussian smoothing[2]. Fingerprint images are to be processed in order to retrieve information. The image pre-processing steps are used like Gaussian smoothing, thinning. Then, use cross over technique for minutiae detection. Edge minutiae is eliminated as it is false minutiae. False minutiae are due to broken sacral connections and ridges. After pre-processing steps, minutiae matching verify the genuine fingerprints. In a nutshell, triangle's angle, distance between triangle are able to correctly determine spurious and genuine images using good thinning images to remove false minutiae rejection.



Fig 1: A fingerprint image by optical sensor

### II. MAIN APPROACHES

#### A-Pattern matching

It includes the four basic patterns for fingerprint. These are:-

**Left loop:** The ridges enter from left side of a finger and then exit on that same side.

**Right loop:** The ridges enter from right side of a finger and then exit on same finger.

**Whorl loop:** Ridges form circularly around a central point on the finger.

**Arch loop:** The ridges enter from one side of the finger, rise in the centre forming an arc.

#### B-Minutia matching

For minutiae extraction stage, we take the help of a three thinning algorithm and we got a morphological thinning operation with a very fine thinning quality and high efficiency. Then the minutiae marking is a simple one just some regular MATLAB functions can handle them.

For the post-processing stages, a better and a very fine algorithm is required to remove false minutiae like H-breaks and isolated points etc.

#### **Minutiae matcher**

The basic concept is to take a reference point or line then decide the origin for the co-ordinates and now translate and rotate the whole image in order to get the match. It takes any two random minutiae as reference pair and then matches their associated ridges. If, the ridges are matched then both fingerprints are aligned, matching is done for all extracted minutiae.

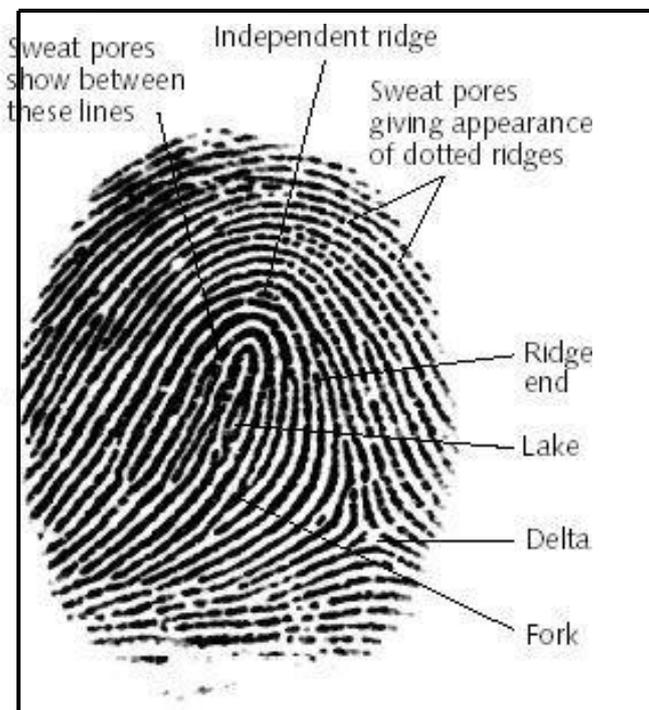


Fig 2: Fingerprint minutiae points

- **Ridge ending**-the abrupt end of a ridge.
- **Ridge bifurcation**-a single ridge that divides into two ridges.
- **Island**-a single small ridge inside a short ridge or ridge ending that is not connected to all other ridges.
- **Ridge enclosure**-a single ridge that bifurcates and reunites shortly afterward to continue as a single ridge.
- **Crossover or bridge**-a short ridge that runs between parallel ridges.
- **Delta** - a Y-shaped ridge meeting.
- **Short ridge, or independent ridge**-a ridge that commences, travels a short distance and then ends.

#### **C-Minutiae Detection**

After the thinned image is ready, it is applied. The algorithm is to calculate the pixels that cross to Pixel centre(Pc). The process is applicable for the images that are binary and produces vector results with the characteristics points.[3]

### **III. SOFT COMPUTING**

Conventional computing called as hard computing, requires a stated analytical model and is time-consuming.

Soft computing differs from conventional (hard) computing, it is tolerant of uncertainty, partial truth. The guiding principle of soft computing is: Exploit the tolerance for impression, partial truth and approximation to achieve tractability, robustness and low solution cost.

Few soft computing tools are: Fuzzy Systems, Neural Networks, Evolutionary Computation, Machine Learning and Probabilistic Reasoning. Different soft computing tools are used in the proposed systems. Noise is a big issue in storing data, signals in processing and networking. To remove noise, wavelets can be chosen. For the hierarchical classification, clustering, wavelets, fuzzy logic and neural can be used.[4]

It is possible to define it in different ways. Nonetheless; SC is a consortium of methodologies which work synergistically and provides flexible information processing capability for handling real life ambiguous situations. Its aim is to exploit the tolerance for imprecision, reasoning and partial truth to achieve tractability, robustness and low-cost solutions. SC includes fuzzy logic (FL), neural networks (NNs), genetic algorithm (GA). SC combines these methodologies as FL and

NN(FL-NN),GA and FL(GA-FL),NN and GA(NN-GA).Recent years have witnessed the growth of biometrics by using computational techniques.

**A. Wavelets**

A wavelet is a wave-like oscillation with amplitude that starts out at zero, increase and decrease back to zero. Wavelets can be combined using a “shift, sum and multiply”.A use of wavelet is that of smoothing/de-ionising data based on wavelet coefficient thresholding, also called wavelet shrinkage. Spatial data mining refers to handle huge amount of spatial data obtained from fingerprint acquisition equipments. The objective is to automate the process of understanding spatial data by concise representation and reorganization to accommodate data semantics. Wavelet transform is a signal processing technique that decomposes a signal or an image into different frequency sub bands at no. of levels and multiple resolutions. This property led to application of image fusion.

**B. Neural networks**

The term neural network was used to refer to a network or circuit or biological neurons. Artificial neural networks are composed of interconnecting artificial neurons (programming constructs that mimic the properties of biological neurons). It may be either be used to gain an understanding of biological neural networks, solving artificial intelligence problems without creating a model of a real biological system. Real life application include classification; including pattern and sequence recognition, novelty detection and sequential decision making.

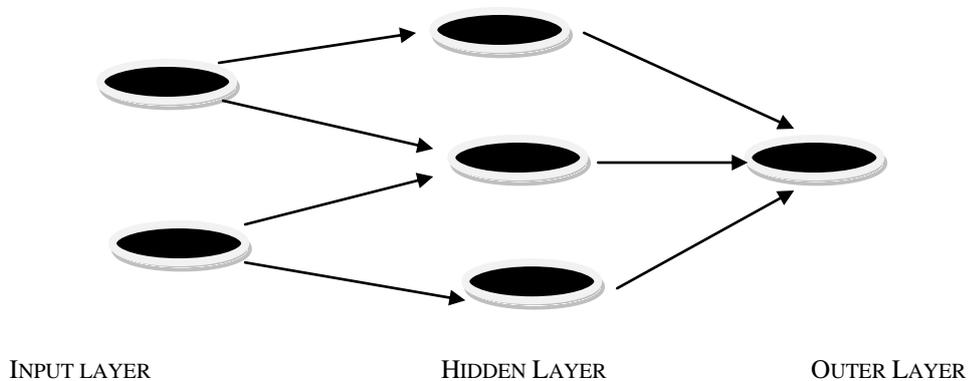


Fig3.1: A Simple Neural Network

**IV. FILTERING**

Gabor Filter captures both frequency information and local orientation from a fingerprint image. It is suited for the images where texture information is required [5].The filtering is performed in the spatial domain with a specified mask size.

The proposed filter-based algorithm uses a bank of Gabor filters to capture both local and global details in a fingerprint as a compact fixed length Finger Code. The Finger code is stored in the Smart card that consists of a user ID and Finger Code. On inserting the smart card (PC interfaced with Smart card reader), it will ask for the user ID and a live fingerprint. The fingerprint matching will be successful only if the Euclidean distance between the Finger code of the live fingerprint and stored Finger code of the smart card is equal to zero. Hence, the system is ready to perform the required operation. This project had achieved greater accuracy, faster verification (One to One Fingerprint matching), and highly fool proof. The total simulation is performed using MatLAB.

The objective is to get a robust system for security issues. In this work a method for fingerprint verification is considered using a combination of Fast Fourier Transform (FFT) and Gabor Filters by image enhancement, though applied separately and later, an algebraic sum is done to obtain a single output. After that, a thinning algorithm is applied to get an image with the minimum thickness of pixel to look minutiae using a window of 3 by 3pixels image and bifurcation, ending is done.

**V. PARAMETERS OF JUDGEMENT**

THE RELIABILITY OF A MATCHING CRITERIA IS MEASURED IN TERMS OF FOLLOWING TWO FACTORS:

**A-False Matching Ratio:** It is the probability that the system will decide to allow access to an (FMR) imposter is given in an equation.

$$FMR(\text{false matching ratio}) = \frac{\text{FalseMatches}}{\text{Imposter Attempts}}$$

**B-False Non Matching Ratio (FNMR):** It is the probability that the system denies access to an approved user is given in an equation.

$$\text{FNMR} = \frac{\text{FalseNonMatches}}{\text{Enrolle Attempts}}$$

## VI. CONCLUSION

The current fingerprint paradigm needs to data-mined and then refined. There has been a huge population explosion since the advent of fingerprint analysis; and, to complicate matters, there has been a recent incorporation of new pore and ridge measurements. New empirical research should lead to improved match criteria and give us further confidence in the reliability of match or no-match decisions. Therefore, more robust image enhancement algorithm on fingerprint images like Gabor filter and it would be compared with median filter can be integrated to this system to produce more flexible system.

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