

A Comparative Analysis on Various Techniques of Fingerprint Recognition

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ABSTRACT:

The popular Biometric used to authenticate a person is Fingerprint which is unique and permanent throughout a person's life. Fingerprint being the oldest and easily available trait of biometrics, offers an infallible means of personal identification. The matching accuracy using fingerprint has been shown to be very high as compared to other existing biometric traits. In this Paper we discuss the various techniques of fingerprint identification and their comparison.

Keywords:- Fingerprint Identification, Matching Techniques, Biometrics

I. Introduction

Biometric systems operate on behavioral and physiological biometric data to identify a person. The behavioral biometric parameters are signature, gait, speech and keystroke, these parameters change with age and environment. However physiological characteristics such as face, fingerprint, palm print and iris remain unchanged throughout the life time of a person[1]. Fingerprint recognition or fingerprint authentication refers to the automated method of verifying a match between two human fingerprints. Fingerprints are one of

many forms of biometrics used to identify an individual and verify their identity.

Fingerprints are widely used in daily life for more than 100 years due to its **feasibility, distinctiveness, permanence, accuracy, reliability, and acceptability**. Fingerprint is a pattern of ridges, furrows and minutiae, which are extracted using inked impression on a paper or sensors.

II. What is Fingerprint Recognition

A fingerprint is comprised of ridges and valleys. The ridges are the dark area of the fingerprint and the valleys are the white area that exists between the ridges. Fingerprint recognition (sometimes referred to as dactyloscopy) is the process of comparing questioned and known fingerprint against another fingerprint to determine if the impressions are from the same finger or palm. It includes two sub-domains: one is fingerprint verification and the other is fingerprint identification (Figure 1). In addition, different from the manual approach for fingerprint recognition by experts, the fingerprint recognition here is referred as AFRS (Automatic Fingerprint Recognition System), which is program-based.

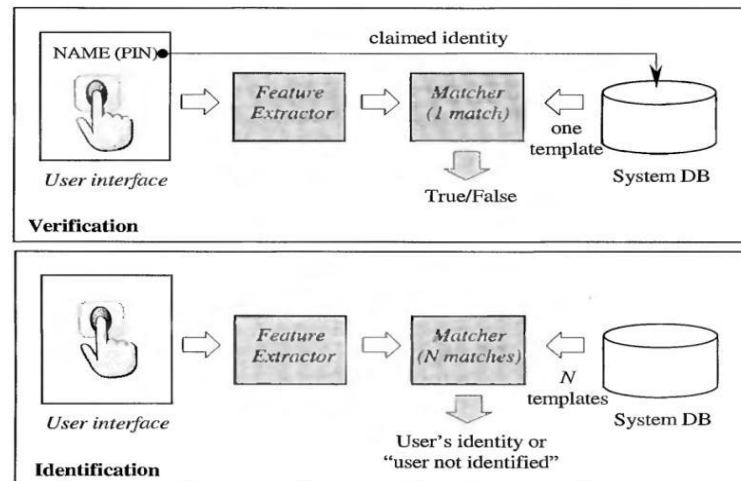


Figure 1: Verification vs Identification

However, in all fingerprint recognition problems, either verification(one to one matching) or identification(one to many matching), the underlining principles of well defined representation of a fingerprint and matching remains the same[2].

III. Various Fingerprint Matching Techniques

There are various number of approaches of fingerprint matching which are classified basically into three families:

- **Pattern-based (image based) matching :**

Pattern based algorithms compare the basic fingerprint patterns (arch, whorl, and loop) between a previously stored template and a candidate fingerprint. This requires that the images be aligned in the same orientation. To do this, the algorithm finds a central point in the fingerprint image and centers on that. In a pattern-based algorithm, the

template contains the type, size, and orientation of patterns within the aligned fingerprint image. The candidate fingerprint image is graphically compared with the template to determine the degree to which they match.

- **Minutiae-based matching :**

This is the most popular and widely used technique, being the basis of the fingerprint comparison made by fingerprint examiners. Minutiae are extracted from the two fingerprints and stored as sets of points in the two- dimensional plane. Minutiae-based matching essentially consists of finding the alignment between the template and the input minutiae sets that results in the maximum number of minutiae pairings.

- **Correlation-based matching :**

Two fingerprint images are superimposed and the correlation between corresponding pixels is computed for different alignments (e.g. various displacements and rotations).

IV. Literature Review

In the field of fingerprint identification, different types of work have been done so far. I had gone through various research papers, the work done till today and the methods used in each work are shown under this section:

➤ **Fast Fourier Transform and Gabor Filters:**

In this work fingerprint recognition has been performed by using Fast Fourier Transform and Gabor Filters [3]. It is used to enhance and reconstruct the information of the fingerprint image, as well as to extract two fundamental types of minutiae, ending points and bifurcations. Finally the extracted features are used to perform the fingerprint recognition.

➤ **Fusion and Context Switching Frameworks:**

Fusion and Context Switching framework concept is implemented in forensic science application to match two latent fingerprints. In this concept unlike matching latent with inked or live fingerprints, proper analysis and attention is paid.

➤ **Segmentation Algorithm:**

Segmentation is one of the first and most integral pre-processing steps for any fingerprint verification and it determines the result of fingerprint analysis and recognition [4].

Robert Hastings [5] developed a method for enhancing the ridge pattern by using a process of oriented diffusion by adaptation of anisotropic diffusion to smooth the image in the direction parallel to the ridge flow. The image intensity varies smoothly as one traverse along the ridges or valleys by removing most of the small irregularities and breaks but with the identity of the individual ridges and valleys preserved.

Bhupesh Gour et al., [6] have developed a method for extraction of minutiae from fingerprint images using midpoint ridge contour representation. The first step is segmentation to separate foreground from background of fingerprint image. A 64 x 64 region is extracted from fingerprint image. The grayscale intensities in 64 x 64 regions are normalized to a constant mean and variance to remove the effects of sensor noise and grayscale variations due to finger pressure differences. After the normalization the contrast of the ridges are enhanced by filtering 64 x 64 normalized windows by appropriately tuned Gabor filter. Processed fingerprint image is then scanned from top to bottom and left to right and transitions from white (background) to black (foreground) are detected. The length vector is calculated in all the eight directions of contour. Each contour element represents a pixel on the contour, contains fields for the x, y coordinates of the pixel. The proposed method takes less and do not detect any false minutiae.

Sharath Pankanti et al., [7] proposed Scale Invariant Feature Transformation (SIFT) to represent and match the fingerprint. By

extracting characteristic SIFT feature points in scale space and perform matching based on the texture information around the feature points. The combination of SIFT and

conventional minutiae based system achieves significantly better performance than either of the individual schemes.

IV. Comparison Of Various Methods used For Fingerprint Recognition

S.No	Year of Publication	Author Name	Method Or Technique Used	Results
1.	2007	Ching-Tang Hsieh [8]	Developed anoid method for Fingerprint recognition.	Robust, Reliable, Rapid
2.	2009	Ravi.J [1]	Fingerprint Matching using FRMSM (Fingerprint Recognition using Minutia Score Matching method)	Better FMR (False Matching Ratios) values
3.	2010	Yilong Yin [9]	Double Low problem is illustrated and its characteristics are analyzed. A hybrid fusion method is proposed and its implementation is described.	Proposed hybrid fusion method has better performance and Double Low problem to some degree.
4.	2008	Sharath Pankanti [7]	Scale Invariant Feature Transformation (SIFT) to represent and match the fingerprint.	Better performance
5.	2008	N. Nain [10]	Proposed a novel minutiae based approach using mass centroid concept.	Enormously fast
6.	2010	B.Roli [11]	Focuses on mathematical morphology. extracts the minutiae in thinned fingerprint image using binary Hit or Miss Transform (HMT).	Provides consistent fingerprint ridge formation thus successfully reduces a lot of effort in the post-processing phase.
7.	2008	Manavjeet Kaur [12]	Introduced method of Segmentation with Morphological operations	Improves Thinning and false minutiae removal,

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