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A Novel Approach to Fractal Dimension based Fingerprint Recognition System

Chiteranjan Sahu[1], Vinay Jain[2]

[1]M.E. Scholar, Dept. of Electronics and Telecommunication, SSGI, SSTC, Bhilai
[2]Associate Professor, Dept. of Electronics and Telecommunication, SSGI, SSTC, Bhilai

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Abstract – *Fingerprint recognition system may be defined as "A modus operandi to identify the individual from his or her fingerprint identity for security or privacy to identify the criminals for evidence in court laws". A fingerprint recognition scheme is a computer appliance for involuntarily identify a person by digital image. Biometric system takes two distinctiveness characteristics are behavioral and physiological biometric information. The behavioral biometric parameters are signature, gait, speech as well as keystroke; each and every one of these parameters is change with age and atmosphere. But in physiological character for example face, fingerprint, palm print and iris cannot transform throughout the era of a person. Fingerprints are extensively used in daily life owing to its viability, uniqueness, stability, precision, consistency, and adequacy. The immutability and exclusivity are distinctive characteristics of fingerprints that make it dependable feature for identify the people in life span. A fingerprint looks similar to a pattern found on a fingertip. A good attribute quality of fingerprints contains 25 to 80 finer points depending on the sensor resolution and finger position on the sensor. The counterfeit minutiae are false ridge break for the reason that of insufficient amount of ink use into it or cross-connections by reason of over inking. In this paper, a novel approach to finger print based recognition system has been introduced. New features has been calculated for fingerprint recognition system and the results obtained hasve been compared with existing method.*

Key Words: Finger print recognition, Fractal dimension.

1. INTRODUCTION

Nowadays, important applications are based on fingerprint recognition primarily is automatic fingerprint identification system (AFIS). In AFIS system, small part of discriminative features is utilized. The other discriminative information available on fingerprint images into matching stage can strongly emphasize the individual fingerprints and improve the performance for fingerprint systems on large scale databases[1].

The vital step in fingerprint recognition procedure, which affect the system accuracy is matching among template and query fingerprint. The matching algorithms classify into three types: minutiae-based approach, correlation based method and feature-based technique. Conversely, the score of these algorithms is not high especially in case that the fingerprint is taken in similar finger because they are rotate or intersection is too small.

Fingerprint detection is one of the popular and reliable personal biometric identification methods. It is well known that image enhancement is extremely imperative step to ensure the extraction of reliable features. Biometric detection from a print prepared by an impression of the ridges in the skin of a finger; often use as proof in criminal investigations. A biometric system is in essence pattern-recognition schemes that recognize a person based on a feature vector that feature vector is usually store in a database after being extracted. Match the finger prints, one that is already in the database of the sensor and second the fingerprint that we enrolled in the sensor currently. Get the matching score and decide the result on the matching score basis, whether the fingerprint is matched or not.

2. BIOMENTRICS

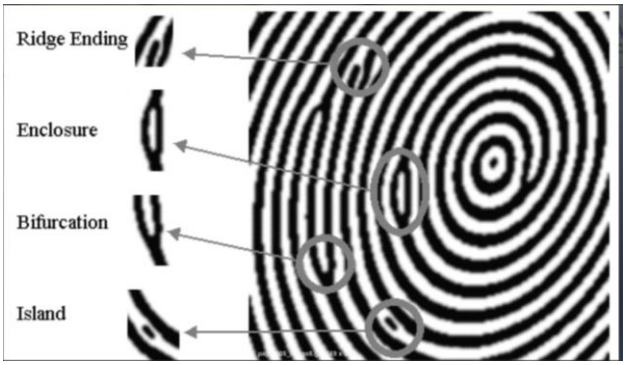
To avoid the complexity with the persistent methods and for compensate to price factor of fingerprint detection, a new image processing technique to identify the fingerprint is projected here. This method requires a fingerprint image to examine the fingerprint representation in order to get images and a PC to process those images. With the aim of this technique is straightforward, money-spinning and provides accurate results.

In the precedent, several image processing technique have been developed to spot the image of a person of diverse features using numerous score matching techniques. Almost all theory, digital technique that authenticates the images of fingerprint was used.

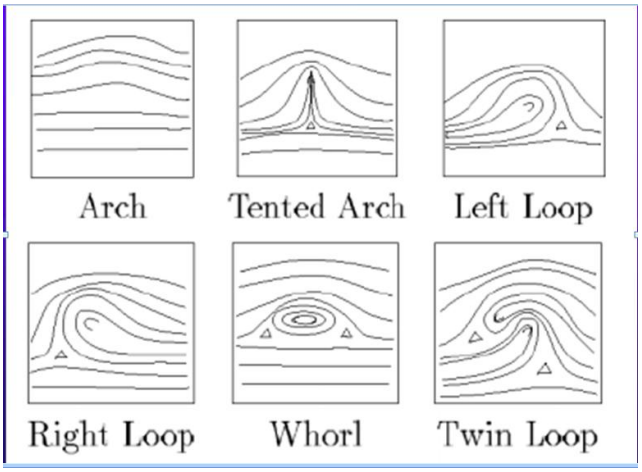
Few imitate the conventional police routine of matching finger points others are using directly sample-matching devices; and still others are a bit more unique. Some verification approach can recognize when a live finger is accessible; a few can't. Fingerprint recognition, the most

imperative step which affects the system accurateness in matching between template and query fingerprint.

A minutia matching is well-known and broadly used technique for fingerprint matching, its strict equivalence with the way that forensic experts evaluate fingerprints and its approval as a proof for identify the people in the courts of law in almost all country. Solitary of the most common application of device pattern recognition is automatic fingerprint detection, because of this; there is a popular delusion that fingerprint recognition is a totally solved problem. On the converse, fingerprint detection is at rest a complex and very difficult recognition task. A great assortment of fingerprint devices is accessible than any of the other biometric. As the worth of these devices and processing costs drop, using fingerprints for user recognition is gaining acceptance regardless of the criminal disgrace. Fingerprint verification is a superior choice for in-home systems, wherever we can give user adequate clarification and training, and where the system or a device operates in a prohibited environment. It is not amazing that the workspace access application area seem to be based almost absolutely on fingerprints, the motive is that the relatively low-priced, small magnitude, and ease of integration of fingerprint confirmation devices. Geometry of hand involves analyze and measure the nature of the hand. These biometric create a good equilibrium between performance distinctiveness and are relatively easy to use. It may be appropriate in that way where there are more users or where users access the system once in a while and are perhaps less disciplined in their approach to the system. Accuracy can be high if preferred and bendable performance tuning and configuration can provide accommodation for a wide range of applications. Organization is use hand geometry reader in various scenarios like include time and attendance recording, where they have proved tremendously popular. Ease of integration into other system and process, tied with accessibility, and make hand geometry as an obvious first step for numerous biometric project. Figure 1.1 represents features of fingerprint images.



(a) Fingerprint features



(b) Fingerprint patterns

Fig -1: Finger print details

3. FINGERPRINT RECOGNITION SYSTEM

A biometric is the most secure and convenient authentication tool for identification. It cannot be borrowed, stolen, forgotten, and forging one is practically impossible. The **Fig 1** describes the process involved in biometric system for security. In this system, the fingerprints images are processed through biometric devices then enrolled the image and finally store it into database and same process applied for verifying the image. The table 1.1 reveals the comparison between different biometric system through its ease of use, accuracy, cost, acceptance, error incidence, security level, long-term stability[2].

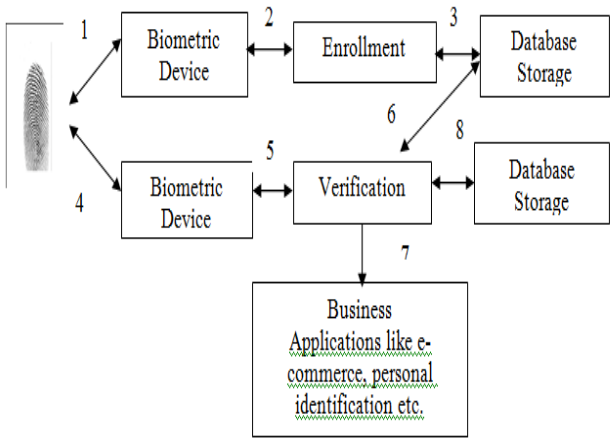


Fig -2: *Block diagram of basic fingerprint recognition system, (1) capture the selected biometric; (2) process the biometric and extract and enroll the biometric database; (3) store the template database in a local repository, a central repository, or a portable token such as a smart card; (4) live-scan the biometric; (5) process the biometric then extract the biometric template; (6) match the scanned biometric against stored databases; (7) provide a matching score to business applications or other applications; (8) record a secure audit trail with respect to system use.*

Table -1: Comparison between different biometrics

**The large number of factors involved makes a simple cost comparison impractical.*

Characteristic	Fingerprints	Hand Geometry	Retina	Iris	Face	Signature	Voice
Ease of Use	High	High	Low	Medium	Medium	High	High
Error incidence	Dryness, dirt, age	Hand injury, age	Glasses	Poor Lighting	Lighting, age, glasses, hair	Changing signatures	Noise, colds, weather
Accuracy	Very High	High	High	High	High	High	High
Cost	*	*	*	*	*	*	*
User acceptance	Medium	Medium	Medium	Medium	Medium	Medium	High
Required security level	High	Medium	High	High	Medium	Medium	Medium
Long-term stability	High	Medium	High	High	Medium	Medium	Medium

4. BOX-COUNTING METHOD

The box-counting method is based on the number of boxes $N(\epsilon)$ of size ϵ essential to fill the whole area of an image[3]. Changing the size of ϵ way that the number of boxes $N(\epsilon)$ also changes, in other conditions, the lesser the size of ϵ the bigger the number of boxes, at the same time as the larger the size of ϵ, the fewer the number of boxes $N(\epsilon)$. The box-counting techniques define the fractal dimension of an object by the expression:

$$d \sim -\frac{\log N(\epsilon)}{\log \epsilon} \quad (1)$$

For computer appliance the data is usually discretized. The pixel covering method is proposed to estimate the FD of fractal binarized images whose points is represented by 1, while the background is represented by 0. The image is Y is divided into square with width ϵ. $N\epsilon\,(Y)$ represent the minimum number of sets with radius less than or equal ϵ that covers Y. Hence, a group of data is obtained and the FD is estimated by changing the value δ of it is the slope of the line derived from these data using the least squares linear regression. It is not easy to calculate the box dimension of a locally bounded subset $Y \subseteq I^m$, where $\delta\,(r^n)\ \lim_{n\to\infty} In\,\frac{N\left(\frac{1}{2}\right)n(Y)}{nin(2)}$. Therefore, we can estimate the value of δ using box counting dimension. Hence, we proposed new estimation method to calculate δ.

5. TRAINING

The fingerprint images are taken for creation of database the average fractal values can be store in the database of the images. Database used for training is DB1 FVC2002. Many fingerprint images are low quality. Size of each image is 388x374 pixels and its resolution is 96 dpi. FVC2002 DB1 has 100 fingerprint images. The images are store in database. In training set, the image is read then

preprocessed by the methods used in preprocessing (enhancement, binarization and thinning) this will describe above. After preprocessing the feature of the image can be extracted and calculate their FD values and also calculate the mean FD values. In training phase, we store the person's information (like name, address etc.) to the database for identify the persons. The database image is shown in fig 4.2 and training phase is shown in **fig 3**.

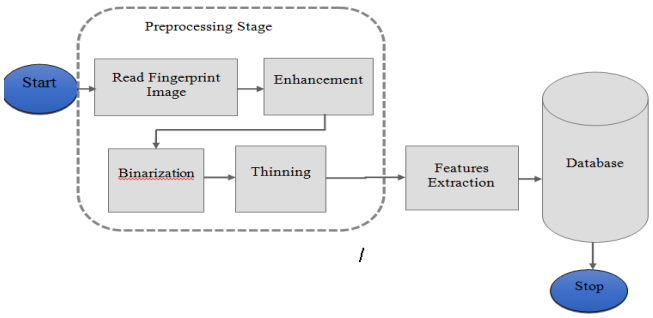


Fig -3: Training phase

6. RESULTS AND DISCUSSION

In this section, the proposed method of finger print recognition has been evaluated using fractal dimension. In these method total twenty four features of every finger in database has been extracted. On the basis of their FD values a mean value of the features has been calculated. First four features i.e. ridge terminations (RT), bifurcations count (BC), minutia count (MC) and minutia count after false minutia removal (MCFMR), are based on the texture of the fingerprint after preprocessing. The images represented in table 1 represent features value for fingerprint recognition

Table -2: Feature value of Proposed Method

Features	Image1	Image2	Image3	Image4	Image5
RT	324	282	334	598	441
BC	20	1	5	6	3
MC	344	283	339	604	444
MCFMR	67	46	59	46	37

Table -3: Features and FD value of Proposed Method

Features	Image1	Image2	Image3	Image4	Image5
FDROI1	151.750	141.2500	154.2500	220.2500	181
FDROI2	152	141.5000	154.5000	220.5000	181.2500
FDROI3	152.2500	141.7500	154.7500	220.7500	181.5000
FDROI4	152.5000	142	155	221	181.7500
FDROI5	152.7500	142.2500	155.2500	221.2500	182
FDROI6	153	142.5000	155.5000	221.5000	182.2500
FDROI7	153.2500	142.7500	155.7500	221.7500	182.5000
FDROI8	153.5000	143	156	222	182.7500
FDRROI9	153.7500	143.2500	156.2500	222.2500	183
FDROI10	131	122.6000	133	185.8000	154.4000
FDROI11	131.2000	122.8000	133.2000	186	154.6000
LCROI1	0.0497	0.0476	0.0502	0.0634	0.0556
LCROI2	0.0473	0.0452	0.0478	0.0609	0.0531
LCROI3	0.0449	0.0428	0.0454	0.0584	0.0507
LCROI4	0.0426	0.04063	0.0431	0.0560	0.0484
LCROI5	0.0405	0.0384	0.0410	0.0538	0.0462
LCROI6	0.0384	0.0364	0.0389	0.0516	0.0441
LCROI7	0.0365	0.0345	0.0370	0.0496	0.0421
LCROI8	0.0346	0.0326	0.0351	0.0477	0.0402
LCROI9	0.0329	0.0309	0.0333	0.0458	0.0384
LCROI10	0.0643	0.0624	0.0648	0.0768	0.0697
LCROI11	0.0623	0.0604	0.0628	0.0748	0.0676
Feature Mean	**74.4293**	**69.3692**	**75.6340**	**107.4404**	**88.5252**

7. CONCLUSIONS

Fingerprint recognition systems work well in matching systems that reveals the matching or non matching ratio between template and input image. Instead of this, the fingerprint recognition systems also work well in different orientation fields. Fingerprint recognition algorithms fail under those conditions where humans need to identify other people while do not analyze how the object causes neurons in the fingerprint image and then how the signals are interpreted in the brain using neural network approach. This kind of detection method can be used to identify criminals from their specific features.

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