ISSN : 2347 - 8446 (Online)
ISSN : 2347 - 9817 (Print)

A Review Paper on Fingerprint Identification System

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Abstract
Fingerprint authentication is the most sophisticated method of all biometric techniques and has been thoroughly verified through various applications. Even features such as person's face or signature can change with changing in time and may be fabricated or imitated. But a fingerprint occurs uniquely to an individual and remains unchanged for lifetime. This paper defines the various aspects and methods to be used for the fingerprint-basedidentification system.

Keywords
Biometric, histogram, Minutiae

I. Introduction

Fingerprint is the oldest and easily available traits of biometrics,it shows an infallible means of personal. identification. Accuracy is matching by use of fingerprint technique. it has been shown to be very high as compare to other existing biometric traits [2]. Unlike face and voice patterns, fingerprints are persistent with age and can't be easily changed. We can say that fingerprint is one of the most researched and matured field of biometric authentication. The first example of biometrics is that it was a form of fingerprinting that being used in China [3]. Fingerprints are incomparably the most sure and unchanging form of all other forms of signature [4]. A fingerprint is defined by a set of ridge lines and they run parallel and sometimes terminates and sometimes intersects. The points are known as Minutiae where the ridge lines are terminated. [5] whereas according to Galton, each ridge is characterized by numerous minute peculiarities called Minutiae, which may divide and almost immediately reunite, enclosing a smallcircular or elliptical space or sometimes the independent beginning or ending of ridges. In a fingerprint image, ridges are dark whereas valleys are bright. Ridges and valleys often run in parallel; sometimes they bifurcate and sometimes they terminate. Minutiae based fingerprint identification system approaches towards extraction of the ridge patterns correctly.A good quality fingerprint contains 25-80 numbers of minutiae [6] depending on the sensor resolution and finger placement on the sensor. However the fingerprint image captured through poor scanners, are found to have fewer number of minutiae points. In order to ensure the minutiae extraction procedure to be mages as input, and this gives a reason to the fingerprint images for enhancement.

II. Literature Review

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

A. Fast Fourier Transform and Gabor Filters

In this work fingerprint recognition has been performed by using Fast Fourier Transform and Gabor Filters [7]. 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.

B. 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.

C. 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. Different segmentation algorithms have been used which are described as below:

1. Gauss Filtering In this process of collecting the fingerprints

Noises are usually drawn into the fingerprint image for many reasons, such as inhalation of dust and spots on the sensor surface [8]. Therefore, the Gaussian filter is used to weaken this effect and improve the quality of the images.

2. Histogram Processing

Histogram manipulation can be used effectively for fingerprint image enhancement. Histograms are simple to calculate in software and also lend themselves to economic hardware implementations, thus making them a popular tool for real-time image processing.

3. Histogram Equalization

Here we consider a continuous function, and let the variable represent the gray levels of the image to be enhanced. We assume that r has been normalized to the interval [0, 1], with r=0 representing black and r=1 representing white. The transformation can be written as:

$s = T(r) \quad 0 < r < 1$

This produces a level s for every pixel value r in the original image. The transformation Function T(r) satisfies the following conditions: T(r) is a single-valued and monotonically increasing in the interval

$0 < r < 1$ and

$0 < T(r) < 1$ for $0 < r < 1$

III. Pattern Recognition And Feature Extraction

A pattern is an arrangement of descriptors. It is characterized by the order of the elements of which it is made, rather than by the intrinsic nature of these elements. Pattern recognition is divided into two principle areas: Decision theoretic and Structural.

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Decision theoretic deals with patterns described using quantitative descriptors, such as length, area, and texture. Structural category deals with patterns best described by qualitative descriptors, such as the relational descriptors. A pattern class is a family of patterns that share some common properties. Pattern classes are denoted by w1, w2……ww, where W is the number of classes. Pattern recognition by machine involves techniques for assigning patterns to their respective classes-automatically and with as little human intervention as possible. Three common pattern arrangements used in practice are vectors, strings and trees. Pattern vectors are represented in the following form:
x = [x1, x2…….xn]
Where each component, xi represents the ith descriptor and n is the total number of such descriptors associated with the pattern. The nature of the components of a pattern vector xdepends on the approach used to describe the physical itself.
The key concept to keep in mind is that selecting thedescriptors on which to base each component of a pattern vector has a profound influence on the eventual performance of object recognition based on the pattern vector approach. Finally fingerprint recognition is based on the interrelationships of print features called minutiae. This arrangement is shown is a figure 1 given below.

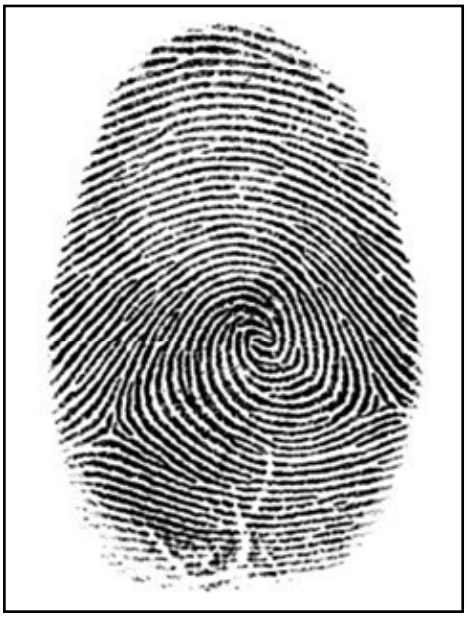

Fig.1: Fingerprint Images

IV. Methodology

The block diagram of the Biometric Identification System (BIS) is clearly referred in a figure 2 given below. It consists of three components which are shown with the help of a flowchart to identify fingerprint image.

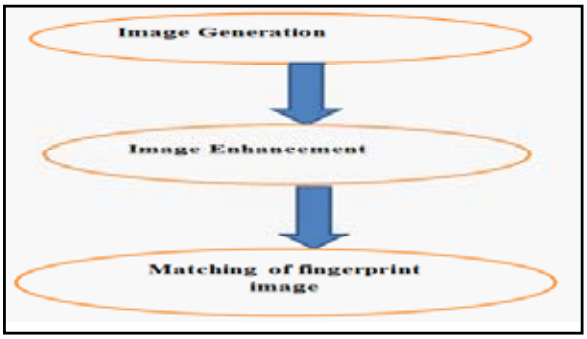

Fig. 2: Flowchart to identify fingerprint image

Each of the component mentioned in the flowchart are described as follows:

A. Image Generation

With reference to problem domain, image sensor acquires digital images. First is a Physical device that is sensitive to the energy radiated by the object. The second, called a Digitizer, is a device for converting the output of the physical sensing device into digits form. Specialized image processing hardware consists of the digitizer and hardware that performs other primitive operations. The Computer is an image processing system which ranges from PC to Supercomputer. Software for image processing consists of specialized modules that perform specific tasks.Mass storage capability is a must in image processing applications. An image of size 1024x1024 pixels, in which the intensity of each pixel is an 8-bit quantity, requires one megabyte (MB) of storage space, if the image is not compressed. Image displays in use are mainly color TV monitors. Monitors are driven by the outputs of image and graphics display cards that are an integral part of the ComputerSystem.

B. Image Enhancement

Image enhancement approaches are basically categorized into two broad categories, which are discussed here.

1. Spatial Domain Methods

Spatial domain refers to the aggregate of pixels composing an image. Spatial domain methods are procedures that operate directly on these pixels. It can be denoted by the expression:
g(x, y) = T [f (x, y)]
Where f (x, y) is the input image,g (x, y) is the processed image and T is an operator of f, defined over some neighborhood of (x, y).

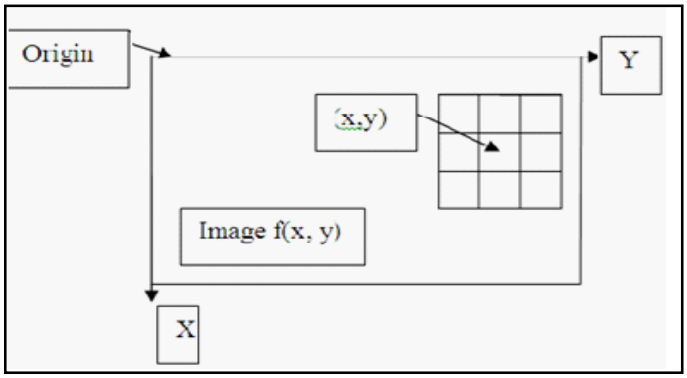

Fig. 4: A 3* 3 neighborhood about a point (x,y) in an image

C. Matching Of Fingerprint Image

Recognition techniques based on matching representeach class by a prototype pattern vector. An unknown pattern is assigned to the class to which it is closest in terms of a predefined metric. The simplest approach is the minimum-distance classifier, which as its name implies, computes the distance between the unknown and each of the prototype vectors.

1. Minimum Distance Classifier

Suppose that we define the prototype of each pattern class to be the mean vector of the patterns of that class:

$$M_j = 1/N \sum_{x \in w_j} X_j \quad j=1,2,3.....W.$$

Where Nj is the number of pattern vector from class j □ and the

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ISSN : 2347 - 8446 (Online)
ISSN : 2347 - 9817 (Print)

summation is taken over.
These vectors. As before, W is the number of pattern classes. One way to determine the class membership of an unknown pattern vector x is to assign it to the class of its closest prototype. Using the Euclidean distance to determine closeness reduces the problem to computing the distance measures:
$Dj(x) = \| x - mj \| \; j = 1, 2 \ldots W$ Where $\|a\| = (a^T a)^{1/2}$ is the Euclidean Norm.

V. Conclusion

In this paper, we have shown different methods and techniques which can be used to identify a person through its fingerprint. These mentioned methods conclude that the fingerprint is fast and accurate for more reliable and secure system. The Gabor filter method is a very useful method which is applied for feature extraction. The methodology of the biometric identification system is represented with the help of diagrams and flow charts which can be used to enhance the quality of the image as well as to verify the identity of a person. Future research work can be carried out to improve the quality of the image by improving the image enhancement technique and develop a better matching technique.

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