An Approach to Identify Imprints using Image Processing

Naveen Kumar Jain, Anurag Paliwal

Abstract— **With the technological advancement the need of identifying the person with respect to its imprints has taken its hives so a recent idea to detect and acknowledge the person with image processing algorithm has been implemented to identify fingerprints. It is used in many real time applications such as in forensic science, security needs and many more.The algorithm implemented reveals the difficult task of matching the images of finger print of a person with the finger print present in the database efficiently. The imprints formed by friction ridges of skin and thumbs are effectively matched with the reference data. The imprint is unique among the people and changes from person to person so algorithm serves the best purpose. The paper illustrates recognition method using various approaches which is based on minutiae located in fingerprints and frequency content and ridge orientation of fingerprints.The algorithm used is implemented through image acquisition amd image processing of MATLAB finger print..**

Index Terms— **Fingerprints, Identifying Algorithm, imprint processing**

I. Introduction

Recently fingerprint identification is used on very large scale due to uniqueness of fingerprints, distinctiveness, persistence and ease of acquisition. Although, there are many real application using this technology but its problem are still not fully solved, especially in poor quality finger print image and when low cost acquisition devices with a small area are adopted.To identify the imprints fingerprints are analysed of fingerprints for matching purposes generally requires the comparison of several features of the print pattern. These include patterns, which are aggregate characteristics of ridges, and minutia points, which are unique features found within the patterns. It is also necessary to know the structure and properties of human skin in order to successfully employ some of the imaging technologies. A typical live-scan fingerprint will contain 30-40 minutiae. Other systems analyze tiny sweat pores on the finger that, in the same way as minutiae, are uniquely positioned. Finger scanning is not immune to environmental disturbance. As the image is captured when the finger is touching the scanner device it is possible that dirt, condition of the skin, pressure and alignment or rotation of the finger all affect the quality of the fingerprint. The paper illustrates recognition method using various approaches which is based on minutiae located in fingerprints and frequency content and ridge orientation of fingerprints. With ever-increasing and evermore complex technologies, exact personal identification is imperative. By using identification processes, it is for example possible to regulate access to certain objects by granting certain rights. Everyone who was positively identified and thus accepted is given pre-established privileges. In the police, identification plays an important role.The surface of the inguinal skin of man and of most mammals shows patterns and their variety seems to be endless.Tthe ridges of the inguinal skin on the fingers of humans are different. Ridges form various patterns (loops, arches, whorls) which – in connection with interruptions of the ridges (minutiae) – differ from finger to finger. For forensic purposes, fingerprints were used as early as at the end of the 19th century in order to identify people .With the advancement of technology, the issue of safety has become more important. The algorithm used is implemented through image acquisition and image processing of MATLAB finger print.

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II. Identifying Algorithm

It basically includes two approaches which are based on minutia located in a finger prints and other on frequency content and ridge orientation of a finger prints.This method is based on comparision of minutiae matching.Minutiae are local discontinuities in the fingerprint pattern. A total of 150 different minutiae types have been identified. In practice only ridge ending and ridge bifurcation minutiae its types are used in fingerprint recognition.

Fig. 1: Ridge ending and bifurcation

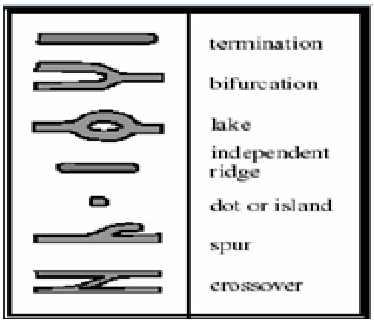

Fig.2: different minutia type

The building blocks of a fingerprint recognition system are

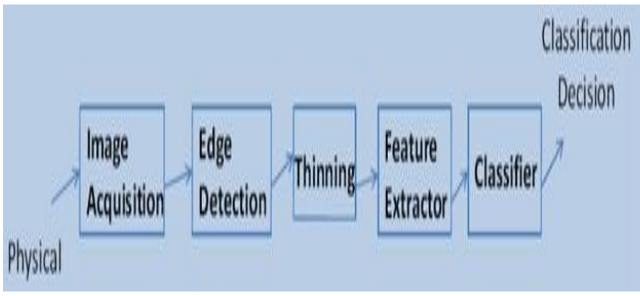

Fig. 3: fingerprint recognition system

A. *Data Acquisition:*

A number of methods are used to acquire fingerprints. Among them, the inked impression method remains the most popular one. Inkless fingerprint scanners are also present eliminating the intermediate digitization process.
Fingerprint quality is very important since it affects directly the minutiae extraction algorithm. Two types of degradation usually affect fingerprint images are the ridge sometimes includes the gap and parallel ridge which are not always well separated due to the presence of cluttering noise.

B. *Edge Detection*

An edge is the boundary between two regions with relatively distinct gray level properties.In practice, the set of pixels obtained from the edge detection algorithm seldom characterizes a boundary completely because of noise, breaks in the boundary and other effects that introduce spurious intensity discontinuities.

C. *Thinning*

An important approach to represent the structural shape of a plane region is to reduce it to a graph. This reduction may be accomplished by obtaining the skeleton of the region via thinning (also called skeletonising) algorithm.
The thinning algorithm while deleting unwanted edge points should not.
Extraction of appropriate features is one of the most important tasks for a recognition system. The feature extraction method used in will be explained below.A multilayer perceptron (MLP) of three layers is trained to detect the minutiae in the thinned fingerprint image of size 300x300. The first layer of the network has nine neurons associated with the components of the input vector.The hidden layer has five neurons and the output layer has one neuron. The network is trained to output a 1 when the input window in centered on a minutiae and a 0 when it is not. Figure 3 shows the initial training patterns which are composed of 16 samples of bifurcations in eight different orientations and 36 samples of non-bifurcations. The networking will be trained using:

- The back propagation algorithm with momentum and learning rate of 0.3.
- The Al-Alaoui back propagation algorithm.

The fingerprint image is scanned using a 3x3 window given

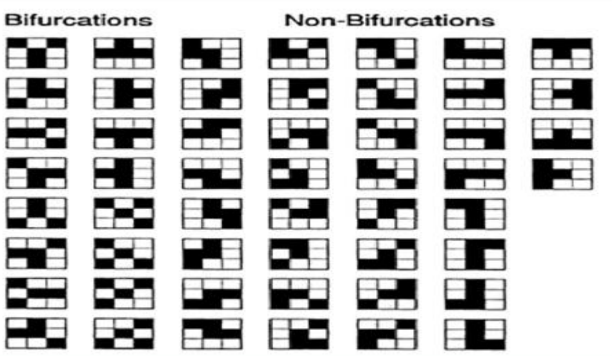

Fig.4: training set

III. Imprint Processing

After scanning the entire fingerprint image, the resulting output is a binary image revealing the location of minutiae. In order to prevent any falsely reported output and select significant minutiae, two more rules are added to enhance the robustness of the algorithm. At those potential minutiae detected points, we re-examine them by increasing the window size by 5x5 and scanning the output image. If two or more minutiae are to close together ,ingnore all of them.
The human fingerprint is comprised of various types of ridge patterns, traditionally classified according to the decades-old Henry system: left loop, right loop, arch, whorl, and tented arch.Loops make up nearly 2/3 of all fingerprints, whorls are nearly 1/3, and perhaps 5-10% are arches. Figure 4 shows some fingerprint patterns with the core point are marked.
After extracting the location of the minutiae for the prototype fingerprint images, the calculated distances will be stored in the database along with the ID or name of the person to whom each fingerprint belongs.


Fig.5: tench arc,right loop,left loop and whorl

Lastly it is inputted to the system and minutiae are extracted. The minutiae matching i.e comparing the distances extracted minutiae to the one stored in the database and the person is identified.The other approach is small scale fingerprint recognition system, it would not be efficient to undergo all the pre-processing steps like edge detection, smoothing, thinning etc.No pre-processing stage is needed before extracting the features.

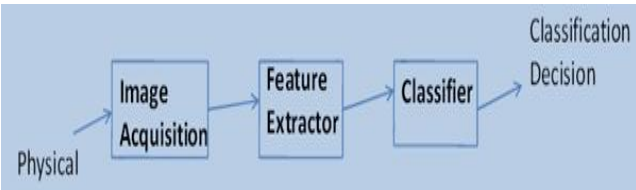

Fig. 6: basic building block

Gabor filter based features have been successfully and widely applied to face recognition, pattern recognition and fingerprint enhancement. The family of 2-D Gabor filters was originally presented by Daugman as a framework for understanding the orientation and spatial frequency selectivity properties of the filter.Daugman mathematically elaborated further his work in In a local neighbourhood the gray levels along the parallel ridges and valleysexhibit some ideal sinusoidal shaped plane waves associated with some noise

IV. Experimental Results

Our preliminary experiments involve a database containing 250 images (size = 640 x 480) from 25 different fingers. Ten impressions of each finger are available for a total of 250 images. The images were captured with an optical scanner manufactured by Digital Biometrics. We have developed a technique to help the subjects in the proper placement of their fingers. The subjects were asked to place their fingers upright at the center of the glass platen and they were asked to provide different impressions of their fingers within **f30”** rotation. These images are not as noisy as the inked fingerprints but they do contain large nonlinear deformations. We have not used any of the standard databases (e.g., NIST 9) because the inked fingerprint images are not representative of the live scan images used in the civilian applications.

Each fingerprint in the database is matched with all the other fingerprints in the database. A matching is labeled correct if the matched pair is from identical finger and incorrect otherwise. A total of 62,250 (250 x 249) matching’s were performed. The distribution for genuine (authentic) matches was estimated with 2,250 (250 x 9) matches and the imposter distribution was estimated with 60,000 (250 x 240) matches. None of the genuine matching scores was zero; the images from the same finger did not yield an identical Finger code because of rotation and inconsistency in reference location. Given a matching distance threshold, the genuine acceptance rate is the fraction of times the system correctly identifies two fingerprints representing the same finger. Similarly, false acceptance rate is the fraction of times the system incorrectly identifies two fingerprints representing the same finger.

A Receiver Operating Characteristic (ROC) is a plot of Genuine Acceptance Rate against False Acceptance Rate for all possible system operating points (i.e., matching distance threshold) and measures the overall performance of the system. An “ideal” ROC curve is a step function at zero False Acceptance Rate. Figure compares the ROCs of a state-of-the-art minutiae-based matcher with our filter-based matcher. Since the ROC curve of the filter-based matcher is above the minutiae-based matcher, we conclude that our matcher performs better than a state of- the-art minutiae-based matcher on this database.

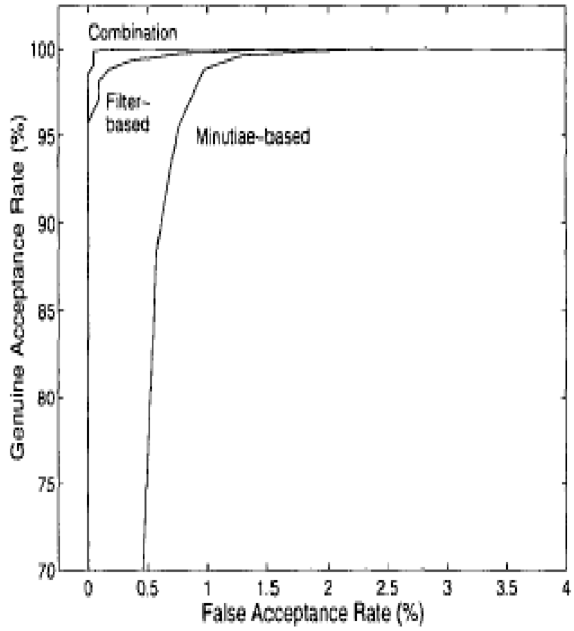

Figure 7: Receiver Operating Characteristic (ROC) curve

V. Conclusion and Future Scope

We have developed a fast fingerprint identifying algorithm which can adaptively improve the clarity of ridge and valley structures based on the local ridge orientation and ridge frequency estimated from the input image. The performance of the algorithm was evaluated using the goodness index of the extracted minutiae and the performance of an online fingerprint verification system which incorporates our fingerprint enhancement algorithm in its minutiae extraction module. Experimental results show that our enhancement algorithm is capable of improving both the goodness index and the verification performance.

The algorithm also identifies the unrecoverable corrupted regions in the fingerprint and removes them from further processing. This is a very important property because such unrecoverable regions do appear in some of the corrupted fingerprint images and they are extremely harmful to minutiae extraction. These properties suggest that our enhancement algorithm should be integrated into an online fingerprint verification/identification system. The global ridge and valley configuration of fingerprint images presents a certain degree of regularity. A global model of the ridges and valleys that can be constructed from partial “valid” regions can be used to correct the errors in the estimated orientation images, which, in turn, will help the enhancement. Currently, we are investigating such a model-based enhancement algorithm. The configurations of ridges and valleys within a local neighborhood vary with the quality of input fingerprint images, so well-defined sinusoidal-shaped waves of ridges and valleys may not always be observed. Global features are needed for a more precise region mask classification

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