IJCEM International Journal of Computational Engineering & Management, Vol. 16 Issue 1, January 2013
ISSN (Online): 2230-7893
www.IJCEM.org

Fingerprint Recognition for Library Management

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Abstract

Fingerprint Recognition is one of the leading and best biometric technologies that are to be widely used now days. This paper is the implementation of the Fingerprint recognition for the Library Management purpose. Every educational institution has to maintain a proper record of library books of students or staff for proper functioning of library. Designing a better authentication system for students so that records are maintained with ease and accuracy is the motivation throughout this work. In this work we first identify the user/student with the help of fingerprint recognition and later on we process it for further library transaction part.

Keywords: *Fingerprint Recognition, Library Transaction, Thinning, Binarization.*

I. INTRODUCTION

Among biometrics, fingerprint systems have been one of most widely researched and deployed. A fingerprint is one of the first biometrics to be widely used. It is popular because of their easy access, low price of fingerprint sensors, non-intrusive scanning, and relatively good performance. In recent years, significant performance improvements have been achieved in commercial automatic fingerprint recognition systems.

The first step in fingerprint recognition is known as “image acquisition”. In this part of the process, a user places his or her finger on a platen (also referred to as a scanner), which is located on the top of most fingerprint recognition devices. Numerous images of the fingerprint are then captured. It should be noted that during this stage, the goal is to capture images of the center of the fingerprint, which contains many of the unique features. All of the captured images are then converted into black and white images [4] .

The second step in fingerprint recognition is the location and determination of unique characteristics of the processed fingerprint image. The fingerprint is composed of various “ridges” and “valleys” which form the basis for the loops, arches, and swirls that you can easily see on your fingertip. The ridges and valleys contain different kinds of breaks and discontinuities. These are called “minutiae”, and it is from these “minutiae” that the unique features are located and determined. There are two types of “minutiae”: (1) Ridge endings (the location where the ridge actually ends); and (2) Bifurcations (the location where a single ridge becomes two ridges).

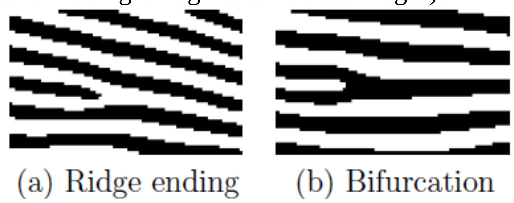

Figure 1. Example of Ridge ending and a Bifurcation

In this example, the black pixels correspond to the ridges, and the white pixels correspond to the valleys.

When human fingerprint experts determine if two fingerprints are from the same finger, the matching degree between two minutiae pattern is one of the most important factors. Thanks to the similarity to the way of human fingerprint experts and compactness of templates, the minutiae-based matching method is the most widely studied matching method.

The fingerprint of every creature is considered to be unique. No two persons have the same set of fingerprints. Also, Finger ridge patterns do not change throughout the life of an individual. This property makes fingerprints an excellent biometric identifier. So it is one of the popular and effective means for identification of an individual and used as forensic substantiation.

The third step in fingerprint recognition is that of template creation, based upon the unique features found in the “minutiae”. The location, position, as well as the type and quality of the “minutiae” are factors taken into consideration in the template creation stage. Unlike iris recognition technology in which there is only one primary vendor (and thus only one set of algorithms), fingerprint recognition technology consists of many vendors (and thus, many more algorithms). As a result, each type of fingerprint recognition technology has its own set of algorithms for template creation and matching.

The fourth and final step of fingerprint recognition is template matching. This is where the system will either attempt to verify or identify you, by comparing the enrollment template against the verification template

A growing number of biometric technologies have been proposed over the past several years, but only in the past around 7 years have the leading ones become more widely deployed.

Some technologies are better suited to specific applications than others, and some are more acceptable to users. The leading seven biometric technologies are:

- Facial Recognition
- Fingerprint Recognition
- Hand Geometry
- Iris Recognition
- Signature Recognition
- Speaker Recognition

Also, a fingerprint recognition system can make two types of errors: a false match, when a match occurs between images from two different fingers, and a false non-match, when images from the same finger are not a match. Thus a major challenge behind any good fingerprint recognition system is to reduce both these errors.

II. FINGERPRINT AS A BIOMETRIC

Fingerprints are considered to be the best and fastest method for biometric identification. They are secure to use, unique for every person and do not change in one's lifetime. Besides these, implementation of fingerprint recognition system is cheap, easy and accurate up to satisfaction.

Fingerprint recognition has been widely used in both forensic and civilian applications. Compared with other biometrics features, fingerprint-based biometrics is the most proven technique and has the largest market shares. Not only it is faster than other techniques but also the energy consumption by such systems is too less.

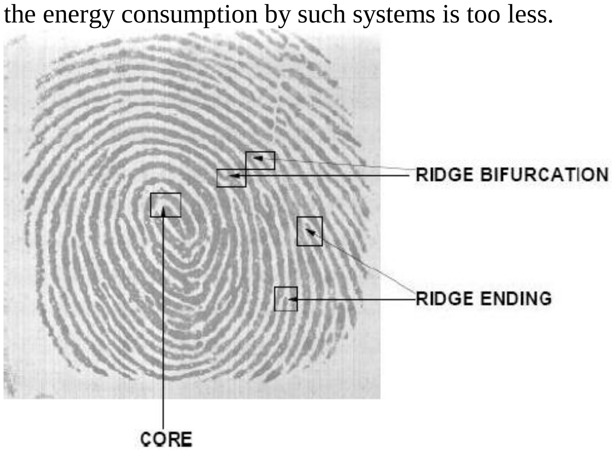

Figure. 2: A Fingerprint Image

Although not scientifically established, fingerprints are believed to be unique across individuals, and across fingers of the same individual. Even identical twins having similar DNA, are believed to have different fingerprints. Traditionally, fingerprint patterns have been extracted by creating an inked impression of the fingertip on paper.

The electronic era has ushered in a range of compact sensors that provide digital images of these patterns. These sensors can be easily incorporated into existing computer peripherals like the mouse or the keyboard (figure), thereby making this mode of identification a very attractive proposition. This has led to the increased use of automatic fingerprint-based authentication systems in both civilian and law enforcement applications.

III. FINGERPRINT MATCHING TECHNIQUES

The large number of approaches to fingerprint matching can be coarsely classified into three families.

1) Correlation-based matching: Two fingerprint images are superimposed and the relationship among consequent pixels is computed for different alignments like different displacements and rotations [2].

2) Minutiae-based matching: This is the mainly admired and generally used technique, being the origin of the fingerprint evaluation 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 result in the maximum number of minutiae pairings [2].

3) Pattern-based (or 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 [2].

We have implemented a minutiae based matching technique. This approach has been intensively studied, also is the backbone of the current available fingerprint recognition products.

IV. PROPOSED WORK

- Loading of Image

A color image is a digital image that includes color information for each pixel. A color image is usually stored in memory as a raster map, a two dimensional array of small integer triplets, or as three separate raster maps, one for each channel.

- RGB to Gray

RGB is a device-dependent color model: different devices detect or reproduce a given RGB value differently, since the color elements (such as phosphors or dyes) and their response to the individual R, G, and B levels vary from manufacturer to manufacturer, or even in the same device over time. Thus an RGB value does not define the same color across devices without some kind of color management. Hence we prefer grayscale images for processing.

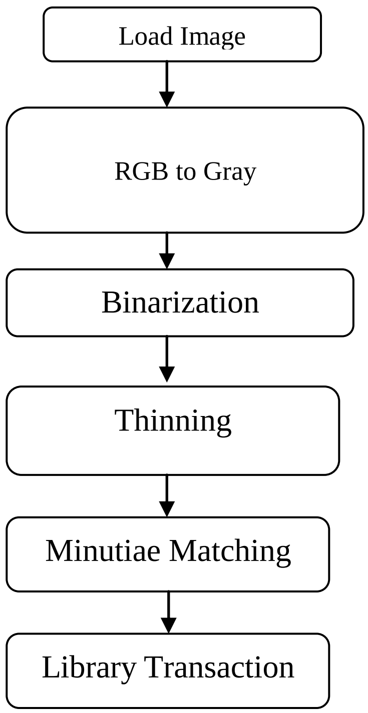

Figure. 3: Used Design Flow

Grayscale images contain only brightness information. Each pixel value in a grayscale image corresponds to an amount or quantity of light. The brightness graduation can be differentiated in a grayscale image. In a grayscale image, each pixel is represented by a byte or word, the value of which represents the light intensity at that point in the image. An 8-bit image will have a brightness variation from 0 to 255 where '0' represents black and '255' represents white. A grayscale image measures only the light intensity. Each pixel is a scalar proportional to the brightness.

- ### Fingerprint Image Binarization

Fingerprint Image Binarization is to transform the 8-bit Gray fingerprint image to a 1- bit image with 0-value for ridges and 1-value for furrows. After the operation, ridges in the fingerprint are highlighted with black color while furrows are white.

- ### Fingerprint Thinning

Thinning is to eliminate the redundant pixels of ridges till the ridges are just one pixel wide. An iterative, parallel thinning algorithm is used. In each scan of the full fingerprint image, the gorithm marks down redundant pixels in each small image window (3x3). And finally removes all those marked pixels after several scans.

- ### Minutia Marking & Match

After the fingerprint ridge thinning, marking minutia points is relatively easy. The concept of Crossing Number (CN) is widely used for extracting the minutiae.

Given two set of minutia of two fingerprint images, the minutia match algorithm determines whether the two minutia sets are from the same finger or not.

Library Transaction.-

After the Fingerprint Recognition then next step that is to be used in this work is to maintain the Library data i.e. a) Issue and b) Return the books.

V. REMOVAL of FALSE MINUTIAE

The procedure for the removal of false minutia is:

1. If the distance between one bifurcation and one termination is less than D and the two minutia are in the same ridge(m1 case), both of them are removed. Where D is the average inter-ridge width representing the average distance between two parallel neighboring ridges.

2. If the distance between two bifurcations is less than D and they are in the same ridge, the two bifurcations are removed.

3. If two terminations are within a distance D and their directions are coincident with a small angle variation. And they suffice the condition that no other termination is located between the two terminations. Then the two terminations are regarded as false minutia derived from a broken ridge and are removed.

4. If two terminations are located in a short ridge with length less than D, remove the two terminations.

VI. RESULTS

While our implementation is successfully able to decide whether multiple fingerprint images belong to the same finger or not, it is by no means perfect. Also, the computation time of the algorithm is still too high for a seamless real-time application.

In order to make our implementation more efficient, there is scope for improvement in the image binarization step and minutiae matching algorithm. We have tested out algorithm on online images of a reasonably high quality. This may not be the case every time in a real-world application. There is always the possibility if fingerprints which have come from fingers which were too dry or too wet. Also, there is a chance that a person may have injured his/her finger and significant alterations may have taken place in the ridge ending minutiae due to cuts/burns etc.

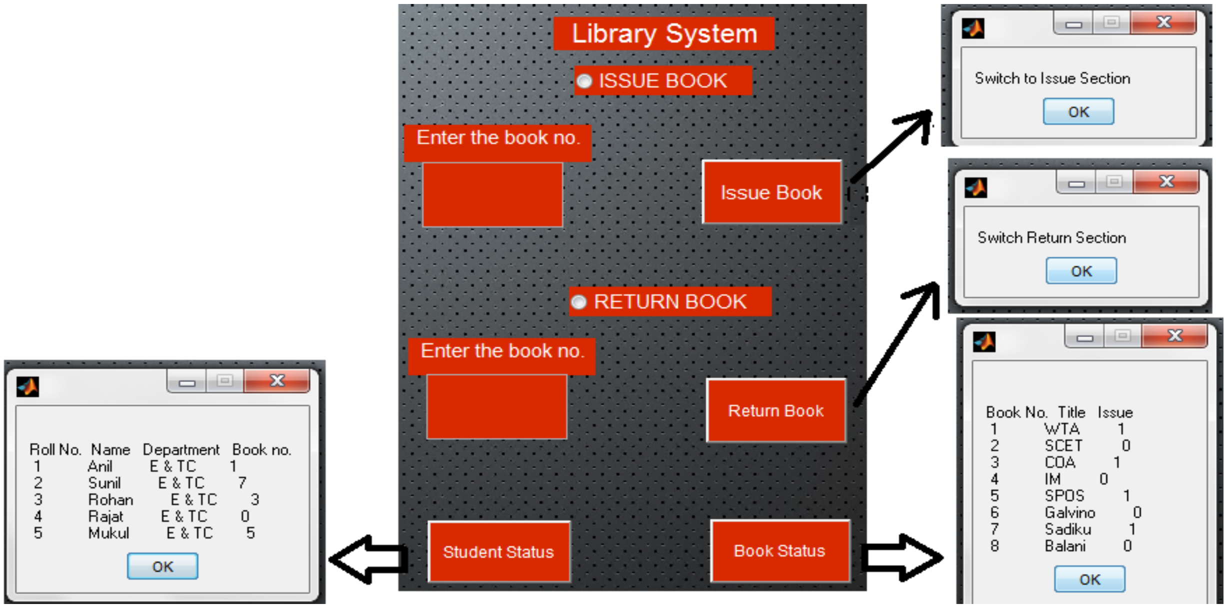

Figure 4. Result obtained After Fingerprint recognition.

VII. CONCLUSION

Our main focus throughout this work is to first identify the finger from the student/user i.e. we can recognize it first and later on going towards the library part handling the library transaction such as return the particular book as well as issue the different book.

Our main aim is to avoid the tedious human (librarian) effort to handle the library job.

The on the whole accomplishment is an effort to understand how Fingerprint Recognition is used as a form of biometric to recognize identities of human beings. It includes all the stages from minutiae extraction from fingerprints to minutiae matching which generates a match gain. Various standard techniques are used in the intermediate stages of processing.

The reliability of any regular fingerprint system strongly relies on the precision obtained in the minutia extraction process. A number of factors are detrimental to the correct location of minutia. Among them, poor image quality is the most serious one.

VIII. REFERENCES

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