FINGER PRINT RECOGNITION SYSTEM USING RIDGE THINNING METHOD

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Abstract **–Extraction of minutiae reliably and automatically from the input fingerprint images is the critical step in automatic fingerprint matching. The quality of the input fingerprint images is of highly important on which, the performance of a minutiae extraction algorithm relies heavily. It is essential to incorporate a fingerprint enhancement algorithm in the minutiae extraction module to ensure that the performance of an automatic fingerprint identification/verification system will be robust with respect to the quality of input fingerprint images. We present a fast fingerprint enhancement algorithm, which can adaptively improve the clarity of ridge and valley structures of input fingerprint images based on the estimated local ridge orientation and frequency. Using the goodness index of the extracted minutiae and the accuracy of an online fingerprint verification system, we have evaluated the performance of the image enhancement algorithm. Experimental results show that incorporating the enhancement algorithm improves both the goodness index and the verification accuracy.**

1. INTRODUCTION:

People are becoming more electronically connected with the rapid evolution of information technology. Personal identification is to associate a particular individual with an identity. Many questions relating to identity are asked asked millions of times every day by hundreds of thousands of organizations in financial services, health care, electronic commerce, telecommunication, government, etc. As a result, the ability to achieve highly accurate automatic personal identification is becoming more critical.

A wide variety of systems require reliable personal authentication schemes to either confirm or determine the identity of individuals. Such schemes are to ensure that the rendered services are accessed by a authorized user, and not anyone else. Examples of these systems include authorized access to computer systems in a business, laptops and ATMs. These systems are vulnerable to illegal activities in the absence of strong authentication schemes.

Traditionally, Passwords and ID cards which are knowledge-based and token-based securities respectively have been used to restrict access to the systems. However, the major advantages of this traditional personal identification are that

(i) They are of very simple.
(ii) Integrated with different systems will be easy at a low cost.

There are also many disadvantages like PIN may be forgotten or guessed by frauds; tokens may be stolen, forgotten, lost, or misplaced. Security can be easily broken in such systems when a password is known to a illegitimate user or a card is stolen is by someone and there is also a chance that the simple passwords may be guessed by impostors and the difficult ones become hard to legitimate users to remember. Therefore such systems are unable to address the problems that are being faced by the traditional verifications and also arises the security problems of our electronically interconnected information society.

An image of the fingerprint is captured by a scanner, and then, enhanced, and converted into a template. There are three types of scanner technologies. They are Optical, Silicon and Ultrasound technologies. In 2002, the most commonly used are the Optical scanners and. Ultrasound technologies, in spite of being potentially most accurate, has not been demonstrated in widespread use. The definition of ridges had been increased during enhancement by reducing the “noise” caused by such things like scars, cuts, dirt, creases of dry, wet or worm fingerprints. Extraction of minutiae points relating to breaks in the ridges of the fingertips is used as the base for their algorithms by approximately 80 percent of the

ISSN: 2278 – 7798

vendors. Extracting ridge patterns is the other way on which algorithms are based.

II TECHNIQUES:

Biometric:

Biometrics refers to authentication techniques that rely on measurable physiological and individual characteristics that can be automatically verified. In other words, for distinctive identification purposes, each have unique personal attributes which includes fingerprint, voice characteristics and pattern of retina. Strong or two-factor authentication—identifying oneself by two of the three methods of something you know (for example, a password), have (for example, a swipe card), or is (for example, a fingerprint)—is becoming more of a genuine standard in secure computing environments. Now-a-days, some of the personal computers are provided with fingerprint scanner to provide authentication. The computer system based on your identity followed by a pass phrase or pass code analyzes yur fingerprints and determines who you are and provides you different levels of access. Examples of access level include authorization to open confidential files, to make use of credit card information, to make online shopping(purchases) and so on.

Matches are based on threshold settings:

Whenever, a Biometric is captured, it is likely to be a unique template and because of which matches are never perfect either in identification or verification. So, in order to make a match or no-match decision, the biometric systems can be configured based on a predefined number which establishes the acceptable degree of similarity between the trial template and the already enrolled reference template. This pre-defined number can be referred to as a threshold. After the comparison between the two templates, a score is generated representing the degree of similarity between them and this will be matched with the threshold to make match or non-match decision. Sometimes, the trial templates can be considered matches to the several enrolled reference templates that generated better scores corresponding to better matches depending on the setting of threshold in identification systems.

Fingerprint as a biometric:

Among all biometric traits, fingerprints are highly reliable and have been used by the forensic experts in criminal investigations extensively. A fingerprint refers to the flow of ridge patterns in the tip of the finger. The ridge flow exhibits anomalies in local regions of the fingertip (Figure), and it is the position and orientation of these anomalies that are used to represent and match fingerprints.

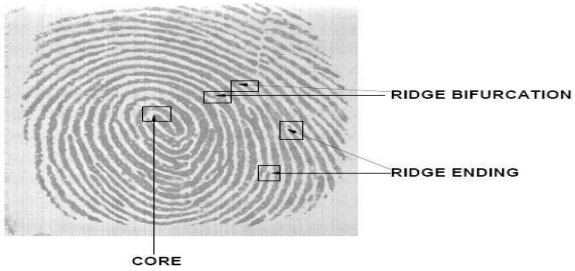

Fig 1.fingerprint type, redigeendings and ridgebifraction

Although not proved scientifically, fingerprints are believed to be unique across every individual and across fingers of the same person. Even, identical twins who share the same DNA are said to have different fingerprints. In olden days, fingerprint patterns have been extracted using inked impression of the finger tip on a paper.

Now-a-days digital images of these patterns can be obtained by using wide range of compact sensors. These sensors can be easily fitted into computer peripherals like the keyboard or the mouse. This has resulted in increased use of automated fingerprint-based authentication systems in many fields.

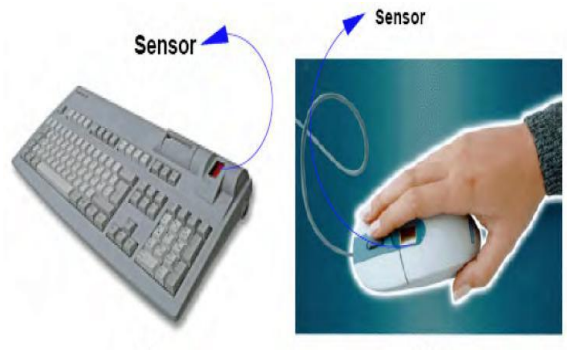

Fig 2.fingerprint usage with sensor communication

Fingerprint representation:

Topographic relief of its ridge structure determines the uniqueness of a fingerprint. And the minutiae points refers to certain ridge anomalies. The class of the fingerprint will be determined by the global configuration defined by the ridge structure and the similarity between the trail and enrolled reference fingerprints will be determined by the distribution of minutiae points.

ISSN: 2278 – 7798

Usually, Automatic fingerprint identification systems, matches a query print against a large database of prints. So, in order to narrow their search in database, firstly, it depends on the pattern of ridges in the query image(fingerprint indexing) and then, the exact match will be determined by minutiae points(fingerprint matching). The ridge flow pattern itself is rarely used for matching fingerprints.

Minutiae:

Minutiae, in fingerprinting terms, are the points of interest in a fingerprint, such as bifurcations (a ridge splitting into two) and ridge endings. Examples are:

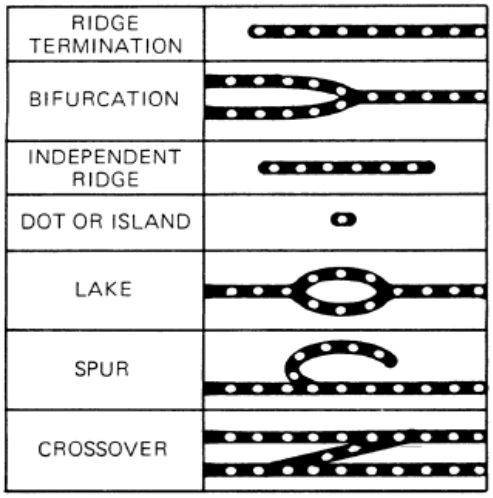

Fig.3:Different types of ridges

a.) ridge endings - a ridge that ends abruptly

b.) ridge bifurcation - a single ridge that divides into two ridges

c.) short ridges, island or independent ridge - a ridge that commences, travels a short distance and then ends

d.) ridge enclosures - a single ridge that bifurcates and reunites shortly afterward to continue as a single ridge

e.) spur - a bifurcation with a short ridge branching off a longer ridge

f.) crossover or bridge - a short ridge that runs between two parallel ridges

Minutiae also refer to any small or otherwise incidental details.

But the focus when matching is only on the 2 main minutiae; ridge ending and ridge bifurcation.

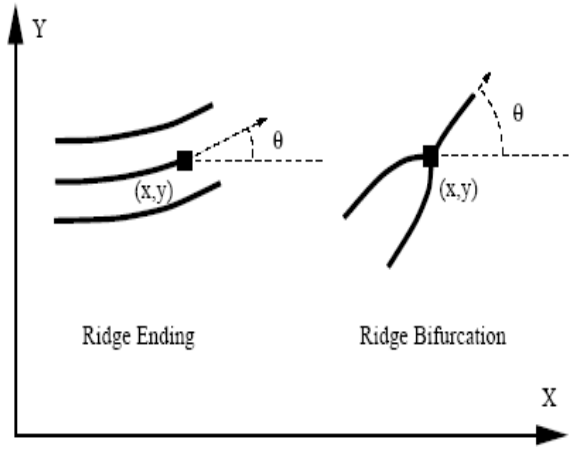

Fig.4: shape of the redge endings and redge bifraction

III. The Science behind Fingerprint Recognition:

The first step in fingerprint recognition is "image acquisition". In this process, the user places his finger on platen(scanner), which will be usually on the top of most fingerprints devices. During this process, numerous images of fingerprints are captured and the main aim of this is to capture the middle portion of the finger which consists of many unique features. And then all the images captured will be converted to black and white.

The second step involves recognition of location and determination of unique characteristics of the processed fingerprint image. The loops, arches, and swirls that you can easily see on your fingertip are because of the "ridges" and "valleys" on the fingerprint which contains 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).

The third step is the "template creation". This is based on the unique features that are found in the "minutiae". The factors that are to be considered for this template creation are location, position, as well as the type and quality of the "minutiae". Fingerprint recognition technology consists of many vendors and as the result, there will be many more algorithms. Each type of fingerprint recognition technology has

ISSN: 2278 – 7798

its own set of algorithms for template creation and matching.

The fourth and the final step is template matching. This is step in which the system will either attempt to verify or identify you, by comparing the enrollment template against the trial template.

Fig.5: communicate modules with fingerprint

Fingerprint sensors in everyday products.

Fingerprint systems are generally best utilized in verification systems or small-scale identification systems as because large-scale identification system requires extensive computational resources under current products.

Ridge Feature-Based:

It is difficult to conduct minutiae extraction in an efficient manner. Problems for minutiae-extracting algorithms will be because of low quality image containing a large amount of noise. It is necessary going for options which give meaningful data from a fingerprint. This versatility can be provided by analyzing various ridge features. Several features are being examined in today's systems ranging from basic to most advance. The physical size and shape of the external fingerprint silhouette can be computed at the basic end. Recording the number, type, and position of singular regions provides additional information. Although there is much variation to these numbers, this approach offers some data when little else can be extracted.

The spatial relationship and geometrical attributes of the ridge lines can be examined, on a slightly more advanced level. Gathering global and local texture information is another option available. The analysis can also be done by the ridge feature where the sweat pores within the ridges can be analyzed. Detecting the sweat pores requires an advanced collection system, and their presence would most likely be unnoticeable in low quality images even though sweat pores are highly discriminant among the population. But the basic ridge features are obtainable in any quality images.

Ridge features offer an alternative for poor images as minutiae-based methods require an image of good quality. Further it is not necessary that ridge feature-based techniques need to be limited to images of poor quality. Furthermore ridge feature-based methods can be used along with minutiae-based techniques for images of good quality. As more data to be used in the matching process, there will be an undoubted increase in accuracy and robustness of a system.

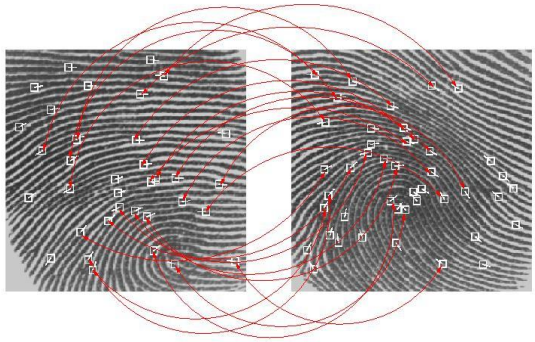

Fig.6: fingerprint match

Fingerprint Recognition:-

Fingerprint-based identification has been the oldest method which is successfully used in various applications, among all the biometric techniques. The surface of the finger will be having a series of ridges and furrows, which forms the finger print. By the pattern of ridges and furrows and also with all the minutiae points we will be able to determine the uniqueness of a fingerprint. Local ridge characteristics will be called as the minutiae points which occur either at a ridge bifurcation or at a ridge ending.

Fingerprint Scanning:-

The process of acquiring and recognizing a person's fingerprint characteristics for identification purposes is called Fingerprint scanning. The identity of an individual can be verified by this, which recognizes person quantifiable physiological characteristics. Basically, this is made possible by two different types of finger-scanning technology.

To make an image of a finger, in optical method a visual image of a finger will be used whereas the other uses a semiconductor-generated electric field.

ISSN: 2278 – 7798

To identify fingerprints there are a range of ways which includes traditional police methods of matching minutiae, straight pattern matching, moir? fringe patterns and ultrasonics.

To access networks and PCs, enter restricted areas, and to authorize transactions has been used by many people and many times in each and every day. In wide range of vertical markets and within a range of horizontal applications, primarily PC/Network Access, Physical Security/Time and Attendance, and Civil ID this technology has been used. Maximum of the deployments will be only 1:1, but there is also number of "one-to-few" deployments where individuals are matched against modest databases, typically of 10-100 users. A user can be identified from a large finger print database from Large-scale 1:N applications ,which will be classified as AFIS.

IV.APPLICATION:

As per the decades-old Henry system fingerprint comprises various types of ridge patterns like left loop, right loop, arch, whorl, and tented arch. Finger prints contains 66.6% of loops and remaining of whorls and perhaps 5-10% are arches. In many large-scale forensic applications these classifications are used, whereas these are rarely used in biometric authentication. The right loop fingerprint will be like the image below.

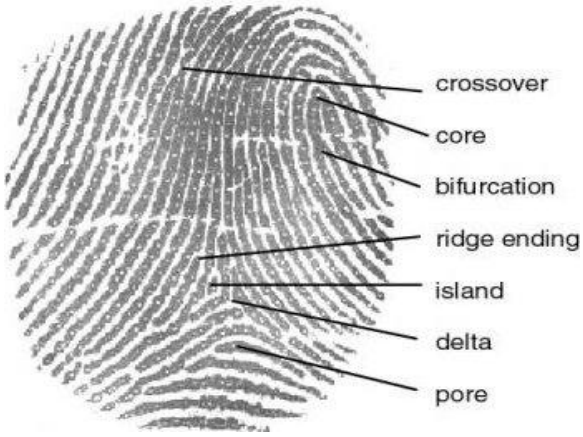

Fig.7: Different types of special characters on fingerprint

Minutiae, the discontinuities that interrupt the smooth flow of ridges, acts as the basis for most fingerprint authentication. Minutiae are at their most basic ridge endings, the points at which a ridge stops, and bifurcations, the point at which one ridge divides into two which is codified in the late 1800's as Galton features. Many types of minutiae exist, including dots (very small ridges), islands (ridges slightly longer than dots, occupying a middle space between two temporarily divergent ridges), ponds or lakes (empty spaces between two temporarily divergent ridges), spurs (a notch protruding from a ridge), bridges (small ridges joining two longer adjacent ridges), and crossovers (two ridges which cross each other).

Other features are essential to fingerprint authentication. The more important is the inner point, normally in the middle of the print, around which swirls, loops, or arches center. It is frequently characterized by a ridge ending and several acutely curved ridges. Deltas are the points, normally at the lower left and right hand of the fingerprint, around which a triangular series of ridges center.

The ridges which appear at steady intervals are also marked by pores. Some initial attempts have been made to use the location and distribution of the pores as a means of authentication, but the resolution required to capture pores consistently is very high.

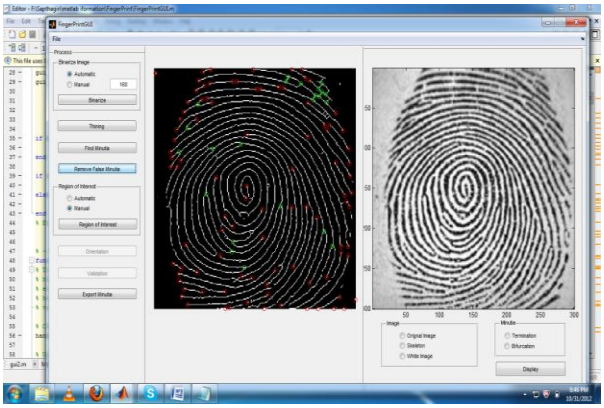

Fig.8:fingerprint enhancement and recognition matched

V.CONCLUSION:

In this project the enhancement of finger print images, and the subsequent extraction of minutiae will be the basic work. Initially, to facilitate the extraction of minutiae a series of techniques for fingerprint image enhancement has been implemented. To provide an equalised evaluation on the performance of the implemented algorithm , a combination of both synthetic test images and real fingerprint images experiments have been conducted. For the performance of more quantitative and accurate measure synthetic images have been used. Since they provide a natural representation of fingerprint imperfections like noise and corrupted

ISSN: 2278 – 7798

elements; though real images rely on qualitative measures of inspection still this can provide a more realistic evaluation. The clarity of the ridge structures while reducing noise has been effectively enhanced by the Gabor filter which resulted with the combination of an accurate estimation of the orientation and ridge frequency. Since estimation of the orientation and ridge frequency parameters are inaccurate the filter is less effective in enhancing the image due to low quality images that exhibit high intensities of noise. As fingerprint matching techniques generally place more emphasis on the well-defined regions, and will disregard an image, it will be severely corrupted since this does not practically pose a significant limitation. Finally it has been resulted that the implemented enhancement algorithm has been a useful step to employ prior to extraction of minutiae. For the extraction of minutiae the Crossing Number method has been implemented. Many experiments have been conducted which verified that this method accurately detects all valid bifurcations and ridge endings from the thinned image. There are also cases to it in exemptions, that the extracted minutiae do not correspond to true minutia points. Therefore to validate the minutiae an image, post processing stage has been implemented. For eliminating various types of false minutiae structures this additional post processing stage has been concluded effective by the experimental results from the minutiae validation algorithm.

On a sample set of fingerprint images, preliminary experiments on the statistics of fingerprints have been conducted with the combination of implemented techniques for image enhancement and minutiae extraction. Minutiae density, distance between neighboring minutiae, and ridge wavelength were the three types of statistical data collected. As a basis for future work the results presented in this dissertation can be used even though full analysis of the statistical data has not been conducted.

Finally, a set of reliable techniques for fingerprint image enhancement and minutiae extraction has been implemented by me. For the further study of the statistics of fingerprints these techniques can be used. Additionally these techniques can also be used in other fingerprinting applications like fingerprint matching and classification.

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ISSN: 2278 – 7798