

Survey of Fingerprint Matching Techniques for Privacy Protection

Sayali Kapre,
(student) *M.Tech 3rd sem,*
G.H.Raisoni college of Engg. And Tech. for women.

Antara Bhattacharya
(Asst. prof)
G.H.Raisoni college of Engg. And Tech. for women.

Abstract- Now-a-days identification of fingerprint is an active area of research. In most areas we are using recognition of fingerprint for improving the privacy and security. The recognition is done by using methods of fingerprint matching. Matching methods can be of two types-verification of fingerprint and identification of fingerprint. Combination of fingerprint for protecting privacy is a system for guarding fingerprint isolation by integrating two distinct fingerprints into new indirect identity. Fingerprints are taken from FVC databases. In the enrolment phase two fingerprints will be taken from two distinct fingers. We will take out the minutiae position from one fingerprint, from other orientation and from both points of references are taken out. From the information taken out an impression of combined minutiae is generated and deposited in the database. In authentication phase system requires two fingerprints from similar two fingers which were used previously during enrolment time. A minutia cylinder code matching algorithm is recommended for matching the two fingerprints query against template of combined minutiae. By keeping combined minutiae template, full attributes of single fingerprint will not be recognized even if the database is grabbed. As there is likeness in topology it is not possible for raider to draw out a template of combined minutiae from actual templates of minutiae. Thus a new virtual identity is generated for disparate two fingerprints.

Key Terms- *identification, recognition, FVC database, minutia cylinder code, combination, fingerprints.*

1. INTRODUCTION-

Fingerprints are greatly used feature of biometric for identification and verification of individual in area of biometric identification. A fingerprint is design of furrows and valleys on surface of fingertip. Each individual has distinctive fingerprints. Local ridge characteristics and relationship helps to determine distinctiveness of fingerprints. The local ridges are not distributed evenly. The two prominent local ridge characteristics called minutiae are ending of ridge and bifurcation [2]. The ending of ridge is given as the point where there is unexpected end of ridge. Divarication of ridge is given as the point where ridge subdivide into branch ridges. A good class fingerprint mostly contains about 40-100 details [2]. Fingerprint recognition means proving a match between two human fingerprints. Among many biometrics, fingerprints are used to pinpoint individuals and validate originality. There are three basic patterns of fingerprint ridges like whorl, loop, arch. Arch-from one side of finger, ridges enter forming an arc in middle and then end other side. Loop-ridges enter from one side, loop is formed and depart on same side. Whorl-ridges circularly form around

median point on finger. An image of fingerprint can have two structures the local structure and global structure. The global structure is such a structure which tells all-inclusive pattern of valleys and furrows. Local structure is the one which tells thorough patterns around minutiae point. Within each fingerprint there are usually two types of singular points known as deltas and cores. The singular points can be used for fingerprint classification, as well as for adjustment and location [1].

Fingerprints are graphical flow like furrows present on fingers of individual. Mixture of ridged does not change all through the life of an individual in case due to misfortune and cutting of fingertips. This quality makes fingerprints very nice looking biometric identifier. Personal identification based on fingerprint has been used for a very long time. Owing to specialness, firmness, longevity and good fingerprints are widely used feature of biometrics. A fingerprint is a mark left by the friction ridges of individual finger. The healing of finger-marks from crime scene is important method of forensic science. Biometric template privacy protection is earning importance with worldwide use of biometric identification and had an increase in privacy issues. Fingerprint recognition system plays a pivotal role where individual needs to be verified or identified with high belief. There are three different levels of features of fingerprint. Level 1-mainly refer to orientation ridge and attribute. Level 2-it denoted ridge and its features derived from it. Level 3-it includes outline and location of ridges [4].

Biometrics is assessable biological attributes used for identification of a person. Fingerprints are ordinary biometric. They provide strong validation and user comfort. Fingerprint biometrics are highly dependable as it cannot be amended, reproduced, stolen. Affirmation is becoming a safety foundation in todays dispersed background of systems. The biometric is a thrilling and rising field of automation which gives solution in application for affirmation recognition, security tracking, displacement, banking transactions, law imposition firm, trade sales. When correlated with other items of biometric, biometrics of fingerprint are usually used and has largest market share. Conventional methods of encoding are not enough for protecting privacy of fingerprint, as pairing of fingerprint decipherment is needed before pairing of fingerprints. Thus maintaining the isolation of fingerprint becomes important. The principal aim of using system of biometric is to give non-repudiable verification [4]. Non-repudiation suggests that person who uses certain services cannot say he was not using it. Verification recommends that only users who are

sanctioned can access analytical or concrete resources which are safeguarded by organizations using biometrics.

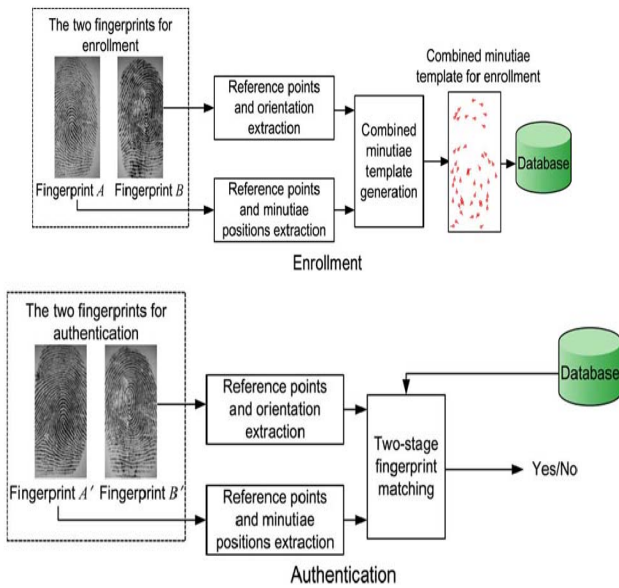


Fig.1. The System with two phases- enrolment and authentication

2. RELATED WORK

In [1], authors suggested a novel algorithm for detecting singular points. There are mostly two kinds of singular points in each fingerprint known as cores and deltas. Singular points are used in various forms like classification, adjustment and location of fingerprints. Singular point analysis and detection is of two types Poincare index and other is ridge analysis, shape, template pairing. Poincare index is used to consider discontinuous location around SP'S. The algorithm is used for calculating sum of changes in orientation to decide the point is singular or not. Addressing of SP'S detection is based on approach called DORIC (differences of orientation of clock values). DORIC is used mainly for SP verification. Using an analysis of delta-core relation, optimal combination of SP'S are selected with help of global constraints. To differentiate true SP'S from false ones classifier called two-step classifier is used in this paper. For each point which has Poincare index as non- zero in candidate set S, its DORIC feature is computed. If there is positive pulse for core and negative pulse for delta then SP is valid and kept in set S. Otherwise it will be placed in another set S'. Disadvantage of this paper is that it is mostly effective for singular points not for others.

In [2], authors presented the extension of a novel algorithm for detecting singular points from fingerprint images, where core and delta points are used. Here SP are identified by symmetry properties. Then SP's are taken out by complex field of orientation. Complex filters are used to detect symmetry and type of symmetry. Mostly fingerprint image has two structures local and global structures. Global means overall pattern of furrows and valleys. Local means detailed pattern. Here, in this paper two different filter are used one for core and one for delta. Filtering is applied to

complex images. A method to extract SP's in fingerprints I by using Poincare index. In this paper, method of complex filters is used than Poincare index to identify SP's as it not only extract position of SP but its orientation also. Filters of first order symmetry or parabolic symmetry are used. If some certainty measures are used for core and delta, it is used to identify whether SP is of core or delta type. In this modified filter response is used to avoid bad quality fingerprints in SP's. disadvantage is that in this paper, filters that detect parabolic symmetry design is used as designs are same to design of core and delta.

The works in [3], proposed that a fingerprint is design of furrows and valleys. In automatic fingerprint pairing an important step is to reliably and automatically take out minutiae from input image of fingerprint. Here, in this paper digital fingerprint image is used which is of three different types, well defined, recoverable corrupted, unrecoverable corrupted region. This paper is used in signal processing to analyze non-stationary signals. Recoverable region is that region which is corrupted by small smudges etc. but they are visible even after this and gives correct valley and ridge structure. Unrecoverable region is that which are corrupted by large noise and so ridges and valleys are not visible and does not give much information about correct furrows and valleys. The enhancement algorithm is used to improve clarity of furrows of fingerprint images in recoverable regions and destroy unrecoverable regions. A fast enhancement algorithm is used which enhance furrow and valley structure using local ridge and local frequency information. Here fingerprint enhancement algorithm has following steps- normalization, orientation estimation, frequency estimation, masking, filtering. This paper does not work on unrecoverable regions. This paper has certain disadvantages like-This paper does not work on non-recoverable region. Here user has to calculate both recoverable and non-recoverable regions. And user has to manually see where ridges have ended incompletely and decides whether it is possible to re-correct that part of fingerprint.

The authors Y.Wang and J.Hu in [4], suggested that, paper focuses on identifying incomplete or partial fingerprints from huge fingerprint database. Partial fingerprints focus on one to one pairing with help of local furrows. The problem of retrieving candidate list is investigated for pairing of partial fingerprints by topological features. In this paper, problem of partial fingerprint is addressed by supplementing partial fingerprint first. The estimation of global ridge topology is formulated as solving an inverse problem. We know that exact details of ridge can never be recovered in missing parts. So constructing same pattern as original fingerprint is searched in fingerprint database. Effective candidate list reduction is hard job for identification of partial fingerprints. So the global ridge orientation reconstruction for identification of partial fingerprints is developed. In this, reconstruction problem is described as an inverse model. This approach has reduced size of candidate list for pairing and has improved efficiency of retrieving partial fingerprint identification.

The authors Sheng Li , Alex Kot, in [5], proposed a novel system for protecting privacy of fingerprint by combining

two different fingerprints into a new identity. There are two phases like enrollment and authentication. At time of enrollment phase, the two fingers from two different fingers are captured by system. To create combined minutiae template from two fingerprints a combined minutiae template generation algorithm is proposed. From one fingerprint, minutiae positions are taken, from other fingerprint minutiae directions are taken and from both point of reference are taken out. For authentication, template will be stored in a database that needs two query fingerprints. For matching two query fingerprints against template of combined minutiae a two stage fingerprint matching process is used. The complete minutiae feature of single fingerprint will not be compromised even database is looted by using combined minutiae template. As there is combined minutiae template of similar topology to original templates it can be converted in real look alike fingerprint by using reconstruction approach. A new virtual identity is issued for two different fingerprint matching. The authentication will be successful if matching score is over predefined threshold.

Combined minutiae template generation is developed by minutiae position alignment and direction assignment. In position alignment there are two primary reference points for the two fingerprints. By rotating each detailed point proper alignment is done. Two stage fingerprint matching includes query minutiae determination and matching score calculation. Query minutiae determination is very important step during matching fingerprint. To find out matching score, minutiae matching algorithm is used.

3. FINGERPRINT MATCHING TECHNIQUES

[A] DORIC AND POINCARÉ INDEX METHOD-

Various fingerprint matching techniques have been used till now. An algorithm is suggested for detection of singular points. Poincaré index is used to consider discontinuous orientation distribution. This helps to see whether point is singular or not. The other approach uses ridge analysis, shape analysis, or template matching. The addressing of singular point detection is done using DORIC, feature for verification of SP, it can easily remove spurious detection. Thus using singular point detection matching is possible only when cores and deltas are used [1]. SP's are identified by symmetry properties. For extracting SP's Poincaré index is used. But now complex filters are used as it not only extract position but also orientation of SP. Parabolic symmetry is used. These methods are mostly used in fully automatic verification of fingerprint [2]. Only filters that detect parabolic symmetry are used as they are same as delta and core. Thus, this symmetry representation can be used to match and align fingerprints.

[B] FAST ENHANCEMENT ALGORITHM-

IT is able to enhance ridge and valley structure using ridge orientation and frequency information. In this algorithm image is made better and then it is enhanced. But it is mostly used in signal processing. Goal of enhancement

algorithm is to improve clarity of ridge structure in recoverable regions and remove out unrecoverable regions. The algorithm identifies unrecoverable corrupted regions and removes it. It tells that the enhancement algorithm must be integrated into online verification system [3].

[C] TWO STAGE FINGERPRINT MATCHING-

This process is suggested for matching two fingerprints against a stored template. The algorithm also includes query minutiae determination and matching score calculations. Query minutiae determination is very important step during matching of fingerprint. In this local and global features of fingerprints are used. Matching score is calculated using minutiae matching algorithm for authentication. But the algorithm is not global algorithm. It has border problems, noise problems, not reliable [5].

[D] MINUTIA CYLINDER CODE ALGORITHM-

So, a new algorithm is developed called MCC (minutia cylinder code) algorithm. The algorithm is globally used. It is designed as matching needs more accuracy. The algorithm is having a fixed radius approach, it is error tolerant, deals with noisy fingerprint regions, and because of bit oriented coding matching becomes simple, fast.

4. CONCLUSION

This paper presents the survey of various methods for fingerprint matching techniques of privacy protection. As in the previous methods there were many drawbacks. So to overcome the drawbacks of previous methods, we proposed a new algorithm minutia cylinder code (MCC), for matching the run time minutiae with the database stored in enrolment phase. As in previous methods or algorithms, there were certain problems like border, noise problems, not fully reliable, not accurate. So the new algorithm MCC will overcome these problems.

MCC has certain advantages like fixed radius approach, problems of border are managed properly, it deal with noisy regions of fingerprints. So, introducing the new algorithm MCC gives more reliability, correctness, robustness.

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