A Study of Optimistic Approaches and Applications of Biometric Systems

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Abstract— **In this new era of information technology, authentication and security is a major issue of concern nowadays. Several methods are used for maintaining the privacy of the human. Many physical and behavioral measures are used for better recognition of people. Despite there is a major progress in field of biometrics, but dealing with noisy and modular input is a matter of severe concern. A fingerprint is emerging as a better method for authentication purposes. In this paper an overview of fingerprints, process flow, applications and several issues are prospected.**

Index Terms— **Authentication, Security, Biometrics, Fingerprint.**

I. INTRODUCTION

Several distinct patterns like ridges, valleys and bifurcation of ridges forms different fingerprints patterns. These patterns may vary from person to person of different age group. No two people can have same fingerprints. Even two biological twins cannot have same patterns of fingerprints. Therefore, fingerprint recognition system plays a vital role in human recognition for providing confidentiality, authenticity and increasing the security of a system.

Recent developments in fingerprints have made use of several methods and algorithms for the development of better security system. The fingerprint verification system is presented in M. Kawagoe [7] is based on a novel robust secure fingerprint matching technique, which is secure against side channel attacks. Since hundreds of years, fingerprints are very much helpful in law enforcement agencies to find out the criminals.

Injuries like cuts, burns and bruises can temporarily spoil quality of fingerprints but when/if fully healed patterns will be restored in most cases. This property makes fingerprints a very strikingly attractive biometric identifier [1].fingerprint classification has been done only mainly two approaches.

The approaches are mostly based on two main features in a fingerprint:
1) Global ridge and furrow structures that form special patterns in the central region of the fingerprint.

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2) Local ridge and furrow minute details.

Usually, a fingerprint is classified based on the first type of features and is uniquely identified based on the second type of features (ridge endings and bifurcations, also know a as minutiae) [2].

Today there are over 10,000 computer rooms, vaults, research labs, day care centers, blood banks, ATMs and military installations to which access is controlled using devices that scan an individual's unique physiological or behavioral characteristics [3].

However coupled with the upcoming developments in the field of biometrics, Fingerprints methods also have undergone several changes in recent years to help in intact with the improvement of performance of the system for increasing the security of systems.

Several rates that need to be calculated while dealing with fingerprint performance which can be described as follows:
a) False Accept Rate (FAR): it mainly describes the rate at which a given system falsely matches with the images in database. Though the person is not an authenticated user. The FAR can be calculated using :

FAR = No. of persons accepted from out of database /Total no. of persons in database

b) False Rejection Rate (FRR): it provides the rate at which system fails to recognize the actual pattern and cannot be able to match with the images present in the databases. It is the ratio of number of correct persons rejected in the database to the total number of persons in database and can be calculated using :

FRR = No. of true persons rejected / Total no. of persons in database

c) Equal Error Rate (EER): It is the value where there is an equal rate of accepts and reject. Hence, we can conclude that smaller is the value of EER more will be the performance and efficiency of system. The EER can be calculated as follows:

False acceptance rate=false rejection rate

d) Success rate: The rate at which any system can successfully identify the real user in limited time by matching with already existing stored database. More is the success rate; greater is the performance of any system.

Fingerprints recognition system offers high security as level-3 features like pores are used which is not available previously. In earlier days patterns used are available in lower resolution hence degrade the quality of image. While developing recognition system there are several parameters which need to be taken into account such as cost, performance, easy to use, non-intrusive in nature.

Several factors that need to be considered while detecting fingerprints are as follows:

• Live fingers shows some kind of moisture patterns due to perspiration. While spoofed fingers are dry.

• In case of live fingers we can detect a pulsation that can describe that the fingertip is lively.

• Temperature sensing can only be done by a lively finger.

• Fingerprints recognition does not require too much computation for matching or feature extraction. Both live and spoofed fingers can be detected using several recognition methods available.

• Spoofed finger undergoes quality degradation which require spatial enhancement to identify the patterns. As poor quality of image may results missing of features.

• Both live and spoofed fingers are vulnerable to dirt, burns, distortion that may lead to quality degradation of image that needs to be recognized.

II. ISSUES IN FINGERPRINTS

Several issues in current fingerprint recognition systems:

1. There are several factors which need to be monitored like ease of use, ease of access and continually improving the performance of the system. Dealing with the cost and performance of sensors is main challenge now days.

2. Dealing with the spoof fingers is a major matter to be dealt with because in that scenario we are not able to perform better minutiae recognition.

3. Recognition performance is a difficult task and highly complicated to be achieved. The finger is a small area through which features need to be extracted however, the fingerprint patterns may get damaged due to wear and tear, cut, burn or dirt.

4. Level-1 and level -2 features like ridges and cores sometimes does not give required results as they do not give better evaluation of minor and finer details of fingerprints.

5. Indexing and storage of generated templates in database is a concerning issue to be dealt with. However large amount of stored templates is to be matched with the input is a complicated task.

6. Several sensors are used to perform better scanning of fingerprints .Additional hardware device led to increase in the cost and complexity of system. In that scenario sensing the temperature and using better method and algorithm is a

key concern and lots of work still needs to be done in this field.

There are several patterns which are used in fingerprints which can be given as follows:-

1. Local binary patterns: It is a type of patterns that are used in fingerprints systems which are based on binarization of image by calculating the distance between center pixel and adjacent pixel value. LBP features are distributed into several regions or vector that act as a fingerprint descriptor. Local binary patterns are widely used nowadays. However it does not dealt well with irregular images and large scale structures.

2. Local directional patterns: It is a type of patterns which are used for dealing with the local features of any image for better fingerprints descriptor. Encoding in LDP patterns is done by calculating the edge response. With the encode data LDP patterns histograms are generated which act as a better descriptor for the image. Accuracy of LDP patterns shows their superiority and outperforms in recognition process. Local directional patterns better deal with large scale image and non-regular images.

Fingerprints is not a new technique it has been used by enforcement of laws since many years however they are working with biological traits and examine the tissues and cells of human .As DNA never undergoes changes. In practice also no two people with same fingerprints or same DNA was found even not in case of twins.
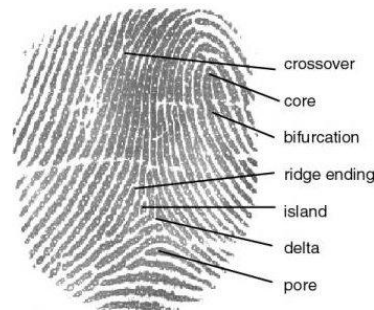

Fig 1: Showing Several Features of Fingerprints [1].

III. APPROACHES USED IN FINGERPRINTS

1. RECOGNITION BASED ON MINUTIAE APPROACH: Fingerprints are the special patterns that are present on fingertip of each human. A common hypothesis is that certain features of the fingerprint ridges, called minutiae, are able to capture the invariant and discriminatory information present in the fingerprint image [2].minutiae based approach mainly deals with the ridges their endings, ridge bifurcations to describe the actual patterns of different people. However this approach does not work well for large and irregular images.

2. RECOGNITION APPROACH BASED ON THE PATTERNS:
Patterns are mainly a family of same properties that belong to same class based on the structure and quality of image. The

structural features mainly include the area captured by image, size of image, length of patterns etc. The relation between these features mainly describes the qualitative analysis of image that is helpful to the descriptor.

3. RECOGNITION APPROACH BASED ON WAVELETS:
This approach mainly uses several transformations on input image and performs composition of image in spatial domain. Several classifiers like support vector machine, neural networks etc can be used for pattern classification. The drawback of using this approach is that it does not perform well for multiscale images and hence it is not a better approach while dealing with large amount of database.

Steps that are performed by fingerprint recognition system:
1. Firstly an input image is provided by the human to the system which needs to be matched with the data present in the database.
2. Enhancement of image is done to improve the quality of image. Several techniques that are used for enhancement are segmentation; transformation of image etc. enhancement allows better retrieval of patterns with better resolution.
3. Preprocessing of image need to be done to remove noise by using several filters like Laplacian, Gabor Filter etc. Preprocessing is helpful in removing the noise and spurious data.
4. Detecting and aligning the several features presents on the fingertip and representation in form of patterns. This also supports extraction and finding out the useful patterns.
5. Local and several global features are used for template generation. Template can be in any format .these template allows better representation of image and act as a useful descriptor of an image.
6. In this step generated template is matched with the image stored in the database to identify whether they are valid user or not. The output can be shown on application device.
7. In final step, classification of fingerprints can be done by using any technique such as support vector machine and neural networks. Training of data led to better verification of fingerprints.
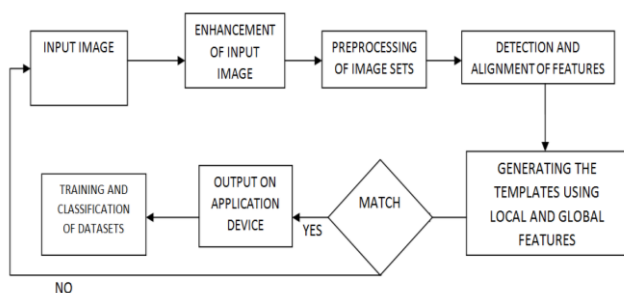

Fig 2: Process flow diagram of fingerprints system.

Researchers have proposed algorithms for level-3 feature based fingerprint verification .these algorithms extract level-3 features and fusion with level-2 information is performed hierarchically or at match score level [4]. Fingerprints are important biometrics system that depends on the physical characteristics presents on the fingertip of human. As we know fingerprints are present since the birth of human and can never be changed. The computational

efficiency of system decides the accuracy of any system. Several algorithms and techniques are available that are used by several application to get useful results. Fingerprints have an ability to convince the user because of their uniqueness, convenience and consistency over time. Lack of robustness of system due to quality degradation of any image is a major challenge nowadays. Another recent issue in fingerprint recognition is achieving the desired EER (equal error rate) which is a very difficult task. Use of multiple sensors for getting the desired image increase the complexity and cost of system that led to increase in overheads

IV. APPLICATIONS OF FINGERPRINT SYSTEMS

1. CYBER AUTHENTICATION:
In cyber world, fingerprint help in authentication of user that led to preserving the security of any system. In today era of technology authenticity and security is the major concern. Hence fingerprints are a major key for developing an efficient system.

2. DETECTING LIVELINESS OF HUMAN:
The major challenging issue nowadays is to find out that whether any fingerprints belongs to a live person or spoofed one. In that scenario fingerprints system plays a vital role in detecting the fingerprints which in turns provide security and efficiency to the system.

3. LAW ENFORCEMENT AGENCIES:
Fingerprint method is also used by several law related agencies to identify the culprits in any crime cases. Fingerprints in this field are useful from several years and act as an efficient method.

4. IN ORGANIZATIONS AND CORPORATE:
This method is widely used nowadays in several organizations at entry level to identify the real person who has legally the permission to enter in any particular firm.

5. IN RETAIL AND GROCERY SHOPS:
Fingerprints are scanned in several shops at entry level in order to identify the real customer which is helpful for the owner. The scanning of fingerprints of human is done at entry level to identify the actual customer.

6. BANKING APPLICATION:
Fingerprints are helpful in ATM's services also for authentication of user. Security is a challenging goal that needs to be achieved in that case.

7. REGISTRATION OF REAL VOTERS
Registration of real voters is an important issue .validating and verification of user to identify that they belongs to a particular country .fingerprints verification system allows identification of valid users.

8. IN COLLEGES AND SCHOOLS:
Fingerprints have become an efficient technique for attendance purpose of faculty members. The absence and presence of staff members can be find out using these systems. On the other hand, it is also helpful in identifying the actual member of any organization.

V. CONCLUSION

In this paper, we are able to understand the application of fingerprints in several fields and to find out that this method has better and greater future scope. Fingerprints are able to meet the security requirements and validating the real users. Several features of fingertips are also studied like ridges, core, deltas and bifurcations. However several researchers and scientists are engaged in work all over the world to make it a better approach and increasing its applications in future. Also, an overview of the fingerprints is discussed. Several factors are discussed that need to be considered along with the issue that came while dealing with fingerprints. An overall description of process flow of fingerprint system is made to describe working of entire system. We can conclude that fingerprints are a useful technique in several scenarios and can be easily used as per the requirement of user. Fingerprints can be foreseen as an important biometric system. In Future work, we will try to outperform existing methods and techniques to increase the efficiency of present system.

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