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Comparing the Efficiency of Minutia Based and Improved Fingercode Fingerprint Algorithm

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***Abstract*- A biometric authentication system operates by acquiring bio-metric data from a user and comparing it against the template data stored in a database in order to determine the identity of an individual. Among all the biometric techniques fingerprint-based identification is the oldest method and is the most popular approach having successfully used in numerous applications. Everyone is known to have unique, immutable fingerprints. The uniqueness of a fingerprint can be determined by the pattern of ridges, by minutiae points and as well as by reference points. In this research study two most widely used algorithms namely improved fingercode for filterbank based fingerprint matching algorithm and minutia based algorithm are discussed for identification of fingerprints and their performance was evaluated in terms of execution time taken by each algorithm for identification, storage and matching. The experimental results obtained from the study shows that the improved fingercode for filterbank based fingerprint matching algorithm has in general a better performance than minutia based matching algorithm in terms of above mentioned parameters.**

***Keywords*-Biometric, fingerprint identification, feature extraction, minutiae points, reference point, improved fingercode for filterbank based fingerprint matching algorithm, minutia based matching algorithm.**

I. INTRODUCTION

A. Biometric Recognition

The human body has some traits which differentiates one human being from another. These traits establish the individual identity of a person. Biometrics-based authentication systems are good alternatives to the traditional methods [1]. User authentication systems which are based on knowledge such as password or physical tokens such as identity card are not much reliable as compared to biometric based authentication systems because the user may forget the password or lose the identity card. The biometric-based systems are more reliable as biometric data cannot be lost, forgotten, or hacked and are more user-friendly because the users don't need to remember or carry anything [2]. Fingerprints have long been used for personal identification. It is assumed that every person possess unique fingerprints and hence the fingerprint matching is considered one of the most reliable techniques of people identification. A fingerprint image exhibits a pattern of ridges and valleys. Fingerprints are permanent physiological features of human beings [3].

B. Fingerprint Recognition

In the early days, the technique of personal identification was manual and it involved an individual to judge the identity of an individual. The work was tedious, expensive and time consuming. But in today's modern computing era there is a need for an automated system which eliminates the manual work because it is not feasible to operate the identification system manually for millions of users. Therefore, automatic fingerprint authentication has become a popular research area over the last few decades [4]. The most prominent local ridge structures are ridge endings and bifurcations. Ridge endings refer to the termination of ridge lines and ridge bifurcations are the fork-like structures means single ridge splits into two ridges called as minutiae points in fingerprints [5]. Since the locations and directions of minutiae are unique for every finger for all persons, they form the base of fingerprint matching [6]. The process that extracts these discriminative features from a fingerprint image and represents them in quantitative forms is called fingerprint recognition [7].

C. *Fingerprint Matching Algorithms*

The fingerprint matching algorithms can be broadly classified into two categories: minutiae-based and filterbank-based. The minutiae-based matching algorithms first extract the local minutiae such as ridge endings and ridge bifurcations from the thinning image [8] or the grayscale image [9] and then match their relative placement in a given fingerprint with the stored pattern.

Although the minutiae-based matching is widely used in fingerprint verification, it has the problem of efficiently matching two fingerprint images containing different number of unregistered minutiae points. Further, it does not utilize a significant portion of the discriminatory information available in the fingerprints. The filterbank-based matching algorithm [10] uses a bank of Gabor filters to capture both local and global information in a fingerprint as a compact fixed-length FingerCode, which is suitable for matching and storage. The filterbank matching is based on the Euclidean distance between two corresponding FingerCodes. Thus, it overcomes some of the problems of the minutiae-based matching algorithm.

The original feature extraction algorithm assumes that the fingerprints are captured in a vertical position. While the reference point location method works well for vertically oriented fingerprints, it fails to locate the reference point after the original fingerprint is rotated. A filter bank-based fingerprint matching algorithm was proposed which is also known as improved fingercode for filterbank-based fingerprint matching in which a new rotation-invariant reference point location method is used to overcome this problem [11].

II. EXPERIMENTAL RESULTS

To test the performance of improved fingercode for filterbank based fingerprint matching algorithm and minutia based algorithm the researcher implemented both the algorithms in Matlab. To conduct the research study the fingerprint database is collected from http://bias.csr.unibo.it/fvc2004/downloads/DB1_B.zip. The

fingerprint database comprised of 80 fingerprints. Then the implemented algorithms were applied on the downloaded data.

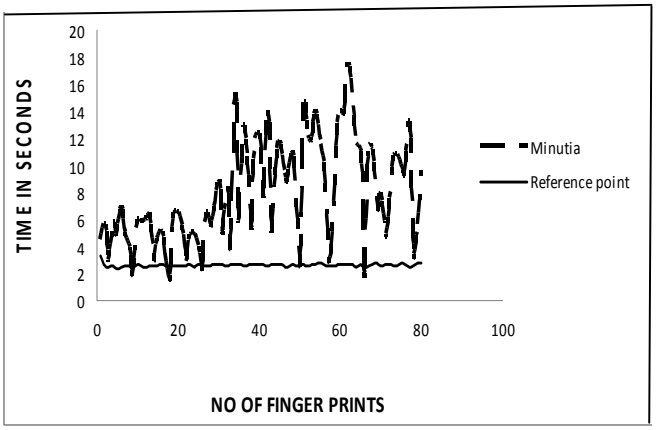

Fig.1 Time taken to identify minutia point and reference point

The criteria used to test the performance of improved fingercode for filterbank based algorithm and minutia based algorithm were namely identification time, storage time and matching time. The performance criteria's were evaluated on the same database and performance was observed independently for both the algorithms.

Fig. 1 illustrates the time taken to identify minutia point and the reference point. From the graph it is observed that Improved fingercode based algorithm takes less time to identify reference point as compared to the minutia based algorithm which identifies the minutia points.

It is observed from Figure 2 that time taken to store the fingerprints in database increases as the size of the database increases in case of both minutia based algorithm and improved fingercode for filterbank based algorithm however the time taken by the improved fingerprint algorithm is less as compared to the minutia based algorithm.

Figure 3 highlights that the time taken to match the fingerprint in the database by the improved fingercode based algorithm is much less than the minutia based algorithm.

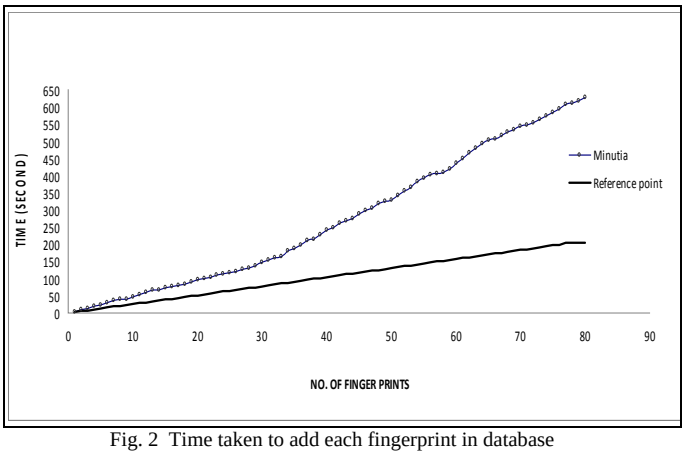

Fig. 2 Time taken to add each fingerprint in database

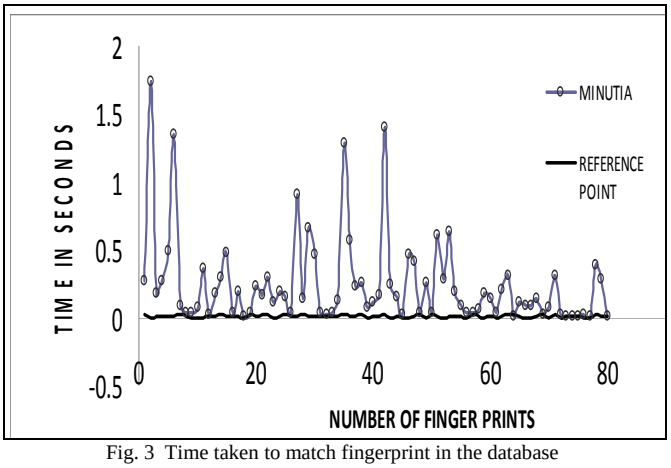

Fig. 3 Time taken to match fingerprint in the database

III. CONCLUSION

In this research study the performance of two fingerprint matching algorithms was compared. The performance of the algorithms was evaluated in terms of their identification, storage and matching efficiency. The experimental results obtained from the study shows that the improved fingercode for filterbank based fingerprint matching algorithm has in general a better performance than minutia based matching algorithm in terms of the above mentioned parameters.

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