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Touchless Fingerprint Recognition System

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Abstract:- *Fingerprint Recognition system are the most widely used biometric identification. Touchless Fingerprint Recognition system is a new option for the old conventional touch-based fingerprint recognition system in the way that it uses a digital camera to acquire the fingerprint image. This is comfortable, inexpensive and now fast enough for practical use. This paper helps to find a new ideal solution to the problem in view of maintenance, hygiene and latent fingerprints. In this paper a touchless fingerprint recognition system based on a novel fingerprint minutiae matching algorithm is presented. The system consists of mainly three stages- pre-processing, feature extraction and matching stage. The extraction and matching performances are totally dependent on the quality of fingerprint images. Better quality images lead to better extraction and matching performances*

Keywords:- *Touchless fingerprint image; Fingerprint pre-processing; Ridge filtering; Minutiae Extraction; False Matching Rate; False Non-matching Rate.*

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I. INTRODUCTION

Biometrics are biological traits which are unique for each and every individual and also it does not change with time. To confirm the identity of a human, various biometrics like voice, face, fingerprint, iris, the retinal pattern of eyes has been used. Among all these features, fingerprints is one such biometrics which have been used for over a century. Fingerprint is the ridges and furrow patterns found in the upper skin layer of fingers.

In today's world where the spread of coronavirus is increasing rapidly, hygiene has become an important factor. But in touch based fingerprint recognition, there is contact between the skin of the finger & the surface of the plate which capture the image. So in order to avoid this touch so as to maintain cleanliness and also to avoid the distortion caused due to contact, the idea of touch- less fingerprint recognition system has been proposed.

Digital camera is used for capturing the fingerprint image. A fingerprint is formed from an impression of the pattern of ridges on a finger. A ridge is defined as a single curved segment, and a valley is the region between two adjacent ridges. The minutiae, which are the local discontinuities in the ridge flow pattern, provide the features that are used for identification. Details such as the type, orientation, and location of minutiae are taken into account when performing minutiae extraction. From the various types of minutiae, there are two most significant minutiae features. One is called ridge ending where the ridge curve terminates and other is bifurcation where a ridge splits from a single path to two paths [4].

After extraction of features, the final step is Matching. Database is created where biometric features from a set of individuals are stored. An input image is taken from the camera and features are extracted from the input image. These features are then compared with all the fingerprints stored in the database. It gives out the matching score for each comparison. The one with matching score greater than threshold is considered as the 'matched fingerprint'.

II. LITERATURE SURVEY

1. Prof A.C.Suryawanshi, "Touchless Fingerprint Recognition System", In this paper pre-processing algorithm is used for enhancement. Touch-less system is mainly divided into four major parts. They are data acquisition, pre-processing, extraction of features and matching. In feature extraction, minutiae from fingerprint images are extracted and in the matching process the number of minutiae pairings between two fingerprints is matched. Here they used MATLAB software to implement this project.

2. L. Hong, Y. Wang, and A. K. Jain, "Fingerprint Image Enhancement: Algorithm and Performance Evaluation", In fingerprint recognition system in order to extract minutiae features it is essential to improve the performance of image enhancement algorithm. So, in this paper fingerprint enhancement algorithm which improves the clarity of ridge and valley structures based on the local ridge orientation and ridge frequency estimated from the input image is discussed.

3. Joshua Abraham, Paul Kwan and Junbin Gao, "Fingerprint Matching using A Hybrid Shape and Orientation Descriptor", In this paper fingerprint feature extraction, minutiae representation, and registration, which are important components of fingerprint matching algorithms has been discussed. A novel hybrid shape and orientationdescriptor to achieve above features is introduced.

4. A.Garge, Z.Saquib and S.Karamchandani, "Performance comparison of orientation sensitive filters for low quality fingerprints", The efficiency of any fingerprint algorithm depends upon the input image quality. There is need of some fingerprint enhancement algorithms to reconstruct low quality fingerprint images. In this paper a comparative analysis of orientation sensitive filtering mechanism is proposed.

5. A.A.Paulino, J.Feng and A.K.Jain, "Latent Fingerprint Matching Using Descriptor-Based Hough Transform", Latent are usually partial fingerprints with small area, contain nonlinear distortion, and are usually smudgy and blurred. Due to these characteristics, they have a relatively smaller number of minutiae points. which have the greatest impact on efficiency of matching. To solve all these problems they an approach is proposed which is divided into three parts. (1) align two sets of minutiae by using a descriptor-based Hough Transform; (2) establish the correspondences between minutiae; and (3) compute a similarity score.

III. DATASET

Our dataset consists of 120 images of 24 different subject, which counts to 5 images per person.

Figure 1: *Example of High-Resolution images*

Dataset is augmented using data augmentationtechniques like left and right hand finger images toincrease the dataset size. 200 images is obtained which are split as 120/80 as training/testing as adataset. The image size is set to 640x480 pixels.

IV. PROPOSED SYSTEM

This project is notable for its security applications and in many other fields. The proposed system refers to the automated method of identifying or confirming the identity of an individual based on the comparison of an image with the stored database.

A fingerprint is the mirror image of a finger which consists of an impression of the furrows and friction ridges. The fundamental steps for the contactless fingerprint recognition system are shown in the form of blocks in figure below. The proposed system for fingerprints consists of units such as: pre-processing, features extraction and matching.

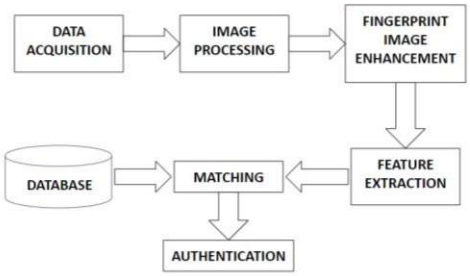


Figure 2: *Block Diagram of the Proposed System*

V. METHODOLOGY ADOPTED

A. Pre-processing:-

The Pre-processing steps includes Sharpening, Conversion to grayscale, Segmentation, Normalisation, Ridge Orientation estimation, Ridge frequency estimation and Filtration.

The image is taken from the camera as an input image. This input image is first sharpened. Sharpening of images highlights the edges and fine details in an image. It subtracts a blurred copy from the input image to detect any edges. A mask is made with this edge detail. Contrast is then increased at the edges and the effect is applied to the input image. RGB image consists of lots of information which makes processing complicated. In order to reduce complexity, less information should be provided per pixel. So RGB image is converted into grey scale image. A grayscale image is one in which the onlycolours are shades of grey.

Next is Segmentation. Separation of foreground regions in the image from the background regions is known as Segmentation. The foreground region is the area of interest consisting of ridges and valleys. The region outside the border of the fingerprint area is called background region. It does not contain any valid information. So when minutiae extraction algorithms are applied to the background regions of an image, it results in the extraction of noisy and false minutiae. Thus, segmentation is employed to discard these background regions, which facilitates the reliable extraction of minutiae [4]. The segmented image is then normalised so as to bring the grey level values into a certain range that is good enough for improved image contrastand brightness.

Then ridge orientation estimation is done. This is based on the characteristic of pixel intensity in a block. Ridge orientation estimation provides ridge angular information and ridge frequency estimation provides average distance between the ridges in fingerprint images [8]. At the end, Thinning is carried out as it is essential for feature extraction.

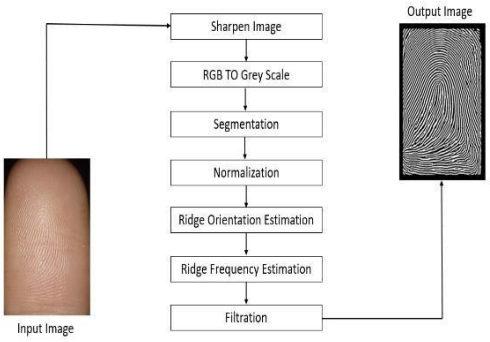
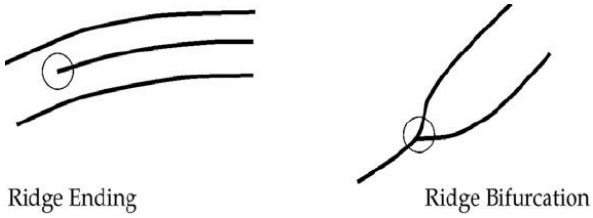


Figure 3: Enhancement process

B. Feature Extraction:-

This paper is focused on few minutiae features i.e. termination, bifurcation and core point for feature detection. Minutiae are the major features of a fingerprint image and are used to determine the uniqueness of fingerprint. All this features extractionrequire a thinned image.



Ridge termination-A ridge termination is defined as the point where a ridge ends abruptly [12].
Ridge bifurcation-A ridge bifurcation is defined as the point where a ridge forks or diverges into branch ridges [12].
Core point- The core point is used to align between the fingerprints in the fingerprint authentication systems faster than the conventional techniques. The core point is refer to as the centre of the fingerprint area. A fingerprint may have multiple cores or no cores.

The core point may be one of several types of patternsincluding the following:

- Whorl pattern: In this the core point is foundin the middle of the spiral [1].
- Loop pattern: In this core point is in the topregion of the innermost loop [1].

C. Matching:-

A fingerprint matching algorithm compares two given fingerprints and returns a degree of similarity (without loss of generality, a score between 0 and 1). The fingerprint feature extraction and matching algorithms are usually quite similar for both fingerprint verification and identification problems. This is because the fingerprint identification problem (i.e., searching for an input fingerprint in a database of *N* fingerprints) can be implemented as a sequential execution of *N* one-to-one comparisons (verifications) between pairs of fingerprints. The most widely used recognition technique, minutiae- based matching, relies on the minutiae points: specificallythe location and direction of each point [5][11].

False Matching Ratio (FMR): When a fingerprint matches with the different fingerprint individual than it is called as false matching ratio. It is given in an equation

$$FMR = \frac{FalseMatches}{\mathrm{Im}\ posterAttempts}$$

The attempts are implemented by matching each input image with all the template images. The False match was recorded for each imposter attempt when the matching score was greater than the established threshold [5][11].

False Non Matching Ratio (FNMR): When a fingerprint does not completely matches with the different fingerprint of individual than it is called as False Non matching ratio. Or FNMR can be define as the probability that the system denies access to an approved user is givenin an equation

$$FNMR = \frac{FalseNonMatches}{EnrolleAttempts}$$

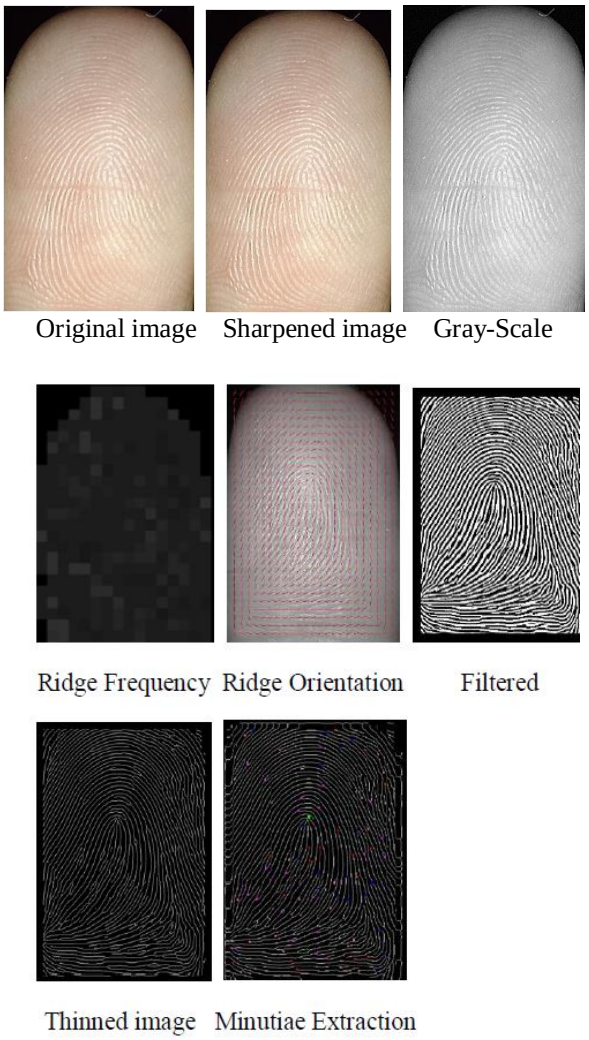
Enrollee attempts are implemented by matching each input image with corresponding template image, it is one-tone matching. When the matching score between an enrollee and its template was less than the established threshold's False Non-match was recorded [5] [11].

Matching Score: It is used to calculate the matching score between the input and template data is given in an equation-

$$Matchingscore = \frac{MatchingMinutiae}{Max(NT, NI)}$$

Where, NT and NI represent the total number of minutiae in the template and input matrices respectively. According to this, the matching score takes on a value between 0 and 1. And the Matching score of 1 and 0 indicates that data matches perfectly and data is completely mismatched respectively [5][11].

VI. RESULTS



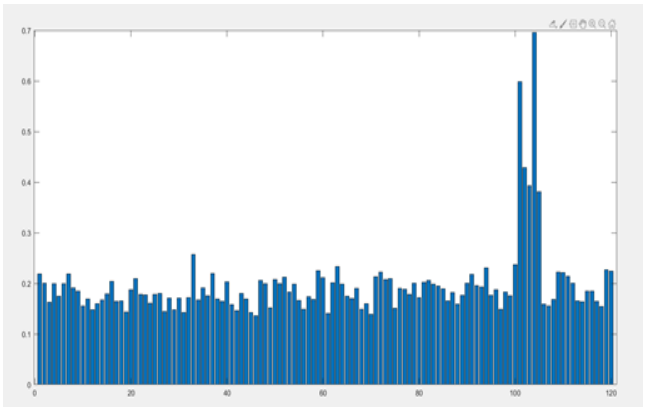


Figure 4: Similarity measure of a test fingerprint image with fingerprint templates in the database.

The above graph fig.(4) indicates that the image which matches with the database image show higher matching score. The matching score is decided by threshold value (S>0.65). If the score is above the threshold then it is termed as a matched finger.

VII. CONCLUSION

In this project, various algorithms is used to implement Touchless fingerprint system. The primary focus of the work is to focus on maximum score of matching and the subsequent extraction of various features such as minutiae, core point. This project has followed the approach adopted by most previous work where the

emphasis is on enhancing the input image. The purpose behind using fingerprint enhancement algorithm was to get maximum minutiae features. Also false minutiae points has been extracted in order to get maximum matching efficiency. Touchless Fingerprint Recognition System has been successfully implemented by using a set of reliable techniques.

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