**TOUCHLESS FINGERPRINT RECOGNITION**

Jainam Shah*, Ujash Poshiya

Vishwakarma Government Engineering College, Chandkheda Gujarat, India

**ARTICLE INFO**

**Corresponding Author:**
Jainam Shah
Vishwakarma Government Engineering College, Chandkheda Gujarat, India.

**Keywords:** Fingerprint, Ridges, Furrows, Minutia, Feature Extraction, Graphical User Interface, image segmentation, thining.

**ABSTRACT**

Touch-less fingerprint recognition system is a reliable alternative to conventional touch-based fingerprint recognition system. Touch-less system is different from conventional system in the sense that they make use of digital camera to acquire the fingerprint image where as conventional system uses live-acquisition techniques. The conventional fingerprint systems are simple but they suffer from various problems such as hygienic, maintenance and latent fingerprints. In this project we present a review of touch-less fingerprint recognition systems that use digital camera. We present some challenging problems that occur while developing the touch-less system. These problems are low contrast between the ridge and the valley pattern on fingerprint image, non-uniform lighting, motion blurriness and defocus, due to less depth of field of digital camera. The touch-less fingerprint recognition system can be divided into three main modules: preprocessing, feature extraction and matching. Preprocessing is an important step prior to fingerprint feature extraction and matching. In this paper we put our more emphasis on preprocessing so that the drawbacks stated earlier can be removed. Further preprocessing is divided into four parts: first is normalization, second is fingerprint Segmentation, third is fingerprint enhancement and last is the minutia extraction and matching.

**INTRODUCTION**

The touch-less fingerprint technology requires no contact between the skin of the finger and the sensing area. Touch-less fingerprint acquisition is a remote sensing technology to capture the ridge-valley pattern which provides essential information for recognition. Because of the lack of contact between the finger and any rigid surface, the skin does not deform during the capture and the repeatability of the measure is quite ensured. Digital camera is used to present a touch-less fingerprint recognition system. Fingerprint images that are acquired using digital camera consist of certain constraints such as low contrast between the ridges and the valleys, defocus and motion blurriness.

**OVERVIEW OF SYSTEM**

A. Disadvantages of touch based sensors

In order to acquire fingerprint images with conventional touch-based sensors, the user must place his finger on the flat window of the sensor. Because the skin of the finger is not flat, the user must apply enough pressure on the window to obtain sufficient size and achieve good image quality. However, this pressure produces unavoidable physical distortion in arbitrary directions, which is represented differently throughout every area of the same fingerprint image.

Fig.1. Distorted images from a touch-based sensor. (a) and (c) are gray-value images, (b) and (c) are corresponding minutiae extracted images, and (e) and (f) show the effects of different strengths of impression.

*Fig. 1 shows the images from touch-based sensor. Because of different pressure, the relative position and types of corresponding minutiae are different (Fig. 1(a)-(d)). Also, the sizes of the fingerprint areas and the quality of the fingerprint images are quite different (Fig. 1(e),(f)). These problems critically affect fingerprint recognition. There are also latent fingerprint problems. A latent fingerprint refers to the trail of the fingerprint on the window of the sensor. This can lead to hygienic problems as well as fraudulent use, such as the faking of fingerprints. The issue of protecting biometric information and privacy is paramount in biometric technology. As mentioned above, previous touch-based sensor approaches can lead to several problems.*

2013, AJCSIT, All Right Reserved.
To solve these problems, proposed the elastic minutiae matching algorithm using the TPS (thin-plate spline) model. In this method, corresponding points were detected using local minutiae information, and global transformation was determined with the TPS model. Although the method produced higher matching scores when compared to the ridge-matching algorithm, it requires a good minutiae extraction algorithm that extracts well in even distorted images.

However, if a fingerprint image is highly distorted, to extract usable minutiae is very difficult. This method showed that detection of a perspiration pattern in a time progression of fingerprint images can be used as an anti-spoofing measure. However, environmental factors (such as temperature and humidity) and user-specific factors (such as skin humidity and pressure) are not taken into account. In this paper, we investigate a touchless fingerprint system that fundamentally overcomes the problems involved in conventional touch-based sensors.

A. Advantages of Touchless Fingerprint Sensors
- No Discrimination
- Large Clear image
- Fake fingerprints using butter papers can’t be used
- Robust and reliable
- Maintenance free and durable

B. Stages of processing
- Preprocessing
- Feature Extraction
- Matching

Preprocessing:
Preprocessing is an essential step in detecting minutiae from the fingerprints. It is used to reduce the noises and increase the contrast between ridges and valleys. In preprocessing, firstly, the RGB fingerprint image is converted to gray scale [0-255]. To reduce the degradation that is caused by the illumination, the image is then normalized by changing the dynamic range of the pixel intensity values. After the normalization, segmentation is done by the skin color detection, adaptive thresholding and followed by the morphological processing. The fingerprint image is multiplied with the binary mask obtained from the segmentation later on. Consequently, the resulting image is cropped and enhanced. Finally, the core point is detected on the enhanced image.

Feature Extraction:
The feature vectors are extracted from the images after preprocessing. The Gabor filter based feature extractor is used to form the feature vectors. A properly tuned Gabor filters are famous in smoothing out noise, preserving the true ridge furrow structures in addition to capture both frequency and orientation information from a fingerprint image. Due to the number of extracted Gabor features is large, Principle Component Analysis (PCA) is used for reducing the dimensionality of the feature vectors while the characteristics of the feature vectors are retained that contribute most to its variance by eliminating the later principal components.

Matching:
For the comparison purpose in verifying the individuality of a person through the feature matching, many distance measures can be adopted like Manhattan distance, Euclidean distance and Cosine. The result of the experiments justify that Cosine Angle is the best measure. Let \( x \) and \( y \) be two normalized feature vectors in \( n \) dimensional. Then the Cosine Angle (Cosine similarity) is defined as the cosine of the angle between them and is formulated as:
\[
d_{cos}(x, y) = \frac{y \cdot x}{||y|| \cdot ||x||}
\]
Let \( d \) be the computed distance score from above equation given a threshold \( T \), the claim is accepted when \( d < T \) and rejected when \( d \geq T \) [1].

Fig 2. Block diagram of system

Fig 3. Outputs of normalization, morphological processing and highpass filter enhancement
In Figure 3, outputs of normalization, morphological processing, and highpass filter enhancement are given. Now to find in which area the thumb is there and for core point detection, some process can be done. To determine the strong view difference image, we measure the distance between the core and the center axis of the finger. Fig 4 shows the distance determined by the rolled finger. When the larger distance is there, more finger is rolled. For checking, the orientation of the fingerprint, highpass mask is used. Then by FFT, we can find the region of interest in which our fingerprint is there. By this, we can detect the thumb and its print although it is in a random region. In Fig 5, these outputs are added.

Fig 4. Core point detection

---

In Figure 6, minutia detection and matching outputs are shown. Now in matching, many methods are available, but we have taken cosine angle distance matching because it can detect cut and rotated prints also. So by these methods, we achieve 76% matching to our fingerprints.

Some minutia-related information is given in the next figure. All the parts given in the figure may be selected as minutia, and distance between them can be measured by cosine angles so that relative distances are measured and can be saved as data reference files.

C. Future Scope

- It can be implemented on a standalone application on Raspberry Pi or Beagleboard using suitable platforms and compilers and become useful in the future.
- On airports and some other critical areas, biometric attendance systems can be implemented using this touchless fingerprint recognition.
- Rotated fingerprints can also be detected.

CONCLUSION

By using digital camera, we take an image of the thumb or finger, and from that, the fingerprint is recognized easily. But for good results, brightness and contrast must be good.

ACKNOWLEDGEMENTS

The authors would like to thank everyone who helped us to do this work.

REFERENCES

1. Touchless Fingerprint Analysis by Prabhjot Kaur, Ankit Jain, Sonia Mittal, I.T. Department, MSIT, New Delhi, India, IJISA, June-2012, 6, 46-52