Fingerprints Detection and Enhancement intended for Biometric Identification

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Abstract

The research paper illustrates the importance of fingerprints detection as biometric technique. The paper elaborates the adopted mechanism used to enhance the fingerprints to have a better image. The research work made use of Matlab as simulation tool for analyzing fingerprints and extracting minutiae points via writing appropriate codes. The input image goes through RGB to Grayscale conversion, canning, whitening boundaries, final segmentation, normalization, and removal of noise, binarization, thinning, and extraction of image ridges.

Keywords – Fingerprints, image, segmentation, ridges.

I. INTRODUCTION

Skin on human fingertips contains ridges and valleys which together forms distinctive patterns. These patterns are fully developed under pregnancy and are permanent throughout whole lifetime. Prints of those patterns are called fingerprints. Injuries like cuts, burns and bruises can temporarily damage quality of fingerprints but when fully healed, patterns will be restored. Through various studies it has been observed that no two persons have the same fingerprints, hence they are unique for every individual [1, 2]. Unfortunately fingerprint matching is complex pattern recognition problem. Manual fingerprint matching is not only time consuming but education and training of experts takes a long time. Therefore, since 1960s there have been done a lot of effort on development of automatic fingerprint recognition systems. Fingerprints have remarkable permanency and individuality over the time. The observations showed that the fingerprints offer more secure and reliable person identification than keys, passwords or id-cards can provide [3, 4].

II. PROBLEMS WITH FINGERPRINT RECOGNITION SYSTEM

The primary problems concerned with this research work are mentioned as under [5, 6,7].

1. ***Quality of image***

- One of the open issues in fingerprint verification is the lack of robustness against image quality degradation. The performance of a fingerprint recognition system is heavily affected by fingerprint image quality [5, 8].
- Several factors determine the quality of a fingerprint image: skin conditions (e.g., dryness, wetness, dirtiness, temporary or permanent cuts and bruises), sensor conditions (e.g., dirtiness, noise, size), and user cooperation [6, 9].

Poor quality images result in spurious and missed features, thus degrading the performance of the overall system. Therefore, it is very important for a fingerprint recognition system to estimate the quality and validity of the captured fingerprint images.

2. *Avoiding False Rejection*

Any biometric method may present some rejection problem, because they involve human and biological characteristics. That means that even a person whose fingerprint is already recorded may not be recognized. This is called "false rejection" and happens with any technology and manufacturer [10].

- This problem rarely occurs (below 0.1% of the cases), but it is important to keep this possibility in mind during the implementation, so you can plan on what to do if that happens. The individuals that present this kind of situation are the elderly and children up to 6 years old.
- Some chemical products may also provoke the temporary reduction of a fingerprint quality. In addition, some people don't have fingerprints on some periods of the year, due to biological conditions associated to weather or to their own organism [11, 12].

However, many false rejections happen because of an error during the registration, with the capture of a partial fingerprint. That increases the possibility of a rejection, because the next time that fingerprint will be read, the captured image may be a different one, not registered yet. A correct registration is the best way of avoiding a false rejection [13, 14, 15].

III. IMPLEMENTATION AND RESULTS

This section illustrates the detailed procedure adopted for enhancing fingerprints image.

Fig. 1 shows the input grayscale image.

Fig. 1: The figure shows image conversion from RGB to gray scale

Fig. 2 shows the image after applying edge detection technique canny to the image shown in Fig. 1.

Fig. 2: The figure shows image after canny

Fig. 3 shows the image after whitening boundary.

Fig. 3: The figure shows the image after whitening boundary

Fig. 3 shows the image after whitening its boundaries to get better and clear picture of the image under study.

Fig. 4 shows the image after final segmentation.

Fig. 4: The figure shows the image after final segmentation

Fig. 4 shows the image after segmentation. Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super-pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze.

Fig. 5 shows image after normalization

Fig. 5: Figure shows image after normalization

Fig. 5 shows the normalized form of the image under study. Normalization is a process that changes the range of pixel intensity values. Applications include photographs with poor contrast due to glare, for example. Normalization is sometimes called contrast stretching or histogram stretching.

Fig. 6 shows image after removing noise.

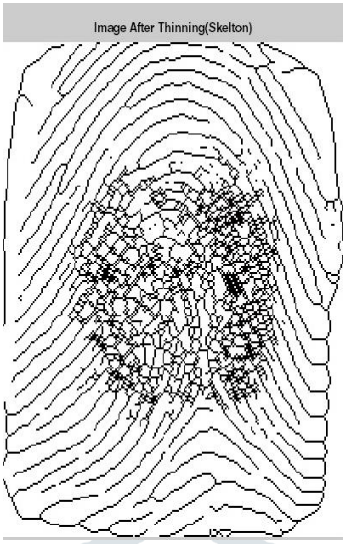

Fig. 6: The figure shows image after removing noise

Fig. 6 shows the image after noise removal. Digital images are prone to various types of noise. Noise is the result of errors in the image acquisition process that result in pixel values that do not reflect the true intensities of the real scene. There are several ways that noise can be introduced into an image, depending on how the image is created. Linear filtering has been used to remove the noise from the image under study.

Fig. 7 shows the image after binarization.

Fig. 7: The figure shows the image after binarization

Fig. 7 shows the obtained binary image after applying binarization on the image under study.Binarization is the process of converting pixel image into binary image.

Fig. 8 shows image after thinning (skeleton).

Fig. 8: The figure shows image after thinning (skeleton)

Fig. 8 shows the image after thinning. Thinning is a morphological operation that is used to remove selected foreground pixels from binary images, somewhat like erosion or opening. It can be used for several applications, but is particularly useful for skeletonizing.

Fig. 9 shows image ridges (white for ending and blue for bifurcation).

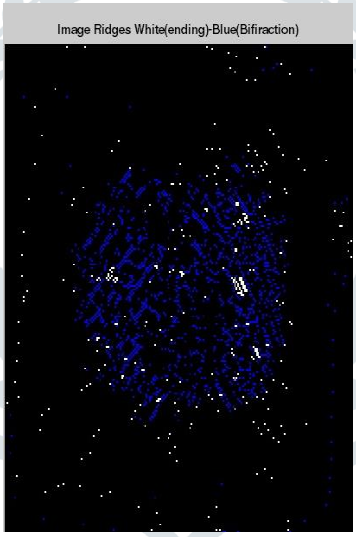

Fig. 9: Figure shows image ridges (white for ending and blue for bifurcation)

Fig. 10 shows image after removing noise and ridges.

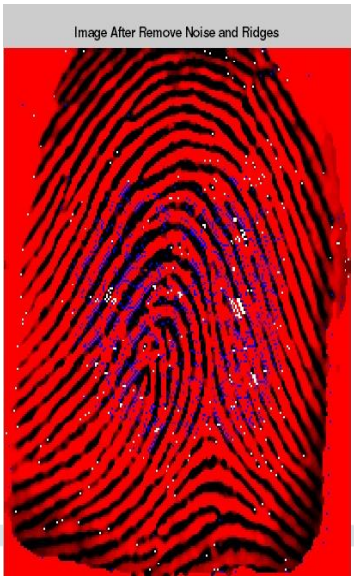

Fig. 10: Figure shows image after removing noise and ridges

Fig. 11 shows image after binarization.

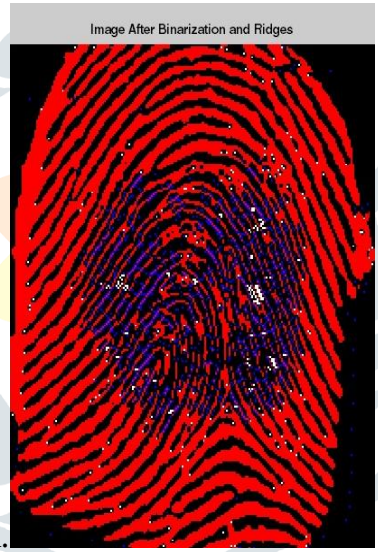

Fig. 11: Figure shows image after binarization

Fig. 12 shows the thinning of images and ridges.

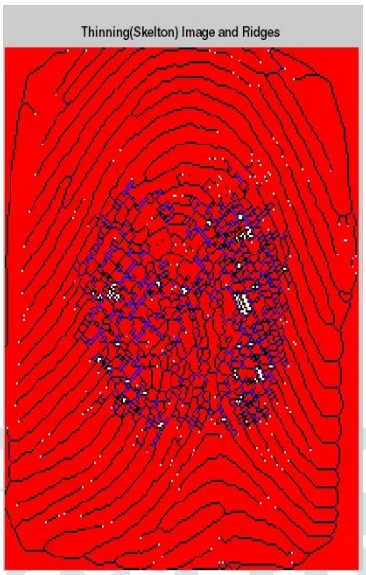

Fig. 12: Figure shows the thinning of images and ridges

IV. CONCLUSION

Different modes of biometrics have individual advantages suiting specific applications. Because of their security, speed, competence and ease, biometric authentication systems have become the standard for access control. The research paper elaborated the detailed procedure of enhancing fingerprints image using multiple filters and techniques to get upgraded image for biometric verification purpose.

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