Fingerprint Image Enhancement Using Different Enhancement Techniques

Upender Kumar Agrawal*
Pragati Patharia**
Swati Kumari***
Mini Priya****

Abstract

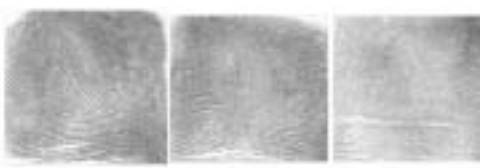
Fingerprint identification is one of the most reliable biometrics technologies. It has applications in many fields such as voting, ecommerce, banking military etc for security purposes. In this paper, we have apllied the Histogram Equalization and Adaptive Histogram Equalization. We have evaluated the performance of the enhancement image method by testing it with fingerprint images.

Keywords: HE, AHE, DNA, CLAHE

I. Introduction

Image Enhancement is one of the necessary step for better analysis. There are various methods to improve the contrast of images [1-3]. Fingerprints are unique patterns, made by friction ridges (raised) and furrows (recessed), which appear on the pads of the fingers and thumbs. They form pressure on a baby's tiny, developing fingers in the womb. The fingerprints are unique. No two persons have been found to have the same fingerprints — Fingerprints are even more unique than DNA, the genetic material in each of our cells. Although identical twins can share the same DNA - or at least most of it -they can't have the same fingerprints. Friction ridge patterns are grouped into three distinct types—loops, whorls, and arches—each with unique variations, depending on the shape and relationship of the ridges:

Upender Kumar Agrawal*
upeagrawal@gmail.com
Pragati Patharia**
pathariapragati@gmail.com
Swati Kumari***
swati.kumari3661@gmail.com
Mini Priya
minipriya9496@gmail.com
Guru Ghasidas Viswavidyalya, Bilaspur



Loops - prints that recurve back on themselves to form a loop shape. Divided into radial loops (pointing toward the radius bone, or thumb) and ulnar loops (pointing toward the ulna bone or pinky), loops account for approximately 60 percent of pattern types.

Whorls - form circular or spiral patterns, like tiny whirlpools. There are four groups of whorls: plain (concentric circles), central pocket loop (a loop with a whorl at the end), double loop (two loops that create an S-like pattern) and accidental loop (irregular shaped). Whorls make up about 35 percent of pattern types.

Arches - create a wave-like pattern and include plain arches and tented arches. Tented arches rise to a sharper point than plain arches. Arches make up about five percent of all pattern types.

2. Histogram Eqalization

Histogram equalization (HE) is one of the popular technique for contrast enhancement of images. It is one of the well-known methods for enhancing the

contrast of a given image in accordance with the samples distribution. HE is a simple and effective contrast enhancement technique which distributes pixel values uniformly such that enhanced image have linear cumulative histogram. HE has been widely applied when the image need enhancement, such as medical image processing radar image processing, texture synthesis and speech recognition.

It stretches the contrast of high histogram regions and compresses the contrast of low histogram region. The goal of histogram equalization is to remap the image grey levels so as to obtain a uniform (flat) histogram in the other words to enhance the image quality .HE based methods are reviewed and compared with image quality measurement (IQM) tools such as Peak Signal to Noise Ratio (PSNR) to evaluate contrast enhancement.

Peak Signal to Noise Ratio (PSNR)

Let, X(i,j) is a source image that contains M by N pixels and a reconstructed image Y(i,j), where Y is reconstructed by decoding the encoded version of X(i,j). In this method, errors are computed only on the luminance signal; so, the pixel values X(i,j) range between black (0) and white (255)[6-7]. First, the mean squared error (MSE) of the reconstructed image is calculated. The root mean square error is computed from root of MSE. Then the PSNR in decibels (dB) is computed as;

PSNR = 20log10 (Max(Y(i,j) RMSE)

Greater the value of PSNR better the contrast enhancement of the image.

3. Adaptive Histogram Equalization

Adaptive histogram equalization (AHE) is a image processing technique used to improve contrast in images [1-3]. It differs from ordinary histogram equalization in the respect that the adaptive method computes several histograms, each corresponding to a distinct section of the image, and uses them to redistribute the lightness values of the image. It is therefore suitable for improving the local contrast and enhancing the definitions of edges in each region of an image. However, AHE has a tendency to over amplify noise in relatively homogeneous regions of an image. A variant of adaptive histogram equalization called contrast limited adaptive histogram equalization (CLAHE) prevents this by limiting the amplification. The size of the neighbourhood region is a parameter of the method. It constitutes a characteristic length scale: contrast at smaller scales is enhanced, while contrast at larger scales is reduced [4-5].Due to the nature of histogram equalization, the result value of a pixel under AHE is proportional to its rank among the pixels in its neighbourhood. This allows an efficient implementation on specialist hardware that can compare the centre pixel with all other pixels in the neighbourhood.

4. Original Data Of Fingerprint Thumb Impression :

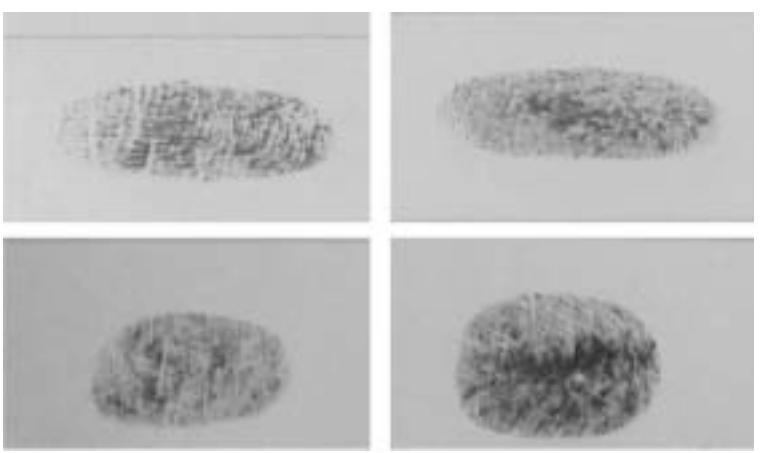


Fig 1: Sample variations of individual left hand thumb impression showing arches, loops and whorls.

5. Results And Comparision

The above discussed methodologies have been implemented by using Matlab. For the testing purpose we have created two Image Database. At first we captured fingerprint image using mobile camera then we enhance the fingerprint image using histogram and adaptive histogram techniques. Results from the above implementation are in described in the following section.

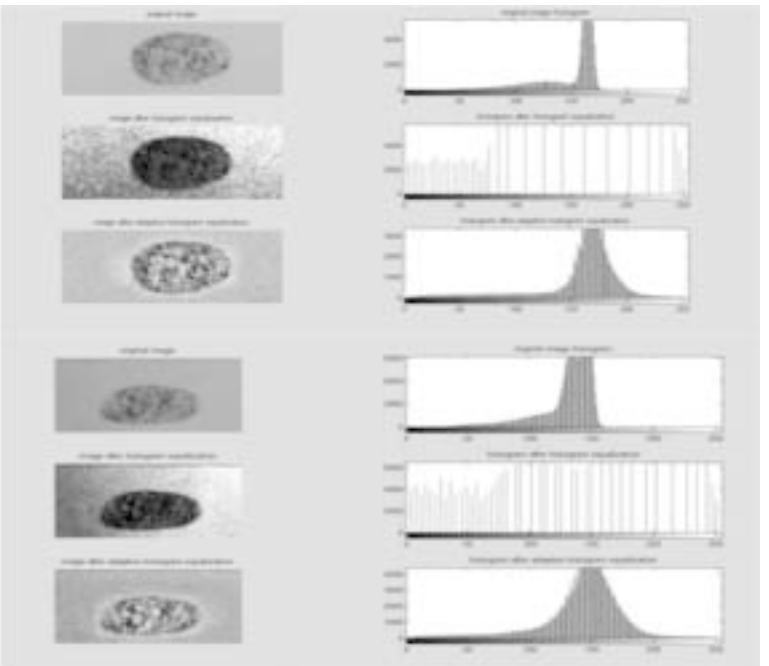
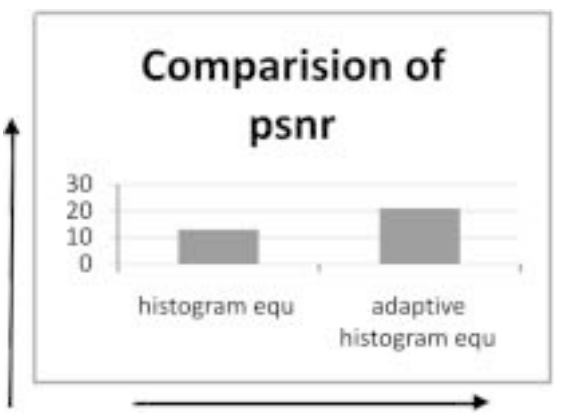


Fig 2. Original image and its histogram, Histogram equalization and its histogram, Adaptive histogram equalization and its histogram.

Comparision of PSNR



(Variation of histogram technique)

6. Conclusion

Based on the result of the experiment phase in this research we found. Firstly, the use of Histogram Equalization enable to increase fingerprint contrasts and for brightness preserving .Secondly by using Adaptive Histogram Equalization (AHE) is an excellent contrast enhancement method for both natural images and medical and other initially non-

visual images. As conclusion, the proposed Technique produces a fine fingerprint image quality. This graph shows the comparison of PSNR. The output shows that the PSNR of adaptive histogram equalization is more than histogram equalization.

References

1. Z. M. Win and M. M. Sein, ¯Fingerprint recognition system for low quality images, presented at the SICE Annual Conference, Waseda University, Tokyo, Japan, Sep. 13-18, 2011.
2. Dr. Muna F. Al-Samaraie, "A New Enhancement Approach for Enhancing Image of Digital Cameras by Changing the Contrast", International Journal of Advanced Science and Technology Vol. 32, July, 2011.pp.-13-22.
3. Mustafa Salah Khalefa 1, Zaid Amin Abduljabar 2 and Huda Ameer Zeki, "Fingerprint Image Enhancement by Develop Mehtre Technique", Advanced Computing: An International Journal (ACIJ), Vol.2, No.6, November 2011,pp.-171-182.
4. D. Ezhilmaran and M. Adhiyaman, "A Review Study on Fingerprint Image Enhancement Techniques", International Journal of Computer Science & Engineering Technology (IJCSET)Vol. 5 No. 06 Jun 2014, ISSN : 2229-3345,625-631.
5. Darshan Charan Nayak, "Comparative Study of Various Enhancement Techniques for Finger Print Images", (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 6 (2) , 2015, ISSN :0975-9646, 1900-1905.
6. C.Nandini and C.N.Ravikumar, "Improved fingerprint image representation for recognition," International journal of computer science and information technology, MIT Publication, Vol. 01-no.2, 2011,pp.59-64.
7. J.Choudhary, Dr.S.Sharma, J.S.Verma, "A new framework for improving low quality fingerprint images," international journal of computer technology and application. Vol.2, no.6, pp.1859 -1866,2011.