Filtering Techniques used for Blurred Images in Fingerprint Recognition

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Abstract- In this world of mobile and cameras, new methods differ from the traditional methods. Traditional methods used contact-based fingerprint matching while the new technique uses contact-less fingerprint matching. Fingerprint matching using sensors uses greyscale images which are very much defining comparative to the images which are taken by cameras and mobiles. And in case of mobile and cameras images can be blurred including noise and distortion. In this paper, we are defining techniques to overcome the issues of blurred images and have to find out better minutiae to match with the database set. To extract the features from blurred images, images which are taken by low cost sensors are filtered and then further processed for minutiae matching.

Index Terms- Minutiae matching, low cost sensors, contact-based fingerprint matching, contact-less fingerprint matching, filtering.

I. Introduction

Fingerprint matching refers to the process of identifying the features and verifying the two human fingerprints. Pattern of fingerprint contains:

- Arch: The ridges enter from one side of the finger, rise in the center forming an arc, and then exit the other side of the finger. Figure 1 up-left shows arch pattern.
- Loop: The ridges enter from one side of a finger, form a curve, and then exit from that same side. Figure 1 up-right shows the loop pattern.
- Whorl: Ridges form circularly around a central point on the finger. Figure 1 lower-right shows whorl pattern.
- Composite: Ridge patterns are not perfectly defined. It is the mixture of two or more patterns. Figure 1 lower-left shows composite pattern.

A fingerprint appears as a pattern of interleaved ridges and valleys where ridges are darklines and valleys are bright in color. Fingerprint information is divided into three levels for identification purposes. There are four types of whorl patterns. Plain whorls consist of one or more ridges which make or tend to make a complete circuit with two deltas, between which an imaginary line is drawn and at least one re-curving ridge within the inner pattern area is cut or touched. Central pocket loop whorls consist of at least one re-curving ridge or an obstruction at right angles to the line of flow, with two deltas, between which when an imaginary line is drawn, no re-curving ridge within the pattern area is cut or touched. Central pocket loop whorl ridges make one complete circuit which may be spiral, oval, circular or any variant of a circle. Double loop whorls consist of two separate and distinct loop formations with two separate and distinct shoulders for each core, two deltas and one or more ridges which make, a complete circuit.

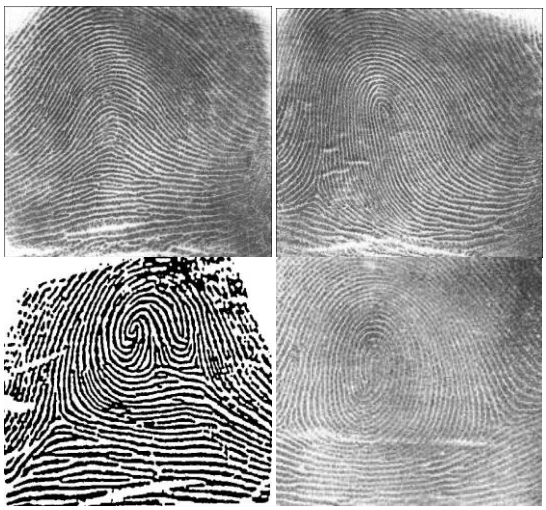

Figure 1: Fingerprint patterns (clockwise from up-left) Arch, Loop, Whorl, Composite

In the process of recognizing minutiae features we should have to find out the structure clear from the blurred images. Features of fingerprint which have different definitions:

- Termination: The ridge which has been started should have to be terminated. The end point of the ridge is called as termination.
- Bifurcation: One continuous ridge divides in two ridges.
- Short ridge (or dot): Ridges which are of small size comparative to other ridges.

Figure 2: Minutiae features: Termination, bifurcation, short ridge.

II. CHARACTERISTICS OF IMAGES

Fingerprint images taken by low cost cameras and others webcams have importance nowadays because they can be found easily like in laptops and mobiles. However, quality of these fingerprints differs from the dedicated sensors. But to resolve this problem new techniques are defined. The images which are taken by cameras are to be processed so that we can obtain the images similar to the dedicated sensors. These images which are obtained by these webcams cannot be as clear as dedicated sensors. So, different pre-processing techniques have to be applied. In this case our area of interest is on blur portion of the fingerprint image. Blur in the images takes place due to distortions in cameras and so as from low quality camera [2]. Fingertip image are taken and ridge structure is defined so that we can get the structure like from dedicated sensors. Dedicated sensors tends to produce image but there are some disadvantages if those sensors like non-uniform pressure, changes in ridge structure, residues which can be there from the previous fingerprint. Using our daily use cameras these problems will not take place. Blur in the images can take place due to several reasons but this blur have to be removed to get ridge structure. In our paper we are defining filtering techniques to get better image from blur image.

III. APPROACH TO REDUCE BLUR

For blur images we have to enhance the contrast of the image so that intensity and frequency of the image rise and blur image tend to give a sharpening values. For the rising of contrast, a method which is called as Histogram Equalization is used. For applying any of the methods the image should be converted into greyscale.

A. Histogram Equalization

The histogram equalization spreads out intensity values along the total range of values in order to achieve higher contrast[1]. Using histogram equalization function histeq() this can be done easily. histeq enhances the contrast of images by transforming the matrix values in an intensity image, or the values in the colormap of an indexed image, so that the histogram of the output image almost matches a specified histogram. After that we get the contrast image of the original image for further processing. In addition to histogram equalization, there is another upgraded method called as adaptive histogram equalization can be used. While histeq function works on entire image, adaptive histogram function adapthisteq works on small portions of image.

B. Wiener Filter

The wiener filtering is a restoration technique for blur reduction, i.e., when the image is blurred low-pass filter, it is possible to recover the image by inverse filtering or generalized inverse filtering. Wiener filter removes the additive noise and reduces the blurring simultaneously [3]. The function which is used for wiener deconvolution is deconvwnr(). Wiener deconvolution can be used effectively when the frequency measures of the image and additive noise are known to some degree.

C. Regularized filter

Regularized deconvolution can be used when constraints we apply on the recovered image and limited information is known about the additive noise. The blurred and noisy image is restored by a constrained least square restoration algorithm that uses a regularized filter. Functions used to implement regularized filter is deconvreg().

D. Regularized filter

When the blur is present in the fingerprint we are concerned about the output image after deblurring. Richardson lucy deconvolution applies the point spead function to reduce blur and get far better output image than the blur image. It restores the image using the PSF.

E. Median filter

The Median Filter block replaces the central value of an M-by-N neighborhood with its median value. If the neighborhood has a center element, the block places the median value there. Median filtering is similar to using an averaging filter, in that each output pixel is set to an average of the pixel values in the neighborhood of the corresponding input pixel [4]. However, with median filtering, the value of an output pixel is determined by the median of the neighborhood pixels, rather than the mean. The median is much less sensitive than the mean to extreme values (called outliers). Median filtering is therefore better able to remove these outliers without reducing the sharpness of the image. The medfilt2 function implements median filtering.

IV. RELATED WORK

In order to implement the blur reduction techniques, we have to find first the different intensity values at different points pixelwise. These intensity values should be changed using filtering techniques. In proper processing of images contains the original image, this image is coverted into greyscale. These greyscale images are used for further execution. Because we cannot process the image with RGB values so we have to convert the RGB matrix into one channel matrix. This matrix is used by the functions of filters.

Initially we take a image from any camera or mobile, there may be possible some blurriness in the features which are to be extracted. Resized image. Then histogram equalization is used to enhance the contrast of the image so that the intensity values of the image are sharpen. Then the wiener filtering technique is applied for better low-pass filtering. After that we get the better feature designing on the fingerprint image. Then binarization and thinning can be applied. Using feature extraction algorithm fingerprint features are evaluated and in final stage minutiae detection and matching is done [5].

V. Experimental results

Images are being taken by Sony Ericson LT26ii model cell phone and processed. In figure 3 original image taken and greyscale converted and once filtered image shown.

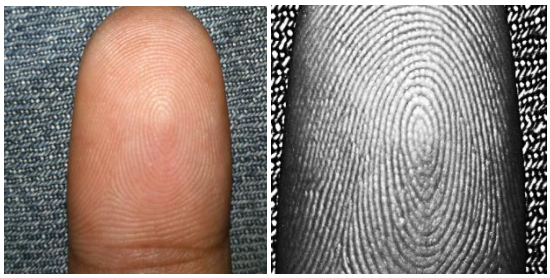

Figure 3: Original image (left) and once filtered and resized image (right).

Histogram equalization and adaptive histogram equalization for contrast enhancement is done.

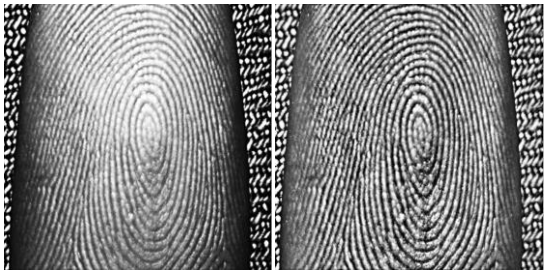

Figure 4: histogram equalization (left) and adaptive histogram (right).

In figure 5 Binarized and filtered using wiener filtered image is shown with better shown feature.

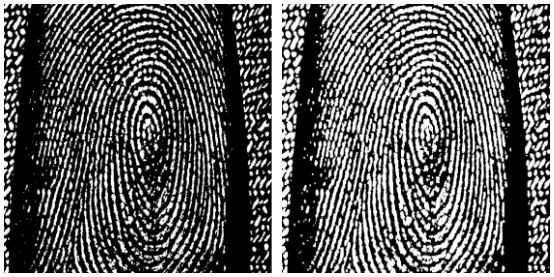

Figure 5: Binarized image (left) and wiener filter after binarization (right).

In figure 6 thinning is done and minutiae are detected. These minutiae features are focused by different colours.

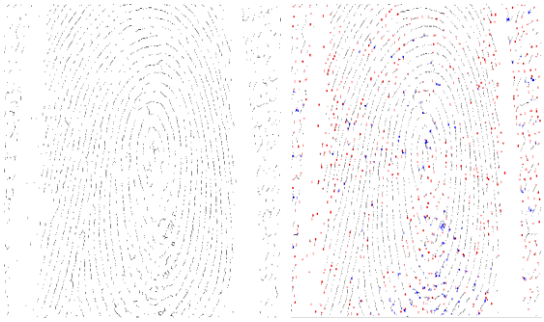

Figure 6: Thinned image (left) and minutiae detected image (right).

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