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A Novel Mirror Reflected Fingerprint Images On Mosaicing Touchless

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ABSTRACT

Touch based sensing techniques generating lot of errors in biometric identification. The solution for this problem is touch less fingerprint technology. They don't have any contact between receiver to the sensor and finger. While they can solve problems caused by the contact of a finger, other difficulties emerge such as a view difference problem and a selected usable area to perspective distortion. To overcome these difficulties I propose a novel touch less fingerprint sensing device capturing three different techniques at one time and a method for mosaicing of different view images. The proposed method for touch less fingerprint image enhancement and minutiae extraction is introduced. Image enhancement is mostly required preprocessing system for finger based biometric system. Normally this touch less device is having a single camera and two planer mirrors which reflecting side view of a finger. And also it is an alternative to the expensive multiple camera based systems. In this mosaic method can composite view the multiple images by using the thin plate spine model to expand the selected area of a finger print images. From this we get three images normally frontal left and right finger. To reduce the affect of perspective distortion we select the regions in each view by minimizing the ridge interval variations in a final mosaic image. Promising of my experiment result show that mosaics images offer more true minutiae and very large quality area than one view unmosaiced images. And also when the side views images are matched to the mosaic images it gives more matched minutiae than matching with one view frontal images. The proposed method can reduce the view difference problem and increase the usable area of a touch less fingerprint images. Experimental result shows that the enhanced image increases the biometric accuracy to improve the performance of my fingerprint recognition system.

Keywords: Mosaic, Fingered Print, Segmentation.

1. INTRODUCTION

A fingerprint is composed of ridges and valleys. Ridges have various kind of discontinuity such as ridge bifurification and ridges, islands and ridges cross over's. Fingerprint recognition systems have been widely adopted for user authentication due to their reliable performance and usability compared to other biometric system. Recently various kind of fingerprint image acquisition sensors have been utilized in a wide range of forensic and commercial application are criminal investigation, e-commerce, ATM security, access control, issuing national id cards and e-passport. These types of sensing systems are touch based user must press or roll their fingers onto a platen surface to capture fingerprint images. Ridge bifurification and ridge ending are commonly used in fingerprint identification or

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verification system and are called minutiae. For the processing of fingerprint images two stages is pivotal importance for the success of biometric recognition image enhancement or feature minutiae extraction. People are becoming more electronically connected with the rapid evolution of information technology. Personal identification is to associate a particular individual with an identity. Many questions relating to identity are asked millions of times every day by hundreds of thousand organizations in financial services, healthcare, electronic commerce, telecommunication, government, etc. as a result, the ability to achieve highly accurate automatic personal identification is becomes more critical. This capturing scheme often introduces degraded images due to skin deformation, skin condition changes, and latent fingerprint on the sensor surface. Due to skin deformation the relative positions of minutiae sets form the two images are different. In realistic scenarios through the quality of a finger print images may suffer from various impairments caused by scores and cuts moist or dry skin sensor noise, blur wrong handling of sensor and weak ridge, valley pattern of the given fingerprint. A latent fingerprint remaining on the sensor surface can be degrading the enhancement result of a newly captured image. Therefore representation of the same fingerprint can vary at each acquisition resulting in the inevitable degradation of the authentication performance. This often result in partial or degraded images due to the improper finger placement, skin deformation, slipping, smearing or sensor noise some of the touch based are shown. A recent touch less devices that can be generate three various representation of fingerprint this new sensing technology removes many the problems stated above from wear and tear of surface coating. To overcome these kinds of problems, a touch less fingerprint sensing technology has been proposed that do not have the contact between a sensor and a finger. Thus the finger and ridge information cannot be changed or distorted as it will be free of skin deformation. Also it can capture fingerprint images consistently because it is not affected by different skin conditions or latent fingerprints. In this section we describe alternative designs based on aerial and line scan cameras compared different imaging and optical system and the tradeoff involved with various design choices. There are two main imaging technologies used within current optical based fingerprinting units. The most widely used due to its simplicity uses a two dimensional array of imaging elements much like the standard CCD found in most consumer cameras. The imaging setup involves a positioning system used to hold the finger steady and a lens system used to form an image of the finger on the surface of the sensor. This technique allows for full fingerprint images to be taken in a single exposure using inexpensive camera system. Images can be taken quickly and successively but sides of the fingerprint image will carry an unavoidable distortion due to the fingers edges being round. Edges of the finger are not perpendicular to the image sensor which causes their projection on to the flat surface of the sensing element to be a distorted representation of the actual figure.

Touch less imaging sensor which uses a complementary metal organic semiconductor camera and red and green light sources to acquire fingerprint images. Proposed a sensing system with a single charge coupled device camera and double ring type blue illuminators to capture high contrast images. Mitsubishi Electric Corporation proposed another touch less approach transmitting the light through the finger acquiring fingerprint patterns under the surface of skin using light with a wavelength of 660 nm. Such sensing system has an inherent problem as they use only a single capturing device such as CMOS or CCD cameras. Thus, capturing an image using a single camera and the geometrical resolution of the fingerprint image decreases from the fingerprint center towards the side area. Therefore false feature may be obtained in the side area and it reduces the valid and useful region for authentication. Moreover if there is a view difference between images due to finger rolling it reduces

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the common area between fingerprints and degrades system performance. To rectify this problem 3-D touch less sensing system using more than one view has been explored. TBS (Thin plate spine) used five cameras placed around a fingerprint image using the shape form silhouette method. Then the unwrapped the 3-D finger image onto a 2-D image by using parametric and nonparametric models to make rolled equivalent images. The structured light patterns are projected onto a finger to obtain its 3-D shape of a hand with fingers by stitching images from 36 cameras. Although all these methods attempted to solve the problems in touch based sensors and acquire expanded fingerprint images with less skin deformation they did not raise much interest in the market because of much higher costs compared to conventional touch based sensors. Considering the above observations we adopted a new touch less sensing scheme using a single camera and set of mirrors. The mirrors work as virtual cameras thus enabling the capture of an expanded view of a fingerprint at one time without using multiple cameras. The device consists of a single camera two planar mirrors light emitting diode based illuminators and lens. Both planar mirrors are used to reflect the left and right side view of a finger. A particular to reduce ridge intervals of a mosaic images as consistently as possible we select the regions to be mosaic from three views by comparing the ridge width values in all images.

2. RELATED WORK

The raw image quality of any optical fingerprinting system is directly related to the systems optical design and configuration. Due to optical limitations which are deeply rooted in optical physics designers of these systems are faced with design tradeoffs which greatly affect the images produced by the system. To overcome the view difference problems and limitations of a single view some touch less fingerprinting systems capture several different views of a finger by using multiple cameras. By using multiple cameras increases the cost and size of a system. We adopt a new sensing system which captures three different views at one time by using the single camera and two planar mirrors. This figure shows the prototype and schematic view of the device. As shown in figure two mirrors are placed next to the finger and reflect the right and left side views of the finger. Then the frontal view and two mirrors reflected views are captured by a single camera simultaneously. The flipped images are regards as the mirror reflected image taken by a virtual camera placed at a different direction compared to the real one. Finally we can capture three different views of a fingerprint using only one camera and also avoid the synchronization problem existing in multiple camera based system.

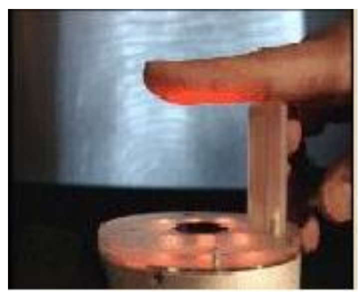

Fig.2.1 Showing the process of Capturing Image

To obtain high-quality fingerprint images we need to consider several optical components in order to design the device. The raw image quality of any optical fingerprinting system is directly related to the system's optical design and configuration. For instance a machine designed for imaging objects that are farther away. When viewed from a fingerprinting perspective these optical limitations translate to practical considerations for a user or perspective buyer of fingerprinting hardware. The machine designed for up close imaging will have less tolerance in the positions that a fingerprinted is allowed to place their fingerprint as deviations from this allowed position will result in higher degree of image degradations than the more zoomed out model. The specifications of the optical components are as follows

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Lens and camera:

We use a 1/3 in progressive scan type CCD with 1024 × 768 active pixels where the pixel size is 4.65 × 4.65 µm. this camera offers a sufficient frame rate of 29 Hz to avoiding image blurring caused by typical finger motion. To design an adequate lens for our system

$$M=q/p \quad \text{(i)}$$

$$1/f = 1/p + 1/q \quad \text{(ii)}$$

Here f is the lens focal length, p and q are the lens to object and lens to image distance respectively and M is the optical magnification. The required image resolution for touch based sensor is 500 dbi. Therefore to ensure a 500-dpi spatial resolution in the fingerprint area and to cover three view fingerprints. The optical magnification parameter M the lens to image distance q and field of view are determined as 0.1, 170 mm, and 50 × 38 mm respectively. We can capture three vie images with 500-dpi resolution at one time. Also the depth of field of the lens range from -2.6 to +2.6 mm at a given working distance and it normally covers the half depth of a finger.

Illumination: The reflectance of human skin to various light sources we used ring shaped white LED illuminators and a band pass filter which can transmit green light to enhance the ridge to valley contrast. The illuminators are placed perpendicular to the finger to remove the shadowing effect on images. Diffusers are used to illuminate a finger uniformly.

Mirror: Both planar mirrors are positioned next to the left and right side of the finger and mirror size is determined to cover the maximum thumb size. To provide enough overlapping area between frontal and side view images. The mirror angles are determined 15º empirically. The mirrors can be used as pegs to place a user's finger firmly on the device.

The images captured by the proposed device are shown in fig.1. as shown in this figure we can capture the frontal, left, and right side fingerprint image at one time.

3. METHODLOGY

In this section, we explain the mosaic method for synthesizing an expanded fingerprint image from frontal and side view images. Overall scheme of the method is presented in fig.3. The method is mainly composed of six stages those are foreground separation, Gabor filtering, feature extraction; transform estimation, mosaic region selection and final mosaic. In feature extraction, we extract minutiae and ridge information of each fingerprint and detect correspondences using minutiae and ridge points. The after I estimate the transform for aligning the center, side images and mosaic regions on the three images are selected to expand the effective area of a fingerprint images are merge to generate a mosaiced image through the blending procedure. Rest of this section we explain the proposed mosaic method in detail.

3.1 Feature extraction

The fingerprint classification we chose to compare two well-known feature extraction methods based on OMs and Gabor filter. In addition we considered two more methods, introduced in this study based on MMs and orientation co linearity. MMs have been motivated by the ideas presented in while the main idea behind orientation co linearity is a coarse representation of OMs. Each of the feature extraction methods considered here requires a registration step to provide translation invariance. The study of translation invariance was achieved using core detection. Before estimating the transform between frontal and side view images it is necessary to find the correspondence between the images. We use the minutiae and ridges as corresponding features because they are distinctive and easily localized for representing a

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fingerprint. Then find the minutiae ridges we apply some preprocessing as follows:

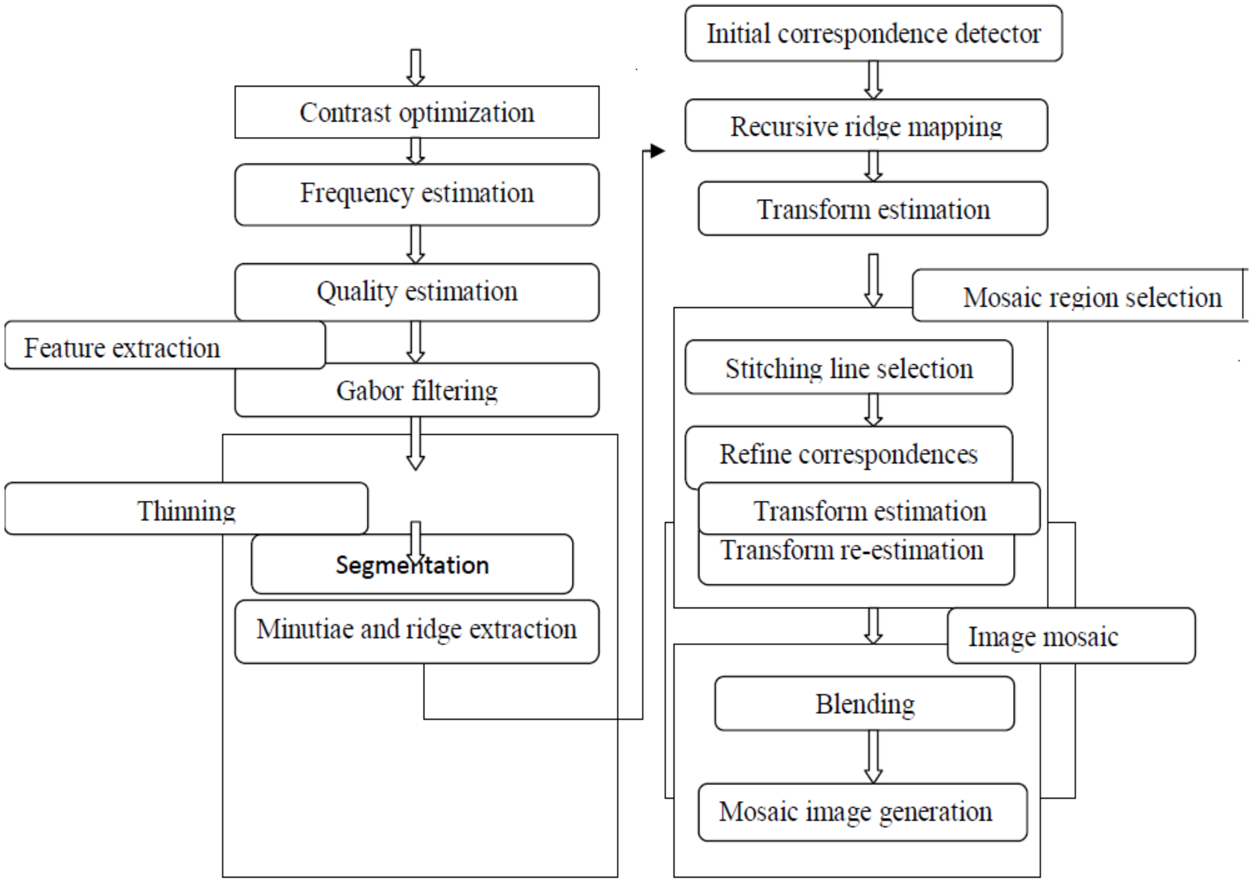

Fig.3.1.1 Showing the Process flow of Mosaic Slice based Architecture.

Segmentation: Many segmentation algorithms use unsupervised clustering algorithm to assign feature vector to either foreground or background. After acquiring the three view images into 8 x 8 pixel blocks. Then the mean and variance of gray values of each block are calculated to determine foreground and background region in the images.

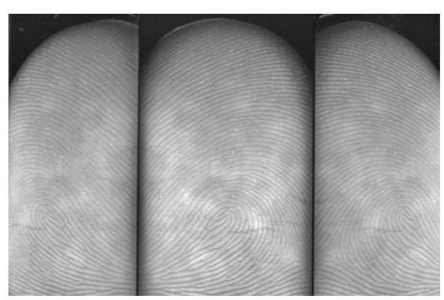

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Fig 3.1.2 segmented captured image

Contrast optimization: The contrast of the touch less images may not be sufficient to processes directly. Therefore block histogram equalization and normalization are applied to enhance the contrast of the images.

Ridge and minutiae extraction: A bank of Gabor filters is applied to extract the ridges. The filter bank parameters are adjusted to cover possible ranges of the ridge frequency for 16 directional orientations. Preserve the ridge information in the fingerprint boundary region as much as possible I apply the Gabor filter with frequency adaptive standard deviation. The binaries and thinned image is obtained as shown in figure.

Orientation and ridge frequency estimation: I apply the regression method to estimate ridge orientation and local ridge frequency is calculated by using the methods which models the local ridge pattern as a sinusoidal shaped surface.

Estimating quality: Obtain the true ridge and minutia sets the quality of the images should be measured. I adopt the method referred in to estimate the quality of the image and use only the minutia and ridges information obtained from good quality regions to remove the negative influence of false ridges and minutiae when mosaicing three views.

ii) Transform Estimation: After initial correspondence is determined I estimate the transform to align frontal and side images. The relation between frontal and mirror reflected views cannot be modified as a linear transformation because a finger is not a planar surface and the cameras are related by rotation and translation.

Fig.3.1.3 Showing the Pixel varationi in the contrast of picture.

The entire procedure for the transform estimation is summarized as follows.

Detect the correspondence of matched minutia and ridge point attached to them.

Estimate the initial TPS transformation f by minimizing the energy function $E_{TPS}(f)$ as shown in (iii)

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$$E_{TPS}(f) = \sum_{a=1}^{k}||y_a - f(v_a)||^2 + \lambda\int[(\partial^2{}_{f/}\,\partial x^2)^2 + 2(\partial^2{}_{f/}\,\partial x\partial_y)^2 + (\partial^2{}_{f/}\,\partial y^2)^2]\,d_x d_y \quad (iii)$$

Where y_a and v_a represents the correspondence in each image. Also the matrix form of equation (iii) can be described as shown

$$E_{TPS}(d,w)=||Y- V_d - \phi\varpi||^2 + \lambda_{trace}(\varpi^T \phi\varpi) \qquad (iv).$$

Where V and Y are K x 3 matrices whose rows are the K correspondences in homogeneous coordinated and ϕ represents a symmetric matrix whose (i,j) element values is $||v_j - v_i||^2\log||v_j - v_i||$. And after QR decomposition the least square solutions of parameter d and w are calculated.

$$E_R = (1- w_1)(RMF_F + RMF_S) + w_1(E_c^F + E_c^S) \qquad 0<w_1<1 \quad (v)$$

Where RMF_F (RMF_S) indicates how well the ridges of the frontal image is aligned to the corresponding ridges of the side image.

And also I normalize the distance value of the image to handle the variations of the ridge interval between the frontal and side

$$D(x,y)=D_r(x,y)/(D_r(x,y)+D_v(x,y)) \qquad (vi)$$

Where $D_r(x,y)$ and $D_v(x,y)$ represents the distance from a given point (x,y) to the nearest ridges and valley respectively. There the ridge mapping error (RME) values are easily measured as below:

$$RME(r_i)=1/N_i\sum_{n=1}^{N_i}D(f(x_n)) \qquad (vii)$$

Where N_i represents the number of ridge points at the ridge r_i in the frontal image and x_n is a point on ridge r_i and $D(f(x_n))$ is the distance values at the corresponding position of x_n on the DM of the side image.

Estimate the transformation more accurately recursive ridge mapping is used to find more corresponding ridge point and eliminate erroneous ridge correspondences.

3.2 MOSAIC REGION SELECTION

In this section I describe how to select the optimal regions from frontal and side images to generate a mosaic image. Once I have aligned the left side and right side images to the frontal images using the estimated transform I need to decide how to produce the final mosaic image.

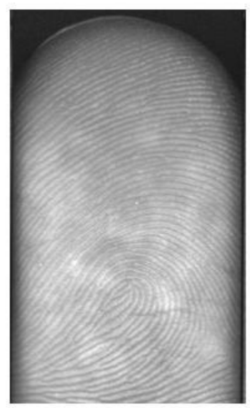

Fig.3.2.1 Final output image.

This section mainly consists of two steps: The first step involves a region selection which chooses the regions from each image to contribute to the final composite image. The second step is the synthesizing of a final image with these selected regions while preserving the ridge and valley structures of the fingerprint and minimizing visible seams and blurring.nin our identifications we conclude that a successful touch less fingerprint but should also preserve the ridge and valley structures as in a good quality rolled image. Accordingly in the frontal image the ridge intervals

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decrease from the center area to the side area of the fingerprint.

4. CONCLUSION

This paper proposes a new method for touch less fingerprint sensing images. The sensing devices which cover three view of a fingerprint and a method mosaicing these images to expand the effective area of a fingerprint. At a time this system composed of a single camera and two flat mirrors and it offers an alternative to an expansive multiple camera based system. We get the better minutiae extraction the three fingerprints (frontal, left, right) are enhanced using Gabor filter method. Feature work can be done on the same concept. According to the result it concluded that the proposed system generate better enhancement on touch less fingerprint then existing methods.

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