International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 12, December-2016

A Survey of Wet and Wrinkled Finger Print Recognition Techniques

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Abstract: **This paper reviews existing techniques of fingerprint recognition. Recognition rate of the wet fingerprint degrades when used for the purpose of biometric identification. Nowadays, different new strategies for authentication are rising for the security purpose. Biometric identification is the reliable method for the verification since password and other security standards can be faked but no one has the same fingerprint, even twins have distinct fingerprints. The existing techniques are not rotation invariant.**
The effect of wrinkling and turned finger prints need as such not been great seen. The paper introduces a particularized report of some techniques of fingerprint matching and differentiates qualitative changes that affect the fingerprint recognition.

Keywords- Image processing, Biometric, wrinkled fingerprint recognition, feature extraction, fingerprint matching

I. INTRODUCTION

Biometric authentication involves face and iris, palm, finger recognition but among all fingerprint recognition is most commonly used Since fingerprints are unique and remain same throughout the lifetime it is very popular. Fingerprint verification techniques validate the match between two fingerprints. It ensures that the sole is who he/she is pretends to be. The existing techniques of fingerprint verification generally involve an image capturing unit, a feature extraction unit and database unit. The image capturing capture the image such as scanner , camera etc . The feature extraction unit extract the features of fingerprint that are necessary for the authentication applying suitable feature extraction algo enhance the quality of fingerprint image, database unit stores the validated fingerprint in the database.

Fingerprints are made up of ridges, valleys. Ridges form the minutiae points , the ridges and valleys patterns are formed on the fingertip.

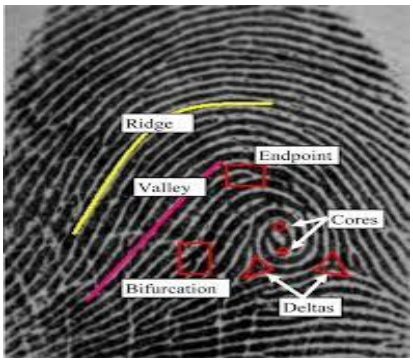

Fig.1 : A normal fingerprint showing ridges,valleys,endpoint

Although the fingerprint authentication has helped a lot but it still needs lot of improvement. Preprocessing a bad quality image is a major challenge in this and how well these existing techniques will perform in marine environment. The course wrinkling is not understood right so far, many theories are available on why it happens some theories claim that it occurs because of expansion of outer layer and some claim that contraction of myo-epithelial cells in the absence of sebaceous glands in glabrous skin is the reason of wrinkling. The paper represents the effect of pruned finger or wrinkled finger on a typical fingerprint verification system.

II. FINGERPRINT PATTERNS

Patterns are categorized in 3 groups arch ,whorl, and loop . 5% are arch , 30% are whorl and 65% of these are loop. The loop has 1 delta, Lines from three directions comes together at a delta point.

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1. Loop: loop is the common fingerprint of all type. In this pattern the ridges get in from one side cross the line that is drawn from delta to core form the loop and terminate on the same side from where ridge entered . Loop pattern are categorized in three categories

a. Ulnar loop
b. Radial loop
c. Double loop

In ulnar loop ridges comes from the pinky side of the hand. In radial loop ridge pattern flow lope in the radius approaching the thumb and ridges enters from thumb side. Radial loops are not so common. In double loop two different loops are going in two different directions.

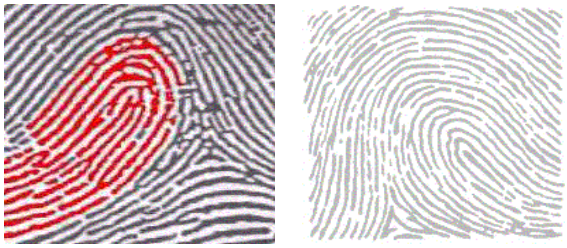

Fig.2: Radial loop and ulnar loop

2. Arch: Arch pattern is of four types : plain arch, radial arch, ulnar arch, tented arch. So basically in this pattern ridges get in from one side and terminate from the other side making no backwards turn. Plain arch does not make any delta, in this ridges just flow-in from a side and flow out making a wave like pattern, In radial arch since ridges flow in from the thumb side they make a slop facing the thumb having one delta . In ulnar arch ridges get in from the pinky side therefore they make slop facing the pinky side, it also has one delta. Tented arch make the angle and a sharpe pointed slope. It has up thrust in the ridges near the middle.

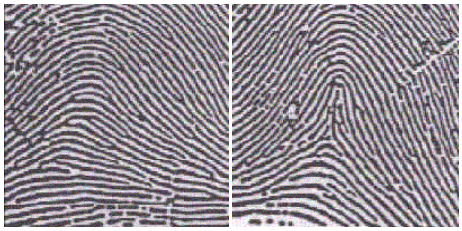

Fig.3 plain arch and tented arch

3. Whorl: In whorl pattern ridges form the circle like structure and contains several deltas.

Fig.4: simple whorl pattern

In simple whorl pattern ridges form the complete circuit making two deltas. Between these two deltas a hypothetical line is drawn and one re curving ridge inside the internal pattern area is touched.

III. FINGERPRINT RECOGNITION PROCESS

Fingerprint recognition mechanism consists of enrollment, identification and verification process. It is a mechanism of differentiating the known fingerprint versus template fingerprint to verify if the sole is who he/she plea to be. Enrollment process records the characteristic of person. Identification process is 1 to N matching and verification process is 1 to 1 matching. In identification, a person is identified by analyzing its fingerprint with entire database and in verification, individual claim his/her identity and this claimed identity is compared to the individual's biometric characteristics. Both the process are necessary but verification is more efficient process than identification

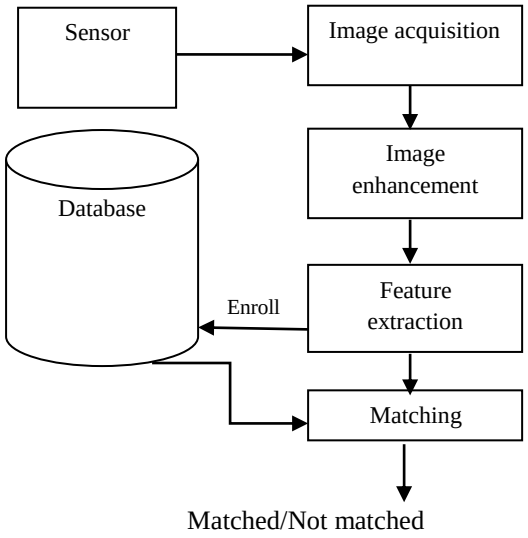

Fig.5 : fingerprint recognition process

There are 3 basic operation that every biometric verification process use.

1. Image Acquisition: Image acquisition is a technique of acquiring image for example camera, scanner etc. It is the first process of any biometric authentication. After image acquisition preprocessing techniques are applied on the image. Such as converting the image into grey level, binary image, black and white etc. The quality of the image needs to be good.

2. Image enhancement: Image enhancement mechanism is performed to remove noise from image hence the resulting image is better than the original image. For this purpose various filters are applied such as Gaussian filter, median filter and many morphological operations are performed. These filters sharpen the image, enhances the dynamic range of the image. There are numerous operations for image enhancement such as point operation, spatial operation, transform operation and pseudo coloring.

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3. Feature extraction: Feature extraction process extract the required features for fingerprint recognition. Many feature extraction processes are there such as SURF, Fourier descriptor, Image moments, invariant moments etc. In fingerprint recognition process feature extraction process extract the necessary details of the finger such as ridges, valleys, ridge bifurcation, minutiae points etc.

4. Matching: Two images of fingerprint are compared depending on their extracted features. Depending on this matching unit score the two compared fingerprints are announced as matched or not matched.

IV. TECHNIQUES OF FINGERPRINT RECOGNITION

Numerous techniques are there for fingerprint matching such as SIFT and SURF. We will discuss these techniques here.

1. SURF: speeded up robust feature (surf) technique is rotation invariant point detector and descriptor. (Dr. Raman Chadha*, march,2016)

Key point detection: The surf identifies the crucial points in the image with the hessian matrix. This hessian matrix can be represented as:

$$H = \begin{matrix} L_{xx} & L_{xy} \\ L_{yx} & L_{yy} \end{matrix}$$

L_{xx} ,L_{xy}, $L_{yx,}$ L_{yy} are filter matrices. (Dr. Raman Chadha*, march,2016). Different filters determine different major points at various scales so to localize them filters are implemented in 3*3*3 neighbourhoods .

Computation of Descriptor vector : Descriptor vector detect the key points of the image, for this purpose it uses the wavelet feedback in horizontal and vertical direction. First it selects the 20*20 region around the key point as this region contains details about the key points. This region is divided into 4*4 sub-regions and for every sub region wavelet feedback in horizontal and vertical direction is calculated and a vector is formed. This vector is called as feature vector. The sum of wavelet response for each region and their absolute values $|d_x|$ $|d_y|$ are called feature values. The vector for the sub-regions is calculated as:

$$V_i = \{\sum|dx| \ \sum|dy| \sum dx \ \sum dy\}$$

Surf feature vector is computed by connecting all sixteen sub region which results in a vector that contains 64 elements.

2. SIFT: scale-invariant transform feature (sift) technique is used to find and define the local features of the fingerprint image. For fingerprint matching certain point on the fingertips are extracted that describe the features of the fingers such points include ridges valleys minutiae, bifurcation etc. Sift is also used to find the similarities between two images .The purpose of development of SIFT algorithm was object recognition and it doesn't need image preprocessing but in this proposed technique image preprocessing is performed (Unsang Park, 2008).

Preprocessing : It is performed in two parts: Adjustment of Grey level distribution in image and removal of noisy feature points. The noisy feature points are removed to enhance the performance of algorithm since SIFT detect the similarities, when fingerprint image shows similar features performance is expected to be improved. The flow chart of the SIFT algo is shown:

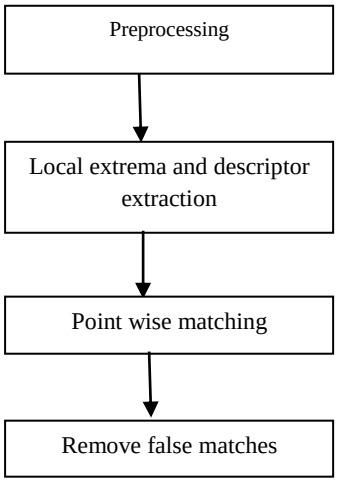

Fig. 6: Flow chart of sift algo

Matching: The initial phase of matching is to straightforwardly analyze and compare each local extrema depend on the descriptor using Euclidian distance metric (Unsang Park, 2008). Let's assume we match two images l1 and l2. The feature point of l1 image is k_{11} and its first closest point is k_{21} second closest is $k_{22.}$ The distance d1 and d2 is figured from feature points in l2. If the fraction of d1/d2 is small feature points are considered to be matched. Matching Score decides the number of matching feature points.

Remove false matches: The component point matching generate some invalid matching points that increase the false rate. So it is important to remove these inaccurate points with the help of geometric duress. In fingerprint images geometric duress are limited to rotations and translations. Hence when we match different fingerprints and draw the matching lines all the valid match points appear as parallel lines of same length. Based on this we select the length value and choose the matching pair which have that same length value.

V. DRAWBACKS OF FINGERPRINT TECHNIQUES:

1. Rotation invariant: The existing fingerprint techniques does not work if the fingerprint image is rotated because it becomes difficult to extract the minutiae points due to rotation the position of minutiae points changes.
2. Cost: The cost of software programs and hardware is very high such as for the scanner cameras etc.
3. Space: For fingerprint recognition algorithms requires image to be captured at 500 dots per inch for which resolution 8bits per pixel. Saving a 500 dpi image requires a large memory space.

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VI. CONCLUSION

The purpose of this paper is to survey the technique of fingerprint recognition operations and techniques. It is summarized that Biometric is most effective method for authentication purpose. Some issues of wrinkled fingerprint recognition are yet to be covered. The impact of wrinkling and turned finger prints need as such not been great seen. For future work , apply the different techniques evaluate the performance, improve the accuracy for wet fingerprint recognition. The future work involves improving the proficiency of SIFT and SURF algorithms, developing better matching schemes, implementing SIFT operators with other minutiae based operations.

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