Geometric Finger Nail Matching using Fuzzy Measures

Kavitha Jaba Malar R, Joseph Raj V

Abstract— This paper proposes a novel method, a Fuzzy Feature Match (FFM) based on a triangle feature set to match the fingernail. The fingernail is represented by the fuzzy feature set. The fuzzy features set similarity is used to analyze the similarity among fingerprints. Accordingly, a similarity vector pair is defined to illustrate the similarities between two fingernails. The FFM method shows the similarity vector pair to a normalized value which quantifies the overall image to image similarity. The algorithm has been evaluated with kaniyakumari district people's fingernail database. Experimental results confirm that the proposed FFM based on the triangle feature set is a reliable and effective algorithm for fingernail matching.

Index Terms — Extraction, Fingernail recognition, Fuzzy features, Matching, Minutia. Triangularization.

I. INTRODUCTION

Finger nail recognition has been applied to identify criminals and currently it is being increasingly used for personal identification as a supportive biometric. Various biometric recognition techniques on hand acquisition, enhancement, matching and classification are developed and advanced rapidly. However, there are still difficult and challenging tasks in this field. Finger-nail features are considered as distinct as others and hence somewhat useful for identification purposes. Recently it has been found that fingernail is used as supportive biometric traits because it is less accurate. Human fingernails bear longitudinal ridges on both their upper surfaces. A nail is a horn-like envelope covering the dorsal aspect of the terminal phalanges of fingers and toes in humans. The nail consists of the nail plate, the nail matrix and the nail bed below it, and the grooves surrounding it. The lunula is the visible part of the matrix, the whitish crescent-shaped base of the visible nail. The lunula is largest in the thumb and often absent in the little finger. The nail bed is the skin beneath the nail plate. The nail wall is the cutaneous fold overlapping the sides and proximal end of the nail. The lateral margin is lying beneath the nail wall on the sides of the nail and the nail grooves are the cutaneous slits into which the lateral margins are embedded. The eponychium is the small band of epithelium that extends from the posterior nail wall onto the base of the nail.

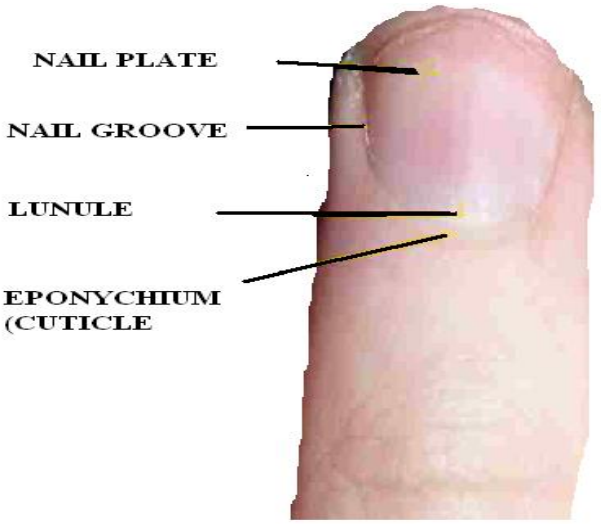

Fig. 1. Structure of a Finger Nail

To improve the performance of biometric system, nowadays researchers prefer the multiple modalities for recognition on the basis of score level as well as feature level. As a supportive biometric aspect, we proposed the new view of biometric that a hand based biometric on the basis of the finger nail.

II. RELATED WORK

A biometric approach has developed stickers, which can be placed over finger nails for an identification process. An acquisition system employing lighting equipment has been designed to acquire images of the nail bed. Such images are then used for identification by extracting features from the nail bed grooves. The thumb images were acquired against a black background to compute the boundaries of the thumb. The stickers glued over the fingernails provide two landmarks which are used the feature extraction process. The matching is done by computing correlation coefficients between distance profiles.A biometric authentication system uses images of hands in order to extract information from the finger nails. First, the nails are segmented by grey scale thresholding. The individual authentication process is developed by the hamming distance of high frequency Haar wavelet coefficients.

III. PROPOSED WORK

In the proposed biometric recognition system we extract the features of fingernail and match the patterns using FFM. The finger-nail is extracted on the basis of ROI Extraction algorithm. The flow of the proposed system is shown below

Manuscript Received on September 22, 2014.

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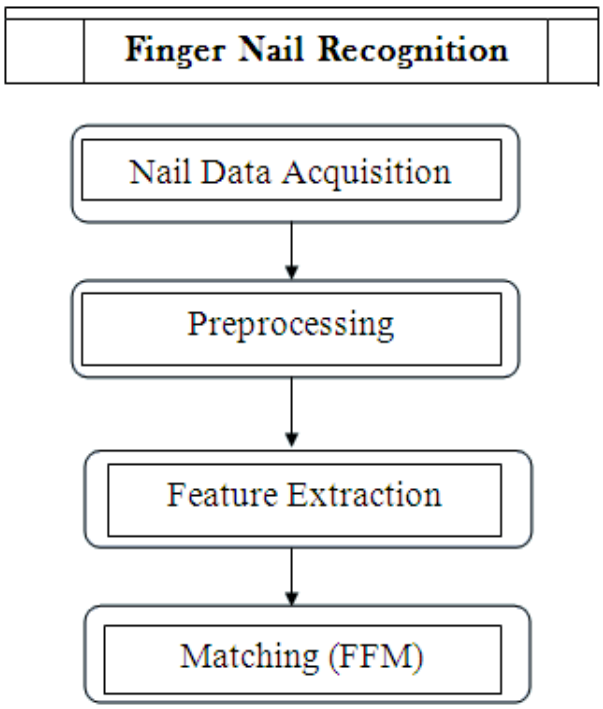

Fig. 2. Flow of proposed system

IV. EXTRACTING MINUTIAE

The distance between two Minutiae is generally greater than a threshold value. They are often detected at the border of the finger nail image.

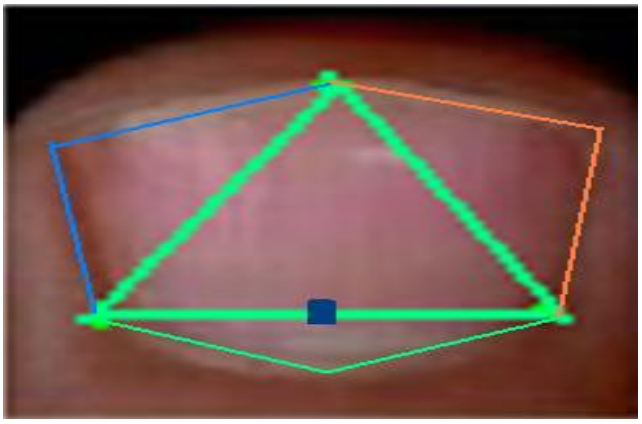

Fig. 3. Triangles Constructed in a Finger Nail

The ridges can be easily detected and minutiae can be correctly extracted from a thinned image. There are many approaches to construct triangles in the triangularization method, but there will be four triangles constructed in a finger nail. The proposed method reduces the complexity.

V. FUZZY MATCHING AND SIMILARITY

The first step is to define a triangular feature set in a finger nail image. The block of the matching is the local triangle feature of the finger nail. Four triangles are constructed in a nail image .The feature vector of a local triangle structure is defined by the distance between minutiae, the angle between the directions from minutiae, the orientation differences within the region of minutiae. FTk={d_{ij},d_{jk},d_{ik},Ψ_i,Ψ_j, Ψ_k,OZ_i,OZ_j,OZ_k,α_i, α_j, α_k}.

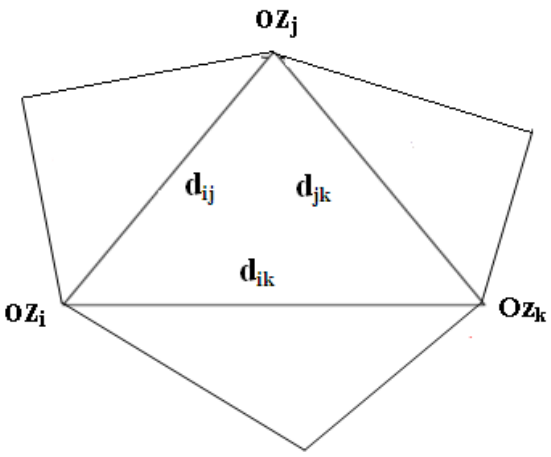

Fig. 4. Triangle Patterns in a Finger Nail

Before measuring the similarity between the fuzzy features set, we define the pattern parameter space. Suppose FRT_{Tk}= { i, j, k, Ψ_i, Ψ_j, Ψ_k, AT, PT} is a controlled local triangle feature in a template fingerprint and FRT_{IK} = { i^l, j^l, k^l ,Ψ^l_i, Ψ^l_j, Ψ^l_k, AT^l, PT^l } is a controlled triangle feature in an input fingerprint, four distorted pattern parameters, vectors len_{diff}, Ψ_{diff}, A_{diff} and P_{diff} are calculated to construct the deformed pattern feature vector. To derive the pattern parameter space we used the training set. The database set contains finger nail images captured from kaniyakumari district peoples finger nail images. To characterize the similarity between finger nails the fuzzy feature set is used. The FFM method maps a similarity vector pair to a normalized quantity, within the interval [0, 1], which quantifies the overall image to image similarity. The image-level similarity is constructed from triangle-level similarities. The FFM method is applied to provide an image to image similarity. The FFM method computes the inner products of similarity vectors with weight vectors. To choose weight vectors, the system takes the area covered by the triangle and the weight based on the viewpoint that the triangle of the proper area in a finger nail. The FFM measure for template and input finger nail is defined as

$$\mathbf{Sim} = [\![(1-p)w_A + w_B]\!]\, L^{(T,I)} \quad (1)$$

Here w_A is the normalized area percentage of both template and input finger nail, w_B is the normalized weight which favours triangle near the image center, p € [0,1] adjusts the significance of w_A and w_B and $L^{(T,I)}$ is the weighted entries of similarity vector of the overall image. The similarity between template and input finger nail is constructed by triangle similarities. Here, we analyze the matched number of triplets of Minutiae which satisfy the entire criterion in the matching process, and the probability of the local triangle feature set matching model.

VI. EXPERIMENTAL RESULTS

We conduct extensive experiments to evaluate the effectiveness and robustness of the proposed system. In order to evaluate the proposed finger nail identification, a finger nail database is to be established by collecting thumb nail images of various persons. The finger nail images are collected from 50 kaniyakumari district peoples.

We presented an algorithm to extract ROI of finger nail. The proposed algorithm has been evaluated on the fingernail of kaniyakumari district people's database. This algorithm is compared with the methods described earlier. The system is developed using dotnet. The proposed algorithm considerably reduces the complexity of computation. In the algorithm controlled four triangles are used for a finger nail. A better performance of 92% accuracy is also obtained. The computation complexity in FFM based method is less.

Method	Accuracy
BP	90%
FFM	92%

Fig. 5.Comparison of BP method with FFM method.

Fig. 6.Feature Extraction Of Finger Nail

Fig. 7.Result of FFM method on Finger Nail

Fig. 8.Result of FFM method on Finger Nail

VII. CONCLUSION

This paper proposes a new method for finger nail matching. The triangle feature constructed in the nail is represented by the fuzzy feature. These features are used to characterize the similarity between the nails. We introduce a fuzzy similarity measurement for two triangles and extend it to construct a similarity vector including the triangle-level similarity in two finger nails. The proposed algorithm has been evaluated with finger nails of kaniyakumari district people's database. Experimental results confirm that our algorithm reduces the complexity of the method and produces better accuracy in matching.

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