

## Recognition of Human Identities Using LDA Features Extracted From Knuckle Images

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### Abstract

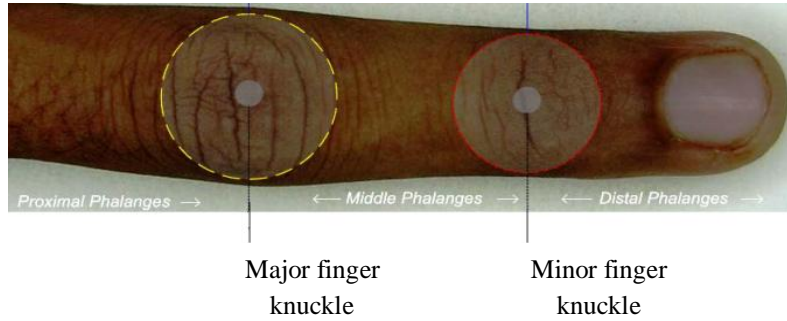
This paper introduces an automated biometric authentication using combined image of major and minor finger knuckle patterns. The major and minor finger knuckle patterns are formed by joining proximal phalanx, middle phalanx and distal phalanx bones. This major and minor knuckle pattern images are segmented from finger dorsal image which is back surface of the finger. Finger dorsal surface is one of the idiosyncratic biometric identifiers. Here, the major and minor finger knuckle patterns are used simultaneously. Linear Discriminant Analysis (LDA) is used to extract the features from the combined image of both finger knuckle patterns. The authentication experiment is done using publically available finger knuckle database from several subjects. Then True Positive False Negative value is calculated to both existing [5] and proposed system. From the TPFN value, we obtained matching accuracy of the authentication. Based on the techniques, existing and proposed system results are compared using TPFN factor. And the skin pattern formed on the finger knuckle is highly rich due to skin folds and creases. The knuckle patterns are unique under varying age. This is proved by comparing the knuckle recognition results of same person under different age. It shows the possibilities of using knuckle recognition with high security.

**Key words:** Major finger knuckle, Minor finger knuckle. Human identities

### Introduction

In day-today life, we must need high security in any field. Biometric authentication is one of the best recognition methods to provide reliable and secure authentication. It is used to recognize the human identities based on physical and behavioral characteristics. Each and every biometric identifier has one interference during

identification. (e.g.) Fingerprint is not suitable in authentication incase of dirty is present in the fingerprint image. Then, wearing glasses is affecting the iris and retinal recognition. But knuckle recognition has no interference. Every biometric identifier is varied with respect to age. The patterns present on the finger knuckle image is does not varied with respect to age. The finger dorsal image is shown in figure.1

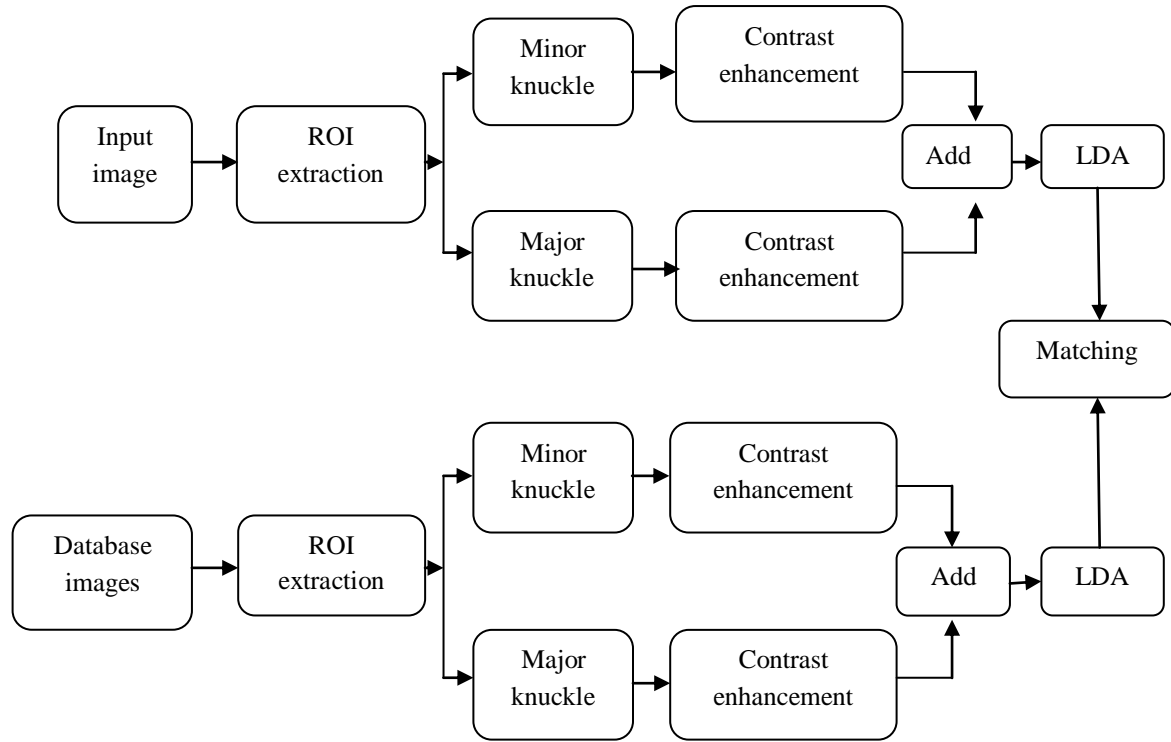


**Figure 1:** Finger Dorsal Image

The main advantage of choosing finger dorsal image is contact less image acquisition. This biometric identifier does not vary with emotions and other behavioral aspects. It is highly convenient to users and easily accessible. In human hand, the fingers contain 3 bone segments and 3 joints. And the thumb finger contains two bone segments and two joints. The joints are called as knuckles. Middle finger is used for recognition. It gives better performance because of its higher surface area and stability.

### **A. Proposed System**

In our proposed system, biometric recognition is done using finger dorsal image. Linear Discriminant Analysis is used to extract the features from the knuckle images. When compared to other biometrics, finger dorsal images are satisfied the requirements such as universality, distinctiveness and permanence. The block diagram of knuckle recognition is shown in figure.2.



LDA: Linear Discriminant Analysis

**Figure 2:** Block Diagram of Knuckle Recognition

## Segmentation & Enhancement

Image segmentation is the process of partitioning an image into many parts of images. Those groups are uniform with respect to some criterion. Regions in an image are a group of connected pixels with similar properties. It offers several advantages over conventional segmentation techniques. The region of interest is the region which has maximum knuckle creases. Region of interest segmentation is used to segment the fixed size of images with respect to given size. The major and minor finger knuckle patterns are extracted from the input.

### A. Contrast Enhancement

The finger dorsal surface is the 3D curved surface. The curves in the surface produce uneven illumination and reflections in the image. To normalize that image enhancement techniques are employed. Contrast enhancement technique is used to enhance the image. In contrast enhancement technique, the variable is multiplied with the image to improve the contrast in the image. The selection of variable is based on the image. Then histogram equalization technique is applied.

### **B. Selective Thresholding**

In major and minor finger knuckle image, we require only the pattern formed on the knuckle. Curved lines and creases are used in feature matching. Selective thresholding technique is selecting the threshold value automatically. Using that threshold value, the required portion is segmented from the enhanced major and minor finger knuckle images.

### **C. Combining Major and Minor Knuckles**

The major and minor knuckle image is combined by adding corresponding pixels in the two images. Adding two images is simpler and straightforward computation. The simultaneous use of major and minor finger knuckle pattern provides higher matching accuracy which is not possible in minor or major finger knuckle recognition.

The combined image is obtained using the following equation,

$$C(i, j) = \sum_{i=0}^n \sum_{j=0}^n (Pma + Pmi)$$

Where  $C(i, j)$  is the combined image,  $Pma$  and  $Pmi$  are major and minor pixel value respectively.

## **Feature Extraction & Matching**

Feature extraction is defined by the transforming the input into set of features. Linear Discriminant Analysis (LDA) is employed in feature extraction.

### **A. Linear Discriminant Analysis**

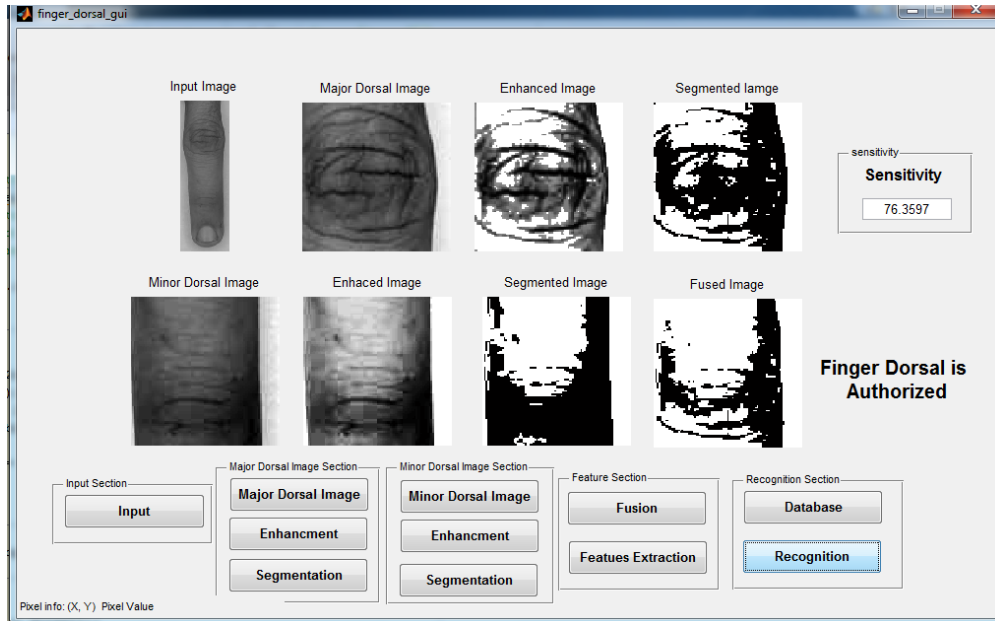
This technique is typically used as feature extraction step before classification. The merit of this technique is dimensionality reduction. It tries to reduce the dimensions of feature vectors without loss of information. The Eigen value and Eigen vector of each pixel value is calculated in this feature extraction technique.

### **B. Matching**

Matching is done using features which are extracted from the input image and database image. The knuckle image gives the information which contains local and global features. The features are same in the authorized finger dorsal images and are unequal in the unauthorized finger dorsal image.

## **Experimental Results**

Knuckle authentication is done using Local Binary Pattern (LBP) feature extraction in existing system [5]. Linear Discriminant Analysis technique is used in proposed system. When compared to LBP, LDA feature extraction has higher performance and recognition accuracy. The recognition output is shown in figure.3. The knuckle recognition result of same person under different age is compared in table.1 (for sample two person's finger). The comparison shows the skin pattern present in the knuckle is stable under different ages. Because the recognition accuracy is same at all ages.



**Figure 3:** Recognition output

**Table 1:** Comparison of Recognition Accuracy At Different Age

Input	Recognition accuracy at 2010	Recognition accuracy after some years
Finger 1	78.2949	78.2947
Finger 2	80.3435	80.348

**A.TPFN**

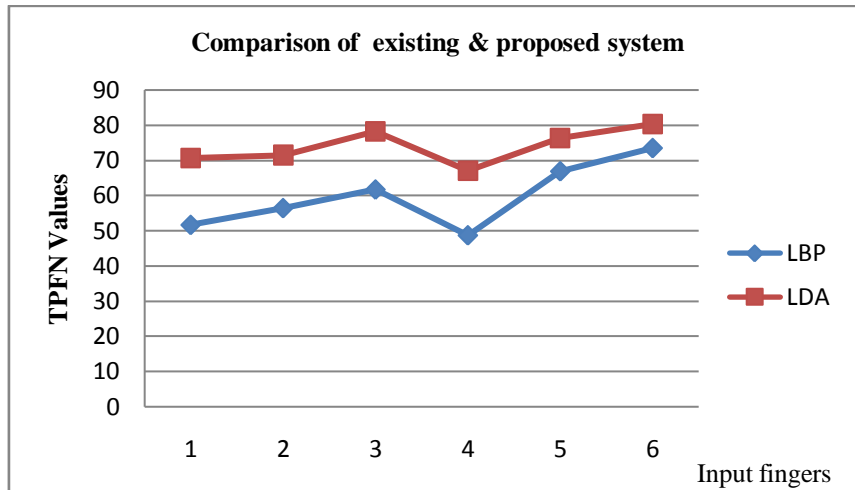
True Positive False Negative (TPFN) factor is used to compare the results of both phases’ recognition techniques. It is also called as sensitivity. It defines the matching factor occurred between the input and database image. Sensitivity is one factor which is used to find the condition correctly. TPFN factor is calculated using the below formula.

$$TPFN = (TP) / (TP + FN)$$

Where TP = True Positive (no of same pixels occur between the images)

FN = False Negative (no of different pixels occur between the images)

The sensitivity is displayed in the right corner of the output. The graph of TPFN values of both existing and proposed systems are shown in figure.4. The graph shows the proposed system has higher recognition accuracy than existing system [5].



**Figure 4:** Graph based on TPFN values

## Conclusion

This paper successfully investigated the possible use of major and minor finger knuckle images. In this knuckle recognition, we have to recognize the human identities easily. And the skin pattern formed on the knuckle is unique under different age was proved. Based on the lifetime, the knuckle recognition has higher efficiency than other biometric recognition. In future the knuckle recognition will be compared to existing biometric authentication based on cost and time.

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