Finger Vein Based Recognition System Using LBP Method

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Abstract- *As the automation in bio metric authentication is increasing there is demand for the high security for protecting private information and access control with increased speed and accuracy. One of the very important solutions for the security issues is the human behavioral and physiological features in bio metrics. However, the existing bio metric systems are not suitable for very high security and are highly complex in terms of time or space or both. Finger vein recognition is a bio metric technique used to analyze finger vein patterns of persons for proper authentication. Authentication using intrinsic bio metrics such as finger veins provides high security and confidentiality. The accuracy of the finger vein recognition system heavily depends on the feature extraction techniques. Here in the feature extraction, Local Binary Pattern algorithm is being used for feature extraction and using the Hamming distance, matching of the extracted feature image is done.*

Keywords- Biometric authentication, Finger vein recognition, Feature extraction, local binary pattern (LBP), Hamming distance.

I. INTRODUCTION

Nowadays there is an increased interest in modern societies with the development and deployment of internet and web technologies for methods that can verify or identify the identity of a user that accesses from a remote location. Traditional security systems such as key locks or identification cards are also targets for a modernization that can upgrade the security of critical locations such as ATMs, banks, nuclear power plants, etc. Those and other different scenarios are pushing the development of more sophisticated systems based on biometric information given the impossibility of a malicious individual to reproduce the information.

The acquisition of biometric parameters is a very hard procedure since it requires the conditions around the acquired parameter be as similar as possible. To achieve this target, it's necessary to make a combination between hardware design and software procedures. Through hardware design, the system may instruct the user to perform properly to make the pattern recognized easily. Through software procedures, the system may correct the problems related to the acquisition of the pattern, relying on algorithms that aid to solve irregularities. Furthermore, the algorithm is able to create the score of similarity in biometrical character from extracted fingerprints, the result of which is assumed to be accurate with infinite decimals.

II. EXISTING WORK AND PROPOSED WORK

- *Existing system*

Many of the existing systems in finger vein recognition have taken more time in the matching phase. The process time for matching the template image of input image and the template image from the database by constructing the lbp code and matching the both.Even this existing system has some misalignment and shading problems which makes the matching accuracy very low.

- *Proposed system*

The proposed model for finger vein recognition will not take much longer in the matching phase as the necessary preprocessing steps are being performed to overcome the misalignment and the shading problem and also the proposed system has been done by taking around 9 individuals consisting of six different images of finger veins. Among every method LBP method is much more accurate and the processing time is less in the matching phase.

III. STAGES OF FINGER VEIN RECOGNITION

- Image Acquisition

The device used for image acquisition, shown at Figure 1, consists into an array of Near-Infrared (NIR) light illuminators regulated by a COM interface that serves the propose as NIR light source, a NIR camera that serves the purpose of capturing the light that passes through the user's finger and create an image that can be processed by a computer and some physical support for the users to place the finger.

Figure 1 Device used for acquisition

- *Preprocessing*

For removing the noise, translational and rotational variation, low contrast, etc., in the captured image, pre-processing of the image is required. Accuracy and efficiency of the recognition process mostly depend on the pre-processing, which consist of operations such as Region of Interest (ROI) detection, image Normalization, segmentation and Morphological Transformations.

- *Feature Extraction*

Feature extraction is a critical step in finger vein recognition as it is used to identify individuals. In this step, a biometric trait called finger vein template is created . The efficiency of feature extraction techniques improves the accuracy of recognition. Several feature extraction techniques were employed for finger veins. But the accuracy of deep learning-based methods exceeds most of the traditional feature extraction methods such as local binary- based, dimensionality based, minutiae-based methods .

Local Binary Pattern (LBP)

Steps that are follwed in the LBP Method,

1. Suppose a facial image in grayscale is present. Get part of this image as a window of 3x3 pixels.
2. It can also be represented as a 3x3 matrix containing the intensity of each pixel (0~255).
3. Then, The central value of the matrix to be used as the threshold.
4. This value will be used to define the new values from the 8 neighbors.
5. For each neighbor of the central value (threshold), A new binary value is set. 1 is set for values equal or higher than the threshold and 0 for values lower than the threshold.
6. Now, the matrix will contain only binary values (ignoring the central value). Concatenate each binary value from each position from the matrix line by line into a new binary value (e.g. 10001101).
7. Then, This binary value is converted to a decimal value and set it to the central value of the matrix, which is actually a pixel from the original image.
8. At the end of this procedure (LBP procedure), A new image which better represents the characteristics of the original image is obtained.

- *Matching*

The likeness of the input and the enrolled templates are compared to check if the input image is genuine or not. Conventional finger vein identification uses distance-based matching, whereas, machine learning techniques uses classifier based matching.The similarity between the extracted binary codes and the enrolled codes is measured using Hamming Distance (HD).The formula is given by

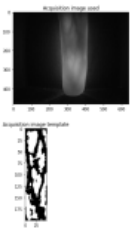
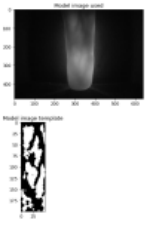
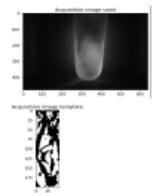
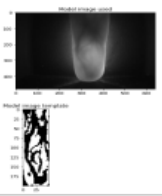
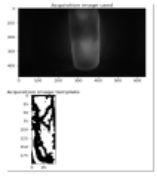
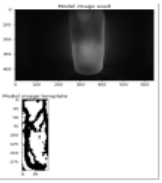
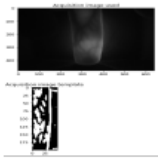
$$HD = \frac{||(codeA \otimes codeB)||}{CodeLength}$$

where $\otimes$ is a Boolean exclusive-OR operator between corresponding pair of bits. The codeA and codeB are the extracted binary and enrolled codes, respectively. CodeLength is the total number of bits of the enrolled code. The HD value is ranging from 0 to 1. The HD is close to 0, when the two codes are from the same finger. When the two codes are from two different fingers, the HD is close to 1.

IV. RESULT ANALYSIS

TABLE I

Matching results for various persons finger vein images

Details of acquisition image and model image	Acquisition image and template	Model image and templates
Match value: 17179 Person ID: 2 Acquisition image used: 1 Matched model: 2 Model image used: 1		
Match value: 21153 Person ID: 3 Acquisition image used: 1 Matched model: 3 Model image used: 5		
Match value: 21889 Person ID: 1 Acquisition image used: 3 Matched model: 1 Model image used: 5		
Match value: 36042 Person ID: 9 Acquisition image used: 3 No matching		No model image found

The first column is about the details of the image used and model and the other two columns are Acquisition images and model images of respective persons.

Here, The first three rows has successfully matched with the model image present in the darabase. Whereas, The row 4 doesn't have any matched model.

V. CONCLUSION AND FUTHER SCOPE

Accurate extraction of finger vein pattern is a fundamental step in developing finger vein based biometric authentication systems. Finger veins have textured patterns, and the directional map of a finger vein image represents an intrinsic nature of the image. The finger vein pattern extraction method using LBP method. In this method finger vein image undergo normalization, thresholding and morphological transformation. Experimental results indicate that this method is a better enhancement and has good segmentation results even with low-quality images.

Future work of this model is to further study finger vein feature fusion with fingerprint and other features to improve system reliability. Time taken in the matching phase can be decreased further.

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