ISSN No. 0976-5697

Volume 8, No. 5, May-June 2017

International Journal of Advanced Research in Computer Science

REVIEW ARTICLE

Available Online at www.ijarcs.info

Review on Secure and Authentic Identification System using Finger Veins

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Abstract: Biometric devices are the latest trend that is used to verify one's unique physical traits.Finger vein is a new biometric identification system that is highly secure and authentic. In this paper a survey has been done on finger vein identification by taking into account a lot of literature study. Also the feature extraction methods have been discussed with various classifiers that classify these features to get the accuracy calculated. This paper also presents some of the advantages of this secure Identification system.

Keywords: Gabor Filter, Median Filter, Repeated line tracking, Local Line Binary Pattern, Frangi Filter, Discriminant classifier, K-Nearest Neighbor Algorithm.

I. INTRODUCTION

Biometric identification is an automated identification that uses unique characteristics of an individual [1]. A lot of biometric identification has been done some of them are face recognition, finger print, palm print, voice, Iris so on and so forth. All of these techniques have some flaws and can be forged easily. With face and voice recognition accuracy rate will be very less also voice can be easily tempered. Another biometric identification is finger prints and palm print which with age may not be clear for identification and can be easily stolen. Iris which gives best results in-terms of accuracy is one of the secure identification system which is less prone to attacks but this secure identification system has also some inconvenience. The direct light that comes from iris biometric device into the client's eyes feels client some mental sickness and due to this they don't feel good to use this sort of biometric device for identification.

The finger vein biometric identification came into existence after the invention of finger print biometric identification in the year 1985thatwas developed by Joseph Rice [2]. Finger vein is a remarkable physiological biometric device for distinguishing people by their physical characteristic and attributes of their vein patters [3]. In this biometric pattern blood vessels are beneath the skin surface that makes this biometric device more powerful against attacks and forgery also you will find no direct contact between system and client which makes it more authentic. This type of biometric is used in various field of medical sciences, law enforcement offices and in various applications where security and authenticity is a critical reason. Finger vein biometric is used to verify the unique identity of an individual. In-fact twins have different vein patters. So, this identification method is much more secure than any other method.

II. RELATED WORK

M.Kono et. al. [4] gave the strategy to enhance the vein patterns by using background-reduction filter to eliminate the background noises i.e. a low pass filter was used. Thedrawback of this method is that some important information from the foreground gets reduced when the background noise was eliminated. After that Miura et al [5] gave the repeated line tracking technique which is the improved version of the previous finger vein identification technique. In this strategy maximum curvature points were used to extract the finger vein features. Both of these strategies use statistical approach that was computationally complex [6].

Another framework for identification of finger vein images was proposed by Kejun Wang et al [7]. In this technique relative distance and angles were used in which the point of interest is extracted from vein imagesby figuring number of arms beginning from a pixel. At that point these focuses were associated with each other with straight lines to shape a cross section topology. At that point the relative distance between the converging points and the angle between them was ascertained. Yet, the relative separation and angle computation from a cross section topology is a difficult task.

A Novel Finger Vein Feature Extraction Technique for Authentication has been introduced by Reshma Rajan and Indu M.G [8]. In this technique he used various feature extraction methods such as Frangi filter FAST algorithm and FREAK descriptors.Abrahán Pérez Vega, Carlos M. Travieso and Jesús B. Alonso[9] proposed unique identification biometric framework of finger veins in which binarization approach, Sobel locator and enhanced filters are used to get the vein images. The mistake rate of this approach is 27.5% and the genuine acceptance Rate of 100% for a False Acceptance Rate of 0%.

The fusion of finger veins, dorsal veins and palm veins has been introduced by Xiangqian Wu, Enying Gao, Youbao Tang and KuanquanWang [10]. In this approach veins of whole hand has been examined that is far better than single feature by using SVM classifier and the error rate is 0.023%.

An algorithm that utilizes adaptive filtering and retinex technique has been developed in-order to enhance the hand vein images has been proposed by Hua-Bin et al [11]. In this proposed work for image acquisition NIR hand vein images were used which are then normalized by using a method known as retinex followed by the adaptive smoothing method for estimation of the illumination.

Anil K. Jain, Arun Ross, and Salil Prabhakar [12] introduced a biometric system for the automatic recognition based on their physiological and/or behavioral characteristics of any individual.In his paper he try to make the biometric fully reliable and secure by using multimode biometrics, which includes fusion of f1ace images and finger prints images. In this fusion they uses multiple matches (minutiae and non-minutiae based matches), multiple sensors (optical and capacitance sensors), multiple units (right, index and middle finger), multiple snapshots (two templates of right index finger) and multiple biometrics (face and finger prints). At last he conclude with that the full personal identification proof doesn't exists and perhaps will not.

The Gradient Feature detector Algorithm has been introduced by Prathiban K., Amitabh Wahi, Sundaramurthy S. and Palnisamy C. [13]for the detection and extraction of finger vein images. This method try to increase the feature information and obtains all the points on the Gradient of finger vein image. Also in his paper a new normalization method has been introduced that reduces disturbances that has been created by different finger pose. The algorithm proposed in this paper is used to extract vein images by identifying different parameters such as finger vein length, intersection,width of veins, position, and pixels. This system proposed is convenient for low power consumption devices such as mobile devices and ATM.

Another method introduced by David Mulyono, Horng Shi Jinn [14] has used source image that has been clicked by web camera whose image quality can't be as good as CCD camera or any other high quality camera. Several authors tried to enhance the image quality for unique identification. So, they achieve 0.275% of FRR, 0% FAR, and identification rate up-to 100% and response time is 0.5s which shows the biometric is very effective and meets the clients requirements.

Shi et al [15] proposed a method that makes devices that have low cost by using vein pattern images with low contrast, and high-quality images. This method extracts the enhanced quality of vein patterns successfully. The principle of vein imaging is discussed to acquire the vein images which could enhance the contrast and the algorithm of extracting the vein pattern from low quality images.

A secure and reliable identification system has been introduced by Desong et al [16] that uses biometric technique which has been fitted into clients hardware devices. This method shows high security and reliability than other identification methods. Random transform is used for feature extraction and normalized distance measure is used for classification purpose.

Lin et al [17] proposed an algorithm for vein extraction and partitioning dorsal hand vein images after which noise is removed by using Gaussian low pass filter and by median filter. These vein patterns are then segmented by using NiBlack algorithm and then area thresholding algorithm is used to remove noise.

Naoto et al [18] has introduced a technique that extracts vein patterns from noisy images by using line tracking method. This research consists of finger vein images that contains vein images as well as shading that is due to the thickness of finger muscles and bones and are captured under infrared light.

III. FINGER VEIN IDENTIFICATION STEPS

A. Image Acquisition and Databases

Two ways that has been introduced for finger vein image acquisition: light reflection and light transmission method. The distinguishing factor between these two methods is in the position of NIR light. In case of light reflection method, NIR light is placed in finger palmer side and by then vein patterns are captured by reflected light from palmar area where as in case of light transmission NIR light is placed in finger dorsal side where the light will go through the finger. Amongst these two cases light transmission method captures high quality images. So, most acquisition devices use light transmission method. So, a typical device of light transmission known as NIR (Near Infra-Red) camera has been used to capture high quality images of veins as NIR light passes easily through the bones of finger even though the bone thickness is more and captures the vein images at high quality.

Also we can use a public database as multiple finger vein databases that have been introduced. Among them the five typical databases are as follows:

The first one is named as SDUMLA-FV database [19] which was built at Shandong University and is the part of multimodal homologous database. It consists of 106 subject numbers. The finger number per subject is 6 and the number of images per subject is also 6 with the pixel size of 320×240. Another database was proposed by Ajay and Zhou [20] known as HKPU-FV which is also a homologous multimodal database. There are 156 subject numbers in this database and finger number per subject is 2 with number of images per finger as 12/6.

The pixel size of images is 513×256.The third database which was built from University of Twente and is abbreviated as UTFV database [21]. It consists of 60 subject number with the finger number per subject is 6 and number of images per finger is 4. Here the pixel size of images is 672×380.The two finger vein databases were recently introduced at Tsinghua University [22] and Chonbuk Nation University [23] which is also the homologous multimodal database known as THU-FV database.It contains 610 subject number and the finger number per subject is 1 with number of images per finger as 2 and pixel size of 200×100.

Another one is named as MMCBNU_6000 database. It consists of 100 subject numbers, 6 number of fingers per subject and 10 images per finger. The pixel size here is 640×480. All these database use light transmission-based image acquisition device.

B. Pre-processing

Generally, image captured by cameras are noisy and such images need to be processed (pre-processed). Pre-processing is a stage in which all the undesirable noise is to be removed from the image. In pre-processing various types of morphological operations and enhancement techniques are to be applied on the image. Pre-processing of image includes:

a. Segmentation

Segmentation is the process of segmenting the image in-order to remove the unwanted noise or useless information from the image and to get the Region of Interest (ROI). In

this process various morphological operations are to be applied on the original image in-order to get ROI.

b. Image Enhancement

The arrangement of finger veins is defective due to which the vein images are not much clear. So, we need to enhance these vein images and this can be done by any of these three methods i.e imadjust, histeq and adapthisteq.

C. Feature Extraction

Feature extraction is actually used for dimensionality reduction. In this the input data is transformed into set of features known as feature extraction. Features of finger vein can be extracted by using various types of filters such as Gabor filter [24], median filter. These two types of filters extracts vein images without deformation and noise. Also Repeated line tracking [25] is used for feature extraction. In this type patterns are extracted on the basis of the number of times tracking lines go through the points. This method can start at various positions and is based on line tracking algorithm. In this the dark lines are first identified and then line tracking is used to move along the lines pixel by pixel. When dark lines are not detected then at another position new tracking operation starts so that all dark lines get traced by repeatedly executing local line tracking algorithm. The error rate of 0.145% and response time of 460ms has been shown by this method. This method is quite effective for personal identification purpose.

For feature extraction authors use Local Line Binary Pattern (LLBP) method. The advantage of this method is that the neighborhood shape is a straight line where in Local Binary Pattern (LBP) the neighborhood shape is a square. 204 image of fingers captured from a prototype device were chosen. Time required by LLBP technique for feature extraction is less than that of LBP method which meansLLBP shows better result than LBP technique [26].Frangi filter can also be used for feature extraction. It is originally developed for finger blood vessel detection. The Frangi filter is used to extract the finger vein structure (feature map) from the image. Extraction of Finger veins can also be done by using Maximum Curvature Points [27] in which the values of veins are precisely determined by calculating local maximum curvatures in the cross-sectional profiles.

D. Accuracy Calculation

The features that has been extracted are used to calculate the accuracy. Various types of classifiers can be used in-order to calculate the accuracy some of them are explained below.

Discriminant Classifier

Linear discriminant analysis (LDA) [28] is a generalization of Fisher's linear discriminant. This is a method used in statistics, pattern recognition and machine learning to find a linear combination of features that isolates two or more classes of objects. The resulting combination may be used as a linear classifier, or, more commonly, for dimensionality reduction.

KNN (K-Nearest Neighbor Algorithm)

In pattern recognition, a non-parametric method used for classification and regression is KNN [29]. It is a type of instance-based learning, or it may be called as lazy learning, where the function is only approximated locally and all calculation is deferred until classification. The KNN algorithm is one of the simplest of all machine learning algorithms.

Naive Bayes

In machine learning, Naive Bayes classifiers are a group of basic probabilistic classifiers in light of applying Bayes' hypothesis with solid (naive) independenceassumptions between the components.Naive Bayes [30] is a basic strategy for building classifiers: models that allocates class names to problem instances are vectors of feature values, where the labels of class are drawn from some limited set. There is a family of algorithms that are based on some principle on which classifiers are trained and the assumption is that a particular feature is not dependent on any other features value. Naive Bayes classifiers for some probabilistic models are trained efficiently on the basis of supervised learning. In numerous viable applications, parameter estimation for Naive Bayes models utilizes the technique of maximum likelihood. A small number of training data is used to estimate the necessary parameters that is used for classification which is the major advantages of naive Bayes.

Tree

Decision tree [31] learning utilizes a decision tree (as a prescient model) to go from perceptions about an items (represented in the branches) to make decisions about the target value of an item's (represented as leaves). It is one of the prescient modelling approaches that is used in data mining, machine learning and statistics. Tree models where the objective variable can take a limited arrangement of qualities are called classification trees; in these tree structures, leaves are class labels and branches are conjunction components that prompt those class labels. Decision trees where the continuous values are taken as objective variable (ordinarily real numbers) are called regression trees. Decision method is mainly useful in data mining. The objective is to make a model that predicts the estimation of an objective variable in view of several input variables.

The features are trained on these classifiers and the accuracy is calculated.

IV. CONCLUSION

Finger vein identification is a new innovation which is used for authentication of citizens for identification purpose. This system provides highly secured, leading and authentic solution than any other identification method. In this review paper, a lot of literature survey has been done. Also this paper deals with various pre-processing methods and feature extraction methods. Once features have been extracted, accuracy can be calculated by applying various classifiers on these extracted features. This paper also incorporates some of the benefits of Finger vein identification system which shows that this pattern is one of the secure, authentic and user friendly which cannot be viably stolen or forged.

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