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A Review on Palm Vein Recognition using Deep Neural Network

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Abstract: *The expansion of the internet has significantly in- creased the use of internet data, which necessitates security through unique identity. Traditional security mechanisms, such as user credentials and personal identification numbers (PINs), failed to meet user's demands. Hence a unique identification mechanism is required to offer excellent security for the data. Bio- metrics plays a vital role in today's authentication and recognition in various situations. Biometrics is concerned with the study of specific behavioral and physical characteristics. Fingerprint, face, iris/ retinal, voice, and vascular authentication are some of the biometric modalities that are used for identification. In this paper, different procedures involving palm vein recognition and authentication are discussed*

Keywords: Biometrics, Palm vein recognition

I. INTRODUCTION

Biometric solutions for personal verification and identifi-cation have seen a surge in popularity in recent years. As a result of this, many applications including access controls, biometric time and attendance systems, and law enforcement systems, have evolved. Palm vein recognition is a sort of biometric recognition that uses the properties of the hand veins to verify identity. The unique pattern of the veins inside the palm region of the hand has various advantages over traditional technologies based on biological attributes, such as fingerprint, iris, face, and palmprint verification. It has a unique shape depending on the complexity of the veins. Even within the framework of the pattern, there are variances between twins. It's hard to spoof since a particular camera is required to record the vein pattern, and the pattern vanishes when the individual dies because it relies on continuous blood flow. Since the vein pattern is internal to the body, it is difficult to alter or destroy. Palm vein identification is highly secure because it recog- nises the network of blood vessels beneath the surface of the palm. Vein patterns are much more complex for intruders to reproduce than other biometric traits as palm veins contain internal biological information about the body. The palm veins are naturally hidden naturally and most of the time individuals hold their hands in a half-fist gesture. Even in monozygotic twins, the vein patterns are not replicated. Indeed, the vein patterns of the left and right hands differ. The collection of palm vein images is simple and painless. There is no contamination from the surface to the subject's hand since it captures a palm vein patterns without direct interaction with the vein pattern-extracting sensor. Moreover, external factors from the hand, such as grease and grime, hand wear and tear, dry and moist hand surface etc, have no impact on the vein structure.

II. RELEATED WORKS

With the advent of technology and the passage of time, the relevance of personal recognition technology in modern society has gained much importance. Because of its unforge- able capabilities, palm vein identification has been a popular research topic in biometric recognition. This research [1] proposes to employ the deep feature of a cnn model merged with HOG features to recognize palm vein, focusing at the complicated architecture of palm vein detection based on classic feature engineering methods. A directional histogram (HOG-Histogram Of Gradient) is picked as a fused feature from the features extracted using the usual method. The directional distribution of gradients is employed as the feature of the image in directional gradient histograms, which are often used as feature descriptors.

Vein recognition is one of the most significant and depend- able identity security solutions for biometrics-based identifica- tion systems, as the demand for security systems increases. For personal identification, the obvious and reliable linefeature- based technique can be employed to clearly depict palm vein patterns.The vein pattern is extracted using a directional filter bank with multiple orientations in this paper[2], and the line- based vein attributes are encoded in binary code using the minimal directional code (MDC). The vein's orientation is matched to the kernel's orientation. A directional filter is applied to every region of interest palm vein picture.The veinsin the palm image seem darker than that of the background dueto their greater absorption coefficients. As a result, to extract the minimal directional filter response (MDFR), the minimumdirectional filter response (MDFR) is employed.

The wavelength in the Near-Infrared (NIR) band examined in this paper [3] is 850nm. The image is captured and processed by the imaging and image processing units. The CNN approach will be used to extract veins from images. The system will adapt to analyze and process the image in a more complex manner using this strategy, making NIR palm vein recognition system by a machine much easier. A rectangular- shaped section is chosen as the zone of interest because it fits for Local Binary Pattern (LBP) specifications and also includes the most important regions of the veins. As a result, the ROIis recovered from the 850nm wavelength NIR palm imageries.In this paper, the ROI is delimited around the palm fingers.The hand structure is discovered using the in-between-finger tipsas a guide. The ROI is defined by the segments that connectto the reference points.

This paper [4] presents a recognition technique based on SIFT and ORB features extraction and score-level fusion to improve the identification rate of palm vein recognition tech- niques. Score-level fusion is a data fusion approach with six common rules for combining . As a complement, two dynamic weight combination rules are suggested. The following are the main steps in the proposed technique: To compute the final decision score, first extract Region of interest (ROI) from the registered palm vein imageries and the to-be-matched palm vein image and sharpen them, then extract SIFT features and ORB features and acquire matching scores, and finally use score-level fusion to calculate the final score.

A stage of processing is required before the ROI couldbe sent to the feature extraction method in order to makethe vein image stand out as much as feasible. Different approaches are combined in this paper [5]: To adjust the lighting disparities and enhance the contrast, the Contrast Limited Adaptive Histogram Equalization (CLAHE) techniqueis used first. The clip limit is 4.5, and the tile size is 14; these numbers were determined through trial and error. The image isthen processed with a Gaussian low pass and a median filterto eliminate noise while keeping the vein pattern. Multiple Gabor filters are used in the first step of feature extraction. Gabor filters are a subset of wavelet filters that are basedon the Gabor wavelet. They are a sinusoid weighted with a Gaussian envelope in their 2D form. Convolutional filters are the most frequent way to use them: the areas with a high response reflect features and structures of a specific size and position, depending on the filter's settings.

An autoencoder with k hidden layers and S hidden nodes evaluated by Bayesian optimization method according to the lowest observed value of validation error, as well as a softmax layer, make up the proposed deep neural network model [6]for palmvein recognition. The input and output layers of an autoencoder have the same size, and there is just one hidden layer. It uses a self-supervised learning technique with backpropagation to recover the original input data by imposing a knowledge representation (code) of the original data into the hidden layer activations. This representation is either sparse (overcomplete) or compressed (undercomplete).The number of hidden nodes in an overcomplete representation is equalto or greater than the number of input data, necessitating the employment of a regularisation approach to avoid fitting problem . The input data is mapped to a new feature spacethat may be more separable using overcomplete representation.The number of hidden nodes in an undercomplete autoencoderis less than the given set of input nodes. The autoencoderis trained unsupervised in k phases, one hidden layer at a moment, while the softmax layer is learned supervised byusing encoded outcomes of the learned autoencoder and labels that match to each individual's ID.

The palm vein characteristic was retrieved using an image processing model that included a Gabor filter [7] for image filtering and a Canny edge detector for edge detection. After using Gabor image filtering, the edge detection approach is used to extract the blood vein structure's edges more accu- rately. The corner point detection technique known as Harris- Stephens feature point detector is used to detect the feature set. The palm vein image matrix is analyzed to compute Euclideandistance metric to produce the distance of an image image pixel in m and n plane coordinates after feature extraction technique of the edges as feature key points.

Because of its discrimination capability and computational efficiency, the local binary pattern (LBP) is popular for texturerepresentation. However, when it is used to characterise the sparse texture in vein images, the discrimination capability is diminished, resulting in lower performance, especially for the matching of contactless palm vein. An improved mutual foreground LBP approach for achieving good matching per- formance for contactless palm vein detection is provided in this study [8]. For texture extraction, the normalised gradient- based maximal principal curvature algorithm and the k-means approach are used, which significantly remove the noise and enhancing the accuracy and resilience.Then, for similarity measures, an LBP matching technique was used on the accountof extracted palm vein patterns and their neighbors, which encompass the vast amount of useful distinguishing data for recognition while removing background interference. The matched image pixel ratio was used to select the best matchingregion(BMR)to increase the LBP performance even further (BMR). Furthermore, the matching score obtained during the search for the BMR was combined with the findings of the score level of LBP matching to enhance the identificationperformance even more.

Researchers have begun to employ local invariant feature extraction technologies to vein detection and have achieved good recognition performance .In this paper [9], mainly two algorithms are SIFT and ORB are discussed for extracting lo- cal invariant feature. SIFT is a software that extracts data. Theyare the blob feature and ORB to extract the corner feature, autonomous as well as supplemental.Because the matching scores not only contains the rich biometric information, butit is also convenient to access and fuse, score-level fusion is one of the most popular and effective fusion approaches. In this paper, a multi-algorithm and score-level fusion palm vein identification algorithm is developed. The following are the main steps: First, extract the ROI of the palm vein image and improve it with image enhancement; secondly, use the SIFT and ORB for extracting features and matching, respectively; finally, choose the optimal score fusion rule to acquire thefinal score, and identify the person based on the final matchingscore.

The compressed sensing approach is used to reconstruct an image in order to acquire a better image in this paper[10]. The goal of compressed sensing (CS) is compressing the signal as itis being sampled.Compressed sensing (CS) uses a low sample rate to reduce storage and transmission bandwidth needs while providing robust anti-noise and security during image transfer.The CS has been shown to be a successful image restoration technology. It's worth mentioning that while the CS demands a sparse measured signal, ensuring the sparseness of the exact transmission signal in the propagation domain is problematic. The sparse representation of signals, the design of the observation matrix, and the reconstruction are the three key aspects of the compressed sensing algorithm.

Palm vein has several advantages over other methods , as it indicates if someone is alive or dead, it is hidden beneaththe human tissue, and it is nearly impossible to duplicate.The goal of this research[11] is to use Principal Component Analysis (PCA) for feature extraction and Probabilistic NeuralNetwork (PNN) for classification. PCA can reduce the amountof a feature's dimension while keeping the key feature. As a result, the operational load is lightening without compromisingthe extracted characteristics. PNN, on the other hand, is a classification approach that is noted for being a rapid method of training while still enhancing performance.

In this paper[12], a new technique was provided to increase recognition accuracy and be well matched to actual application scenarios, which included a novel way of region of interest segmentation and an advanced palm recognition techniqueof VGG16 deep convolutional neural network. To begin, the original palm vein image is obtained by profiling the original image, placing the original image's key point, and extracting the region of interest image. After that, image quality is improved using the adaptive histogram equalisation approach and Gaussian Filters.Moreover, the output of the convolutionallayer of the VGG-16 convolutional neural network is standard-ised in batches for palm vein image recognition application scenarios, and the attention mechanism is added to optimise the VGG-16 neural network. The optimised model is used to extract features from palm vein images and recognise them. Furthermore, the palm vein data set was enhanced, and thena large set of experiments were conducted to determine the optimal recognition rate.

The recognition rate of palm vein images is considerably affected by horizontal rotation, translation, and tilting. To overcome these issues, this paper[13] proposes a palm vein detection approach relying on affine geometric features. To begin, image preprocessing is used to acquire the palm area ofthe vein image. Second, a series of palm and segment centroidsare retrieved. The area radio of the triangles formed with cen- troids is used to create feature vectors. Finally, the matching criteria are Euclidean distance. The suggested technique attainsrecognition ratio and is strong to venous picture rotation and tilt, according to experimental data.

To obtain palm vein images, in this article[14] an equipmentwith a wide-angle, low-resolution camera and a constant power active light source is used. Experiments reveal a link among palm distance and palm vein recognition performance. The image sharpness improves as the distance decreases, although the palm may be too close to the missing portion of the palm vein features due to the usage of a continuous power active infrared light source. When palm distance changes, the match values increase, even while the distance distribution remains within the intra-class range, but still the false rejection rate surely increases.

III. CONCLUSION

The study discusses the different technologies of palm vein recognition, which represents a new era of biometrics. Palm vein biometric technology is very popular currently because it is rooted in human vein features that are hard to manufacture or change throughout one's lifetime. It's considered safe, and it's incorporated with "aliveness" recognition. Because of the uniqueness and intricacy of palm vein patterns, palm veinauthentication provides a high level of authentication accuracy.This is a tough approach to create since the palm vein featuresare inside to the body.

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