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A Review in Various Approaches of Feature Extraction and Feature Fusion in Multimodal Biometric System

Deep Kumar
Software Engineer, Igniva Solutions Private Limited, Mohali, Punjab, India

ABSTRACT

Biometric system is the field of digital image processing that has been used in various applications of security and surveillance. In the process of biometric authentication various approaches have been used for biometric traits based matching. Face, finger, iris and voice are the biometric traits that can be used in the process of biometric recognition system. Due to forgery various attackers are capable of forging biometric sample that allow them to break security available at any application. To overcome this issue multimodal biometric system based concept has been introduced. This process use combination of at least two biometric traits features so that better security system can be developed that can used under those application where high security must be required. In this paper various approaches have been studied that has been used for feature extraction andfeature fusion.

Keywords : PCA, Minutiae, GA, FFT and Gabo filter

I. INTRODUCTION

1.1 Digital Image:

A digital remotely sensed image is typically composed of picture elements (pixels) located at the intersection of each row i and column j in each K bands of imagery. Associated with each pixel is a number known as Digital Number (DN) or Brightness Value (BV) that depicts the average radiance of a relatively small area within a scene (Fig. 1). A smaller number indicates low average radiance from the area and the high number is an indicator of high radiant properties of the area. The size of this area effects the reproduction of details within the scene. As pixel size is reduced more scene detail is presented in digital representation.

1.2 Biometric Systems

A biometric systemis essentially a pattern recognition system that operates by acquiring biometric data from an individual, extracting a feature set from the acquired data, and comparing this feature set against the template set in the database. Depending on the application context, a biometric system may operate either in verificationmode or identification mode.In the verification mode, the system validates a person'sidentity by comparing the captured biometric data with her own biometric template(s) stored in the system database.In such a system, an individual who desires to be recognized claims an identity, usually via a personal identification number (PIN), a user name, or a smart card, and the system conducts a one-to-one comparison to determine whether the claim is true or not. Identity verification is typically used for positive recognition, where the aim is to preventmultiple people from using the same identity.

1.3 Various Characteristics Used In Biometric

- Face
- Finger
- Iris
- Gait
- Voice
- Hand Geometry

1.3.1 Face

Face recognition is a non-intrusive method, and facial images are probably the most common biometric characteristic used by humans to make a personal recognition. The applications of facial recognition range from a static, controlled "mug-shot" verification to a dynamic, uncontrolled face identification in a cluttered background. The most popular approaches to face recognition are based on either: 1) the location and shape of facial attributes such as the eyes, eyebrows, nose, lips and chin, and their spatial relationships, or 2) the overall (global) analysis of the face image that represents a face as a weighted combination of a number of canonical faces. While the verification performance of the face recognition systems that are commercially available is reasonable, they impose a number of restrictions on how the facial images are obtained, sometimes requiring a fixed and simple background or special illumination.

1.3.2 Fingerprint

Unique mark Identification is the technique for recognizable proof utilizing the impressions made by the moment edge arrangements or examples found on the fingertips. No two persons have precisely the same plan of edge examples, and the examples of any one individual stay unaltered all through life. Fingerprints offer an in falible method for individual ID. Other individual qualities may change, yet fingerprints don't. Fingerprints can be recorded on a standard unique mark card or can be recorded digitally and transmitted electronically to the FBI for examination. By contrasting fingerprints at the scene of a wrongdoing with the unique mark record of suspected persons, authorities can build supreme evidence of the vicinity of character of an individual.In 1924 the distinguishing proof division fo the Federal Bureau of Investigation (FBI) was secured to give one focal store of fingerprints.

1.3.3 Iris recognition: Today the demand on security is increasing greatly. Consequently, biometric recognition, which is a safe, reliable and convenient technology for personal recognition, appears. This technology makes use of physiological or behavioral characteristics to identify individual. A biometric system is a pattern recognition system including acquiring the biometric feature from individual, extracting the feature vector from the raw data and comparing this feature vector to another person's feature vector. Fingerprint, palm-prints, face, iris, gait, speech and signature are widely used biometric features.

II. REVIEW OF LITERATURE

Jiali Yu, et al [1]"Face Recognition Based on Euclidean Distance and Texture Features"a new technique for face recognition using the texture features. Texture features often have a rotary deformation, and have strong resistibility to noise. The paper first constructs the gray level co-occurrence matrix of face image to describe texture feature of face image, and then uses the classification method of minimum weighted Euclidean distance to fulfill the matching and identification of face. Experiments results have shown that recognition rate was greatly increased by the combination of weighted Euclidean distance and texture feature.

P. Mohanaiah, P. et al [2] "Image Texture Feature Extraction Using GLCM Approach"a new approach for Feature Extraction for capturing visual content of images for indexing & retrieval. Primitive or low level image features can be either general features, such as extraction of color, texture and shape or domain specific features. This paper presents an application of gray level co-occurrence matrix(GLCM) to extract second order statistical texture features for motion estimation of images. The Four features namely, AngularSecond Moment, Correlation, Inverse Difference Moment, andEntropy are computed using Xilinx FPGA. The results show thatthese texture features have high discrimination accuracy, requires less computation time.

KoneruAnuradha, et al [3] "A Novel Method of Face Recognition Using LBP,LTP And Gabor Features", a

new method for face recognition. In this paper combination of KLDA (combination of LBP and GABOR features) with gradient face features (which are more resistive to the noise effects) for more effective recognition process. This make three main contributions: (i) present a simple and efficient pre-processing chain that eliminates most of the effects of changing illumination while still preserving the essential appearance details that are needed for recognition; (ii) introduce Local Ternary Patterns (LTP), a generalization of the Local Binary Pattern (LBP) local texture descriptor that is more discriminate and less sensitive to noise in uniform regions, and show that replacing comparisons based on local spatial histograms with a distance transform based similarity metric further improves the performance of LBP/LTP based face recognition; and (iii) improve robustness by adding Kernel PCA feature extraction and incorporating rich local appearance cues from two complementary sources – Gabor wavelets and LBP – showing that the combination is considerably more accurate than either feature set alone.

Young Ho Park et al [4] "A Multimodal Biometric Recognition of Touched Fingerprint and Finger-Vein" Multimodal biometric frameworks have been generally used to defeat the limit of uni-modal biometric frameworks and to attain to high distinguishment exactness. In any case, clients feel hindrance on the grounds that the greater part of the multimodal frameworks obliges a few steps so as to obtain multimodal biometric information, which likewise requires the particular practices of clients. In this exploration, we propose another multimodal biometric distinguishment of touched unique finger impression and finger-vein. This paper is novel in the accompanying four ways. To begin with, we can get a finger impression and a finger-vein picture in the meantime by the proposed gadget, which gains the unique mark and finger-vein pictures from the first and second knuckles of finger, individually. Second, the gadget's size is small to the point that we can receive it on a cell phone, effectively. Third, unique mark distinguishment is carried out focused around the minutia purposes of edge zone and finger-vein distinguishment is performed focused around nearby double example (LBP) with appearance data of finger territory. Fourth, based on choice level combination, we joined two consequences of unique mark and finger-vein distinguishment. Exploratory results affirmed the productivity and value of the proposed technique.

Mobarakeh, et al [5] "Applying Weighted K-nearest centric neighbor as classifier to improve the finger vein recognition performance" purposed independent component analysis (ICA) based approach is presented for learning view-specific subspace representations of the face object from multi view face examples. ICA, its variants, namely independent subspace analysis (ISA) and topographic independent component analysis (TICA), take into account higher order statistics needed for object view characterization. In contrast, principal component analysis (PCA), which de-correlates the second order moments, can hardly reveal good features for characterizing different views, when the training data comprises a mixture of multi view examples and the learning is done in an unsupervised way with view-unlabeled data. We demonstrate that ICA, TICA, and ISA are able to learn view-specific basis components unsupervisedly from the mixture data.

Muhammad Faisal Zafar et. al. [6] "Novel Iris Segmentation and Recognition System for Human Identification" In this paper author want to proposed that the richness and apparent stability of the iris texture make it a robust biometric trait for personal authentication. The performance of an automated iris recognition system is affected by the accuracy of the segmentation process used to localize the iris structure. In case of wrong segmentation, wrong features will be extracted and hence, may lead to false identification results. Most of the authors propose Circular Hough Transform to localize the boundary of IRIS. But the problem with this technique is its high consumption of time and memory.

Zhonghua Linet. al. [7] "A novel iris recognition method based on the natural-open eyes "Author want

to proposed that the non-intrusive property of irisrecognition leads to several problems to the images of natural-open eyes and it is hard to increase the accuracy of irisrecognition because of these problems. In order to ensure the non-intrusive property as well as achieve an irisrecognition which has high accuracy simultaneously, this paper presents a novel irisrecognition method based on the natural-open eyes. Firstly, makes preprocess to iris image, ensures the effective iris area adaptively. Secondly, finds all iris feature points by directional information, length information, and width information of texture, the neighboring gray information and relativity in the effective iris area.

Thumwarin, P.et. al. [8] "Iris recognition based on dynamic radius matching of iris image" This paper presents irisrecognition method based on dynamic radius matching of iris image. First, the iris images are segmented to remove the eyelashes and eyelids. Then the individual feature of the iris image can be extracted by expanding their polar images into Fourier series. The obtained Fourier coefficient is used as the individual features for irisrecognition. Moreover, in order to reduce the fluctuation caused by size of pupil and iris, the dynamic radius matching is introduced to calculate the similarity between the iris images. Experimental results were performed on CASIA V1.0 public iris database having 756 iris images from 108 persons. The obtained accuracy rate was 94.8%.

III. APPROACHES USED

Gabor Filter: Gabor feature are perfect for distinguishing the script of a word in a multilingual record. Gabor filter with various frequencies and with introductions in various headings have been utilized to confine and extricate content just locales from complex archive pictures (both dark and shading), since content is rich in high recurrence parts, though pictures are moderately smooth in nature. It has additionally been connected for outward appearance acknowledgment Gabor filter have likewise been broadly utilized as a part of example investigation applications. For instance, it has been utilized to concentrate on the directionality appropriation inside the permeable light trabecular bone in the spine. The Gabor space is exceptionally helpful in picture preparing applications, for example, optical character acknowledgment, iris acknowledgment and unique finger impression acknowledgment. Relations between enactments for a particular spatial area are exceptionally unmistakable between items in a picture. Moreover, vital actuations can be removed from the Gabor space so as to make a scanty article representation.

$$G(x) = \boldsymbol{g_e(x)} + i\boldsymbol{g_o(x)}$$

$$G(x) = \frac{1}{\sqrt{2\pi\sigma}} \boldsymbol{e}^{-\frac{x^2}{2\sigma^2}} (\cos(2\pi\dot{\varphi}_0 x) + I \sin(2\pi\dot{\varphi}_0 \boldsymbol{x}))$$

Fast Fourier transform: A fast Fourier transform (FFT) algorithm computes the discrete Fourier transform (DFT) of a sequence, or its inverse. Fourier analysis converts a signal from its original domain (often time or space) to a representation in the frequency domain and vice versa. An FFT rapidly computes such transformations by factorizing the DFT matrix into a product of sparse factors. it manages to reduce the complexity of computing the DFT from $O(n)^2$, which arises if one simply applies the definition of DFT, to O(n log n), where n is the data size.

$$F(\dot{\varphi}) = \int_{-\infty}^{\infty} \boldsymbol{f(x)} \boldsymbol{e}^{-i\dot{\varphi}x} \, \boldsymbol{dx}$$

Minutiae Extraction: The next step after enhancement of the picture is the extraction of minutiae. The improved picture is binaries firs in this stride. The skeleton of the picture is then formed. The minutiae focuses are then removed by the accompanying strategy. The twofold picture is diminished as an aftereffect of which an edge is one and only pixel wide. The minutiae focuses are subsequently those which have a pixel estimation of one as their neighbor or more than two ones in their neighborhood. This closures the procedure of extraction of minutiae points.

$$G(i,j) = \begin{cases} M_0 + \sqrt{\frac{VAR_0(I(i,j)-M)^2}{VAR}} \\ M_0 - \sqrt{\frac{VAR_{0(I(i,j)-M)^2}}{VAR}} \end{cases}$$

PCA: Principal component analysis (PCA) has been calledone of the most valuable results from applied linear algebra.PCA is used abundantly in all forms of analysis - from neuroscience to computer graphics - because it is a simple, non-parametric method of extracting relevant information from confusing data sets. With minimal additional effort PCA provides a roadmap for how to reduce a complex data set to a lower dimension to reveal the sometimes hidden, simplified dynamics that often underlie it.

2D-PCA: Two-dimensional principal component analysis (2DPCA) and two-dimensional linear discriminant analysis (2DLDA) are new techniques for face recognition. The main ideas behind 2DPCA and 2DLDA are that they are based on 2D matrices as opposed to the traditional PCA and LDA, which are based on 1D vector. In some literature, there has been a tendency to prefer 2DLDA over 2DPCA because, as intuition would suggest, the former deals directly with discrimination between classes, whereas the latter deals with the data in its entirely for the principal components analysis without paying any particular attention to the underlying class structure. In this paper, to compare the performances of the two methods, a series of experiments perform on two face image databases: ORL and CAS-PEA

IV. CONCLUSION

Multimodal biometric system is the combination of various biometric traits that has been used simultaneously for enhancing security of the application. In the process of multimodal biometric recognition various biometric traits that have been used for feature extraction. Various approaches have been used for feature extraction from biometric traits so that these features can be fused in a single feature vector. In the process of feature fusion feature level fusion and score level fusion are widely used. Feature level fusion provides better fusion result as compare to score level fusion.

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