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A Survey of Gait Recognition Approaches Using PCA & ICA

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A Survey of Gait Recognition Approaches Using PCA & ICA

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Abstract - Human identification by gait has created a great deal of interest in computer vision community due to its advantage of inconspicuous recognition at a relatively far distance. Biometric systems are becoming increasingly important, since they provide more reliable and efficient means of identity verification. Biometric gait Analysis (i.e. recognizing people from the way they walk) is one of the recent attractive topics in biometric research. It has been receiving wide attention in the area of Biometric. In Gait biometric research there are various gait recognition approaches are available. In this paper, the gait recognition approaches such as "Wavelet Descriptor with ICA", and "Hough transform with PCA" are compared and discussed.

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I. Introduction

The first and foremost important steps towards preventing unauthorized access are user authentication. User authentication is the process of verifying identity. Biometric authentication is based on something one's physiological and behavioral characteristics. In traditional approaches, passwords and tokens were used and it can be forgotten, lost or stolen. There is also usability limitations associated with them. Recently, biometric is attracting more and more attentions. Generally, biometric is a field of technology that uses automated methods for identifying or verifying a person based on a physiological or behavioral trait.[1] These traits are always measured in different systems are the face, fingerprints, palm print, handwriting, iris, gait, and voice etc. Among them, gait recognition, as a relatively new biometric technique, aims to recognize individuals by the way they walk. The advantages of gait recognition are that it can be applied inconspicuously and it offers an ability to recognize at a distance or at low resolution.

II. Related Work

The Gait recognition approaches for human identification plays an important role in many applications especially in security systems. The first gait recognition approach was developed by Niyogi and Adelson on a small gait database in 1994 [2]. Consequently, the HumanID program sponsored by Defense Advanced Research Projects Agency (DARPA) [3] assists greatly in advancing automatic gait recognition. Spurred by the HumanID program, many international famous universities and research institutes, such as the University of Southampton, the Massachusetts Institute of Technology (MIT), Carnegie Mellon University (CMU), Institute of Automation Chinese Academy of Sciences, etc, have made a lot of researches on gait recognition. There are various approaches available for gait recognition which can be divided into two broad categories such as Model based and Model free approaches. Zhang et al. [4] proposed a novel two-step, model-based approach to recognize gait by employing a five-link biped locomotion human model. . Meyer et al. [5] extracted and tracked the contours of different parts of the human body. Lee et al. [6] fitted seven ellipses in the human body area, and used their locations, orientations, and aspect ratios as features to represent the gait. In general, the features used in model-based approaches are insensitive to background cluttering and noise. Model based approaches has high computational complexity and more difficult in low resolution images. However, Model-based approaches are somewhat difficult in real environment because feature extraction process and matching is very difficult. The Model-free approaches are well suitable for real time systems because it is easy to extract the feature and computational complexity is low.

III. Techniques Used

a) Wavelet Descriptors with ICA for Feature Extraction

In this approach, the automatic Gait recognition has been accomplished based on wavelet descriptors and independent component analysis (ICA) for the purpose of human identification at a distance. The background extraction method is applied to subtract the moving human figures accurately and to obtain binary silhouettes. The binary silhouettes are described with wavelet descriptors and convert it into ID signals to get Independent Components (ICs) of these signals using ICA. The fixing point algorithm is used for calculating the Independent Component adoption and selection. Finally using Nearest Neighbor and SVM classifiers are used for recognition.

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Fig.1: Example of gait image preprocessing [7]

a. Original Image b. Background subtraction

c. Image after d. Last edge

b) Shadow Elimination

Wavelet descriptors are used to describe human silhouettes $d_i = \sqrt{(x_i - x_c)^2 + (y_i - y_c)^2}$ where (x_c, y_c) is the centroid of human boundary.

a. original boundary b. boundary with wavelet descriptor

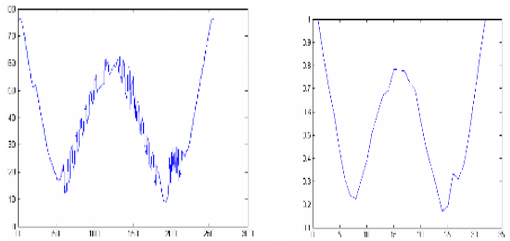

Fig. 2 : Feature representation using wavelet descriptor

Then, the feature extraction and training gait using ICA is done. Using Wavelet descriptors the required variables obtained. Finally the classification process is done using Nearest Neighbor and SVM classifiers. To evaluate the discriminatory of two gait sequences Euclidean distance is applied. There are several kernel functions used in SVM, here radial basis function (RBF) is adopted.

IV. Hough Transform and PCA

a) Hough Transform for Feature Extraction

For efficient gait recognition, the information of straight lines in gait silhouettes is very important. In spatio-temporal gait representation based on the Hough transform contains more straight lines information, and is more insensitive to image noise. Hough Transform is a feature extraction technique which was proposed by Paul Hough who patented the method in 1962. This technique can be used to isolate features of a particular shape within an image [8]. Using some mathematical functions, it is possible to find imperfect instances of objects to describe the boundary curves. Since its computational complexity, Hough Transform is normally restricted to first and second order equation. Commonly, the classical Hough Transform is used for the detection of regular curves such as lines, circles, and ellipses, etc.

PCA

Principal component analysis (PCA) is a mathematical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components.[9] Principal Component Analysis (PCA) is widely utilized to reduce the dimensionality of the data. The goal of PCA is to reduce the dimensionality of the data while retaining as much as possible of the variation present in the original dataset. PCA allows us to compute a linear transformation that maps data from a high dimensional space to a lower dimensional space. Based on these two methods the gait recognition approach was generated. In this approach, initially the preprocessing works were done as follows. First, the image sequences were aligned using some mathematical approaches. It is used to resize the various sizes of images into same size. The Fig.4 shows several gait silhouette images after alignment.

Fig.3 : The Silhouette images after alignment

Secondly the Gait cycle detection was done. Before constructing the Hough template it is very important to compute the periodicity of walking in a gait sequence. After constructing a Hough Transform the Gait Template was constructed. The Gait template was constructed using Laplacian of Gaussian methods. Using this method the edges in intensity gait images were detected. Finally the PCA technique was applied for Feature extraction.

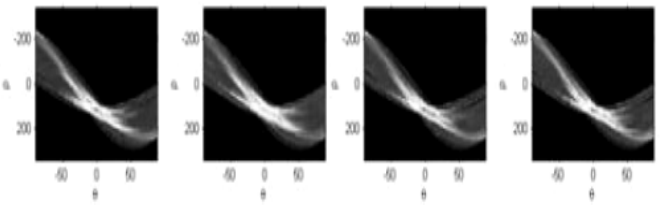

Fig.4 : Gait Templates using Hough Transform

V. Discussion on Analysis

The Gait recognition using Wavelet Descriptor with ICA used two public gait databases, namely Chinese National Laboratory of Pattern Recognition (NLPR) and Chinese Xi'an University of Technology (XAUT) gait database were used to test and evaluate this approach. Here NLPR database having 20 subjects and four sequences for each views angle and have three angles, namely laterally (0°), obliquely (45°) and frontally (90°), XAUT database includes 10 subjects and four sequences for each views angle and have three angles, namely laterally (0°), obliquely (45°) and frontally (90°). The Gait recognition using Hough Transform with PCA used CASIA-A gait database for the analysis purpose [10]. All subjects walk on a straight line under normal conditions. Similar to the Wavelet Descriptors with ICA the three different view angles were [11] used to capture every subject. The database consists of 20 different persons. Each person has 4 sequences per view. The database thus includes a total of 240 (20×4×3) sequences. The length of each collected sequence varies with the pace of the walker, but the average is about 90 frames [11].

Table 1: Ranking & Accuracy of Features extracted

View Angles & Ranks	Performance Analysis (Accuracy %)	
	Wavelet Descriptor with ICA (SVM - NN)	Hough Transform with PCA (CMS)
Laterally (0°)		
Rank 5	97.5%	98.5%
Rank 10	100%	97.5%
Obliquely (45°)		
Rank 5	92.5%	100%
Rank 10	100%	98.5%
Frontally (90°)		
Rank 5	90%	100%
Rank 10	100%	100%

The above table shows the accuracy percentage of the two techniques with respect to the three view angles such as laterally (0°), obliquely (45°) and frontally (90°). In this table for all the three angles the Rank 10 has 100% accuracy for Wavelet Descriptor with ICA technique. Hough Transform with PCA has 97.5% accuracy for Rank 10 and 98.5% accuracy for obliquely (45 °). In the case of frontally (90°) angle both the techniques has 100% accuracy. The increase in the percentage of accuracy for wavelet descriptor with ICA is shown in the below graph.

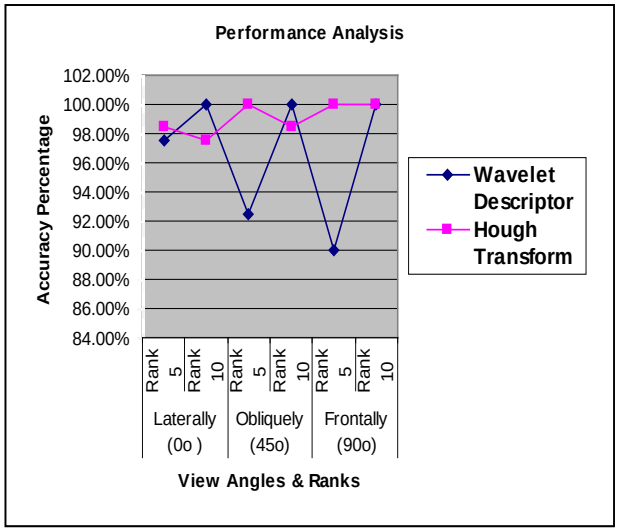

Fig 5 : Accuracy (%) of PCA & ICA techniques

VI. Conclusion

The wavelet descriptor with ICA uses SVM and Nearest Neighbour classifier for classification and recognition. The second approach uses Cumulative Match Scores (CMS) for gait recognition. Both the techniques were compared with different kinds of databases and the results were shown.

References Références Referencias

1. Qinghan, "Technology review - Biometrics-Technology,Application, Challenge and Computational Intelligence Solutions," IEEE Computational Intelligence Magazine, vol. 2, pp. 5-25, 2007.
2. Niyogi, S., Adelson, E.: Analyzing and Recognizing Walking Figures in XYT. In:IEEE Computer Society Conference on Computer Vision and Pattern Recognition, Seattle, Wash, USA, pp. 469–474 (1994)
3. Sarkar, S., Phillips, P.J., Liu, Z.Y., et al.: The HumanID Gait Challenge Problem: Data sets, Performance, and Analysis. IEEE Trans. Pattern Anal. Mach. Intell. 27(2),162–177 (2005)
4. Zhang, R., Vogler, C., Metaxas, D.: Human Gait Recognition at Sagittal Plane. Image Vision Computing 25(3), 321–330 (2007)
5. Meyer, D., Denzler, J., Niemann, H.: Model Based Extraction of Articulated Objects in Image Sequences for Gait Analysis. In: Proceedings of International Conference on Image Processing, October 1997, vol. (3), pp. 78–81 (1997)
6. Lee, L., Grimson, W.E.L.: Gait Analysis for Recognition and Classification. In:Proc. IEEE Int. Conf. Automatic Face and Gesture Recognition, Washington, DC, pp.148–155 (2002).

7. Jiwen Lu et.al., Gait Recognition Using Wavelet Descriptors and Independent Component Analysis Springer-Verlag Berlin Heidelberg 2006
8. Yu, J., Duan, J., Su, K.: A Hough Transform Based Method for Gait FeatureExtraction Journal of Image and Graphics 10(10), 1304–1309 (2005)
9. Boulgouris, N.V., Plataniotis, K.N., Hatzinakos, D.: An Angular Transform of Gait Sequences for Gait Assisted Recognition. In: Proc. IEEE Int. Conf. Image Processing, Singapore, pp. 857–860 (2004)
10. CASIA-A Gait Database [OL/DB], http://www.cbsr.ia.ac.cn/
11. Wang, L., Tan, T.N., Hu, W.M., Ning, H.Z.: Automatic Gait Recognition Based on Statistical Shape Analysis. IEEE Transactions on Image Processing 12(9), 1120–1129 (2003)
12. Ling-Feng Liu, Wei Jia1, and Yi-Hai Zhu : Gait Recognition Using Hough Transform and Principal Component Analysis Springer-Verlag Berlin Heidelberg 2009.
13. Jiwen Lu, Erhu Zhang, and Cuining Jing : Gait Recognition Using Wavelet Descriptors and Independent Component Analysis Springer-Verlag Berlin Heidelberg 2006.