Gait Biometrics: Current Trends and Challenges

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Abstract: **In this era of growing technology, security is a major concern to avoid fakes and forgeries. There are various** Biometrics systems, **which help in personal identification, such as Finger print analysis, Irish identification, Face recognition, Voice recognition and etc., among those systems Gait is one. Biometrics can be classified into two broad categories, such as behavioral and physiological. The Gait is represented as a behavioral Biometrics. This paper explains the significance of the Gait systems and presents the survey of various approaches related with one another. Further this paper provides a comparison of those approaches on the basis of the algorithm and methods, and hence intends to help the researchers working on Gait.**

Keywords: Gait, KLT, SVM, ICA, PCA, MICA, HOG, KNN, CMS, FLDA;

I. INTRODUCTION

Now various security systems such as Finger print analysis, Irish identification, Face recognition and Voice recognition etc., are used to provide authorization and authentication in many application areas ranging from Airports to Banks. Those biometric systems are having some merits and demerits. Hence there is a need of a system which rectifies the demerits of those biometric systems. Being a high performance system which can identifies the intruders from the distance, the Gait biometric system which is overcoming the disadvantages of other systems. Gait has been called as a way of walking. The biological motion of a human being is identified by this biometric system.

The difficulties available in other biometrics systems such as fake lens usage in Irish recognition, lack of the person's coordination being tracked, Image clarity in Finger print analysis are conquered in the Gait systems. The Gait has many advantages, it is easy to identify a human at a distance, it will recognize the unauthorized person's entry within the surveillance area; it is unique, non-invasive and non-contact. This made Gait a most acceptable technique and motivated the users to use it in the real time monitoring systems.

Gait has been classified into two different categories as a model based and motion based methods. The model based method is comparing the extracted features of a human swings and stride by the stored model features(fig 1.1). The motion based method is a dynamic identification and classification of the features extracted from a moving person. It is further divided into two methods as state-space and spatio-temporal.

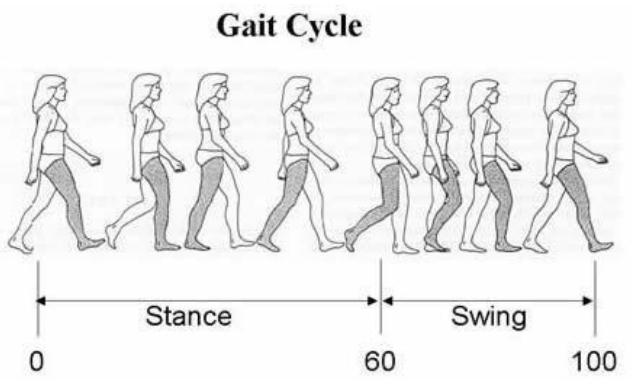

Fig.1.1. Gait Cycle

Now several technologies are available with the effective and reliable means of identification processes, still some modern researchers are continuing in Gait recognition. The following sections present a crisp description about some of the researches about Gait.

II. REVIEW OF AVAILABLE METHODS

Ling-Feng Liu, Wei Jia1, and Yi-Hai Zhu [1] used the spatio temporal representation of a Gait image and classified the extracted features using the Principal Component Analysis (PCA), after the K-Nearest Neighbor algorithm has been used to train and classify the features and attained the 100% accuracy rate.

The Zero-mean Gaussian noise has been added by Michela Goffredo, Imed Boucherika, John N.Carter and Mark S.Nixon[2] for background subtraction captured by multi view surveillance camera. The Third-Order Polynomial Interpolation Technique is used to estimate the marker less joint positions. The Adaptive Sequential Forward Floating Selection method has been used for feature extraction, and the KNN method is used for feature classification. The method adapted by them included the features of low complexity and a fast computation method. Two novel methods are utilized to classify the extracted features, Viewpoint Rectification and Cumulative Match Score (CMS) and attained the 92.2% accuracy rate when using 25 fps, and 81% when the frame rate is 15fps.

Dr.M.Pushparani and Dr.G.Arumugam [3] presented an approach an efficient human Gait recognition system using Modified Independent Component Analysis (MICA). They composed the system with three main modules, firstly, Human detection and tracking, secondly training using Modified ICA and thirdly human recognition. The moving objects (human) are segmented and tracked in each frame using background subtraction method using median value computation, the extracted foreground images are processed by morphological skeleton operator to skeletonization the given image and the features are extracted by using Modified Independent Component Analysis (MICA) training and testing done by using parametric Eigen space and the L2 Norm Distance to measure the exact similarities, they have obtained the 100% accuracy rate.

Table I Brief Representation of Methods

Sl. no.	Year	Author	Pre Processing Background Subtraction method	Feature Extraction method used	Classification Technique	Accuracy rate
1	2009	Imed Boucherika and Mark.S.Nixen Ling-Feng Liu, Wei Jia1, and Yi-Hai Zhu	Spacio Temporal representation	Principal Component Analysis (PCA)	K-Nearest Neighbor (KNN)	100%
2	2008	Michela Goffredo, Imed Boucherika, John N.Carter and Mark S.Nixon	Adding Zero-mean Gaussian noise	Third-Order Polynomial Interpolation Technique	KNN	92.2 % in 25 fps
3	2010	Dr.M.Pushparani and Dr.G.Arumugam	Background subtraction using Median Value computation	Modified Independent Component Analysis (MICA)	Eigen vector and L2 Norm Distance Measure	100 %
4	2011	C.Sasi Varnan, A. Jagan, Jaspreet Kaur, Divya Jyoti, Dr.D.S.Rao	Recursive method using sliding window and Non-Recursive methods by updating the background image frequently	and Angular Radial Transform coefficients feature vector and PCA to process the feature vector	Hidden Markov Model	Width+ART coordinates 100%
5	2012	L.R.Sudha and Dr.R.Bhavani	Background subtraction using Median Value computation	Wavelet Energy Component computation method	SVM	97.92% spatio, temporal & wavelet features
6	2012	L.R.Sudha and Dr.R.Bhavani	Background subtraction using Median Value computation	Wavelet Energy Component computation method	KNN	95.83% spatio, temporal & wavelet features
7	2010	David Kasiska and Anuj Srivastava	Differential Geometry	Dynamic programming, Pseudo Metrics	Dynamic Time Warped system	100%
8	2013	C.Murukesh and Dr.K.Thanushkodi	Gaussian Mixture Model	Principal Component Analysis (PCA)	Multi-Layer Perceptron	98%
9	2010	I. Bouchrika, J. N. Carter and M. S. Nixon and R. Morzinger, G. Thallinger	Frame Differencing	Sparse Optical Flow method based on the KLT	Enhanced Histogram of Oriented Gradients (HoG), (KNN)	100%
10	2013	Dr.M.Pushparani and A.Athishakthi	Gathering Gait Signals	Wavelet Transformation function	SVM	100 %

Gait recognition using extracted feature vectors is proposed by C.Sasi Varnan, A. Jagan, Jaspreet Kaur, Divya Jyoti, Dr.D.S.Rao[4]. They used two different methods for background estimation, the recursive and non-recursive approaches are used. In recursive method a sliding window approach has been used. In non-recursive the background image is updated frequently. Width vector of outer contour of binary silhouette and ART (Angular Radial Transform) coefficients are taken as the feature vector by them to extract the feature from the silhouettes. PCA is applied to remove correlation between the features and also to reduce its dimensionality of the features, finally the Hidden Markov Model is suggested for the classification of the extracted features. They attained the following two different accuracy rate as 83.3% and 100%. The 83.3% have been attained when the Width of the contour is used and the 100% is attained by using the width + ART coefficients.

L.R.Sudha and Dr.R.Bhavani[5] compared the performance of SVM and KNN method in the Gait

recognition. They used a Median value computation for background subtraction and to identify a moving person the

spatial component computation is used. To extract the features the Wavelet Energy Component computation method was assumed by them. For classification, the SVM and KNN methods used separately and provided the comparison among them. The result proved by them is having 97.92% of accuracy while using SVM classifier and 95.83% of accuracy while using KNN classifier. The said accuracy rates are classified according to the spatial, temporal and wavelet features. They proved different accuracy rate for different feature inputs.

David Kasiska and Anuj Srivastava[6] have presented joint Gait cadence analysis for human identification using an elastic shape framework. The Differential Geometry is used to reduce the background image and the extracted shape of a human is defined by Square Root Velocity representation. The Cyclostationary processes or a stochastic process have preferred to compute the Karcher mean to differentiate the human from other moving objects. The Dynamic programming, Pseudo Metrics has been chosen by them to extract the features from the represented shape of a human. Finally, the Dynamic Time Warped system is adopted to provide the linear and non-linear time warping classification to publish the results.

The Gender classification using a side view is addressed by L.R.Sudha and Dr.R.Bhavani[7]. It works under the method of Median Value Computation to perform the background subtraction and SVM for feature extraction and KNN methods used for classification. The gender identification has been done by the extracted features and compared with the available feature vectors with the level of 100% identification rate.

C.Murukesh and Dr.K.Thanushkodi [8] proposed an efficient Gait recognition system. The Gaussian Mixture model is used to remove the background of an input video file image and the relevant features are extracted using Principal Component Analysis (PCA). The Multi-Layer Perceptron is used to recognize the Gait pattern and compares its performance. Fisher Linear Discriminant Analysis (FLDA) to identify the Gait images from the video stream. The real time database is used to evaluate their experiments.

I. Bouchrika, J. N. Carter and M. S. Nixon and R. Morzinger, G. Thallinger[9] developed a Gait system which is used to identify the persons who are walking in the public places. They used the enhanced HoG (Histogram of Oriented Gradients) system to detect the moving things in the frame. The frame difference method has been used to identify the movements. The rhythmic pattern of Gait motion is identified and the sparse optical flow based on KLT is used to extract the

Dr.M.Pushparani and A.Athishakthi[12] developed a Gait system to identify the movement disorders. The Gait is recognized through the signals. They used Wavelet Transform function to extract the features. The SVM classifier is used to classify the features extracted from the previous step. Gait signals are collected from the public database physionet. It is an automated method for detecting movement disorder.

III. Discussions

Above discussed methods have been proved with reasonably good accuracy ratio. The Fig.1.2 explains the ratios with graphical representation. The ratio marked here is between the different methods and the accuracy level of classification.

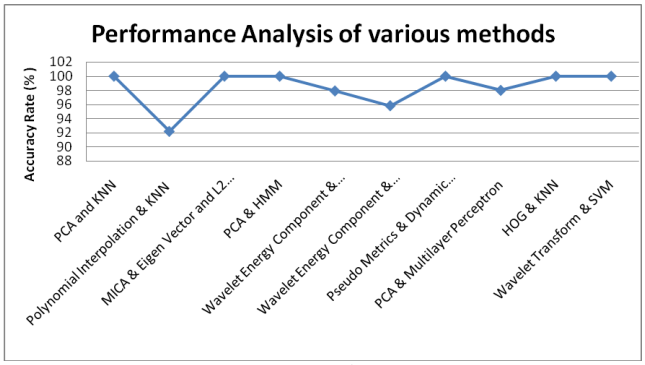

Fig. 1.2 Performance Analysis

Hence most of the methods are proved with the state of the art performance with 100% accuracy; further some researches need to be done in Gait with the correspondence of different application areas like physiological analysis and psychological analysis.

IV. Conclusion

The Gait is unique for every subject when all Gait movements are considered. The different functionalities employed in those methods are discussed above and the methods were tested with the database like CASIA-B, NLPR. All those researchers have proved the methods with high accuracy rate.

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