Analyze And Compare Gait Recognition Using BPNN, MDA AND SVM Simultaneously: A Review

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ABSTRACT

Gait is person’s mode of walking or moving on foot. Gait Recognition is a method to identify or verify individuals by the manner in which they walk. Gait also offers the possibilities to identify people at a distance, without any co-operation or interaction with the subject; this is the property which makes it as attractive as a method of identification. This paper describes the methodology and steps includes in a gait recognition system with an overview of the techniques that are BPNN (back propagation neural network), SVM (Support vector machine) and MDA (Multiple Discriminant analysis) used in the proposed.

Index Terms: Biometric, Gait recognition, Feature extraction, BPNN, MDA and SVM

I. INTRODUCTION

Human gait is biometric for person’s identification. Biometric system is generally used to prevent any kind unauthorized intervention. Biometric resources such as fingerprint or palm print or iris have been employed in many applications like in shopping malls, banks and airports for identification. Every person has different features therefore biometric means unique feature of individual.

There are two categories of Biometric characteristics:

Physiological

Physiological biometrics is obtained from direct measurement of a part of human bodies. Most elegant and effectively used measures are fingerprints, face, iris, DNA, palm print etc. These are associated with human body.

Behavioral

Voice and Gait are related to behavior of the human. Extracted characteristics are all based on any action performed by an individual; they are not direct measure of the characteristic of the human type. The key feature of a behavioral biometric is the use of time as a metric. Some renowned measures include keystroke-scan patterns and speech. Biometric identification should be an automated process. There is need for automation in application such as surveillance, access control and smart interfaces. The process of manual feature extraction would be both undesirable and time consuming, due to the huge amount of data that must be acquired and processed in order to produce a biometric signature. In a real-world application inability to automatically extract the desired characteristics would make the process infeasible on realistic size data sets.

Gait Analysis
Gait analysis is the systematic scrutinize of human locomotion, improved by instrumentation for measuring body movements, activity of the muscles and body mechanics. Gait recognition can be used in various scenarios. Example: To analyze the video stream from surveillance camera. If any unauthorized authority walks in front of camera. System will evaluate and compare his gait with stored gait sequences and recognize him and alerts the appropriate authority for required action. From distance the threat has been detected successfully. Such systems have large scope in areas like in banks, airports and any organization requiring high security. Gait recognition is more suitable in video surveillance applications due to its following merits:

- Gait Recognition does not need any cooperation from the user.
- Gait of an individual can be perceivable from distance.
- Gait recognition perceptibly does not need pictures of very high resolution or quality and provide good results in low resolution.

II. MOTIVATION

The Gait recognition methods proposed in the literature has several parameters but there is always requirement for better parameters to enhance the recognition. So by introducing additional parameters like distance between hands during movements. For enhanced Proposed gait recognition system, Pal and Pal Entropy [1] is investigated which is one of the motivations of this work.

III. RELEVANT WORK

Jeevan, Mahadevu, Neha Jain, Madasu Hanmandlu, and Girija Chetty propose a novel temporal representation of Gait using Pal and Pal Entropy (GPPE) for each cycle of the silhouettes [1]. The Principal component analysis is applied to each and every feature extracted to create a feature matrix. For training and testing of individuals by the proposed method Support Vector Machine (SVM) is used. For experiments, the Treadmill dataset and the CASIA datasets A, B, C have been used for identification.

Huang and Boulgouris proposed a system for gait recognition which uses multiple views. In their purposed system they used six views according to Motion of Body (MoBo) database. They provide an improved recognition rate of 96% by combining gait cycles [10].

Guo and Tian proposed a gait recognition method based on anatomical knowledge and for their experiment purposes they applied Hidden Markov Model. At first, they extracted the silhouette applying morphological operation and selected gait period. For the experiment, they used CMU gait database and selected three walking styles gait cycles which are fast, slow and carrying a ball for identification purposes [12].

Sharmila and kirubakaran designed an approach to extract human gait feature automatically even in low resolution. The applied two techniques for silhouette extraction called Image Based Gait Recognition and Formula Based Gait Recognition in free motion features from video sequence.[14] The Image based gait recognition technique can deal with clothing, segmentation, tracking and lightning. The formula based approach deals with height and stride parameters of wander. They used their own video frame sequencing and applied that for Identification purposes.

Using human shapes and their temporal change, Murase and Sakai presented a template matching method based upon binary representation to distinguish different gaits. Huang et al. extended the
approach of Murase and Sakai by adding canonical analysis. HMMs (Hidden Markov Models) have also been successfully used in gait recognition [17].

Hayder Ali, Chekima Ali, Ervin Gobin Moung, Jamal Dargham, firstly Principle Component Analysis (PCA) is applied for gait recognition purposes. The side view of slow walk, fast walk and ball walk have been selected from the CMU MoBo gait database and described about silhouette extraction technique and rearranged the gait database for Identification purposes. Results achieved equal error rate 85.18%, 80% and 89.90% for side view of slow walk, fast walk and ball walk respectively [11].

For each gait image sequence, an adaptive silhouette extraction algorithm is firstly used to segment the frames of the sequence and a series of post-processing is applied to obtain the normalized silhouette images with reduced noise. A novel feature extraction approach based on outermost contour is performed. Principal Component Analysis (PCA) is adopted to reduce the dimensionality of the distance signals derived from the outermost contours of silhouette images. Then Multiple Discriminant Analysis (MDA) is used to optimize the separability of gait features. In order to verify the effectiveness and robustness of our feature extraction algorithm, we also use other classifiers – Back-propagation Neural Network (BPNN) for recognition.(Lili Liu, Yilong Yin, Wei Qin & Ying Li 2012)[9].

Sanjeev Sharma, Ritu Tiwari, Anupam shukla and Vikas Singh [5], firstly binary silhouette of a walking person is detected from every frame. Secondly, Image processing operations are applied on every frame for feature extraction. Here center of mass, step size length, is talking as key feature. At last, neural network is used for training and testing purpose.

IV. FRAMEWORK OF GAIT RECOGNITION

Steps included in Gait Recognition system:

Capture Video

It is a method of accurate tracking of a person in indoor surveillance video stream obtained from static camera. Example: Any video recording camera that is placed on front door or anywhere in multi-complex or malls can store gait sequences of a person walking there, and that recording can be used for further processing.
Background Subtraction:

In this approach, firstly moving objects in the scene are identified. For the purpose of identification of moving objects from the portion of video frame that differs from the background model, a range of background subtraction techniques are applied. These techniques include segmentation of objects in a scene which are of interest for applications such as surveillance. Background subtraction produce binary images containing only black and white (moving pixels) also called as binary silhouettes.

Fig 2. Background subtraction

Pre-processing

Silhouette segmentation is the initial step to gait recognition. Pre-processing is applied on video frames for noise reduction. Post that filters are applied which aids to shadow removal. Post processing is applied on binary image generated in background subtraction containing white (moving pixel) and black (background) to obtain normalized silhouette images with less noise. Morphological operators like dilation and erosion are used to fill up small holes inside silhouette and to filter small noise from the background.

Feature Extraction

Feature extraction is a method of dimensionality reduction. When input data is very much large to be processed and it is notoriously redundant (e.g. the same measurement in both feet) then set of features (also called feature vectors) are selected for representation of input data. This transformation of the input data into the set of features is called feature extraction. In this process, we use Gait Pal and Pal Entropy (GPPE) representation on sequences of frames i.e. gait cycle and Principal Component Analysis (PCA) is applied to extracted features. Different approaches of feature selection are:

- **Model Based approaches**: Aims to model human body or motion with geometrical curves in these parameters are determined by processing of binary silhouettes. This requires a superior video quality so that characteristics can be extracted more accurately. Parameters used as a feature are distance between head and pelvis, distance between feet. These methods are view invariant, scale.

- **Holistic approaches**: The holistic methods characterize the spatial variation of dynamic variables in Gait cycle. They analyze the variations in shape, distance vectors in the sequence of images of moving person silhouette to characterize the Gait features. These methods can directly operate on binary silhouette. Contour of silhouette are suitable features used in this approach.
Recognition

Gait uses recognition as the final step of human identification. As a first step here the captured video inputs are compared with sequences stored in database. Different types of classifiers are used for the recognition. The minimum distance classifier may be used for gait recognition. In this project we are using SVM MDA (Multiple discriminant analysis) classifier to optimize the separability of gait features.

V. TECHNIQUES USED IN GAIT RECOGNITION

MDA

Multiple discriminant analysis classifiers is used to solve multiple class classification problems. It is useful to optimize the class separability and gives best results. To achieve best class separability in gait recognition, Hanet al. [4] uses MDA. With [5] CRC results by MDA is: MDA+NN = 96.67 percent and MDA+ENN = 97.67 percent.

SVM

Support vector machine. In many applications SVM is considered as powerful classifier for classification problem. SVM is a two class classifier. Firstly, it maps the training samples into a high dimensional space. And in high dimensional space it finds a separating hyper plane that maximizes the margin among two classes. SVMs belong to the general category of kernel method that depends on the data only through dot-products. In this case, the dot product can be replaced by a kernel function which computes a dot product in some possibly high dimensional feature space. SVM has two merits:

Firstly, it uses the methods designed for linear classifier to generate non-linear decision boundaries.

Secondly, the use of kernel functions allows user to relate a classifier to data that have no clear fixed-dimensional vector space representation.

CCR

This is used to estimate the accuracy of classification. We adopt the definition of correct classification rate (CCR) provided by Lee as follows:

\[
Ccr = \sum p(ci)niNici=1
\]

Where \( n_i \) is the number of samples correctly classified to the \( i \)th class via the classifier, \( N_i \) is the total number of samples in the \( i \)th class, \( p(\cdot i) \) is the prior probability that an observed data falls in class \( i \).

BPNN
BPNN stands for Back propagation neural network. Neural networks are very effective for solving multiple class classification problems. A neural network can be viewed as a machine that is designed to model the way in which the brain performs a particular task. We will be using BPNN classifier here to find CCR results. BPNN usually has input layer and output layers, with some hidden layers in-between. Complexity is reduced and computational efficiency is increased using hidden layers. A neural network can be seen as a machine that is designed to model the way in which the brain performs a particular task. Neural networks have been used to identify system as well as data classification technique with significant success rate. [7] They used neural network as a classifier. It is function approximation technique in that network can approximate any function. Neural network is also a nonlinear model. It contains three layers: an input layer, an inside hidden layer and an output layer.

![Multiple Neural Networks](image)

Considering the advantages of neural network we can say that neural network has ability to adjust themselves to data without any explicit function.

VI. CONCLUSION

Gait recognition aims to identify or verify people by the way they walk. Therefore previously several parameters have been proposed for Gait Recognition but there is always requirement for better parameters to enhance the recognition. The existing Gait Recognition Approaches do not consider the distance between hands during movement. Proposed recognition system implement an enhanced Gait Recognition Technique which is based on model based approach that is more accurate and assures quality of result as it considers more parameters like distance between hands during movement. Proposed Gait Recognition Technique show enhanced result and the results will be obtained using BPNN, MDA and SVM technique.

VII. REFERENCES


[14] Sharmila and E. Kirubakaran; “Image and Formula Based Gait Recognition Methods”.

