International Journal of Advanced Trends in Computer Applications
www.ijatca.com

Review on- GAIT RECOGNITION WITH K-REANS USING SVM, MDA and LDA

[1]Anjana, [2]Mandeep
[1]M.Tech Student, LR College,HPTU
[2]Asstt.Professor,College,India
[1]anjnakumari87@rediffmail.com

Abstract: *Human recognition methods are used for identifying individuals on the basis of different biometrics as iris, face, fingerprint, retina, voice patterns and signatures. Among these generally all the biometric traits require a user's cooperation, either via physical contact or close proximity. Such schemes are unable to identify a person at some distance. To overcome this, gait recognition is introduced in biometrics. It is relatively new technique of recognition without these disadvantages. Gait biometric recognize an individual on the basis of their walking pattern. It is a biometric that comes under the type of behavioral characteristics. This paper aims to confer number of techniques such as SVM, K-Means, LDA and MDA that can be application for human identification on the basis of gait biometrics.*

Keywords: *GAIT, Biometric, Support Vector Machine (SVM), LDA, K-Means, recognition, MDA.*

1. Introduction

Biometrics is utilized as a part of a wide exhibit of uses that makes an exact definition hard to build. The word 'Biometrics' constitutes of two words bio which means life or here human being and metric that refers to characteristics of human. These characteristics can be physical or behavioural. Physical characteristics are those related to physical appearance that is shape of human body such as iris, face, retina, finger print so forth and behavioural characteristics are those that relates behaviour of a person, this involves voice patterns, signatures, gait and many more. Biometric recognition is a mean by which an individual can be identified uniquely with the evaluation of one or more distinct characteristics. In the field of computer science biometric authentication is used for the identification purpose and for controlling access.

Gait recognition is a biometric technology that includes individuals being recognized on the basis of their walking pattern. The further research is still going on this field of biometric but it appeals to the researcher as this identification technique is non-invasive and moreover subject's cooperation is not required which make it applicable in area necessitating more security. In early times, verifying identity or authenticating systems were based on key, chip, PIN, or password. Nevertheless, all these things were probably get stolen or lost and sometimes disclosed or forgotten. This was the reason why biometric field uses automated methods to identify and verify an individual. Gait recognition system has been apprehending ardor as it is an approach for identification that is unobtrusive and does not constrain subject's cooperation or any kind of participation. In biometrics, gait is a new territory of study in which the researchers are interested. In gait recognition system the identity of an individual can be validate from their feature obtained by walking pattern. The recognition system will identify the person who is not an authorized person and then correlates the feature of unauthorized person with that stored in the database and then on the basis of result, decision is made that weather the individual get the access or not. The fig 1 shows the basic recognition system. In basic system of recognition any biometric (like gait, face, iris) can be used. The phases of recognition remain same with using any biometric trait. Firstly, the image or video is captured by using camera or sensors. Then database in created by including all images captured in Matlab compatible form.

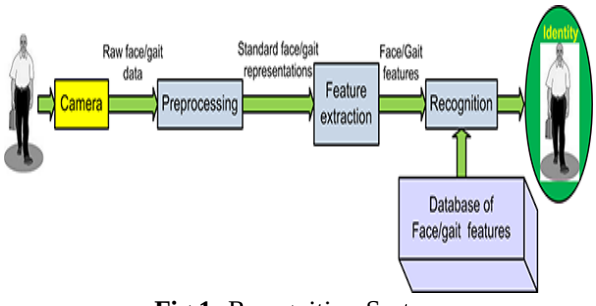

Fig 1: Recognition System

The second phase background subtraction is performed where non stationary objects are subtracted and binary image is obtained. In noise presence, noise reduction is done by applying distinct methods of filtration. The method of Gait recognition mainly consists of two parts; training and testing part. In the laboratory where Gait analysis is performed is equipped with several cameras placed around where individual walking patterns can be recorded from different directions.

In the gait recognition, target is movable, for which the moving target classification algorithm is used. This algorithm segregates a person from the objects present in foreground. This means boundary (edge) and shape (silhouette) information is used for classification of moving target. The feature extraction is an approach of creating combinations of variables to construe the data with ample accuracy.

The Gait Recognition system has various advantages in comparison with other biometric recognition systems as subject's cooperation is not required and also low resolution camera gives promising results but in face recognition system and iris recognition system high resolution cameras along with subject's cooperation is required.

GAIT Applications

The gait recognition system is not restricted to the applications related to security, it is also foresee in medical applications. For instance, by early recognition of the changes in walking patterns can help in identifying the conditions in their earliest stages such as Parkinson's disease and multiple sclerosis.

1. ***Medical diagnostics:*** In gait labs, the patients of Cerebral palsy and stroke are commonly seen. The study of gait allows the diagnoses and intervening scheme to be made, further consenting future developments in rehabilitation engineering. Other than clinical applications, gait analysis is used in training of professional sports for optimizing and improving the performance of athletic.

In computerized gait analysis, patient walks with sensors in his foot. These sensors send information involving foot pressure, timing, and range of motion, to computer and after that on the basis of information gathered, computer creates a diagram. Doctor review the diagram and came up with treatment scheme. The figure 2 shown below shows a person walking with sensor connected on his foot.

Fig 2: Person walking with sensor on his foot

2. ***Biometric identification and forensics:*** Gait Recognition system with little changes in gait pattern can be used for identifying an individual. In this example, gait is applicable as a biometric identifier. Figure shown below shows the gait application in high security area.

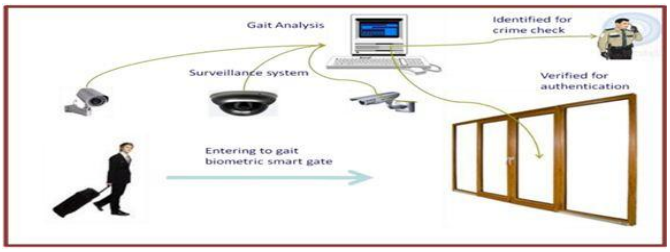

Fig 3: High security application area

In the example shown in figure above, gait recognition is used in security access application area. In this CEO walks firmly towards enterence and as he gets close his gait pattern is recognised and automaically door opens. When an illegimate gets close to door the gait pattern is recognised as unauthorised or criminal and before he becomes an threat, all security alerts are triggered.

2. LITERATURE REVIEW

In this section the review of literature related to gait recognition and biometrics is discussed. The researcher has work on different aspects of recognition along with different techniques. Some of the works that has been done earlier is deliberated in this section.

Niyogi and Adelson developed the first gait recognition approach in the year 1994 on small gait databases [1]. In [1] a general method is described and actuality development of gait recognition, authors illustrates three approaches for recognition by gait, that comprise model based method, statistical based method, and fusion based method. Model based method is a model that constructs human model defining gait dynamics like dimensions of stride and kinematics of joint angle, motion and rotation of thigh and lower leg that depicts both walking and running [2]. In model based approach

different parameters are used as features such as height of a person, distance between head and abdomen, the maximum distance between abdomen and feet and distance between feet, distance between both hands, length of arm, length of leg and so forth.

M. Jeevan *et al.* [3] proposed an approach named pal and pal entropy. Existing Gait representations that can seizure both appearance and motion information are susceptible to transition in numerous conditions like carrying bag and clothing. The randomness in the silhouette is encoded by Shannon Entropy and it mostly seizures the motion information and is sturdy to conditions that influence the appearance. To overthrown this, Pal and Pal Entropy is introduced. The database used in this paper is CASIA and datasets A, B, C have been executed for demonstrating the effectiveness of proposed Gait representation. The authors achieved reasonable results on a large database like CASIA dataset B and C, and proved the suitability of this approach for large datasets.

Maodi Hu *et al*. [4] a modelling approach for gait-based gender classification is proposed that involves extraction of shape features. Shape appearance of both genders is integrated into a model. Estimating walking patterns can provide valuable information regarding physical conditions of individuals. They use both CASIA dataset B and IRIP gait database for gender recognition. For the extraction of features, conditional random field (CRF) is used. It is a form of graphic model, which model arbitrary features. The result obtained in this paper shows the superior performance over model free approach.

S. Yu *et al.* [5] and X. Li *et al*. **[**6**]** each gait image is partitioned into several different parts such as head, chest, and legs, and perform classification on each part with SVM. The outputs of different parts were then combined and fused. Gait analysis is difficult because of the wide variety of movements of the different parts of the body. AGI has shown to be effective for both human Identification and gender recognition.

X. Huang *et al.* [7] study the problem in which most gait recognition methods assume that the view is consistent that is the walking path is already defined earlier but this assumption is not real as human walk freely and walking direction may vary time-to-time. A gait recognition system is proposed where the walking direction changes during the walking period. Shifted energy image and Structural features extraction is used for gait recognition.

Ahmad Puad Ismail *et al.* [8] represented the Sex grouping by means of model-based human walk information was still adolescent. Firstly, six traits placed at lower some piece of human stride particularly from beneath waist onwards have been distinguished as the huge focuses are skeleton zed focused around the human walk form accomplished. Introductory discoveries with correctness of 90% or more affirmed that the proposed technique suited to be used as sexual orientation recognition focused around human walk.

Qiong Cheng *et al.* [9] proposed gait recognition based on PCA (Principal Component Analysis and Linear Discriminate Analysis (LDA). PCA is mainly used for dimensional reduction technique and LDA is performed to optimize the pattern class. For the experiment, they used their own database and they achieved better recognition rate from PCA compared to LDA.

C. Y. Yam *et al.* [10] has proposed gait was a rising biometric. Current frameworks are either all encompassing or gimmick based and have been showed to have the capacity to perceive individuals by the way they walk. This paper portrayed another framework that stretches out the gimmick based methodology to perceive individuals by the way they walk and run. A two-sided symmetric and coupled oscillator was the key idea that underlies this model, which incorporates both the upper and the lower leg. This method has turned out to be fit for perceiving individuals when strolling or running and future work plans to create invariance characteristics of running for the new depiction.

Ai-Hua *et al*. [11] highlighted on the gait recognition subject that distinguish people by examination of walk example. Here a basic and proficient walk recognition technique focused around situating body joints was displayed. At the outset key edge was concentrated focused around cyclic step investigation.

3. TECHNIQUES USED

Support Vector Machine (SVM)

Boser, Guyon, and Vapnik introduced the SVM classifier in 1992. It is a state-of-the-art method for classification with main advantages of its ability to construct a non-linear decision boundary using linear classifiers. The Kernel function is used in SVM that permits the users to apply a linear classifier to non-fixed dimensional data in vector space representation. The protein structure and sequence like DNA, protein are some examples in bioinformatics. The SVM classifier is widely used in various applications because of its high accuracy, capability of estimating and processing high-dimensional data (like gene expression) and so forth. In SVM, a kernel trick only relies upon the dot products of data. This dot product can be reinstated by a kernel function that calculates a dot product in high dimensional feature space.

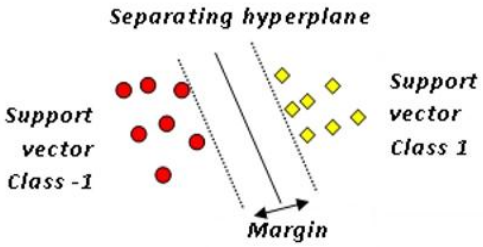

Fig 4: SVM Classifier

K-Means

It is a repetitive refinement interrogative algorithm which works faster in comparison to others. A prevailing technique is to operate the algorithm various times to attain the most excellent clustering found. K-means clustering procedure is a measure that can be applied for retrieval of scalable image from enormous databases. These clustering algorithms combine the images to form clusters on the basis of color content. Clustering is a conjointly exclusionary segregating process of feature space of the feature vectors in a substantial way for the context of application domain. With these clusters, search of nearest neighbor can be performed efficiently. The different facet of this system is the use of hierarchical and k-means clustering techniques. Most of the images are filtered in the hierarchical clustering and then these clustered images are applied from hierarchical clustering to the K-Means, so as to get better recommended image results. After clustering, the cluster centres are selected, and then the given query image is firstly compared with all the cluster centres. The clusters are ranked in accordance with their similarity with the query. Then after, the query image is directly compared with the images present in these clusters. Now, clustered images from the hierarchical clustering are applied to the k-means algorithm that takes the input parameter k, and segregation a set of n objects into k clusters so that the resulting similarity (intra-cluster similarity) is high. An object is assigned to the cluster to which it is the most similar one. Thus, the retrieval of images will be very precise with the hierarchical and K-Means clustering. It leads to the better performance than by using individual algorithmic techniques.

Linear Discriminant Analysis (LDA)

LDA is a method used for classification of data and reducing dimensionality. In PCA, the location and shape of the original data sets varies when transformation is performed to different spaces when in fact LDA doesn't alter the location however only attempts for providing more class separability and draw decision among the given classes. In discriminant analysis, there are two scatter matrices, named *within-class* (*Sw)* and *between-class* (Sb) matrices. These matrices are construed to appraise the quality.

Multi-Linear Discriminant Analysis (MDA)

MDA is a general supervised dimensionality reduction framework. It can avoid the curse of dimensionality dilemma and also helps alleviate the small sample size problem. In the mode of optimization, the sample size is effectively multiplied by a large scale and mode optimization performed in each step which reduces the computational cost to a large extent.

MDA has the characteristics, delineated as;

1) MDA algorithm can avoid the curse of dimensionality and serves the problem of small sample size.
2) Multiple interrelated subspaces can be collaborated to discriminate between different classes.
3) The computational cost is reduced in the learning stage.

Multi-class LDA is based on the analysis of two scatter matrices: with–class scatter matrix and between-class scatter matrix. Given a set of samples

$X_{1, \ldots\ldots\ldots\ldots, } x_n$

And their class labels

$Y_{1, \ldots\ldots\ldots\ldots, } y_n$

The with-class scatter matrix is given by equation,

$$S_w = \sum_{i=1}^{n} (x_i - \mu_{y_i})(x_i - \mu_{y_i})^T$$

Here, is the sample mean of the k^{th} class.

3. CONCLUSION

Gait Recognition system is new arena in biometrics that attracts the researchers. In traditional recognition system, other biometrics related to physical characteristics of human was used. There are two types of biometrics namely based on physical appearance or shape which includes iris, face, finger print and other is based on behavioural characteristics such as voice, gait, and signature. Gait biometric has many advantages over face/iris and other biometrics such as it is unobtrusive and do not require any cooperation from subject. There are three main phases in Gait recognition system that is creating database, pre-processing, and recognition and matching. Different techniques are available for recognition and matching such as K-means, SVM, LDA, MDA and so forth.

All the different algorithms have advantages of own. The technique used for recognition and matching should provide reliable and improved accuracy rate.

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