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Human Identification using MDA,LDA,BPNN,NN Techniques

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Abstract: Gait recognition is one kind of biometric technology that can be used to monitor people without their cooperation. Controlled environments such as banks, military installations and even airports need to be able to quickly detect threats and provide differing levels of access to different user groups. Gait shows a particular way or manner of moving on foot and gait recognition is the process of identifying an individual by the manner in which they walk. Gait is less unobtrusive biometric, which offers the possibility to identify people at a distance, without any interaction or co-operation from the subject; this is the property which makes it so attractive. This paper proposed new method for gait recognition. . In this thesis I will present the review of gait recognition system, different approaches and classification categories of Gait recognition like model free and model based approach, MDA, ENN, NN.

Keywords: Multiple Descriminant Analysis (MDA), Neural Network (NN), Linear Descriminant Analysis(LDA),Back Propagation Neural Network(BPNN),Feature Extraction, Background Subtraction.

I. INTRODUCTION

Traditionally password were set as a string which included integer or special characters and were used for authentication and these password can easily cracked but now Biometric authentications are used. Biometric is a field of technology that uses automated methods for identifying and verifying a person based on physiological and behavioral traits [1]. In real time applications like in banks, airports authentications and verifications are always required. In such type of applications biometric identification methods are used. Every individual has different features therefore biometric means unique feature of a person. Biometric characteristics are of two types physiological and behavioral. Physiological characteristics are face, fingerprints, iris, palm print, DNA etc and behavioral characteristics are voice and gait. As these physiological characteristics does not provide good results in low resolution and need user cooperation therefore recognition using Gait is more attractive. Recognition using gait means to identify a person by the way he move or walk. Gait recognition can also used for low resolution images.

a. Gait recognition system:

System will identify unauthorized individual and compare his gait with stored sequences and recognize him. Background subtraction is the common approach of gait recognition. Background subtraction method [2] is used to subtract moving objects and to obtain binary silhouette. Using background subtraction, preprocessing is done to reduce noise. Background subtraction techniques are also classified into two types: non- recursive methods and recursive methods. Non recursive techniques use sliding window approach for background subtraction. Recursive methods use single Gaussian method and Gaussian mixture model. Gait recognition method contains two parts 1) training part 2) testing part.

b. Feature Extraction:

Feature extraction is an important step in gait recognition. Features are the best function to differentiate between objects from each other. Feature vector is one method to represent feature of image or a part of an image by carrying out measurements on set of features [4]. As silhouette images capture almost the motion of entire body so they are the best features. Two basic feature extraction techniques are classified as 1.Model-based approaches

A. Holistic approaches:

a. Model Based Approach:

Model-based approaches employ models whose parameters are determined by processing of gait sequences (binary silhouettes). These methods are scale, view invariant and requires good quality video sequences. In these methods, parameters used as features are the height, the distance between head and pelvis, the maximum distance between pelvis and feet and the distance between feet. In [1], the silhouette of a walking person is divided in to some regions (generally seven regions). Subsequently, ellipses or rectangles are fit to each region and region feature vectors are determined.

This includes averages of the centroid and the aspect ratio.Model based approach is difficult to follow in low resolution images also they have high computational complexity. Advantage of this approach is the ability to derive gait signature from model parameter and free from the effect of different clothing [4]. Features used in this approach are insensitive to background cluttering and noise [2]. Model based gait recognition system includes motion of thigh and lower leg rotation that describes both walking and running . Parameters used in this approach are height, distance between head and pelvis.

b. Holistic approaches:

Holistic methods operate directly on binary silhouettes without assuming any specific model for the walking human. The contour of the silhouette is the most reasonable feature in this method. For high quality binary silhouettes, width of outer contour of the silhouette was proposed as a suitable feature. For low quality binary silhouettes, the binarized silhouette may be is used as a feature.

c. Model free approach:

Model free approach is easy to follow and has less computational complexity and this approach is best suited for real time systems. [8] They used model free approach for gait recognition based on outermost contour.

II. ALGORITHMS USED

A. Mda (Multiple Discriminant Analysis):

We summarize the advantages of our algorithm, multilinear discriminant analysis (MDA), as follows.

a. MDA is a general supervised dimensionality reduction framework. It can avoid the *curse of dimensionality dilemma* by using higher order tensors and *-mode optimization* approach, because the latter is performed in a much lower-dimension feature space than the traditional vector-based methods, such as LDA, do.
b. MDA also helps alleviate the *small sample size problem*. As explained later, in the *-mode optimization*, the sample size is effectively multiplied by a large scale.
c. Many more feature dimensions are available in MDA than in LDA because the available feature dimension of LDA is theoretically limited by the number of classes in the data, whereas the MDA is not.
d. The computational cost can be reduced to a large extent as the -mode optimization in each step is performed on a feature space of smaller size.
e. The extension from vector to tensor for data representation and feature extraction is general, and it can also be applied in SVM and many other algorithms to improve algorithmic learnability and effectiveness.

Algorithm:

Multilinear Discriminant Analysis:

Given the sample set $\tilde{\mathbf{X}} \in \mathbb{R}^{m_1 \times m_2 \times \ldots \times m_n \times N}$, their class labels $c_i \in \{1, 2, \ldots, N_c\}$, and the final lower dimensions $m_1' \times m_2' \times \ldots \times m_n'$.

1. Initialize $U_1^0 = I_{m_1}, U_2^0 = I_{m_2}, \ldots, U_n^0 = I_{m_n}$;
2. For $t = 1, 2, \ldots, T_{max}$ do

a) For $k = 1, 2, \ldots, n$ do

$$\mathbf{Y}_i = \mathbf{X}_i \times_1 U_1^t \ldots \times_{k-1} U_{k-1}^t \times_{k+1} U_{k+1}^{t-1} \ldots \times_n U_n^{t-1}$$

$$Y_i^k \Leftarrow_k \mathbf{Y}_i$$

$$S_B = \sum_{j=1}^{\prod_{o \neq k} m_o} S_B^j, S_B^j = \sum_{c=1}^{N_c} n_c (\bar{Y}_c^{k,j} - \bar{Y}^{k,j})(\bar{Y}_c^{k,j} - \bar{Y}^{k,j})^{\mathrm{T}}$$

$$S_W = \sum_{j=1}^{\prod_{o \neq k} m_o} S_W^j, S_W^j = \sum_{i=1}^{N} (Y_i^{k,j} - \bar{Y}_{c_i}^{k,j})(Y_i^{k,j} - \bar{Y}_{c_i}^{k,j})^{\mathrm{T}}$$

$$S_B U_k^t = S_W U_k^t \Lambda_k, \quad U_k^t \in \mathbb{R}^{m_k \times m_k'}$$

b) If $t > 2$ and $\| U_k^t - U_k^{t-1} \| < m_k' m_k \varepsilon, k = 1, \ldots, n$, break;

3. Output the projections $U_k = U_k^t \in \mathbb{R}^{m_k \times m_k'}, k = 1, \ldots, n$.

B. Nn (Neural Network):

Neural networks are composed of simple elements operating in parallel. These elements are inspired by biological nervous systems. As in nature, the connections between elements largely determine the network function. You can train a neural network to perform a particular function by adjusting the values of the connections (weights) between elements. Typically, neural networks are adjusted, or trained, so that a particular input leads to a specific target output. There, the network is adjusted, based on a comparison of the output and the target, until the network output matches the tar. Typically, many such input/target pairs are needed to train a network.Neural networks have been trained to perform complex functions in various fields, including pattern recognition, identification, classification, and speech, vision, and control systems. Neural networks can also be trained to solve problems that are difficult for conventional computers or human beings. The toolbox emphasizes the use of neural network paradigms that build up to—or are themselves used in—engineering, financial, and other practical applications.

C. Bpnn(Back Propagation Neural Network):

Neural networks, which have been widely used in image and signal processing very effective for solving multiple-class classification problems. Many researchers have successfully applied neural networks to face/gait recognition. Chau18 notes that neural networks facilitate gait recognition because of their highly flexible, inductive, and non-linear modeling ability. In this paper, we use one classical type of neural networks –BPNN. BPNN usually has input and output layers, with some hidden layers in between. Actually, BPNN can be likened to a flexible mathematical function which has many configurable internal parameters. In order to accurately represent the complicated relationships among gait variables, these internal parameters need to be adjusted through training process. In training process, *gait features* and corresponding labels are input to the network, which iteratively self-adjusts to accurately classify as many *gait features* as possible. Training is complete when some criterion is satisfied (e.g., interaction times reach a preset value or prediction error falls below a preset threshold). Once the neural network is trained, we can use it to predict the *gait features* of testing gait sequences. It is to be noted that the trained neural network simply performs function evaluation using the internal parameters established during training process to produce an output.

D. Lda(Linear Descriminant Analysis):

Linear Discriminant Analysis (LDA) is a well-known scheme for feature extraction and dimension reduction. It has been used widely in many applications involving high-dimensional data, such as face recognition and image retrieval.

In this section, we give a brief overview of classical LDA. Some of the important notations used in the rest of this paper are listed in Table 1.

Given a data matrix $A \in \mathrm{IR}^{N \times n}$classical LDA aims to find a transformation $G \in \mathrm{IR}^{N \times l}$ that maps each column a_i of *A*, for $1 \leq i \leq n$, in the *N*-dimensional space to a vector b_i in the *l*-dimensional space. That is $G : a_i \in \mathrm{IR}^N \rightarrow b_i = G^T a_i \in \mathrm{IR}^l (l < N)$. Equivalently, classical LDA aims to find a vector space *G* spanned by $\{g_i\}_{i=1}^{l}$ =1, where $G = [g_1, \cdots,$

g_l],such that each a_i is projected onto G by $(g_1^T{\cdot}a_i\ ,\cdot\cdot\cdot,\ g_l^T{\cdot}a_i)T \in \mathrm{IR}^l$.

Assume that the original data in A is partitioned into k classes as $A = \{\Pi_1, \cdot\cdot\cdot, \Pi_k\}$, where Π_i contains n_i data points from the ith class, and $\sum_{i=1}^{k} n_i = n$. Classical LDA aims to find the optimal transformation G such that the class structure of the original high-dimensional space is preserved in the low-dimensional space.

In general, if each class is tightly grouped, but well separated from the other classes, the quality of the cluster is considered to be high. In discriminant analysis, two scatter matrices, called *within-class* (S_w) and *between-class* (S_b) matrices, are defined to quantify the quality of the cluster, as follows:

$S_w = \sum_{i=1}^{k} \sum_{x\in\Pi_i} (x - m_i)(x - m_i)^T$ and $S_b = \sum_{i=1}^{k} n_i\,(m_i - m)(m_i - m)^T$, where $m_i = \frac{1}{n_i}\sum_{x\in\Pi_i} x$ is the *mean* of the ith class, and $m = \frac{1}{n}\sum_{i=1}^{k}\sum_{x\in\Pi_i} x$ is the *global mean*.

III. PROPOSED WORK

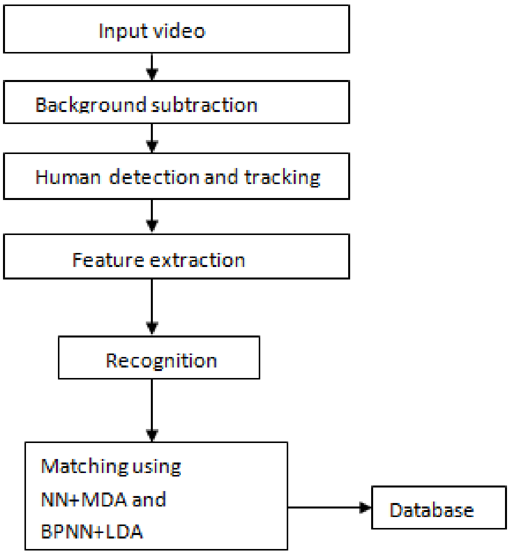


Figure 1: block diagram of proposed work

a. *Input Video:*

Capture an input video for gait identification. First input video will be converted into frames known as video sequences, and those frames are used for further gait Recognition process.

b. *Background Subtraction:*

After converting video into frames, next is background subtraction. Identifying moving objects from a video sequence is a fundamental and critical task in many computer-vision applications. A common approach is to perform background subtraction, which identifies moving objects from the portion of a video frame that differs significantly from a background model. Gaussian mixture model is used for foreground object estimation in which an additional step of filtering by median filter is incorporated to remove noises.

a) Gaussian mixture model*:* GMM is an adaptive model which uses a mixture of normal distributions to model a multi-modal background image sequences. Each surface which comes into the view of a given pixel is represented by one of set of states k ∈ {1.2....K}. Where the number of surfaces k is an assumed constant. The process which generates the state at each frame time t = 1, 2, 3…. is simply modeled by a set of k parameters w_k = p(k), k ∈ {1, 2, ...,K} each representing the priori probability of surface k appearing in the pixel view. The pixel value process X is assumed to be modeled by a mixture of K Gaussian densities with parameters sets, one for each state k.

$$f_{X/k}(X/K,\theta_k) = \frac{1}{(2\pi)^{\frac{n}{2}}\left|\sum_k\right|^{\frac{1}{2}}} e^{-\frac{1}{2}(X-\mu_k)^T \sum_k^{-1} (X-\mu_k)}$$

The first step in this is estimating current state. The k which maximizes the value $w_k f_{X/k}(X/k,\theta_k)$ gives the current state.

b) Median Filtering: after background subtraction, median filtering is used to remove noise.

c. *Human detection and tracking:*

Human detection and tracking is one of the important steps in gait analysis. Tracking is a process of locating moving object. Tracking algorithm is adopted which is based on background subtraction and silhouette correlation to extract and track moving silhouettes of a walking figure from the background image in each frame. Although this integrated method basically performs well on our data set, it should be noted that robust motion detection in unconstrained environments is an unsolved problem for current vision techniques because it concerns a number of difficult issues such as shadows and motion clutter.

Figure: 2 dataset image used for tracking

Figure: 3 Tracking of binary silhouette image

Object tracking is used for determining the position and other relevant information of moving objects in images sequences or to track moving object frame to frame. Idea of tracking is, when we subtract two subsequent frames, part of images which does not change (background) gets subtracted to give zero intensity (black). Only moving object don't get reduces to zero as intensity of two subsequent frames are different and that's, we get non zero intensity for pixel corresponding moving object.

Steps:

(a). Grab i^{th} frame.
(b). Subtract it form $(i-3)^{th}$ frame.
(c). Convert image into binary image.
(d). Fill all holes and label connected pixels.
(e). Run the loop to no of labels and find label for maximum area.
(f). Find centroid of obtained area.
(g). Go to step 1.

d. Feature Extractions:

Feature selection is a crucial step in gait recognition. The feature must be robust to operating conditions and should yield good discriminability across individuals. Each gait sequence is divided into cycles. Gait cycle is defined as person starts from rest, left foot forward, rest, right foot forward, rest. Figure 17 shows the stances during gait cycle. Gait cycle is determined by calculating sum of the foreground pixels. At rest positions this value is low. By calculating number of frames between two rest positions, gait cycle (period) is estimated. Figure 3.5 shows the sum some of the foreground pixels of two persons. x axis denotes frame index, y axis denotes sum of foreground pixels. Valley points represent rest position. In the proposed method, two types of features are extracted.

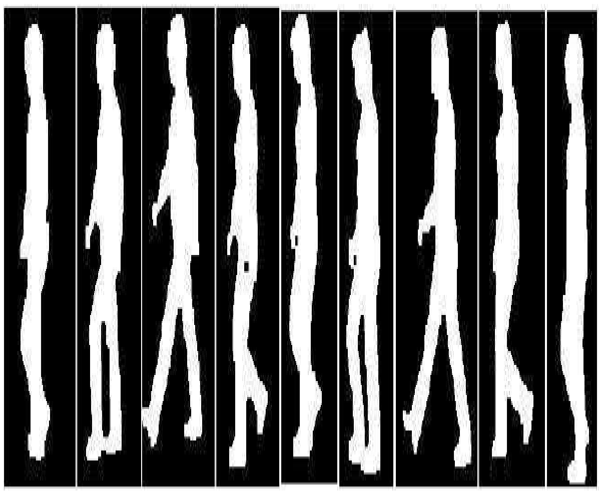


Figure 4: stances during gait cycle

e. Recognition and matching of trained database:

Recognition is the final step of gait-based person identification. Here, input test video sequences are compared with the trained sequence in the database. In general, minimum distance classifier may be used for gait recognition. Some of the generally used recognition techniques are described below. In the training, after parallel processing of two training processes, spatial and temporal templates are extracted. Test sequences are preprocessed by template extraction and projection. The projected vectors of spatial and temporal templates are concatenated in to extended vectors before recognition. Then these extended vectors are matched to the trained data base with the help of Neural Network, Back propagation neural network, linear discriminant analysis and multi linear discriminant analysis.

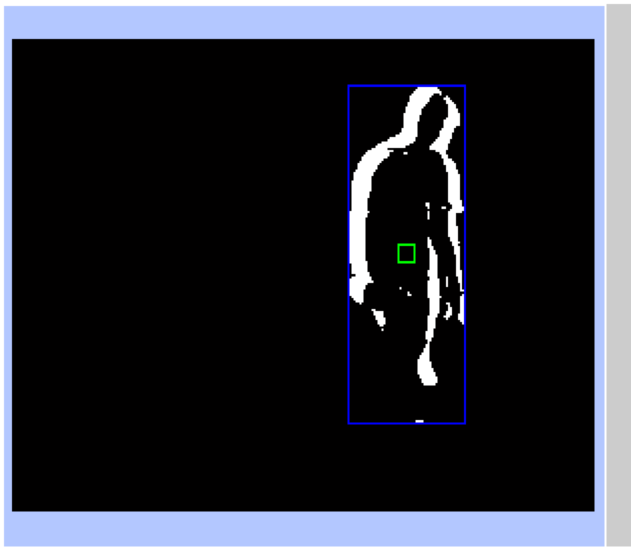
IV. PLANNING OF WORK

Here first, recognition is done with the help of grow cut algorithm is applied on image sequences. Grow cut is an interactive segmentation algorithm used for foreground extraction.

A. Segmentation results:

a. Consider this picture of walking person:

b. After loading the input image we remove the unnecessary data from the video by using the background subtraction.



c. After performing the background subtraction we can be able to get the parameters like height of the silhouette and the center of mass, with the help of these parameters we are able to find further parameters. These are done for the feature extraction.

d. After calculating the features extraction part , we further able to create the database, and the we can move on to the recognition part.

e. For the recognition part we also use in this retrieval of images based on visual features such surf.
After this, matching of input images will be done with trained database using MDA+NN and LDA+BPNN.

V. CONCLUSION

Gait recognition aims to identify people by the way they walk. Several Parameters has been proposed for Gait Recognition previously but there have been always need for better parameters to improve recognition. Enhanced Gait Recognition Technique assures quality of result as it considers more parameters than previously considered like distance between hands enhanced (MDA+NN)+(LDA+BPNN).

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