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Gait Recogniton System for Human Identification Using BPNN Classifier

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Abstract*— Recognition of any individual is a task to identify people. Human recognition methods such as face, fingerprints, and iris generally require user's cooperation, physical contact or close proximity. These methods are not able to recognize an individual at a distance therefore recognition using gait is relatively new biometric technique without these disadvantages. Human identification using Gait is method to identify an individual by the way he walk or manner of moving on foot. Gait offers ability of distance recognition or at low resolution. In this paper, firstly binary silhouette of a walking person is detected from each frame. Secondly, feature from each frame is extracted using image processing operation. Here center of mass, step size length, and cycle length are talking as key feature. At last BPNN technique is used for training and testing purpose. Here all experiments are done on gait database and input video.

Index Terms*— Backpropagation neural network (BPNN), gait recognition, silhouette images, background subtraction, features extraction.

I. INTRODUCTION

In most of the metropolitan, identity cards and passports are used for authentication and verification of human beings. But now days, biometric identifications are most suitable for human recognition. Biometric means unique features of a person. Biometric identification aims to recognition of an individual from their physiological and behavioral characteristics. Different biometrics measures or vectors are used to identify an individual, physiological characterstics like fingerprints, palm geometry, DNA, iris, face recognition- they all are related to the body of person and other features such as voice, gait and they are related to the behavior of person. Gait is effective way of human recognition. Gait is unobtrusive and distance recognition. It overcomes all the disadvantages of physiological characterstics like- it needs user's cooperation, also these physiological characterstics needs only high resolution images. Example: only few authorized doctors are allowed to go into operation theater, in this scenario gait analysis technique is used as, gait sequences of those authorized doctors are stored in hospitals' database, therefore whenever an unauthorized person tries to enter into room, then his gait sequences will not match with stored sequences and a system will generates an alarm to alert the authorities of department for any action.

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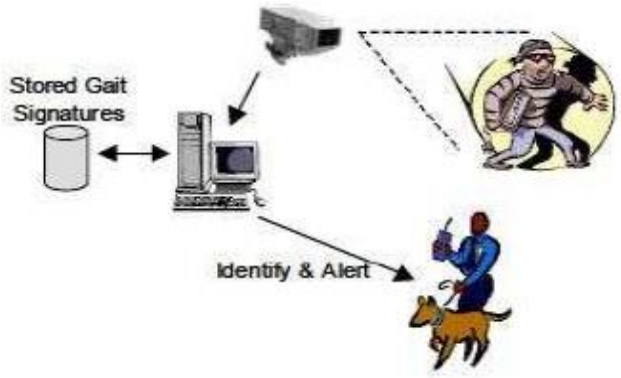

Fig 1: Gait Recognition Scenario (Mark, 2002)

Background subtraction, feature extraction and Recognition are three main parts of gait recognition system. Background subtraction is the first step of gait recognition system. In this process foreground objects in a particular scene are extracted and binary silhouette images will be obtained. Next is feature extraction process. In this step input data will be transformed into a reduced set of features. In this paper we are using model based approach of feature extraction. Final step of gait system is recognition. Here both the input and trained sequences in database are compared with each other.

II. REVIEW OF RECENT RESEARCH

Many researchers had given their contribution in model based approach of gait recognition. In this model based gait recognition system both the motion of lower leg rotation and motion of tigh describes walking and running [1]. In our paper we are also proposing a model based approach as this approach can handles self occlusion, noise, scaling and rotation. Earliest model based approach of gait recognition system able to obtain gait signatures, when human walking as a pendulum and representing the tigh motion with combination of velocity Hough transform and Fourier representation [2]. Model based approaches can handle self occlusion, noise, scaling and rotation. [5] They used static body parameters without analyzing gait dynamics for gait recognition. Model-based approaches aim to explicitly model human body or motion, and they usually perform model matching in each frame of a walking sequence so that the parameters such as trajectories are measured on the model. Model based approaches are further divided into two main classes. First class, state space method and second is spatiotemporal method [6]. Latest model based gait recognition provides good recognition rates, when both motion model of thigh and lower leg rotation describes walking and running[3].

In model based approach moving person is divided in different regions and these different regions are fitted into seven ellipses and their aspect ratios, orientation, location used as features for gait representation [4]. First class takes in to account the sequence of static poses in gait motion and recognizes the motion by considering temporal verification of observation with respect to static poses [6], [7], [8]. Second class considers spatiotemporal method which specifies the spatiotemporal distribution brought about by gait motion in its perpetuity [6], [9], [10]. In model based approaches, the accuracy of reconstruction of human model depends on quality of extracted human silhouette [11]. In paper [12] three components based features are: area of each body component, the center of each body component and the orientation of each body component. Much of explicit features which characterize gait dynamics such as stride dimension and kinematic of joint angle are recovered by a model fabricated by Model Based Approach [13]. In [14] they use gait energy for gait analysis. To improve recognition they used statistical feature extraction approach for learning effective feature. Many researchers used fuzzy principal component for gait recognition [15], [16], [13]. In [13] gait energy image is obtained by processing original gait sequences and then using fuzzy principal called fuzzy logic Eigen values and Eigen vectors are extracted then at last they use NN classifier for feature classification. Model based approaches extract the motion of human body by means of fitting their models to the input image. In gait recognition system using the extended features which incorporate spatial and temporal information and the combination of Eigen Space Transformation(EST) and Canonical Space Transformation (CST) for feature extraction was proposed. Advantages of this method are, EST and CST have been used to reduce data dimensionality with less computation time, and the use of extended features greatly increases the robustness and accuracy of recognition. But, it needs further improvement for large databases. Silhouette analysis based recognition system was proposed. In this, distance signal was the feature vector, which is obtained by calculating distance between each pixel and centroid of binary silhouette. In this paper some of these limitations are overcome by taking combined features in the form of width and shape information of binary silhouette of the person to be identified. Many famous international universities have made a lot of researches on gait recognition such as the universities of Southampton, Carnegie Mellon Universities (CMU), and Massachusetts institute of technology (MIT).

III. SYSTEM DESIGN

First step of our proposed method is the extraction of foreground objects i.e. background subtraction. Gaussian Mixture model is proposed for background subtraction. After background subtraction, humans are separated from other moving objects using one classification metric. A new feature, combination of width and MPEG-7 region-based shape descriptors is used to represent binary silhouette. Advantage of these shape descriptors is more efficient representation of disconnected regions of the silhouette. Various parameters like distance between hand and distance between leg are calculated. Finally BPNN results are calculated which is far better in comparison to previous research paper.

***Background subtraction*:** in this step moving objects from background are identified first. Then some of the background subtraction techniques are applied on it. Binary silhouettes from images are obtained in this method. Gaussian mixture model is proposed for background subtraction, and filtering is done by median filter to remove noise.

Background subtraction is being used in foreground detection. LMedS (Least Median of Squares) methodology is adapted to construct the background from a small portion of image sequences which even include moving objects. Computation of background image b_{xy} can be done by using the formula [20].

$$b_{xy} = \min_{p} med_t(I_{xy}^t - p) \quad (1)$$

Where p is the background brightness value to be determined for the pixel location (x, y), med represents the median value, and t represents the frame index ranging within 1 _ N.

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. But in case of images including shadows, this tracking algorithm will not provide good results.

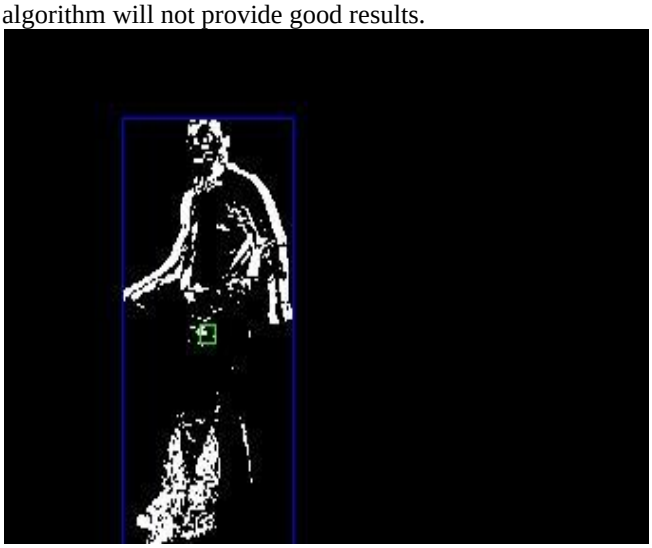

Fig 3: tracking of video.

Differencing for brightness changes: The brightness change is obtained through differencing between the background and current image. In case of low contrast images, it is very difficult to select suitable threshold for binarization. As in these images changes in brightness is too low, such that they do not distinguish properly. To solve this problem, following extraction function [20] will indirectly perform differencing.

$$f(a,b) = 1 - \frac{2\sqrt{(a+1)(b+1)}}{(a+)+(b+1)} \cdot \frac{2\sqrt{(256-a)(256-b)}}{(256-a)+(256-b)} \quad (2)$$

Where a(x, y) and b(x, y) are the brightness of current image and the background at the pixel position (x, y), respectively, $0 \le a(x,y), b(x,y) \le 255, 0 \le f(a,b) < 1$. This function can detect the change sensitivity of the difference value according to the brightness level of each pixel in the background image. For each image I_{xy}, the distribution of the above Extraction functions $f(a(x,y), b(x,y))$ over x and y can be easily obtained. Then, the moving pixels can be extracted by comparing such a distribution against a threshold value decided by the conventional histogram method.

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***Feature Extraction*:** Feature extraction can be done by two methods model based and holistic approach, here in this paper we proposed model based approach of feature extraction. These methods used for processing are scaling, view invariant. This requires good quality video sequences. Parameters used in this methodology are features such as the height, the distance between head and pelvis, the maximum distance between pelvis and feet and the distance between feet and distance between hands. The silhouette of a walking person is divided in to some regions (generally seven regions). After that, ellipses or rectangles are fit to each region and region feature vectors are determined. This includes averages of the centroid and the aspect ratio, where as holistic method does not assume any model; they operate directly on binary silhouettes. In this paper combined features in the form of width and shape information of binary silhouette of a person to be identified. Width vector of outer contour of binary silhouette and MPEG-7 ART (Angular Radial Transform) coefficients are taken as the feature vector. These extracted feature vectors are used to recognizing individuals. Various parameters like distance between hand and distance between legs are calculated.

In width vector of outer contour difference between left and right extremities of silhouettes gives the width vector. From the binarized silhouettes, the left and right boundaries are traced. The width along a given row is simply the difference between leftmost and rightmost boundary pixel of that row.

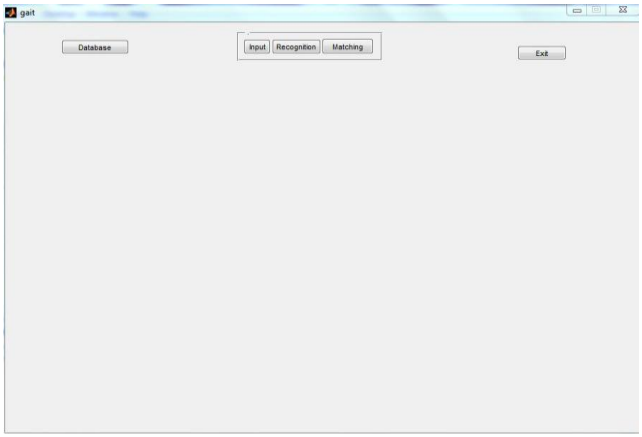
MPEG-7 ART coefficients used as second feature vector in this paper. MPEG-based-region-based descriptors used to represent shapes. These descriptors take into account all pixels constituting the shape, both the boundary of interior pixels.

Recognition: After extracting feature from walking silhouettes. Recognition is the final step, using which input sequences are compared with stored sequences in database. For this step, we introduce a neural network technique. Most popular back propagation neural network is proposed in this paper. It is multilayer networks. Here, the output values are compared with the correct answer to compute the value of some predefined error-function. By various techniques, the error is then feed back through the network. Using this information, the algorithm adjusts the weights of each connection in order to reduce the value of the error function by some small amount. After repeating this process for a sufficiently large number of training cycles, the network will usually converge to some state where the error of the calculations is small. In this case, one would say that the network has *learned* a certain target function. To adjust weights properly, one applies a general method for non-linear optimization that is called gradient descent. For this, the derivative of the error function with respect to the network weights is calculated, and the weights are then changed such that the error decreases (thus going downhill on the surface of the error function). For this reason, back-propagation can only be applied on networks with differentiable activation functions. It is a supervised learning method, and is a generalization of the delta rule.

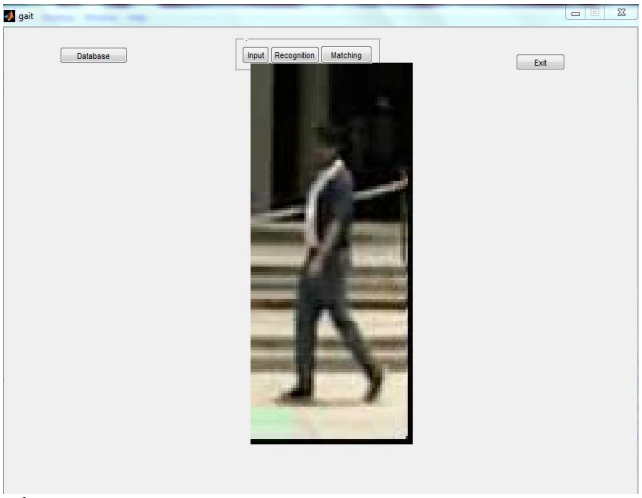
Back propagation requires that the activation function used by the artificial neurons (or "nodes") be differentiable. It requires a dataset of the desired output for many inputs, making up the training set.

IV. IMPLEMENTATION RESULTS

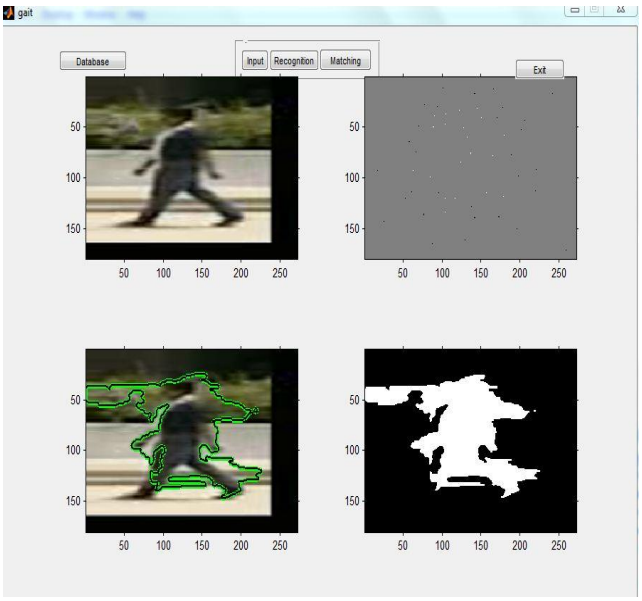
1st: GUI was created.



2nd: database input video was selected.



3rd: background subtraction and various parameters of input video is calculated.



4th: now, input video is matched with database video and BPNN result is calculated, in this case input video is different to database video means not authentic user.

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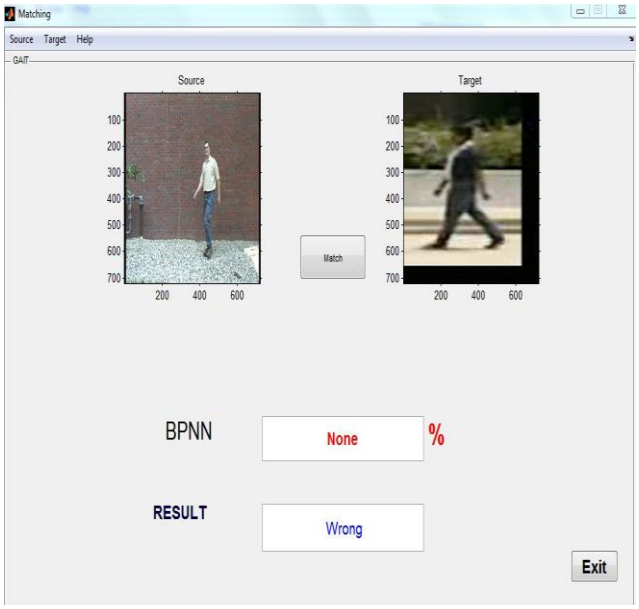
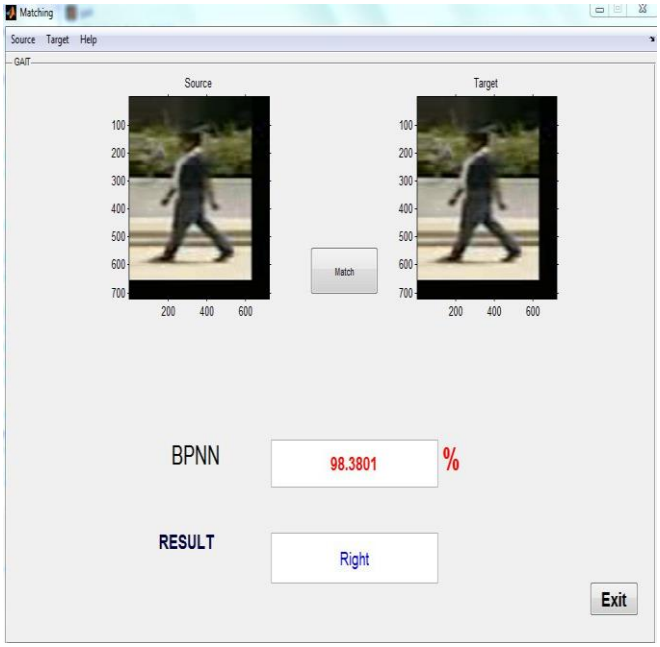


5th: here in this step all the previous steps are performed with different input video. Input video is matched with database video and BPNN result is calculated, in this case input video is same as database video and BPNN results are better. This shows our enhanced and better results than previous research.



V. CONCLUSION AND FUTURE WORK

With the increasing demands of visual surveillance systems, human identification at a distance has recently gained more interest. The development of computer vision techniques has also assured that vision based automatic gait analysis can be gradually achieved. This paper has described a simple but effective method for automatic person recognition from body silhouette and gait. Simple feature selection and parametric Eigen space representation reduce the computational cost significantly during training and recognition. A large number of experimental results have demonstrated the validity of the proposed algorithm. This work has been proven to be an encouraging progress to gait-based human identification. Intermediate results describes the effectiveness of proposed system. Results obtained in all intermediate steps have been discussed. Two types of gait features, width of outer contour of the binary silhouette and ART coefficients to describe gait shape are investigated. Using these shape descriptors (ART coefficients), disconnected objects can also be represented. Promising results of proposed approach can be further improved for large databases and for different clothing style conditions

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AUTHOR PROFILE

Oshin Sharma has done her BE from Chitkara University, Baddi, India. At present she is doing her ME thesis from Chitkara university under the supervision of Mr. Sushil Kumar Bansal, HOD of CSE Department Chitkara University. Her research area includes digital image processing.

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