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Gait Recognition System for Improved Human Identification using ENN and NN

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Abstract—Recognition of any individual is a task to identify people. Human identification using Gait is method to identify an individual by the way he walk or manner of moving on foot. Gait recognition is a type of biometric recognition and related to the behavioural characteristics of biometric recognition. 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. In this thesis, 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 NN and ENN technique is used for training and testing purpose. Here all experiments are done on gait database and input video.

Keywords— Feature Extraction, Gait Recognition System, Neural Networks(NN) and Enhanced Neural Network(ENN).

I. INTRODUCTION

Biometric system is mainly used to prevent the unauthorized access. Gait recognition is an effective biometric for human identification, by the manner of walking by this a registered/authorized person can be verified. There are three different systems which are knowledge based, object based and biometric based. Knowledge based system uses password which were set as a string that included integers or special characters and were used for authentication and these passwords can easily be cracked. Object based system is the combination of knowledge based and object based such as ATM card, Credit card with a given pin code. But both the knowledge based and object based system can be steal or lost or forgotten. Therefore to curb this problem biometric based system can solve the above problem. Biometric is a field of technology that uses automated methods for identifying and verifying a person based on physiological and behavioral traits.

Today, in the banks, metropolitan public transport stations, and other real time applications, authentication and verification are always required. In such applications Biometrics Identification are more attractive. Biometric recognition refers to an automatic recognition of individual based on feature vectors derived from their physiological and behavioral characteristic. The physiological are related to the body such as face, fingerprint, DNA and iris. And the behavioral is related to the behavior of the person such as voice and gait. As these physiological characteristics does not provide good results in low resolution and need user cooperation therefore Gait recognition is more attractive. Gait is effective way of human recognition. Gait is unobtrusive and distance recognition. It overcomes all the disadvantages of physiological characteristics like- it needs user‟s cooperation, also these physiological characteristics 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

II. GAIT RECOGNITION SYSTEM

The Gait Recognition System is which that identify the gait of the authorized individual by comparing it with the stored sequence in the database. The proposed human gait recognition system is represented by the blocks diagram showed in Fig. 1.This section illustrates how the capture video is converted into the frames and after that background subtraction is applied on that so as to remove the unwanted information. Background subtraction is a process of extracting the foreground object in a particular location. After that features are extracted by using hanavan‟s model , by using this model various features can be extracted like distance between distance between head and feet, distance between both hands, length of one hand, length of leg etc. And finally the individual is finally recognized by comparing the obtained characteristics with the ones previously stored in the database.

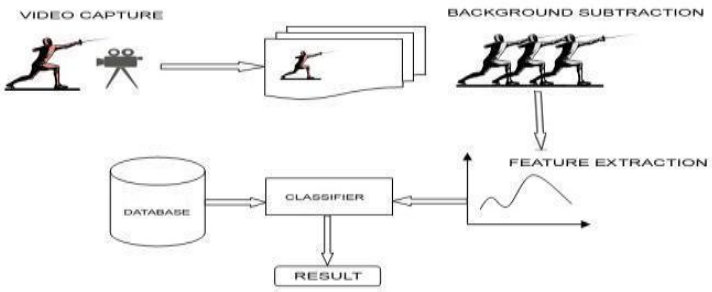

Fig. 1 The basic GAIT Recognition System

The proposed Gait Recognition System is the one which consists of the following steps which is further shown with the help of the flow chart. There are various processes are carried out to obtain the better and accurate output.

A. Video Capture

Method of accurate tracking person in indoor surveillence video stream obtained from static camera. Example a video camera on front door or any where in multicomplex can store gait sequences of a moving person, so that video can be used for further processing.

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 computervision 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.

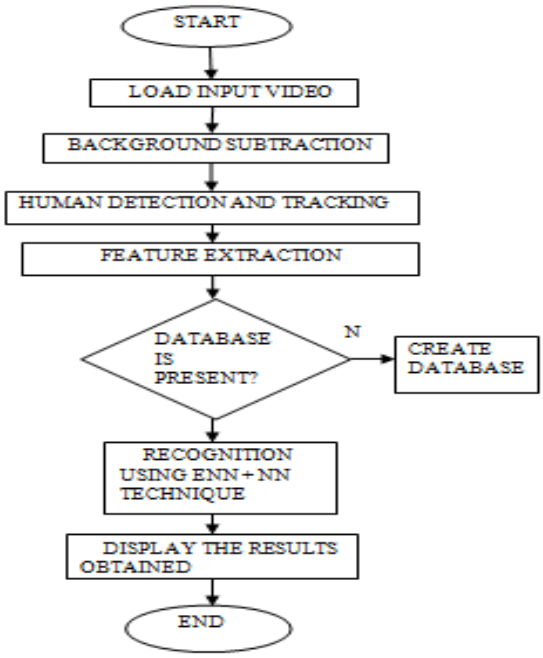

Fig. 2 The Proposed Gait Recognition System

C. Gaussian mixture model

GMM is an adaptive model which uses a mixture of normal distributions to model a multimodal 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.

$$f_{x/k}(X/K\,,\theta_k) = \frac{1}{(2\pi)^{\frac{n}{2}} \mid \sum_k \mid,^{\frac{1}{2}}} e^{-\frac{1}{2}(X-\mu k)T \sum_k^{-1}(X-\mu k)}$$

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

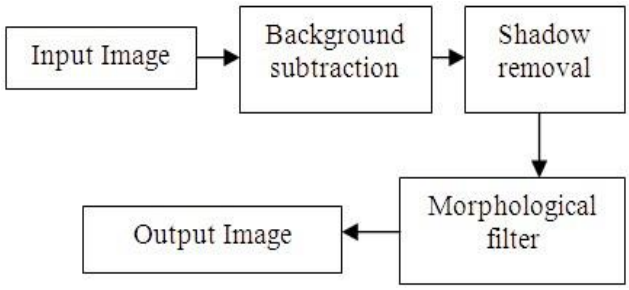

Fig. 3 The original input image

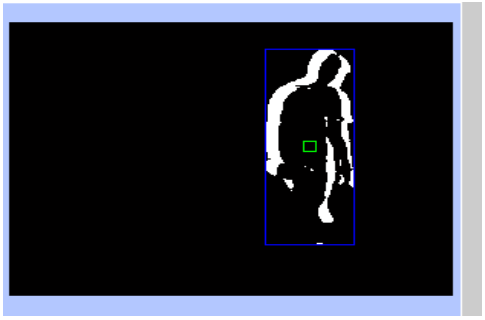

Fig. 4 The image obtained after Background Subtraction

Silhouette is defined as a region of pixels of the walking person. Silhouette extraction mainly focuses on segmenting the human body. The goal is to obtain the binary image of the silhouette that is nearly match the actual silhouette of the walking person.

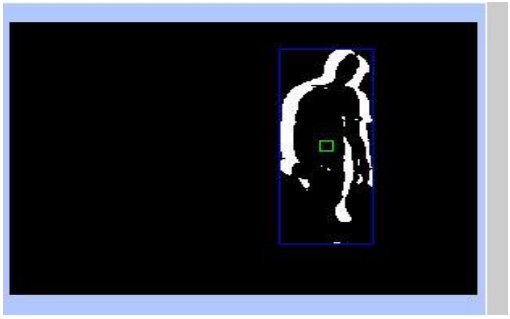

Fig. 5 Silhouette Extraction

D. 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. 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.

Step 1). Grab i^{th} frame.
Step 2). Subtract it form $(i-3)^{th}$ frame.
Step 3). Convert image into binary image.

Step 4). Fill all holes and label connected pixels.

Step 5). Run the loop to no of labels and find label for maximum area.
Step 6). Find centroid of obtained area.
Step 7). Go to step 1.

E. *Feature Extraction*

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. Based on the extracted silhouette with the background subtraction process, a rectangle is drawn. Reference points are located at the outermost points of the rectangle as can be seen in figure6

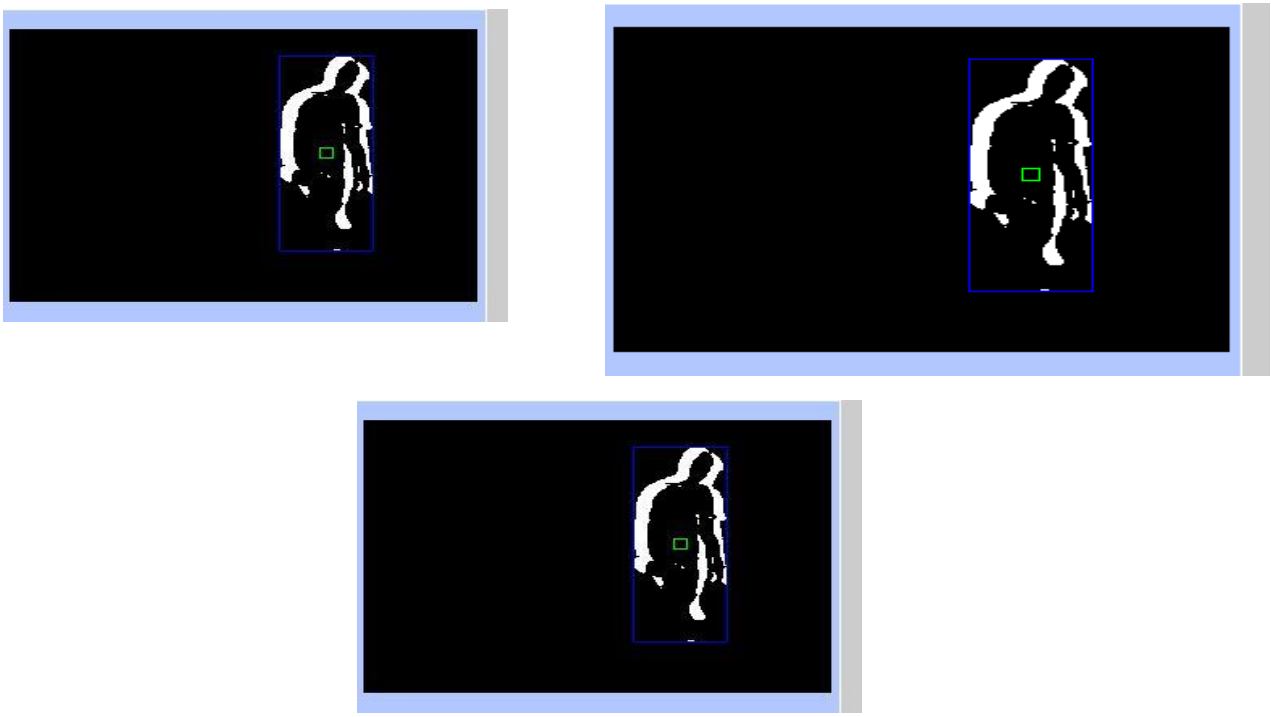

Fig. 6 Silhouette with the outer rectangle

Upper left and right points, and bottom left and right points can provide their position *(x, y)* given in pixels. At each time instant *t*, both left points *–LP–* and right points *–RP–* share the same position on axis x, as upper points *–UP–* and bottom points *–BP–* do on axis y. By this the height of the silhouette can be calculated

$$H = \frac{\sum_{j=1}^{NH} [y_{UP}(t) - y_{BP}(t)]_i}{N_H}$$

where N_H represents the total quantity of data gathered for height feature. The measurement values not only specify the person height but also the change on tiptoe position in the gait cycle. Now height of the particular silhouette can be calculated, now by using the Hanavan's model various parameters can be calculated. The parameters that we are using in the proposed model are like distance between head and feet, distance between both the hands, length of one leg, distance between right hand and left leg, and distance between left hand and right leg.

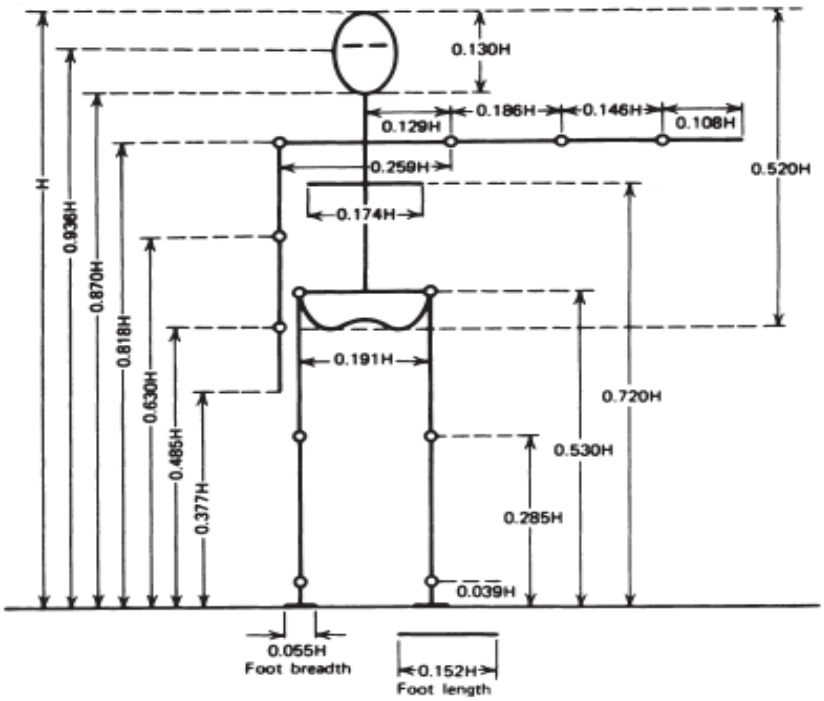

Fig. 7 Body segment length expressed as a function of body height H.

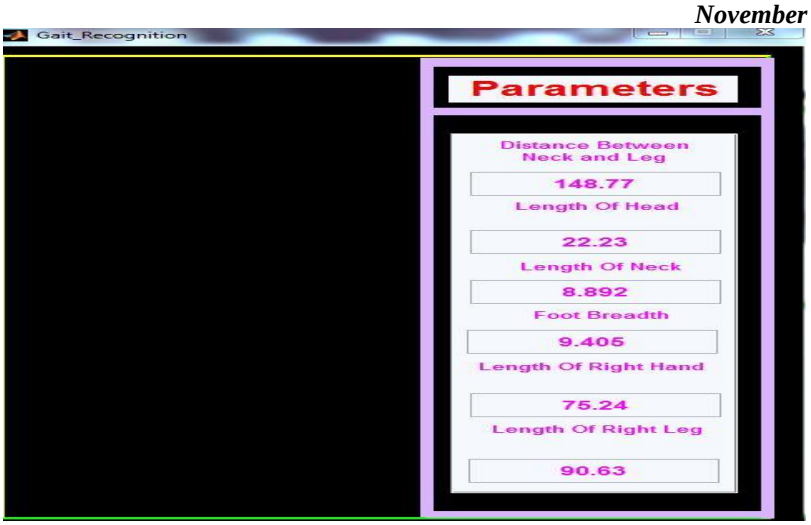

Fig 8 The various calculated parameters

F. Recognition

Once we obtain gait features, the next step is gait recognition. In this section, we introduce Neural Network. We give a brief description of the Neural Network method.

G..Neural Networks

Artificial neural networks are composed of interconnecting artificial neurons (programming constructs that mimic the properties of biological neurons). Artificial neural networks may either be used to gain an understanding of biological neural networks, or for solving artificial intelligence problems without necessarily creating a model of a real biological system. The real, biological nervous system is highly complex: artificial neural network algorithms
attempt to abstract this complexity and focus on what may hypothetically matter most from an information processing point of view. Neural networks give effective results for solving multiple class classification problems. The neural network facilitate gate recognition because of their highly flexible and non linear modelling ability. Neural network has three types of layers: input layer, output layers and hidden layers. Hidden layer does intermediate computation before directing the input to output layer. Back propagation can also be considered as a generalization of delta rule. When back propagation network is cycled, an input pattern is propagated forward to the output units through the intervening input to hidden and hidden to output weights. Neural network have been widely used in image and signal processing.

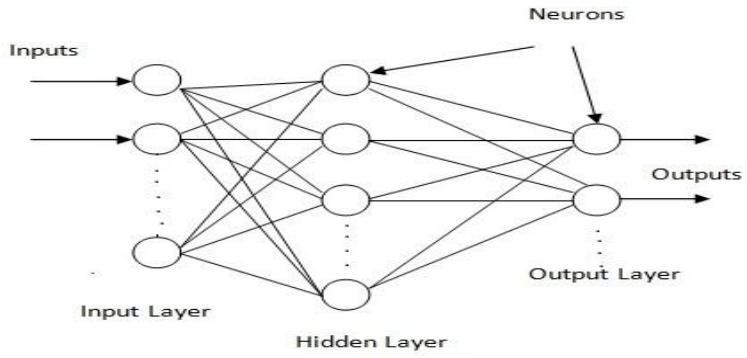

Fig. 9 Basic layout of the Neural Networks

This class of networks consists of multiple layers of computational units, usually interconnected in a feed-forward way. Each neuron in one layer has directed connections to the neurons of the subsequent layer. In many applications the units of these networks apply a sigmoid function as an activation function. The universal approximation theorem for neural networks states that every continuous function that maps intervals of real numbers to some output interval of real numbers can be approximated arbitrarily closely by a multi-layer perceptron with just one hidden layer. This result holds only for restricted classes of activation functions, e.g. for the sigmoidal functions. Multi-layer networks use a variety of learning techniques, the most popular being back-propagation. 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 fed 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, backpropagation can only be applied on networks with differentiable activation functions. The following are the outcomes of the system:

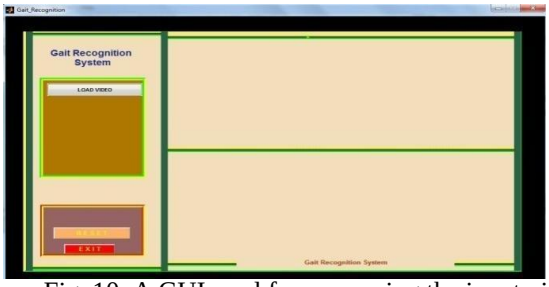

Fig. 10 A GUI used for processing the input video

Fig. 11 Background subtraction of input video

After processing the input video we will imply the background subtraction method on the input video, so that we are able to get the frames.

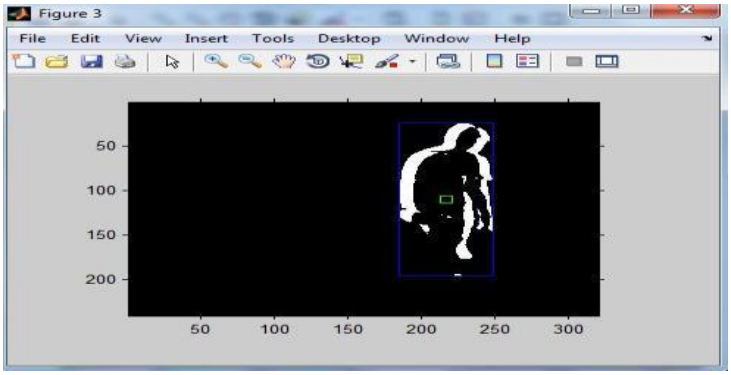

Fig. 12 Background subtraction of input video

After this step we do the feature extraction so that we get the vaious parameters. And then we will do the recognition part i.e the matching of the input image and the source images are carried out.

Fig. 13 Using feature extraction of input video

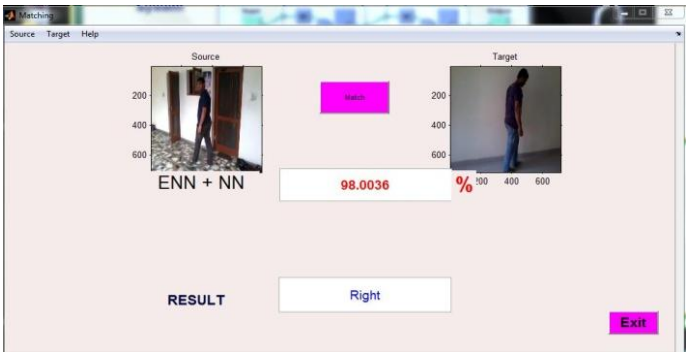

Fig. 14 Input Video was matched with database image and NN AND ENN results were calculated. In this case input video is same as database image. NN AND ENN results are better

Recognition Methods	CCR (%)
NN	95.00
ENN	94.88
NN + ENN	98.20

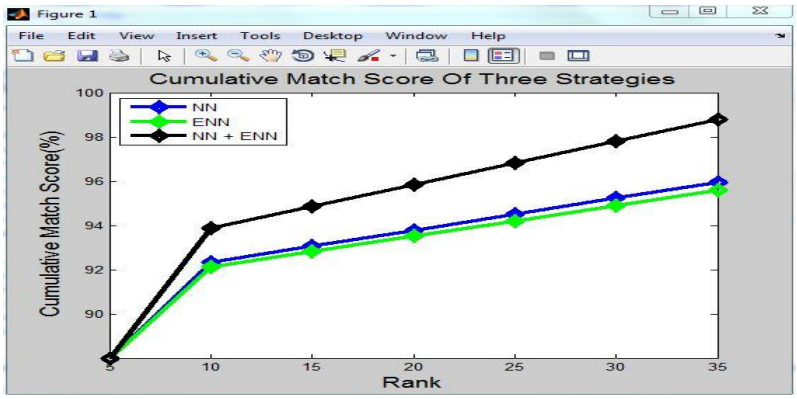

Fig. 15 The accuracy value of NN+ENN

After this step we do the feature extraction so that we get the vaious parameters as in figure 8. And then we will do the recognition part i.e the matching of the input image and the source images are carried out.

III. CONCLUSION

With the increasing demands of visual surveillance systems, human identification at a distance has recently gained more interest. Gait is a potential behavioural feature and many allied studies have demonstrated that it has a rich potential as a biometric for recognition. 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. The combination of a background subtraction procedure and a simple correspondence method is used to segment and track spatial silhouettes of a walking figure. 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. Although accomplished under some simplified assumptions like previous work, this work has been proven to be an encouraging progress to GAIT-based human identification. GAIT based recognition has been described in context of person authentication. Several existing techniques for GAIT recognition have been discussed. Intermediate results describe the effectiveness of proposed system. Results obtained in all intermediate steps have been discussed. Gaussian mixture model in addition with median filtering has been investigated for background subtraction. Moving target classification algorithm has done to separate human beings from other moving objects. 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. So, using these shape descriptors we can get features in better way. Model has been developed for classification/recognition of individual. Even though we are getting promising results with the proposed approach, it has to be improved for large data bases. Performance rate have to be improved for occlusion, clothing style conditions and also for different walking considerations

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