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An Efficient System for Person Recognition Using Gait Features

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Abstract-

Biometrics traits based person recognition system has become essential part of our day to day need. In office , in home or any other commercial area it being employed for identification as well as for security. These system basically utilizes some physiological and behavioural characteristics of the human being for this vary purpose. Gait is one of the biometrics trait which can also be utilized for same purpose. The authenticity of the unique gait analysis has yet to established but even then it can be used for person recognition. In this paper authors, presents a person recognition system on the basis of the gait analysis or by gait features.
Experimental results shows its high accuracy and reliability.

Keywords: *Gait Recognition, Biometrics, PCA, LDA, Neural network.*

I. INTRODUCTION

One of the critical assignment for recognizing the general population is identification. Biometrics is fundamentally physiological or behavioral qualities of people which is special for people. Since these qualities are one of a kind in this manner it can be utilized for ID purpose.

Vision based human ID has been the zone of interest for biometrics look into. One of the upsides of this technique is that in this sort of biometrics framework individual can be distinguished from the separation. This sort of biometrics is basic for observation and checking reason. "Programmed", "Non-Forensic" and "continuous" are the attributes of the biometric distinguishing proof framework. This framework works simply like the individual work for perceiving the individual e.g. one individuals perceive the other individuals by face when they meet each other or by listening their voice when they address each other[1].

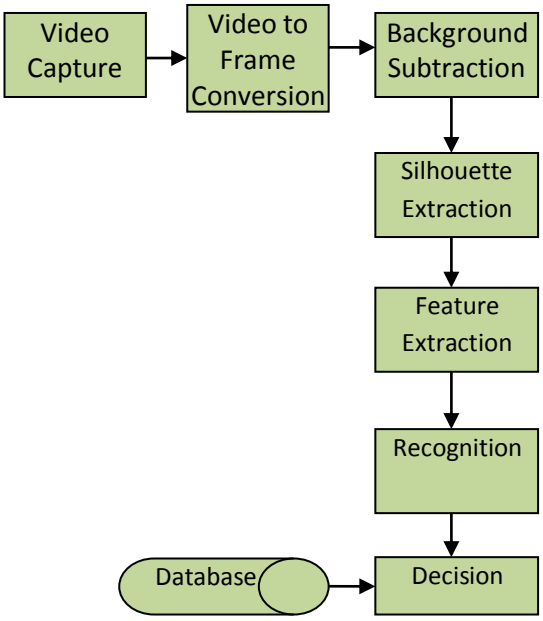

Figure 1 Biometrics gait Recognition System

A biometric framework can be considered as an pattern recognition framework which build up the individual ID by making a comparision of the b binary code of different unique special natural or physical qualities.

For fulfilling this assignment, a live specimen is as a matter of first importance taken from the camcorder. Framework at that point apply a mind boggling and concentrated calculation to the example taken and change over this specimen to a binary code. This binary code is the contrast and the twofold code as of now put away to judge the personality of the people. The layout containing the biometrical qualities are put away in a framework. These layout are coordinated with the present specimen format to distinguish the person[2].

II. LITERATURE SURVEY

In the paper[3], first time displayed an approach of gait recognition errand by determining the binary outline or silhouette of strolling individual which are later on changed over into a one dimensional normalized distance motion by form unwrapping system which is brought as for the centroid position.

In the paper[4] suggested a method to extract out the foreground from the background by using the dynamic filtering, in this approach, first of all, the signal is summed up and then taking minima of the signal. According to this paper, dynamic as well as the static features can be used for enhancing the accuracy.

In the year 2004 Yam et al. in the paper [5] suggested that bottom-up model based approach is better to remove the dynamic gait features from the gait video.

In the paper[6] Work on the idea suggested by[5] by taking out the dynamic as well as the static features of the gait cycle on the basis of the model baed approach.

In the paper [7] revealed that all the features which are extracted out from the silhouettes depends on the speed of the subjects. As per the authors some preprocessing steps must be necessary for the better accuracy of the recognition

In the paper [8] suggested the person outfit or the clothing also affect the gait pattern significantly. As per the authors, static features of the gait cycle depends on the clothing, bags or any other factors.

In the paper [9] explained the importance of the gait cycle in forensic science. With the help of the gait analysis they became successful in identifying the two bank robbers. They also outlined the importance of the gait features, body features in gait based recognition.

In the paper[10] explained different methods of extracting the important features from the gait cycle for person recognition. As per the authors, extraction of the most discriminative features from the gait cycle is one of the most crucial step in the gait based person recognition.

In the paper[11] suggested that the DTW(discrete time wavelet) can also be used for gait recognition. For this the period of the walking is used which can be found out by partitioning the gait cycle. They also used the autocorrelation for finding the gait cycle.

In the paper[12], a new approach of the gait recognition iwas presented by developing the matrix representation of the gait data. Image matrix is concatenated into a single dimension vector and PCA and LDA are used for reducing the dimension .

In the literature[13] three new algorithm for exatrcting the features of the gait is presented. Two out of these method are based on the radial integration transform and circular integration transform. Both of these actually the variants of the radon transform. In the third approach , they have used weighted Krawtchouk moments. Method based on the Krawtchouk moments gave the best result followed by the radian and circular integration radon transform.

In another literature[14], binary silhouette of the gait is obtained and radon transform is applied on this binary silhouette for obtaining the template. Subspace rojection and LDA is used in this algorithm for reducing the dimension. This radon template is then used for recognizing the person.

In another approach cited in the paper[15] 2D deformable model of the gait is proposed for gait recognition. The model has 10 body segment which are represented by the 22 diverse parameters. These parameter actually tells about the size position and the oriehtation of the body segment.

In the paper[16], apart from presenting the various method of gait recognition, another approach for gait recognition have alos been proposed which are suitable for recognizing the gait of the distant person and of low resolution.In the literature [17], another approach of identifying the distant person using gaity analysis has been presented. This method applies the PCA, KNN and non linear machine learning for classification. Here PCA is used for reducing the dimension which is known as the kernel principal component analysis(KPCA).

In the literature[18], gait signature based gait analysis has been proposed for gait recognition. Angle and contour of the Silhouette of the walking person is extracted which act as a gait signature.

Dynamic features of the gait can also be used for gait analysis[19].HOG(histogram of oriented gradient) based approach for recognizing and improving the gait based recognition is another noteworthy contribution in this field. In this paper, gait based recognition is presented by extracting the different features of the gait.

III. METHODOLOGY

In order to design the person recognition using gait, as many as 29 different candidates has been selected and these candidates are made to walk in their natural way. A video is captured while these candidates were walking. The captured video is used as the database for this project.

The block diagram of the feature extraction phase of this project is shown in the figure 2.

First of all the gait video of the candidate is taken as the input and this gait video is then converted in to a frames for extracting the important features of the gait.

Video to frame conversion block is used here to convert the video in to a frame. Once the whole video is converted in to a frame then background subtraction is used to extract the object i.e. person from the background.

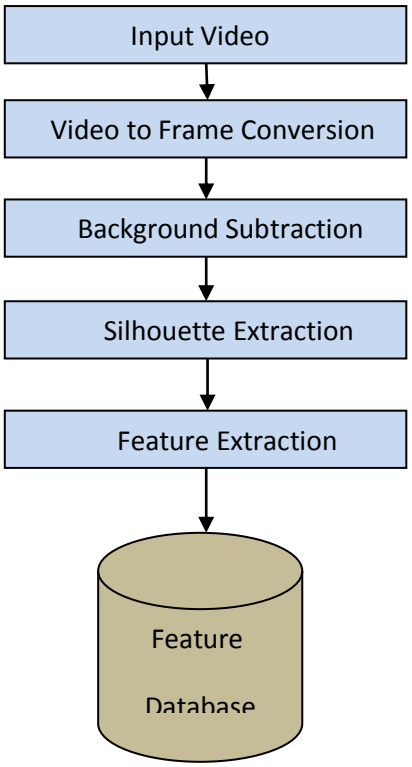

Figure 2 Feature Database Creation

Once the background is separated from the foreground i.e. person then the silhouette of the segmented person is produced.

Figure 3 Background subtraction

Silhouette is basically the outer boundary of the person. Silhouette of the person is shown in the figure 3. silhouette is very important to extract all the features of the gait of the person.

As many as 11 different features have been extracted from the silhouette for recognizing the gait of the person.11 different features from each person's gait video constitute a feature vector database of the person. Such kind of feature vector database has been created for all the nine person by making them walk in different way.

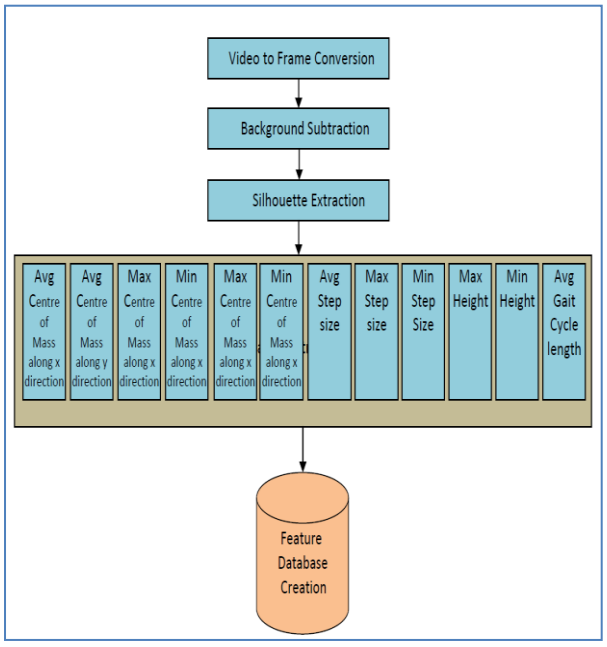

Figure 4 Feature Extraction

A. Feature extraction phase

In order to recognize the gait of a person as many as 11 different features have been extracted. These are as follows

i. Average value of Xbar- It is defined as

$$\bar{x} = \frac{\sum_{i=1}^{m}\sum_{j=1}^{n} j \times B(i,j)}{A}$$

Where

B(i,j)= brightness of the image at the point (i, j)

And A is the area of the region which is calculated by using the formula-

$$A = \sum_{i=1}^{m}\sum_{j=1}^{n} B(i,j)$$

ii. Average Value of Ybar- It is defined as

$$\bar{y} = \frac{\sum_{i=1}^{m}\sum_{j=1}^{n} i \times B(i,j)}{A}$$

iii. Maximum value of Xbar- It is the highest value of the Xbar.

iv. Minimum value of Xbar- It is the lowest value of the Xbar.

v. Maximum value of Ybar- It the highest value of the Ybar.

vi. Minimum Value of Ybar- It is the lowest value of the Ybar.

vii. Maximum Step Size- Step size is the distance between the legs when they are far apart.

viii. Minimum Step size- it is the distance between the two legs when they are very close to each other.

ix. Maximum Height- it the distance between the legs loweest point to the upper most part of the head of the person.

x. Minimum height-It is the minimum of all the height measured during the gait cycle.

xi. Gait Cycle- Gait cycle begins when one leg contacts the ground and end when that leg again contacts the ground. Number of frames during this interval is taken as the gait cycle.

A. Algorithm Steps for Feature Extraction & Database creation

Step 1 Input the gait video of the candidate.

Step2 Convert the video into frames.

Step3 Subtract the background from the frame in order to extract the foreground from the background.

Step4 Apply the Silhouette Extraction algorithm.

Step5 Extract the feature of the gait from the silhouette.

Step6 Prepare the database of the feature vector for the candidates video.

B. Designing Back Propagation Neural Network (BPN) for classification

Once the features of the gait video of the different subjects is extracted then it is stored in a database called feature database. Next steps in this regard is to classify the gait video on the basis of feature vector database prepared earlier. In order to classify the feature vector, neural network has been used in this project. Back propagation neural network is designed for this vary purpose. Since there are 11 features for each gait video is taken therefore number of neurons for neural network is set to 11. "Pure-linear" function is used as activation function**.** A target vector is also prepared for training purpose.

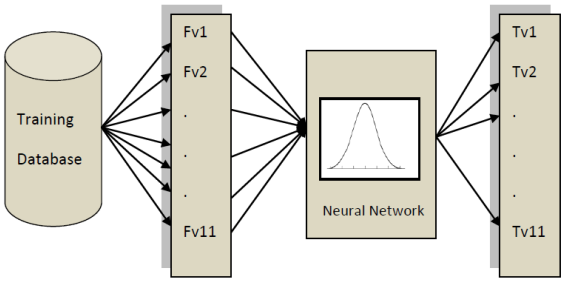

Figure 5 Illustration of BPN(Back propagation Network) training phase

IV. EXPERIMENTAL RESULT

In this project work, application of a gait based person recognition and authentication system which is based on the features of the gait is presented. As many as 11 different feature has been extracted from the gait of the subjects. In order to perform this task, first of all, all the subjects are made to walk from left to right and right to left and their walking was shot to make a video sequence. Once all the videos of different subjects are shot then a video database of all the video are collected which work as a database. These videos are then converted in to a frames using module especially designed for this operation. Once the video is converted in to a frames then each frames are pre-processed for getting the required brightness . In this type of task it is very important to extract the background

from the foreground for extracting the person from the background. This is done with the help of silhouette extraction. Once the silhouette extraction is carried out then all the feature as explained in the previous section is extracted out from the various frame of the video , different features has been extracted out from each video and stored in the database known as the feature database.

Figure 6 Some walking subjects of database1

Once the feature database is prepared then in order to classify the feature data base and hence for recognizing the person, neural network is used in this project.

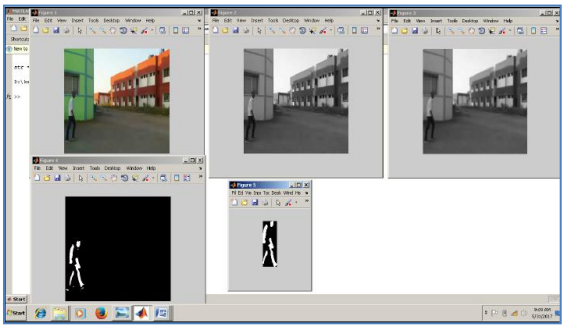

Figure 7 Screen shot of Pre-processing stage

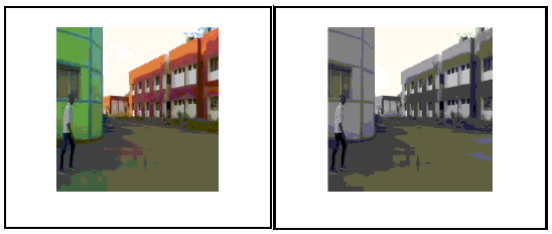

Figure 8 Original Color frame (left) and Gray Scale Frame (Right)

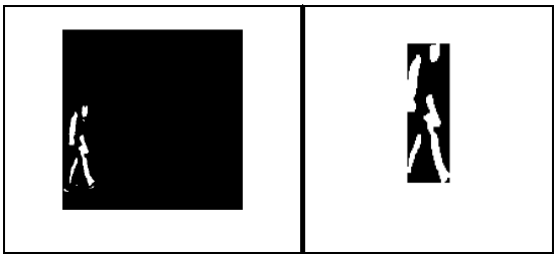

Figure 9 Background subtraction(Left) and Silhouette extraction(Right)

There are two phases in the classification task using neural network.

First phase is training phase in which neural network is trained using the feature database as the input and the target feature as the target data. Once the neural network is trained then in the next phase, this neural network is tested in different subjects for recognition task. This system is tested for different number of features and the results obtained is shown in the next section.

Table 1 Various Numerical Values of Features

Features	Person1	Person2
Feature1	14.04	38.69
Feature2	72.38	54.51
Feature3	24.18	64.07
Feature4	20.17	15.12
Feature5	90.01	64.59
Feature6	12.23	11.16
Feature7	44	106
Feature8	22.14	16.17
Feature9	123	127
Feature10	18.13	21.72
Feature11	11.65	13.11

In order to check the validity of the proposed system in recognizing the right person using gait features, gait video of the person is given as the input to the proposed application and on the basis of the output obtained, accuracy is computed.

Accuracy is defined as

$$Accuracy = \frac{Number\ of\ correctly\ identified\ \ person\ in\ test}{Total\ number\ of\ person\ in\ test}$$

For testing , 4 different test have been carried out by selecting the person randomly. 10 different coefficient taken at an angle of 18 degree has been as the features of the finger knuckle. For classification back propagation neural network is used. The result obtained is tabulated in the table 2

Table 2 Accuracy table when number of feature is 10.

S. N.	Test No.	No. of Randomly selected	No. Features	Classification Method	Accuracy (in %)
1	Test 1	11	10	BPN	81
2	Test 2	14	10	BPN	84
3	Test 3	09	10	BPN	79
4	Test 4	12	10	BPN	79
Average Accuracy					81

In the similar manner in order to check the relationship of accuracy with the number of features, we decrease the number of feature from 11 to 07 . Again the same test is performed and the result obtained is tabulated in the table 3

Table 4 represents the accuracy% when we decrease the number of features of coefficients from 7 to 9. In such case the radon coefficients are extracted at the angle difference of 20 degree.

Table 3 Accuracy when the number of features are 07

S.No.	Test Number	No. of Randomly selected	No. Features	Classification Method	Accuracy (in %)
1	Test 1	11	07	BPN	72
2	Test 2	14	07	BPN	79
3	Test 3	09	07	BPN	76
4	Test 4	12	07	BPN	74
Average Accuracy					75.25

Table 4 Accuracy when the number of features are 20

S.No.	Test Number	No. of Randomly selected	No. Features	Classification Method	Accuracy (in %)
1	Test 1	11	09	BPN	84
2	Test 2	14	09	BPN	75
3	Test 3	09	09	BPN	81
4	Test 4	12	09	BPN	76
Average Accuracy					79

Once the above mentioned tests have been carried out then in order to understand the performance of the proposed system , a table is prepared. Table 5 shows the summary of the accuracy for proposed system for different number of features while figure 10 shows the accuracy in different cases in graphical form.

Table 5 Accuracy summary of the proposed system for different number of features

S.No.	No. Features	Classification Method	Accuracy (in %)
1	11	BPN	81
2	07	BPN	75.25
3	09	BPN	79

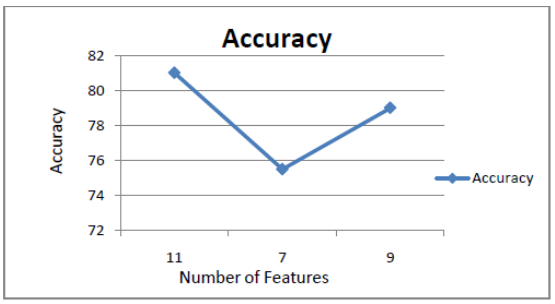

Figure 10 Accuracy Vs Number of Feature Graph

V. CONCLUSION

In this paper, feature based gait analysis and on the basis of the gait features, person recognition is also carried out. As many as 11 different features of the gait of the person has been extracted out from the silhouette of the walking person. This paper also examined the effect of the number of features on

the gait recognition accuracy. Experimental results reveals that the highest accuracy of 81% is achieved through this method.

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