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A NOVEL TECHNIQUE TO IDENTIFY HUMANS FROM GAIT SEQUENCES WITH ARBITRARY WALKING DIRECTIONS

Manjeet Singh[1], Er. Sukhpreet kaur[2]
[1]Mtech student, Shaheed Udham Singh College of Engineering & Technology
Tangori, Mohali, Punjab
[2]Assistant Professor, Shaheed Udham Singh College of Engineering & Technology
Tangori, Mohali, Punjab
msmanjeetsingh94@gmail.com, er.sukhpreetkaur@gmail.com

Abstract: *Gait recognition is a biometric technology that identifies people without their cooperation. Gait displays particular aspects of walking on foot. Similarly, gait recognition investigates humans by the ways in which they walk. This paper investigates the problem of identification of humans and recognition of gender from gait sequences with arbitrary walking directions. In this research, first step is extraction of foreground objects i.e. human and other moving objects from input video sequences or binary silhouette of a source is detected from each frame and human detection and tracking is performed. After getting binary silhouettes of human beings model based approach is used to extract the gait features of a person. At last CAWGR technique is used for training and testing purpose. Here all experiments are done on gait database and input video.*

Keywords: *GAIT recognition, Human identification, Gender Recognition, C-AGI, CAWGR.*

I. INTRODUCTION

Biometric authentication methods are more attractive in various applications where authentication or verification using conventional technologies are practically feasible. Biomechanics research (e.g. gait analysis, sport or rehabilitation biomechanics, motor control studies) often involves measuring different signals such as kinematics, forces, and EMG. Gait is defined as “a manner of walking” in the Webster Collegiate Dictionary. The extend definition of gait is that it contains both the appearance and dynamics of human walking motion. Gait analysis is the standarized study of human walking, using the eye and brain of experienced observers, intensified by instrumentation for measuring body movements, body mechanics and the activity of the muscles. Gait analysis works on both qualitative as well as quantitative ethics for the gait parameter. Human gait displays those features of a person that is determined by weight, limb length, and habitual postures. Hence, gait emerges as a biometric measure to recognize known persons and classify unknown subjects which can be detected and measured at low resolution. Therefore it is only applicable when face or iris information is not in high resolution for recognition. Areas such as military installations, banks and airports need these different labels of access to immediately remove threats and also authorize different user groups Gait is restrained biometric, which identify people at a distance even subject does not have any interaction with it. This property of Gait is so unusual.

Gait as a biometric technique which is more advantageous over other forms of biometric identification techniques for being Restrained, Distance recognition, Reduced in detail and Difficult to conceal.
Biometric features will be affected by certain features of individuals like Stimulants, Physical change, Psychological and Clothing.

Example: In bank , only few authorized people are allowed to go into lockers room, here gait analysis technique is used, gait sequences of those authorized people are stored in bank’s database, therefore whenever an unauthorized person tries to enter into room, his gait sequences will not match with stored sequences and alarm system will be activated for any action.

Gait-based gender recognition or classification includes each gait energy image (GEI) into several different local parts such as head, chest, legs and performed classification with support vector machine (SVM) on each local part. The outputs of different local parts were then combined and fused. Unlike some existing methods, this paper aims to recognize human genders from their gait sequences which are captured from arbitrary walking directions.

II. LITERATURE REVIEW

Jiwen Lu, Gang Wang et al in 2013 [1] proposed a sparse reconstruction based metric learning approach for gait-based human identity and gender recognition from arbitrary walking directions. Experimental results showed the efficiency of the approach. This research applied proposed SRML method on the existing USF and CASIA-B gait datasets and achieved comparable recognition rate with most existing state-of the- art gait-based human identity and gender recognition methods.
Dacheng Tao *et al.* have focused on the representation of appearance-based models for human gait sequences. Two important novel representation models were offered, Gabor gait and Tensor gait. Some extensions of them were being made so as to improve upon their abilities for the recognition tasks. In this research, three different methods using Gabor functions have been developed to minimize the computational complexities in calculating the representation classifiers as training and testing.

Yang *et al* analysed variations to attain the progressive regions in Gait Energy Image (GEI) which depicts the walking manner of an individual. A dynamics weight mask was built to improve the dynamic region of the image and to cover up the noises on regions where it is not required. As a result of this an Enhanced Gait Energy Image (EGEI) was obtained. Then, it is shown in low dimensional subspace by Gabor-based discriminative common vectors analysis.

Jianyi Liu *et al.* proposed Silhouette quality quantification (SQQ) method to evaluate the quality of silhouette sequences. SQQ examined the quality of the sequence which was analyzed on the basis of the 1D foreground-sum signal modeling as well as signal processing techniques. Silhouette quality weighting (SQW) is a common enhancement framework basically designed to enhance most of the current gait recognition algorithms by considering sequence quality and it is attained as an immediate application of SQQ. The experiments were performed on the USF Human ID gait dataset v1.7 (with 71 subjects. Gait Energy Image (GEI) implements two instantiations of the SQW. Enhanced recognition performance was obtained when compared to the original GEI as well as previous methods.
Xiaoli Zhou and Bir Bhanu presented an novel approach that gathers information from side face and feature level of the Gait. These were obtained separately by using principal component analysis (PCA) from enhanced side face image (ESFI) and gait energy image (GEI), respectively. The use of PCA and MDA allowed the generation of better features and also works upon dimensionality reduction. Multiple discriminant analysis (MDA) concatenates features of face and gait to discriminate synthetic features. Experimental results shows that the synthetic features that were encoded on both sides face and gait information carry more discriminating power than the other individual biometrics features. This feature level fusion scheme surpasses the match score level as well as traditional feature level fusion schemes.

Seungkyu Lee et al presented shape variation-based frieze and symmetry map representation for gaits that capture the intra and inter-shape variations respectively. This method works under the assumption that combines features into gait recognition which improves recognition performance particularly, when there is a serious silhouette appearance variation between gallery as well as scrutiny sequences. This algorithm is experimentally proposed against number of published gait recognition systems on CMU, MoBo database and UoS HumanID image database. Test results used only key frames that show that the shape component contributes to gait recognition effectively.

Kale *et al.* proposed a view-based approach to identify humans from their gait. Two distinct image features have been taken into consideration as the width of the outer contour of the binary silhouette of the walking person with the entire binary silhouette itself. The first method was taken as the indirect approach in which the high-dimensional image feature was conformed to a lower dimensional space for generating the frame into exemplar (FED) distance. FED vector sequences which contain the Gait information was captured in a hidden Markov model (HMM) for effective gait representation and recognition. In the second method, direct approach works with feature vector directly and trains the HMM.

III. METHODOLOGY

Step 1: Code is developed for loading an input video from the database.

Step 2: Developed a code for Background Subtraction using Silhoutte Extraction and preprocessing of the input video for making it noise free.

Step 3: After that Gender Recognition and matching is done while using CAWGR, SURF techniques.

Step 4: It will then finally verify the proposed result by developing code for MSE, CCR and PSNR and Matching Time.

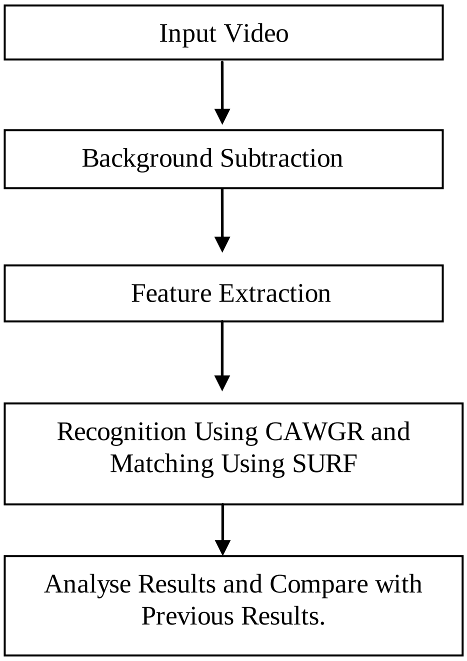

Fig 1: Flow Chart of Proposed work.

IV. TECHNIQUES USED

(a) Silhoutte Extraction

Silhouette is a temporal change in a walker's motion that describes the motion of the walking figure. Binary silhouette is used to make the proposed method independent to changes of color and texture of clothes. Additionally, for the sake of computational efficiency, these 2D silhouette changes are converted into an associated sequence of 1D signal to approximate temporal pattern of gait. After tracking the moving silhouette of a walking figure, its outer contour can be easily retrieved using a border following algorithm. Shape centroid (x_c; y_c) is computed by taking the centroid as a reference origin, the outer contour wraps up the counter clockwise to turn it into a distance signal

$$S = (d_1, d_2, . . . , d_i, . . . ; d_{Nb})$$

that is composed of all distances d_i between each boundary pixel (x_i, y_i) and the centroid.

This signal indirectly represents original 2D silhouette shape in the 1D space. To eliminate the influence of spatial scale and signal length, these distance signals are normalized with respect to magnitude and size. First, signal magnitude is normalized through L1-norm. Then, equally spaced re-sampling is used to normalize its size into a fixed length (360 in our experiments). Additionally, we regularize the walking direction of sequences taken from the same view based upon the symmetry of gait motion during shape representation (e.g., from left to right for all sequences with lateral view). Conversion of sequence of silhouette images into an associated sequence of 1D signal patterns will no longer suffer with noisy silhouette data.

Each of the frames in the image sequence is subtracted from a background model of the respective image sequence. If the pixel value of each frame is not the same with the pixel value of the background, the pixel is marked as region of silhouette.

(b) C-AGI

It is difficult to find Human identification and gender recognition from gait sequences with arbitrary walking directions. To deal with this, first a new gait dataset is collected, where people walk freely in the frame scene and the walking directions are erratic or irrational and time-varying throughout the sequence. Human silhouettes are obtained by background subtraction in each gait sequence and manage them into several clusters. For each cluster, cluster-based averaged gait image (C-AGI) as the feature is obtained.

(c) Feature Extraction

Feature selection is an essential venture in gait recognition. Every gait arrangement is separated into cycles. Hanavan's model is used to extract features. In this step each gait sequence is divided into cycles. Gait cycle is defined as person starts from rest, left foot forward, rest, right foot forward, rest. 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. 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.

(d) Cluster Based Arbitrary Walking Gait Recognition

The theory of CAWGR is based on the idea of structural risk minimization. It is a powerful tool for solving classification problems. However, it is to be noted that CAWGR is fundamentally a two-class classifier. CAWGR first maps the training samples into a high dimension space (typically much higher than the original data space) and then finds a separating hyper plane that maximizes the margin between two classes in this high-dimension space. Maximizing the margin is a quadratic programming (QP) problem and can be solved from its dual problem by introducing Lagrangian multipliers.

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Without any knowledge of the mapping, the CAWGR can find the optimal hyper plane by using the dot product functions in original space that are called kernels. There are several kernels proposed by researchers. Here, radial basis function (RBF) is used. Once the optimal hyper plane is established, a decision function to classify testing samples can be used directly. For solving multi-class problems, various methods have been proposed for combining multiple two classes CAWGRs in order to build a multi-class classifier, such as "one-against-one" and "one-against rest" methods. In this paper, the "one against-one" method is used in which $k(k*1)=2$ classifiers are constructed and each one trains samples from two different classes. In classification, a voting strategy is used: each two-class CAWGR is considered as a voter (i.e. $k(k * 1)=2$ voters in all), and then each testing sample is classified to the class with maximum number of votes.

(e) SURF

SURF or Speeded Up Robust Features is a robust local feature detector that can be used in computer vision tasks like object recognition or 3D reconstruction. Interest points are selected at distinctive locations in the image, such as corners, blobs, and T-junctions. The most valuable property of an interest point detector is its repeatability. The repeatability expresses the reliability of a detector. Surf feature is used for matching in the recognition system here surf feature is used to find out the critical points which helps in matching the images more accurately. Surf feature has been used first time in gait recognition system.

In this system each extracted image in the database is compared to the features of the query image. This involves two steps:

1. Feature Extraction: The first step in the process is extracting image features to a distinguishable extent.
2. Matching: The second step involves matching these features to yield a result that is visually similar[7].

V. EXPERIMENTAL RESULTS

In this section, experiments have been performed to prove the adequacy of the proposed approach. The comparison of the accuracy, PSNR, MSE is done with the given values to the proposed work. The accuracy rate is approx 98.8398 percent i.e. much higher as compared with the previous methods.

Figures shows all the graphs for estimated average CCR, feature point and the matching point in the proposed approach. This shows that the proposed system is much efficient as compared with the previous system. All the parameters are calculated just to verify the efficiency of the system.

Fig 2: Feature Extraction and parameters involved in recognizing various Walking directions of a human.

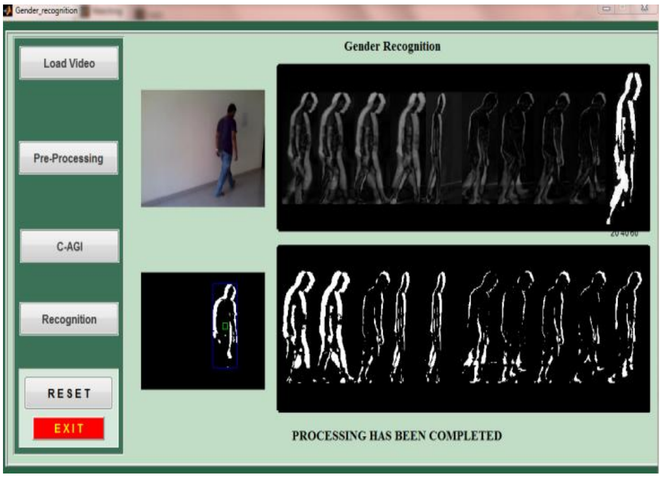


Fig 3: Gender Recognition and processing of the image frame.

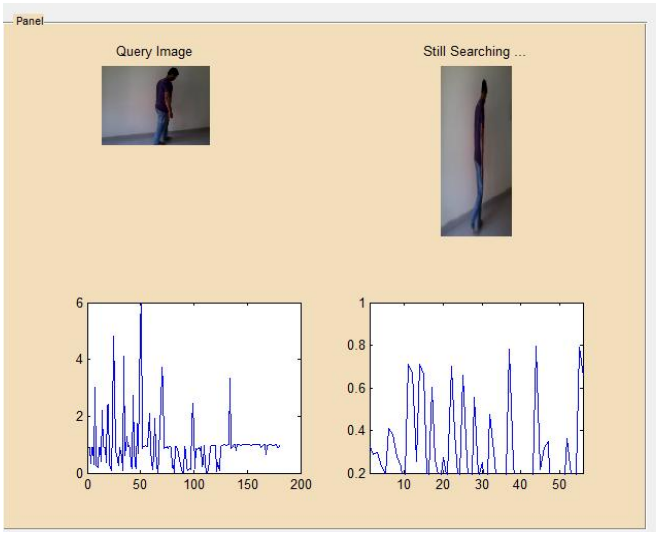


Fig 4: SURF graph of the source image or video.

Fig 4 shows the SURF graph of the proposed approach which is used for matching the source with the database.

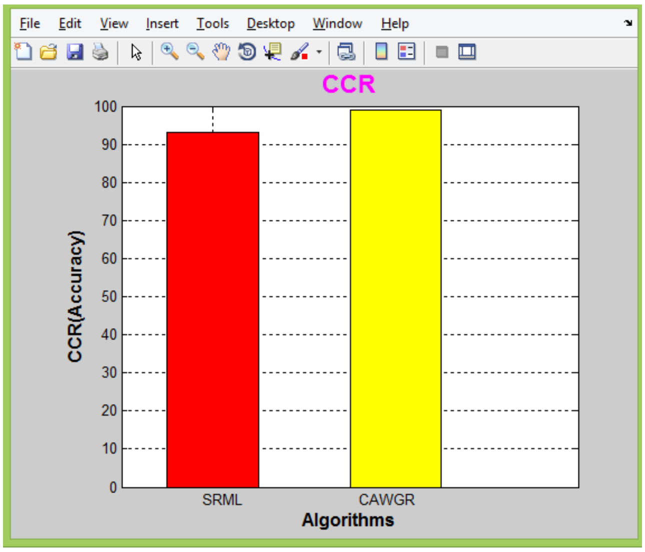
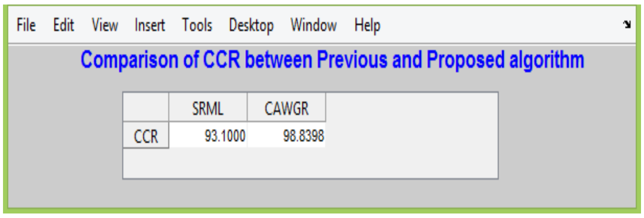


Fig 5: shows graph for CCR (accuracy) of previous approach (SRML) and proposed approach (CAWGR)



	SRML	CAWGR
CCR	93.1000	98.8398

Fig 6: Comparison of accuracy for previous approach (SRML) and proposed approach (CAWGR)

Fig 5 and Fig 6 shows the accuracy graph of previous approach (SRML) and proposed approach (CAWGR). After comparison it is shown that the accuracy achieved is approx 98.8398 percent which is better from the earlier methods.

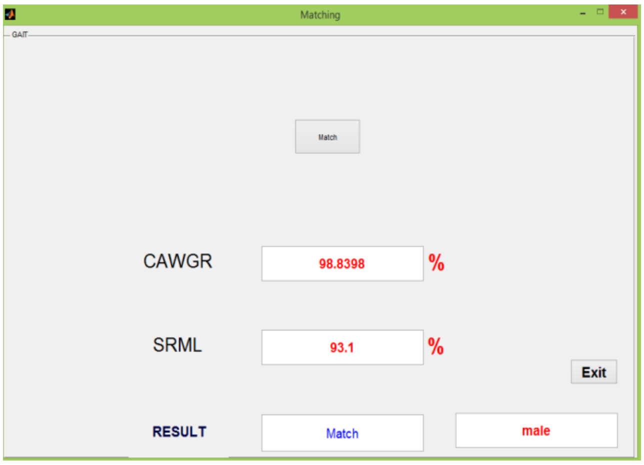


Fig 7: Comparison between previous and proposed algorithm on the basis of average accuracy

The fig shown above shows the comparison between the previous method and the proposed method on the basis of average accuracy. This shows that the approach which is proposed is more decisive and potent when compared with the previous used technique.

V. CONCLUSION

This paper investigates the problem of identification of humans and recognition of gender from gait sequences with arbitrary walking directions. This paper has described a simple but effective method for automatic person recognition from human silhouette and gait while using CAWGR for recognition and identification of human and SURF is used for Matching. The combination of a background subtraction procedure and a simple correspondence method is used to segment and track spatial silhouettes of a walking figure. Intermediate results describe the effectiveness of proposed system when compared with the previous results.

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