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Gait based Human Identification Approach

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Abstract— This paper focus on efficient gait based human identification algorithm to identify the moving person under different walking conditions. The proposed technique is experimented on person identity and gender identity based approaches by using gait. This technique consists of background subtraction, region based segmentation, and wavelet based feature extraction method. The proposed approach gives encouraging performance results by comparing with other existing approaches.

Keywords— Background Subtraction, gait, Segmentation, Supervised Classification

I. INTRODUCTION

To recognize the person for their identification have always been the most interesting part of computer vision processing. The fusion of human gait and biometrics has become a popular research direction over the past few years[1]. Due to the non invasive, unobtrusive, perceivable at a distance and hard to conceal natures of gait feature, This concept is used for visual surveillance and monitoring applications [12]. Rest of these articles is organized as follows: section II described literature survey. Section III described the proposed methodology which contains pre-processing, segmentation, wavelet based feature extraction. Section IV gives experimental results and their comparison and finally section V explain its conclusion.

II. LITERATURE SURVEY

For human identification, we have considered person identity and gender identity based approaches using model based and model free based techniques. In the model-based technique, the human body silhouette structure or motion is model and then the image features are extracted by the measure of structural components of models or by the motion trajectories of body parts ([2],[3],[4],[5]). Model free based techniques can be further divided into two main classes, state-space methods and spatiotemporal methods ([6],[7],[8],[9]). Model based approach has high computational complexity and more difficult in low resolution images so that it found difficulty in real time system due to feature extraction process. In model freebased techniques, computational complexity remains low, this approach is well suitable for real time system as it is easy to extract the features comparatively.[10] presented baseline based human ID analysis experiment. Ju Han and Bir Bhanu [13] present approach for human recognition by combining statistical gait features from real and synthetic templates. Experimental results demonstrate that the proposed fusion approach provides 94 % accuracy for viewing angle and found 9 to 12% recognition rate under clothing condition. This algorithm provides better performance rate in viewing angles but give poor performance under clothing condition. Shiqi Yu et al. [14] proposed the framework consists of a large gait database, a large set of well-designed experiments and some evaluation metrics. There are 124 subjects using CASIA-B dataset of 11 views. Three variations, namely view angle, clothing and carrying condition changes, are separately considered in the database. Ning Li et al. [15] presented an adaptive part-based feature selection method to filter out interference feature blocks and a matching procedure is performed to identify the correct subject. They used side view objects to carry out all the experiments so this approach become view dependent. K. Bashir et al. [16] address of selecting the most relevant features for gait based human identification .They developed supervised and unsupervised feature selection methods by using gait energy image to improve the performance of gait recognition. M Hu et al. [17] obtained lower gender classification rates under carrying a bag and wearing overcoat. They applied Gabor filter banks of 3 different scales and 6 orientations on the image to extract the features. Maximization of Mutual Information (MMI) was used to learn the discriminative low dimensional representation. The Gabor-MMI feature vectors are used to train Gaussian Mixture Model-Hidden Markov Models (GMM-HMMs) to perform classification.

III. PROPOSED METHODOLOGY

The proposed method consist of preprocessing, segmentation, feature extraction and classification.

A. Preprocessing

Initially gait video sequence is captured by using static camera. Input video are taken as RGB format video frames of default size, To minimize the memory requirement and time complexity ,these frames are to be converted into gray scale .By using approximate background subtraction method binary silhouette of the moving objects are extracted. By using morphological operation irregularities present in the silhouette are removed. Using segmentation, Silhouette body

is divided into six components. From these components, gait features are extracted by using two dimensional discrete wavelet transform method. By using K-nearest neighbor classifier, distance between train features and test features are computed and achieve better classification accuracy.

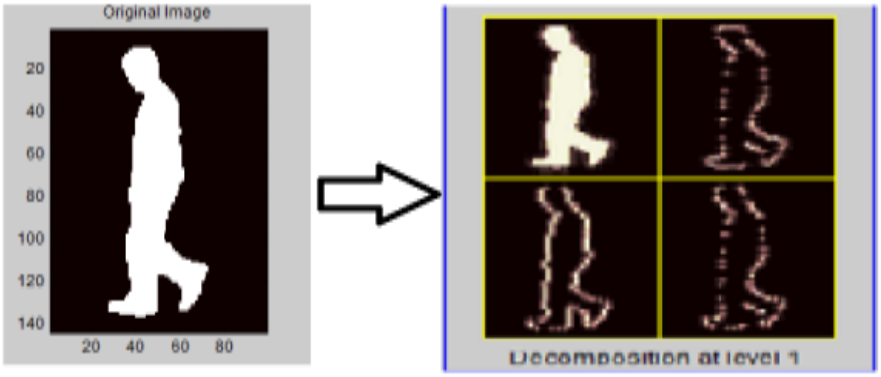
For this stage, it is assumed that background is remaining to be static. Approximate median background subtraction method is used to extract silhouettes object. In this method frame difference between current frame and known background frame is computed and is compared to predetermined threshold level. If this difference is greater than threshold then it is foreground otherwise it consider as background frame. By using morphological technique, irregularities present in foreground silhouette become removed.

B. Segmentation

In this stage, foreground silhouette is segmented into six regions used for extraction of their information. By considering its anatomical knowledge [11] that will facilitate the person recognition task.

C. Feature extraction

Discrete wavelet transform (DWT) is an useful tool for decomposition of the image to extract its low frequency approximation information and high frequency detail information by using low pass and high pass filter.



(a) (b)

Fig-1: (a) Original image (b) single level DWT Decomposition

In single level, image become decomposed in four sub-frequency bands which contains approximate, horizontal, vertical, diagonal coefficients as shown in fig.1(a) and (b). As level of decomposition increases, image becomes split up into approximation, horizontal details, vertical details, diagonal details accordingly to their decomposition level. Notice that the detail coefficients are small and consist mainly of high-frequency information, while the approximation coefficients contain only the low frequency information . In the proposed method, Dmey, coif4, db4, Rbio3.3 wavelet families are used. Using DWT method, approximate wavelet features coefficients are extracted.

D. Classification

For this approach, we have considered three supervised classifiers such as K-nearest neighbor, artificial neural network and support vector machine. K-nearest neighbor (KNN) is one of the simplest but widely used machine learning algorithm. An object is classified by the "distance" from its neighbors, with the object being assigned to the class most common among its k distance-nearest neighbors. Distance is a key word in this algorithm, each object in the space is represented by position vectors in a multidimensional feature space. To calculate distances of all training vectors to test vector, distance measures such as Euclidean distance, City block distance, Cosine distance, Correlation, Hamming distance can be used. With the help of K-nearest neighbor classifier computation take place between extracted train features vector and test feature vector. According to their majority vote of nearest neighbors, their classification is take place.

Artificial neural network can be designed on the basis of number of input nodes, hidden nodes and output nodes with number of epochs and momentum parameter. Once this model is trained on training data it is now be tested with testing data.

SVM is a relatively new learning machine based on structural risk minimization technique.It is basically two class machine that optimally separate two classes of data with maximum margin.The performance of SVM depend on different kernels functions, penalty parameter and lagrange parameter.

We have used person identity and gender identity based approaches using KNN, ANN and SVM classifiers. On the basis of its maximum outputs, we can decide the effectiveness of this algorithm.

IV. EXPERIMENTAL RESULTS

For this experiment, we have used CASIA database with two gait cycle. We have considered ten different person object of male and female categories. This experiment is evaluated on normal, clothing and carrying conditions with five viewing angles using person identity ,gender identity and combine based approach. Table I gives overall performance result in terms of correct classification rate and which are also graphically presented as shown in fig 2.

Table I Overall Performance of proposed method

Walking condition	View angle	Proposed method		
		Person identity	Gender identity	Combined
Normal	0^0	98.28	98.85	98.85
	54^0	96.55	96	96.55
	90^0	99.40	100	100
	144^0	96.84	97.42	97.42
	180^0	98.40	99.42	99.42
carrying	0^0	100	100	100
	54^0	98.58	97.71	98.57
	90^0	99.71	100	100
	144^0	98.28	100	100
	180^0	100	99.71	100
clothing	0^0	99.71	100	100
	54^0	94.57	96.57	96.57
	90^0	95.99	98.28	98.28
	144^0	98.85	97.14	98.85
	180^0	99.42	99.71	99.71

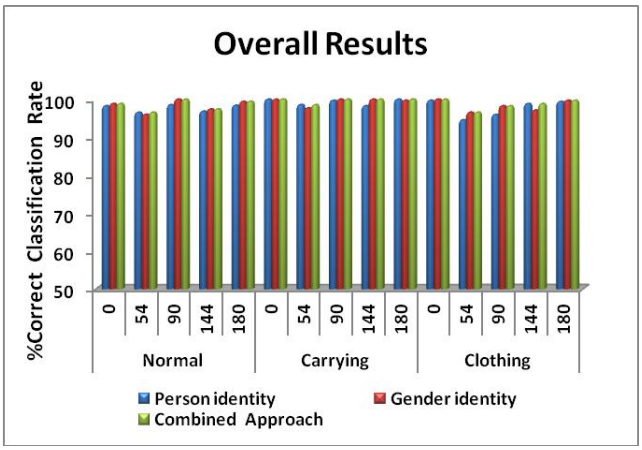


Fig 2: Overall Performance rate of proposed approach

Table III Performance comparison results at 90^0 viewing angle condition for person identity

Methods	Normal	Carrying	Clothing
CAS [14]	97.6	32.7	52.0
UCR[13]	99.4	60.2	22.0
Supervised [16]	98.6	85.5	88.8
Unsupervised [16]	99.4	79.9	31.3
Ning Li et al.[15]	99.2	80.6	75.8
Proposed	99.4	99.71	95.99

Table II shows experimental results of different person recognition algorithms under viewing for normal, clothing, carrying sequences under 90^0 side view consideration. When comparing the results reported with different methods, it is observed that correct classification rate (CCR) of the proposed method gives superior performance for person identification under normal ,clothing, carrying sequences.

Table IIIII Performance Comparison Result for gender identity at 90^0 viewing angle condition

Conditions	% Correct classification rate (CCR)				
	Method reported by M.Hu et al. [17]				Proposed
Normal	96.77	91.94	91.94	80.65	100
clothing	83.87	74.19	72.58	67.74	98.28
Carrying	88.71	85.48	82.24	79.03	100

Performance comparisons of proposed method with the gender identity based results reported in M.Hu et al. [17] for three walking test conditions under 90^0 side view consideration are depicted in Table III. We have achieved effective correct classification rate (CCR) of the proposed method for normal , clothing, carrying sequences for gender identity .

V. CONCLUSION

In this work, we have used person identity and gender identity based approaches under normal, clothing, carrying sequences with five viewing angle conditions found dominating results .It's definitely help to improve the effectiveness of human identification by using gait.

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