Journal of Advances and Scholarly Researches in Allied Education
Vol. 12, Issue No. 2, January-2017, ISSN 2230-7540

A Framework for Silhouette Inspired Robust GAIT Based Human Identification

Vivek Bhatnagar[1]* Dr. Ramesh Kumar[2] Ashok Kumar[3]

[1] Research Scholar of OPJS University, Churu, Rajasthan

[2] Associate Professor, OPJS University, Churu, Rajasthan

[3] Professor, Department of Computer Engineering, Markandeshwar University, Mullana (Ambala), Haryana, India

Abstract – Gait has enticed substantial consideration in the current years as it has number of unique features that are not present in other biometrics techniques. The features like videos of subjects can be used which are recorded from a distance that is without alerting the subject at all and secondly, videos recorded at low resolution can be used for recognition. The researchers have shown interest in gait as its recognition results have shown a promising growth in the controlled environment. In this thesis, solutions are proposed for the real world by taking care of gait controlled situations like view conditions, resolution and fluctuation of gait patterns due to carrying clothes as well as goods. To achieve the human identification in a better way, a new approach has been used. Erosion method for cleaning operation has been used that is followed by the convolution neural network with two convolution layers and pooling layers have been used to optimize the human recognition system. All the results have been obtained from CASIA dataset as well as OU-ISIR data set.

Keyword: Human Motion Analysis, Gait Recognition

---------------------------------x---------------------------------

1. INTRODUCTION:

The newer study has been developed to study the behavior of human walking and these studies involve a lot of mathematical calculations and modelling. This human gait analysis (HGT) study is an important aspect of human motion analysis. HGT has been used in many areas including security, medicine biomechanical and psychological. There is an increase demand in individual identification systems as it is applications are growing in many areas like smart interfaces, access control and visual surveillance. Generally the methodology used for gait recognition consists of detection of subject, extraction of silhouettes, extraction of features followed by selection of features and finally classification. Firstly, from the moving subjects, individuals will be detected and extracted from the background of the images by mostly using background subtraction methods. After this, features are extracted from these segmented walking persons so that identification of humans can be done. The features can be extracted on the basis of model based (Lee & Grimson, 2002), (Kale, Cuntoor, Yegnanarayana, Rajagopalan, & Chellappa, 2003), (Wagg & Nixon, 2004) and model free (L. Wang, Tan, Member, Ning, & Hu, 2003), (Han & Bhanu, 2006)techniques. The features extracted are not effective for classification as presence of high dimensionality in the samples(Bashir, Xiang, & Gong, 2008). So, reduction algorithms should be applied like principal component analysis (PCA)(L. Wang et al., 2003), (Martek, 2010)and Latent Dirichlet Allocation (LDA)(Martek, 2010), (Deepak, 2016). The last step is classification. The classification broadly divided into 3 methods namely direct, temporal and state space. Now a days, gait recognition aims to differentiate the individuals by their walking style and this ways of recognizing the individuals have many advantages like very difficult for individuals to conceal their identities, non-invasive method and is less obscured than other identification methods. The walking status and gender classification is analyzed by various authors on the gait appearances (Lee & Grimson, 2002), (Collins & Gross, 2002), (Sarkar et al., 2004), (Liu & Sarkar, 2005), (Aqmar, Shinoda, & Furui, 2012).

2. GAP ANALYSIS

From the literature studied, the following factors can be the reason for poor performance of gait recognition systems like fatigue, training, viewpoint, change in clothes, carrying conditions. The identification of human using silhouettes is one of the time consuming and complex process(Benabdelkader, Cutler, & Davis, 2004),(Kumar & Nagendraswamy, 2014).Another real time factor is Time that creates a problem in identification of gait signatures of same person at two different times. The complex factor out of all the mentioned factors for gait recognition system is viewpoint change and many researchers have noticed that it gives inaccurate results if viewpoint is ignored(J. Wang et al., 2010), (Y. Dupuis, X. Savatier, 2013), (Kumar & Nagendraswamy, 2014).In the literature, it has been found that deep learning has not been implemented in many studies of gait recognition as it is highly dependent on large training samples.

3. METHODOLOGY

The proposed gait identification system (PGIS) consists of two activities. In the first activity, the data is collected and trained. In the second activity, the gait signatures are used for identification of the humans.

Generally, to capture the walking style of a human, one or more video cameras are used. If only single camera is used to capture the gait of human then camera should be fixed at a defined angle so that side view of human can be captured and stored. If many cameras are used to capture the gait of human, then management of cross view variance should be done to achieve the accuracy for gait identification system. After capturing the video sequences of the humans, data cleaning and preprocessing should be performed for producing silhouettes images and this step is followed by the feature extraction step. After extracting the features from the silhouettes images, the system is trained using deep learning for identifying gait signatures. The whole process is illustrated in Figure 1.

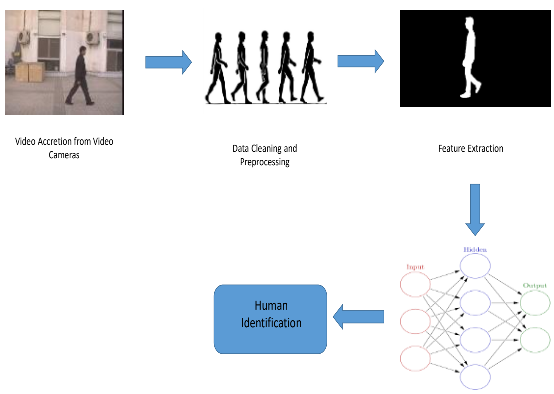

Figure 1: Proposed Gait Identification System

4. EXPERIMENT & RESULTS

4.1: Preprocessing phase and cleaning operation

The subject gait pattern is highly motivated or relied on the joints movement which are always unique in nature. The figure 4.1 shows the joints of the body of a subject with coloring on the outlines. The gait identification becomes very effective if there are sequence of images or you can say silhouette images with respect to the movements of joints. To get the proper sequence of images in which joints movements' rea shown properly then an image processing operation has to be performed. This operation is called erosion and it is basically used in grayscale images or binary scale images in which the pixels outer layer is removed or discarded.

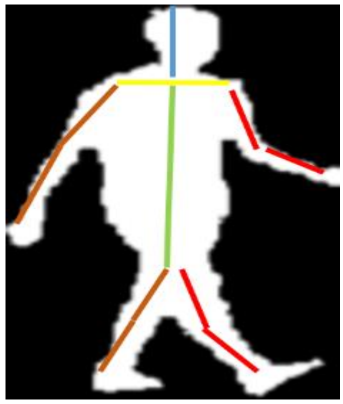

Figure 4.1: Subject body joints

Below the figure 4.2 shows, the silhouette image after applying the operation of erosion and get the cleaned silhouette image. In this figure, it can be clearly seen that outer layer has been discarded so that a very close look to the body structure of the subject can be seen.

4.1.1 Erosion:

Before understanding of erosion, it is important to understand what is morphological operations? These is a set or collection or pool of non-linear operations that are directly or indirectly connected with the shape or morphology features. These all operations are performed on the images.

4.2 Feature Extraction

This phase is executed after the pre-processing and cleaning operations phase. The sequence of silhouette images is given to the recognition system such that features can be extracted from the images like body outlines or body contours so that subject's gait pattern can be identified. The framework which was proposed by the researcher's will firstly identify the subject's body by properly drawing the body contour. Now, most important question arises is that what you mean by contour. It is a curve that is continuous in nature and that can be drawn alongside of the outer points that are having same intensity or color of the silhouette images. The figure 4.3 is an normal silhouette image and the figure 4.4 represents the contour that is drawn by the system on the image. The contours can be better explained by drawing a curve that is combining all the continuous points that is along the boundary of the image.

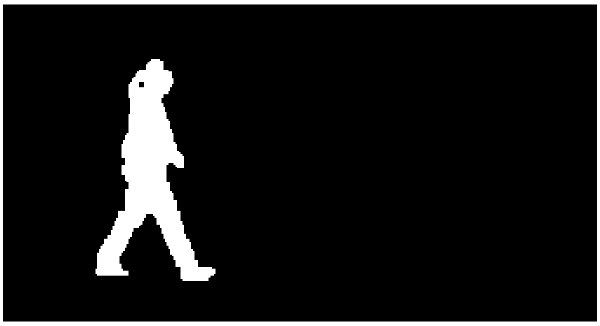

Figure 4.3 Silhouette Image of a subject

Figure 4.4 Contour for Silhouette Image

The tool that is used for object detection & recognition as well as analysis of shape is contour. One of the key aspect is that if the whole body contour is analyzed to identify the pattern of gait of subjects' then the system performance will be tainted. If contour of whole body is analyzed then for the system to process such large amount of input is difficult that leads to slow computational speed. To overcome this disadvantage or to increase computational speed, segmentation of body contour is done i.e. a set of points have been made from the body contour segmentation, where each point is a combination of x and y coordinates and two set of points are set at a distance of d that is represented for coordinates (x,y) and (x',y') as:

$$d` = \sqrt{(x - x`)^2 + (y - y`)^2} \qquad (4.1)$$

Details of Results and Experimentation

The proposed framework was performed on the databases of CASIA (A,B,C) and OU-ISIR database. To measure the accuracy, correct classification rate is the parameter that is used and in the short form it is depicted as CCR. It is defined as the rate at which the system which has been developed correctly identify the images. To calculate gait pattern recognition accuracy of our proposed model, the recognition rate at rank-1 is used. Now, question arises what is recognition rate at rank-1, it is the number of correct people ranked as the first in terms of percentage. Basically, four parameters or arguments have been considered erosion, time factor and both time as well as erosion and without adjusting any confounding factor. But most importantly, how CCR is calculated and formulated. CCR is formulated as:

$$CCR = \frac{True\ Positive + True\ Negative}{True\ Positive + True\ Negative + False\ Positive + False\ Negative}$$

The results are mentioned below in the form of barcharts:

- **CASIA Adataset**

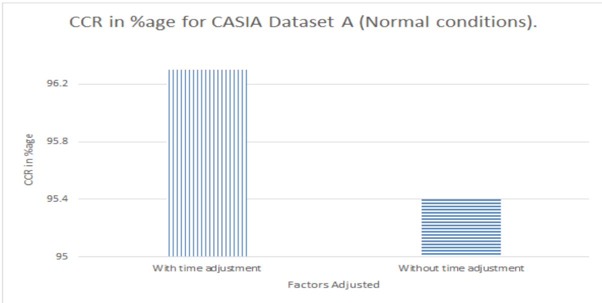

Figure 4.9. CCR for CASIA dataset A (normalconditions) in percentage

- **CASIA Bdataset:**

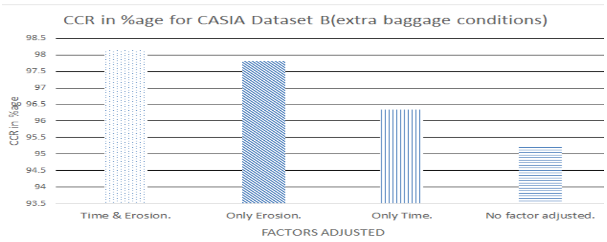

Figure 4.10. CCR for CASIA dataset B (extra baggageconditions) in percentage

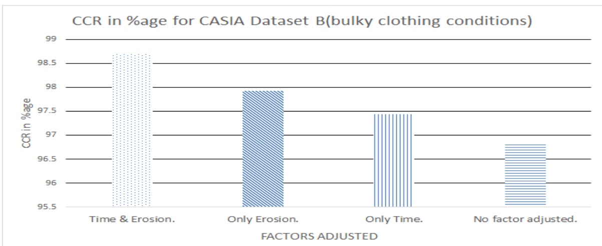

Figure 4.11. CCR for CASIA dataset B (bulky clothingconditions)in percentage

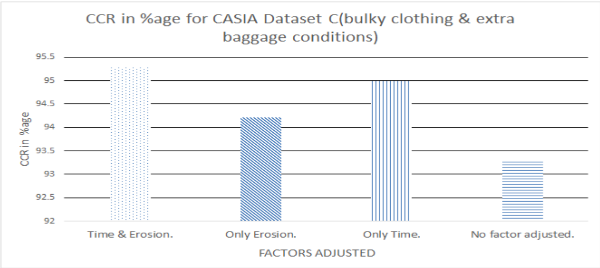

Figure 4.12 CCR for CASIA dataset C (extra baggage & extra baggageconditions) in percentage

The proposed framework was calculated on OU-ISIR database with gait pattern images at an angle of eighty five degree. Erosion and normalized time factors were used to treat the factors that are confounding in nature. The results are mentioned below in the table 4.2.

Table 4.2: OU-ISIR CCR Results

Angle View in degrees	85	75	65	55	ALL
With time factor and erosion	92.2	92.1	91.2	90.8	97.2
Without time factor and erosion	90.98	89.23	89.75	88.12	95.8

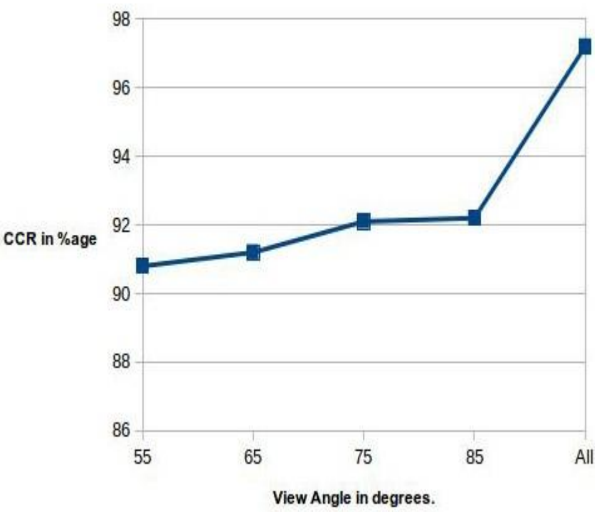

Figure 4.13. CCR achieved at different view angles in OU-ISIR

4.5.1 Comparison of CCR with the other techniques

In this section, comparison is performed with the other gait pattern techniques and the results are mentioned below in the table 4.3.

Table 4.3 CCR of different algorithms with CASIA DATASETS

Algorithms with CCR in percentage Baggage denoted by bgg Clothing denoted by clh			
Algorithm	**CASIA A**	**CASIA B**	**CASIA C**
(Lee & Grimson,2002)	87.5	Not Applicable	Not Applicable
Dupuis, Savatier, & Vasseur,2013)	98.8	73.8[bgg+clh]	63.7
(Kumar & Nagendraswamy,2014)	Not Applicable	82.50[bgg] 83.33[clh]	Not Applicable
(Jia et al.,2015)	Not Applicable	77.5	Not Applicable
(Aggarwal & Vishwakarma,2016)	100	93.1[bgg]	81.3
(Deepak,2016)	85	Not Applicable	Not Applicable
(Tang et al.,2017)	Not Applicable	92.3[bgg] 92[clh]	Not Applicable
(Ma, Wu, & Wang,2017)	Not Applicable	87.85[bgg] 69.16[clh]	Not Applicable
(Chhatrala & Jadhav,2017)	Not Applicable	40.8	Not Applicable
OUR PROPOSED FRMEWORK	96.3	98.16[bgg] 98.71[clh]	95.3

Our proposed system was also compared with HOG and GEI of authors Dalal and Triggs work (Dalal&Triggs,2005) methodsand comparison was totally based on OU-ISIR data sets. The results are shown below in table 4.4.

Table 4.4 Comparison on the basis of CCR in percentage of our proposed framework with HOG and SEI

DATASETS	A-85	A-75	A-65	A-55	A-All
GEI	85.9	86.9	86.6	84.7	94.2
HOG	89.9	91.5	90.9	90.4	96.2
PROPOSED FRAMEWORK	92.2	92.1	91.2	90.8	97.2

In the above table it can be clearly seen that, our proposed framework has out-performs in all the datasets for all the above mentioned techniques. The CCR is high for each dataset in all the techniques whether it is GEI or HOG.

5. CONCLUSION:

One of the most emerging and comparative new biometric technique that is related with the walking style of the individual's so that identification as well as validation of individual's can be performed. The encouragement in the biometric gait method has been increased as there are a number of evidences available in many fields especially in medicine. One of the biggest advantage of gait is to recognize subject's in passive mode i.e. this biometric can be used to identify subject's from a distance and moreover, at a low resolution

REFERENCES:

Wang, J., She, M., & Nahavandi, S. (2010). A Review of Vision-based Gait Recognition Methods for Human Identification School of Engineering. In IEEE International Conference on digital image computing: techniques and applications (pp. 320–327).

Sydney, NSW, Australia. https://doi.org/10.1109/DICTA.2010.62

Wang, L., Tan, T., Member, S., Ning, H., & Hu, W. (2003). Silhouette Analysis-Based Gait Recognition for Human Identification. IEEE Transactions on Pattern Analysis and Machine Intelligence, 25(12), pp. 1505–1518.

Winter, D. a, Patla, a E., & Frank, J. S. (1990). Assessment of balance control in humans. Medical Progress through Technology, 16(1-2), pp. 31–51. Retrieved from

http://www.ncbi.nlm.nih.gov/pubmed/2138696

Winter, D. A. (2009). Biomechanics and motor control of human movement. John Wiley & Sons.

Ý, C. B., Þ, R. C., & Ý, L. D. (2002). Person identification using automatic height and stride estimation Person Identification using Automatic Height and Stride Estimation Ý University of Maryland , College Park. Object Recognition Supported by User Interaction for Service

Robots, (May 2014), pp. 1–5. https://doi.org/10.1109/ICPR.2002.1047474

Y. Dupuis, X. Savatier, P. V. (2013). Feature subset selection applied to model-free gait recognition. Image and Vision Computing, 31(8), pp. 580–591.

https://doi.org/10.1016/j.imavis.2013.04.001

Massachusetts Institute of Technology (MIT) Database, 2002," http://www.ai.

mit.edu/people/llee/HID/data.htm", [Accessed: 2016-08-17].

Defence Advanced Research Projects Agency (DARPA), Human identification at a distance, (2001), " http://www.darpa.mil/, [Accessed: 2016-08-17].

R. Gross and J. Shi, The Carnegie Mellon University (CMU) Motion of Body (MoBo) Database, (2001), "https://www.ri.cmu.edu/publications/the-cmu-motion-of-body-mobo-database/".

Corresponding Author

Vivek Bhatnagar*

Research Scholar of OPJS University, Churu, Rajasthan