SOM Based Human Gait Recognition By Analyzing Silhouette

[1]Ankita Yadav, [2]Dipti Verma
Dept. of Computer Science and Engineering,
Sarguja University, Ambikapur, India

Abstract : Human identification has gained a lot of interest by the researchers recently. Gait analysis identify the people gait behavior. The behavior can be anything, like walking, running and talking behavior. In this paper a simple yet efficient mechanism is proposed for human gait identification using machine learning approach. The proposed system combines silhouette analysis by constructing features and image segmentation. The Training and classification of silhouette is done using self-organizing maps. The proposed method outperforms the existing system with higher accuracy**.**

***IndexTerms* - Human Gait Analysis, behavior, silhouette, image segmentation.**

I. INTRODUCTION

Human gait recognition is one of the customary biometric techniques, similar to fingerprint, iris, face, and voice recognition [1-4]. Such advancements have been broadly utilized in security fields. Notwithstanding, such biometrics methods require physiological and behavioral characteristics of various persons for identification. Utilizing the human gait for identification is an inconspicuous strategy that implies no physical contact is vital between the subjects and the estimation devices. Identification utilizing the human gait does not require the collaboration or the consideration of the subjects. Existing gait recognition approaches for the most part utilize standard video cameras for capturing the development of walking persons. However, their fundamental test is the extraction of trademark features for identification of the human gait [5-7].

Gait recognition strategies are extensively separated into two methodologies, Model-based and Model-free. Model-free approaches utilize binary silhouette data to recognize human gait. Model based methodologies use body data, for example, body joints for building a model. Utilizing a standard camera, capturing body data is impacted by background color and force of the light for the gait recognition. Duo to this, these methodologies require restricted ambience. With a depth camera, it is conceivable to catch the depth picture which can follow body data in the 3-dimension without the prerequisites in the standard camera.

Microsoft Kinect is a depth camera for the Microsoft Xbox gaming console, empowering players to control and play games with their body motion and gestures. The Kinect likewise enables body recognition and tracking of individuals in real-time by an incorporated depth camera utilizing a SDK given by Microsoft [8]. Color image, depth picture, and human body information can be extracted from the Kinect device. Appropriately, a few specialists previously proposed these capacities of Kinect to analysis for human gait recognition.

We show some potential estimations, for example, angle of body joints, walking speed, and length of body to distinguish walking persons utilizing the Microsoft Kinect with the SDK. Likewise we expect that a mix of techniques can enhance accuracy of gait recognition.

Table 1. Specification of Kinect

Kinect	**Specification**
Depth range	Available range 0.5m ~ 4.5m
Depth stream	512 x 424 @30fps
Infrared stream	Enable
Body frame	26 body joints in 3D
Recognizable body	Up to 6 simultaneous bodies

1.1 Gait Cycle

A gait cycle is the time period of movements known as a stride. The gait cycle is isolated into two phases, stance phase and swing phase as appeared in Figure 1. Stance phase is that the foot stays in contact with the ground. It possesses 60 percent of the gait cycle with 5 movements. The main development is heel strike. A heel is the first joint of the foot to touch the ground and the weight is exchanged onto the foot. Mid stance includes arrangement of body weight on the foot. The heel rises while its toes are as yet touching the ground. And afterward, the toe rises into the air. This movement is the start of the swing phase of the gait cycle. The swing phase involves the rest of the 40 percent of the gait cycle. It isn't in contact with the ground. Humans have minimal distinctive gait cycle contingent upon the person. We concentrate to discover diverse examples based on their gait cycle. As per the test outcomes, angle features from subjects can be looked at by the gait cycle.

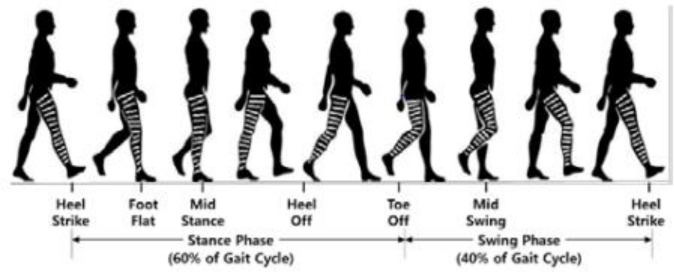


Figure 1. Gait Cycle Phases

1.2 Body Frame with Kinect

The Kinect sensor comprises of a RGB camera and an infrared sensor mix for inferring depths. The Kinect device gives body frame information which comprises of 25 body joints as appeared in Figure 2. Each joint has position in 3D space and an orientation. The body frame information incorporates 2 finger joints on each hand. Since the finger joints are redundant for gait recognition, we chose to prohibit the finger joints.

Joint No.	Joint Name	Joint No.	Joint Name
1	Spine base	12	Hand-right
2	Spine mid	13	Hip-left
3	Neck	14	Knee-left
4	Head	15	Ankle-left
5	Shoulder left	16	Foot-left
6	Elbow left	17	Hip-right
7	Wrist-left	18	Knee-right
8	Hand-left	19	Ankle-right
9	Shoulder right	20	Foot-right
10	Elbow right	21	Spine-shoulder
11	Wrist right		

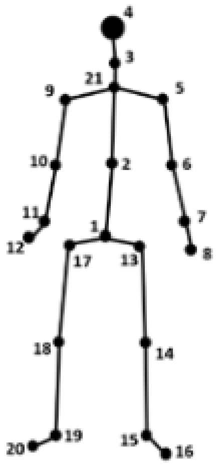


Figure 2. Body Joints List by Kinect

II. HUMAN GAIT ANALYSIS

This segment gives a portrayal of the proposed methodology, including the processing of the making of features, and which highlight can be estimated and have exceptional contrasts for the human gait recognition. The parameters for the gait analysis are step length, stride length, speed, angle, progression line, and so forth. We chose to use angle of body joints, walking speed, and body length for the gait analysis utilizing the body frame information in 3D space gave from the Kinect device.

2.1 Joint Angle

For the joint angle feature, 3 joint angles of the spine-mid/hip/knee, hip/knee/lower leg, and knee/lower leg/foot (Shown in Figure 3). Each angle comprises of body frame information in 3D space. Most researchers about for gait recognition proposed distance features [9, 10]. Be that as it may, the distance highlight could have an issue between walking persons who have comparative body length and stride. In this way, we propose the joint angle as the primary component for human gait recognition. The joint angle can be distinctive paying little respect to the issue.

So as to ascertain joint angles in 3D space without wearable sensors and cameras based on RGB color, we utilize infrared depth information from Kinect device. The joint angle in 3D space is more confounded to be determined and caught than different estimations for gait recognition. Because of the reason, the joint angle can be more unique than the others.

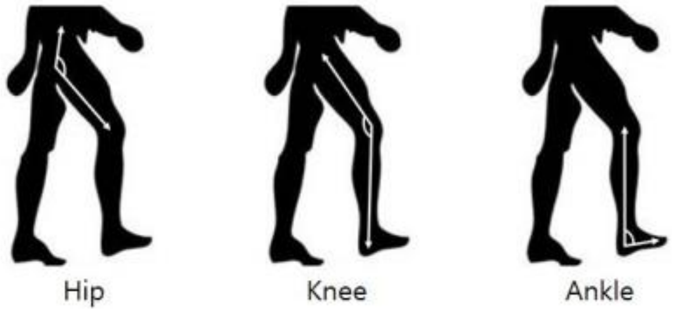


Figure 3. Joint Angles

2.2 Length of Body Parts

Body height is one of the estimations for gait recognition. Be that as it may, the estimation is weakl to discover contrasts between walking persons since human statures are on the whole comparative in correlation. In this manner, we propose a measurement, length of body parts between 21 body joints. Accepting that we think about all length of body parts, diverse persons could have distinctive length of body parts however they could have a similar height. This estimation isn't reasonable for gait recognition. Be that as it may, with consolidating this with different estimations, the length of body parts can be viably utilized for gait recognition, and enhance accuracy of gait recognition.

III. LITERATURE SURVEY

M. Hofmann et al. [8], Author present a new spatiotemporal representation for Gait Recognition, which we call Gradient Histogram Energy Image (GHEI). Similar to the Gait Energy Image (GEI), data is averaged over full gait cycles to decrease noise. As opposed to GEI, where silhouettes are averaged and in this manner only edge data at the limit is utilized, our GHEI computes gradient histograms at all areas of the original image. Accordingly, also edge data inside the person silhouette is captured.

E. Hossain et al. [9], propose a novel human-identification scheme from long range gait profiles in surveillance videos. We research the part of multi-view gait images gained from multiple cameras, the significance of infrared and visible range images in finding identity, and part of soft/secondary biometric (strolling style) in improving the precision and robustness of the identification frameworks. Experimental evaluation of a few subspace based gait feature extraction approaches (PCA/LDA) and learning classifier methods (MLP/SMO) on various datasets from a freely accessible gait database CASIA, demonstrate that it is conceivable to do huge scale human identity recognition from gait data captured in different view-focuses, with numerous cameras and with use of subtle soft/secondary biometric data.

S. Gabriel-Sanz et al. [10], concentrated on the appraisal of gait recognition on a constrained scenario, where limited data can be extract from the gait image sequences. Specifically, author interested in accessing the execution of gait images when just the lower part of the body is procured by the camera and only half of a gait cycle is accessible (SFootBD database). Hence, various state-of-art feature approaches have been taken after and connected to the information. A correlation with a standard and perfect gait database (USF database) is additionally carried out utilizing comparative experimental protocol. Results demonstrate that great recognition execution can be accomplished utilizing such constrained information data for gait biometric (around 85% of rank 5 identification rate and 8.6% of EER).

A. O. Lishani et al. [11], proposes a supervised feature extraction technique which can choose discriminative features for human gait recognition under the variations of clothing and carrying conditions and thus to enhance the recognition performances. The proposed strategy depends on the utilization of Haralick's texture features separated locally from three areas of Gait Energy Images. The execution has been assessed utilizing CASIA Gait database (dataset B). The experimental utilizing one-against-all SVM classifier yields attractive results when contrasted with existing and similar methods.

S. C. Bakchy et al. [12], proposed a developed technique for gait identification utilizing the feature Gait Energy Image (GEI). It is executed utilizing Kohonen Self-Organizing Mapping (KSOM) neural network. GEI representation of gait contains all data of each image in one complete gait cycle and requires less storage and low processing speed. As just a single image is sufficient to store the important data in GEI feature, the recognition process is less easy than any other feature of gait recognition. Gait recognition has a few limitation like viewing angle variation, walking speed, clothes, carrying load and so forth. Robust View Transformation Model (RVTM) is utilized to take care of the issue of viewing angle. RVTM transforms the viewing angle information from different angle to particular angle. RVTM improves recognition performance.

W. G. Bhargavas et al. [13], Identification of a person based on gait has made a circle of interest in computer vision space because of its high recognition capacity even at a far separation. Vision based position recognition can support Human Computer Interaction (HCI) efficiently. Gait recognition innovation can be utilized in numerous regular civilian and high security applications like car parks, banks, military bases, railway stations and airports. The fundamental point of the task is to build up the automatic biometric framework to distinguish a person in view of his Gait. This can be executed by recognizing the subject from the video outline, vital feature extraction utilizing skeleton data got from Microsoft Kinect sensor and classification against the database.

Z. Wu et al. [14], studied a CNN-based gait recognition method, with an extensive empirical evaluation in terms of various recognition tasks, preprocessing approaches and network architectures. With this method, we have updated the best recognition rates on three challenging datasets, showing its robustness to viewpoint and walking condition variations, and its generalization ability to huge datasets and complex backgrounds.

IV. METHODOLOGY

For human gait analysis we have utilized Self Organizing Map which is a type of neural network. The different gait images are provided as input and based on matching it returns the final recognized person of that gait.
The step by step architecture of proposed system is shown in fig. 4.

Proposed architecture consists of:

1. Background subtraction and motion extraction.
2. Human tracking.
3. Silhouette extraction.
4. Normalization.
5. Self-Organizing Maps based learning.
6. Classification
7. Recognition

4.1 Background Subtraction

For foreground detection, background subtraction method has been widely used. The camera is placed in such a way that it does not move and captures the dynamic scenes. To generate reliable frames for extraction of background is critical. To detect background Least Median of Squares method is used. It collects the frame of small portion of video and calculate various intensities of pixels. The calculation involves in least median of squares equation is shown below:

$$b_{xy} = \begin{cases} \min med_t (I_{xy}^t - p)^2 \\ p \end{cases}$$

Where I is the sequence of N images,
b_{xy} *is resulting backround image*
p is the background brightness
x, y are the pixel locations

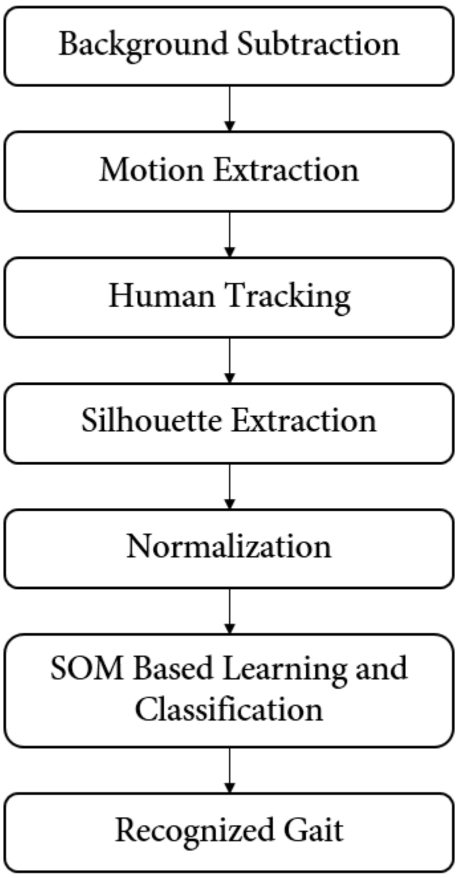


Fig. 4. Proposed System Architecture

4.2 Human Tracking and Silhouette Extraction

To remove the mistake because of segmentation error, each foreground region is then followed from edge to outline by a straightforward correspondence strategy dependent on the cover of their individual jumping confines any two continuous casings. That is, we play out a double edge relationship between the present and past outline profiles over a little arrangement of removals. A case of movement segmentation and the following procedure are appeared in Fig. 5, from which we can see that the human recognition and following method performs well on our information all in all. It completely does not influence the accompanying feature extraction process however there are a little bit of outline bends.

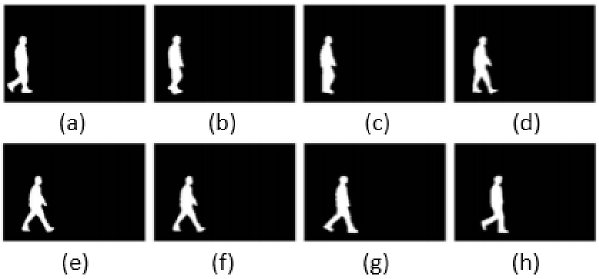


Fig. 5. Shows various frames of silhouette dataset

Normalization

To eliminate the effects of large approximation, we normalize each frame with respect to magnitude and size. The normalization of magnitude is done using L1-norm. The equation for L1-norm is presented below.

$$S = \sum_{i=1}^{n} | y_i - f(x_i)|$$

Where,

$y_i is\ target\ value\ and\ f(x_i) is\ estimated\ value.$

4.3 Neural Network Training

A self-organizing map (SOM) or self-organizing focus map (SOFM) is a kind of artificial neural system (ANN) that is prepared utilizing unsupervised figuring out how to create a low-dimensional (commonly two-dimensional), discretized portrayal of the information space of the preparation tests, called a map, and is hence a strategy to do dimensionality decrease.

V. RESULTS AND DISCUSSION

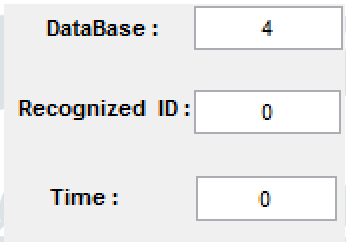
We have collected some of the silhouette images frames from online. The silhouette dataset consists of various person gaits. We have utilized MATLAB for training and classification.

Step by step execution of framework is shown below:

Step 01: Selection of Silhouette images.

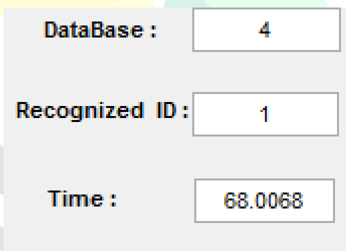
Step 02: Adding to Database

After the analysis of image, extracted features are stored into database.



Step 03: Gait Recognition

After storing all the silhouette data into database we now input some of the id's for testing. This step trains the dataset and produces exact match of ID's found.



VI. CONCLUSION

We have utilized silhouette dataset for proposed work. We have tested around 20 ID's of a human. We found higher accuracy while training and classification of human ID's. The future work will be to carry out the work with more features rather than just limited once.

REFERENCES

[1] Jain, A.K., Hong, L., Pankanti, S., Bolle, R., An identityauthentication system using fingerprints. in Proceedings of the IEEE, vol.85, no.9, pp.1365-1388, Sep 1997.

[2] Neha Kak, Rishi Gupta., Sanchit Mahajan., Iris Recognition System. In International Journal of Advanced Computer Science and Applications, vol. 1, no. 1, 2010.

[3] Roberto Brunelli., Tomaso Poggio., Face recognition: features versus templates. IEEE Transactions on Pattern Analysis and Machine Intelligence, 1993.

[4] L. R. Rabiner., B. H. Juang., Fundamentals of Speech Recognition, Prentice Hall, Englewood Cliffs, N.J, 1993.

[5] Sabesan Sivapalan., Daniel Chen., Simon Denman., Sridha Sridharan., Clinton Fookes., Gait energy volumes and frontalgait recognition using depth images. In international joint conference on Biometrics, IEEE, 2011.

[6] S. Niyogi., E. Adelson., Analyzing and Recognizing Walking Figures in XYT. In Proceedings of the Conference on Computer Vision and Pattern Recognition, pages 469–474, 1994.

[7] Jim Little., Jeffrey E. Boyd., Recognizing People by Their Gait: the Shape of Motion, in Journal of Computer Vision Research; Quarterly Journal, 1996.

[8] M. Hofmann and G. Rigoll, "Improved Gait Recognition using Gradient Histogram Energy Image," 2012 19th IEEE International Conference on Image Processing, Orlando, FL, 2012, pp. 1389-1392.

[9] E. Hossain and G. Chetty, "A multi-modal gait based human identity recognition system based on surveillance videos," 2012 6th International Conference on Signal Processing and Communication Systems, Gold Coast, QLD, 2012, pp. 1-4.

[10] S. Gabriel-Sanz, R. Vera-Rodriguez, P. Tome and J. Fierrez, "Assessment of gait recognition based on the lower part of the human body," 2013 International Workshop on Biometrics and Forensics (IWBF), Lisbon, 2013, pp. 1-4.

[11] A. O. Lishani, L. Boubchir and A. Bouridane, "Haralick features for GEI-based human gait recognition," 2014 26th International Conference on Microelectronics (ICM), Doha, 2014, pp. 36-39.

[12] S. C. Bakchy, M. R. Islam and A. Sayeed, "Human identification on the basis of gait analysis using Kohonen self-organizing mapping technique," 2016 2nd International Conference on Electrical, Computer & Telecommunication Engineering (ICECTE), Rajshahi, 2016, pp. 1-4.

[13] W. G. Bhargavas, K. Harshavardhan, G. C. Mohan, A. N. Sharma and C. Prathap, "Human identification using gait recognition," 2017 International Conference on Communication and Signal Processing (ICCSP), Chennai, 2017, pp. 1510-1513