

Review of Literature on GAIT Based Human Identification

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Abstract – Gait is basically based on human locomotion that is resultant of cyclic and coordinated movements' combination. The movements must have some pattern related with specific temporal. Human walking is a combination of coordinated and cohesive muscles and joints of the body movements. 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. It is quite difficult to analyses the gait pattern when the subject has been occluded with clothes and bag on the back.

Keyword: Human Movement Biomechanics, Human Motion Analysis, Gait Recognition

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1. INTRODUCTION:

One of the most popular techniques for reliable authentication technique is human recognition (HuRe) whereas the traditional user authentication techniques were used for applications to gain access control, security, logical & physical access control and surveillance. The authentication techniques like pins and passwords, moreover biometrics has gained popularity to authenticate the user identity in most applications that are related with computer vision. Biometrics is the field to know the uniqueness of the individual on the basis of behavioral and physical traits that are associated with that particular individual (Ross & Jain, 2007)¹. Generally, in biometric system, firstly required features are extracted and compared with the database that has samples with the features. After this, identity or uniqueness of the individual is validated. The popular biometric techniques are face, palm, signature, ear, gait, iris, finger vein & hand geometry, fingerprint, voice, keyboard stroke pattern etc. as shown in figure 1.1 (Sun et al., 2013), (Nguyen, Fookes, Sridharan, & Denman, 2011), (Fookes, Chen, Lakemond, & Sridharan, 2012), (Lin, Fookes, Chandran, & Sridharan, 2007), (Fookes, Lin, Chandran, & Sridharan, 2012), (J. Wang, She, & Nahavandi, 2010).

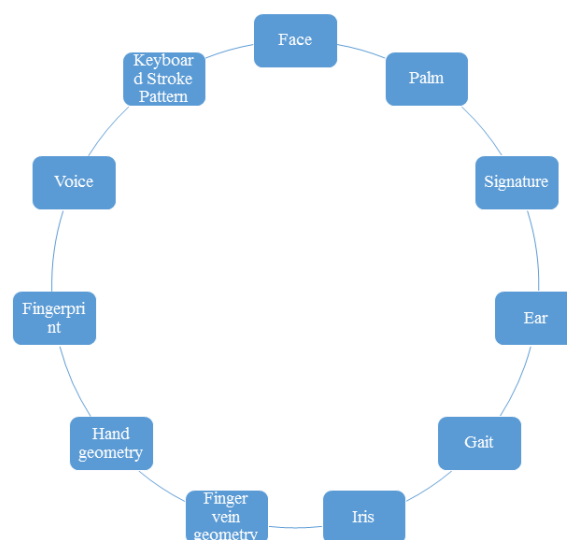


Figure 1.1: Biometric Examples

One of the most popular is Gait method due to its ability to work at distance and low imagery and can work without alerting the subject (J. Wang et al., 2010). In the Gait system, suppose an individual arrives at the smart gate of a main building, the cameras installed at the gate analyzed the Gait of the individual and extract the features and compare with the database samples which they have collected. If found, the individual is a valid person and allow to enter in the main building and if it not recognized then smart gate will not be opened and

that particular individual will not be allowed to enter in the main building. The realistic evidence for gait authentication and recognition have been the main cause for its popularity (Boulgouris, Hatzinakos, & Plataniotis, 2005). Gait is basically based on human locomotion that is resultant of cyclic and coordinated movements' combination. The movements must have some pattern related with specific temporal. Human walking is a combination of coordinated and cohesive muscles and joints of the body movements. Generally, for all humans, these movements will follow the same norm but the difference lies in gait kinematics i.e. their relative timings and magnitude (Boyd & Little, 2005), (BenAbdelkader, Cutler, & Davis, 2002). Gait for an each individual has to be supposed as unique because gait is calculated by the musculo-skeletal structure totality. Gait can be distinguished for each individual by their length of the stride, speed, rhythm, physical parts length, bounce and swagger (Bouchrika & Nixon, 2007).

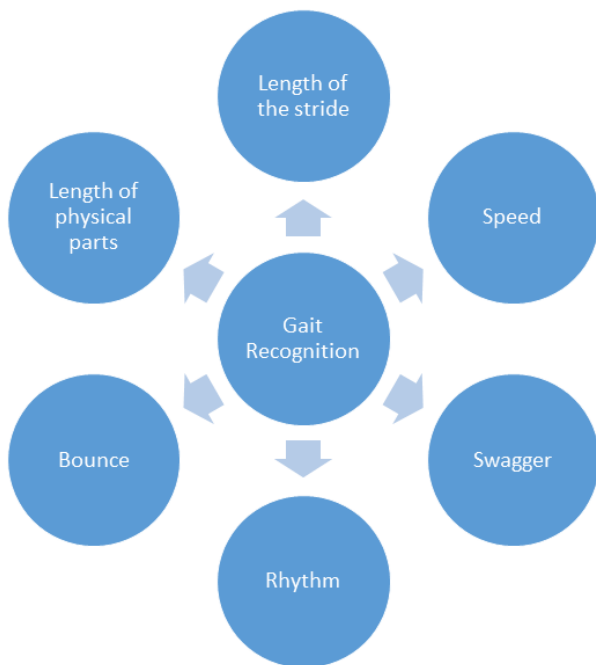


Figure 1.2: Gait Recognition Features

Challenges in Gait Recognition

In automatic gait recognition (AGR), the different features of the gait can be collected or obtained through footages of different surveillance videos. In this process, there is an advantage that features can be obtained in low resolution environment as subject is not alerted or interacted at all whereas other biometric techniques are unable to provide the desired accuracy in these conditions (Nixon et al., 1999). Gait is a combination of both physical as well as behavior nature that makes difficult for people to do fraud without obstructing the movement of the subjects'. One of the other advantage of using AGR is that when other biometrics are disguised i.e. when someone has conceal his face to hide their identity but that person cannot hide their motion so it makes more attractive in

the eyes of researchers or industry persons whose main focus is on applications that are developed for human identification. In viewing these advantages, visions-based AGR system has also its limitations. The performance degrades of this system when the individual carries full occluded clothes as well as there is abnormality in walking style due to age factor or illness factor. The above factors of abnormality can be handled after recognition and a manual authentication system can be used afterwards. There are a number of external factors that can affect the walking style, these are footwear, walking surface, view changes, change in illumination, clothing styles and carrying things (Phillips, Sarkar, Robledo, Grother, & Bowyer, 2002). The common challenges in AGR are:

- i) Illumination
- ii) Occlusion
- iii) Walking surface
- iv) Clothing style
- v) Abnormal behavior
- vi) Aging
- vii) Pose
- viii) Carrying goods

2. REVIEW OF LITERATURE:

(Kale, Cuntoor, Yegnanarayana, Rajagopalan, & Chellappa, 2003) this research paper is basically dedicated to evaluating the different techniques which allude the different styles of a human stroll. Human gait is an alluring methodology for perceiving individuals from distance. In this Study we receive an approach based on appearance to the issue of recognizing gate. Gait alludes to the style of strolling of a person.

(Collins & Gross, 2002)The objective of the specialists is to set up a basic baseline strategy for human distinguishing proof dependent on shape of the body and gait. This benchmark acknowledgment technique provides a lesser bound next to which assess increasingly confounded methods. We present a perspective ward method dependent on layout coordinating of body frame. In spite of the fact that the essential example of bipedal movement is comparable between sound people, gaits do shift between people. An individual's gait relies upon a large number of components including physical form weight of the body, stature of the heels of the shoe, garments and passionate perspective.

(Aqmar, Shinoda, & Furui, 2012)Human gait eludes to the movement of an individual described by his/her spatio-transient development while strolling.

Automatic individual recognizable proof utilizing human gait has been widely examined. For instance, Binary outlines, Gait Energy Image (GEI), higher-order shape setup, what's more, higher-order neighborhood autocorrelation have been utilized as gait features.

(Bashir, Xiang, & Gong, 2015) Among different picture support biometrics, face, unique mark, iris and gait being the most broadly contemplated ones. Apparently understood that iris and unique mark produces better and that's the main dependable acknowledgment execution contrasted with face and walk. Nonetheless, the two require helpful subjects which may not be conceivable in circumstances, for example, secretive video surveillance. Gait acknowledgment systems for the most part fall into two general classifications to be a specific model based and methodologies which are model free. The initial gait of generally gait acknowledgment calculations is the extraction of frame. This is on the grounds that gait, as a conduct biometric, is unique in relation to physical biometrics, for example, face in that gait for the most part catches the dynamic part of a human movement rather than the static physical look of a human. At the end of the day, the gait is worried about how individuals gait instead of how individuals look. By extricating frame, a huge piece of physical appearance features has been expelled from the picture portrayal of person. Recent studies recommend that addition of shape towards gait elements plays a vital role to advance the gait acknowledgment execution since the shape of the body can likewise contain valuable data for recognizing various individuals. Then again, the incorporation of shape data in context with gait features can likewise present varieties that will prevent the acknowledgment performance. For occasion, an individual wearing a coat or not wearing it could be essentially extraordinary fit as a fiddle while the ways he/she strolls would be fundamentally the same as. In view of these perceptions, researchers can presume that incorporating shape for gait portrayal is twofold discrepancy and parity should be struck in wording how much shape data ought to be incorporated. To perform measurable learning based component choice to choose the most significant shape as well as dynamic features for gait acknowledgment.

(Souza, 2017) According to the researcher's gait of human gestures may be categorized in two broad categories: motion and model based methods. The model based method uses mathematical calculations for instance, the researcher used Cunado utilized Hough interpretation to concentrate arms, legs, middle and so forth and utilize a verbalized pendulum to coordinate these moving body parts.

(P & Nagendraswamy, 2014) The proposed strategy for gait acknowledgment framework utilizes GEI and LBP method to concentrate features for gait portrayal. The technique includes the accompanying steps: In the initial step, Gait Energy Image (GEI) is created utilizing the arrangement of frame of a gait cycle.

(Deepak, 2016) The gait features like, advance length, walk length, rhythm, cycle length, is utilized alongside body stature, weight and sexual orientation are utilized for perceiving individuals. The spatio fleeting locale features in are coordinated with help vector machine, for human activity acknowledgment. The probabilistic idle semantic ordering in employments solo learning technique to perceive human actions. Gait biometric signals in and human body developments are likewise used to perceive people.

(Takemura, 2016) A convolutional neural system (CNN), which considers spatial vicinity utilizing a convolution activity, fundamentally improves the precision of picture acknowledgment as showed through a progression of Image Net Large Scale Visual Recognition. The viability of a CNN has been exhibited in research handle that are increasingly significant with gait acknowledgment, for example, activity acknowledgment, video arrangement, and face recognition the CNN based technique beat the benchmark without utilizing CNN. Despite the fact that CNN-based technique requires a huge number of tests for adequate preparing or for measurably solid assessment, there is no step database including countless subjects with wide view edges at the same time. For instance, however CASIA dataset B utilized for assessment in contains walk pictures with a wide scope of view points (11 sees, 0 – 180°), it is made out of just 124 subjects. On the other hand, OUISIR step database, huge populace (OULP) utilized contains gait pictures of an enormous populace (4016 subjects) yet its scope of view edge is tight (4 sees, 55°, 65°, 75°, 85°). In this manner, the assessment of cross-see gait acknowledgment utilizing such databases may not be factually solid. So as to adapt to such an issue, we assembled a step database involving the multi-see enormous populace dataset. In particular, our dataset named as "OU-ISIR Gait Database, Multi-View Large Population (OU-ISIR, MVLP)1" is the biggest step database on the planet, including 10,307 subjects and including wide range see (14 sees, 0°–90°, 180°–270°). The subject's gait is recorded by 12 cameras and 1 camera records a front face view and 1 camera records a depiction of the side view for ear acknowledgment. The CASIA database B is as often as possible utilized for assessment of cross-see gait acknowledgment since it contains enormous view varieties from front view (0°) to back view (180°) with 18-degree interim. This database recorded ten successions for each subject: six ordinary arrangements; two groupings with a long coat; two successions with a backpack. The acknowledgment precision of GEINet, the discriminative methodology with the least complex CNN, for all conceivable view edge paris (14 test perspectives versus 14 exhibition views). in the instance of a similar view edges (e.g., 0° versus 0°), the exactness is the most astounding, and the bigger the view contrasts is, the lower the precision become. Moreover, since two GEIs with 180° view distinction (one of them is flipped GEI) are for all intents and purposes viewed as those from the

equivalent view pair because of viewpoint projection supposition. It is recognizable that the exactnesses for slanted view (i.e., 45°) are moderately great notwithstanding for expanding perspective edge differences. Gait highlights from sideways view contains both forward and in reverse movements saw in the side view just as the body width saw in the frontal view somewhat, and (2) walk highlights for 90° view distinction from the diagonal view (e.g., 135° exhibition for 45 test) is all around approximated by the left-right step symmetry. A gait database involving an enormous populace dataset with a wide view edge and introduced a measurably dependable execution assessment of vision-based cross-see gait acknowledgment. This dataset has the accompanying points of interest over existing gait databases: (1) the quantity of subjects is 10,307, which is multiple occasions more prominent than the quantity of existing open huge scale database, (2) the view edge variety is wide, 14 view edges, running 0°–90°, 180°–270°, (3) the nature of all GEIs is ensured by visual affirmation.

3. RESEARCH METHODOLOGY

Research is a critically way of thinking of various aspects related to the problem such that formulate new methods and principles for testing new theories.

3.1 Characteristics of research

It is pertinent that a process should be called a proper research if it has the following characteristics:

(a) Rigorous:

While finding answers to the research questions, the procedures that have been followed must be suitable, applicable and acceptable. All the above mentioned things must be morally correct while doing research.

(b) Empirical:

The information collected or assembled through the observations or the experiences of the real life acts as a core evidence such that conclusions can be drawn.

(c) Controlled:

There are a number of factors or parameters that can affect the output or outcome in the real life situations. An output or outcome is the result of 1:1 relationship whereas some are the results of complex relationships. Some studies are based on the concept of cause-effect relationship and in these type of relationship it is pertinent to know the connection between the effect with the cause and vice-versa.

(d) Critical:

The methods, process and the procedures used in the research investigation must be selected after the critical scrutiny. The whole research process must be free the cons and it must be near to the perfection.

(e) Correct and Confirmable:

This characteristic states that the results of your research findings must be valid in every aspect and other are able to verify your results.

(f) Systematic:

This concept implies that the process followed to investigate the research must follow some logical sequence of steps. The steps must follow some proper sequence such that findings can be attained i.e. improper sequence of process steps cannot be followed as results can be wrong.

4. COMPARISON OF GAIT WITH OTHER BIOMETRIC

Gait pattern has not been evaluated on the large population size too. Below in the table 2.1 has been shown the comparison of gait with other biometric techniques (Jain, Ross, & Prabhakar, 2004).

Biometric Technique	Universality	Performance	Divergent	Agreeability
GAIT	Medium	Low	Low	High
FACE	High	Low	Low	High
FINGERPRINT	Medium	High	High	Medium
IRIS	High	High	High	Low
HAND GEOMETRY	Medium	Medium	Medium	Medium
SIGNATURE	Low	Low	Low	High
RETINA	High	High	High	Low

Table 2.1: Comparison of Gait and other biometric techniques

5. CONCLUSION

There is considerable amount of support available in the past that says “Every person has its own unique gait”. Moreover, the literature of bio-mechanics also supported that a person can be identified from the distance by its gait pattern. From the past studies, it can be concluded that gait recognition is unique in its own way. It is quite difficult to analyses the gait pattern when the subject has been occluded with clothes and bag on the back. The gait of the subject/person can be gathered easily without proper interaction with the subjects’.

REFERENCES

- Ross, A., & Jain, A. K. (2007). Human Recognition Using Biometrics: An Overview. *Annals of Telecommunications*, 62(1), pp. 11–35.
- Kale, A., Cuntoor, N., Yegnanarayana, B., Rajagopalan, A. N., & Chellappa, R. (2003). Gait Analysis for Human Identification Gait analysis for human identification. *Gait Analysis for Human Identification*, 1(December 2013), 9. <https://doi.org/10.1007/3-540-44887-X>

- Aqmar, M. R., Shinoda, K., & Furui, S. (2012). Efficient Model Training for HMM-based Person Identification by Gait. In *Asia Pacific Signal and Information Processing Association Annual Summit and Conference* (pp. 2–5). Hollywood, CA, USA
- Bashir, K., Xiang, T., & Gong, S. (2015). Feature selection on Gait Energy Image for human identification. *Conference Paper in Acoustics, Speech, and Signal Processing, 1988. ICASSP-88., 1988 International Conference, (March 2008), pp. 2–5.* <https://doi.org/10.1109/ICASSP.2008.4517777>
- Souza, C. D. (2017). A Study on Gait Analysis for Human Identification. *International Conference On Emanations in Modern Technology and Engineering*, 5(March), pp. 188–191
- P, M. K. H., & Nagendraswamy, H. S. (2014). SYMBOLIC REPRESENTATION AND RECOGNITION OF GAIT: AN APPROACH BASED ON LBP OF SPLIT GAIT ENERGY. *Signal & Image Processing: An International Journal*, 5(4), pp. 15–27.
- Deepak, N. A. (2016). Analysis of Human Gait for Person Identification and Human Action Recognition. *Communications on Applied Electronics (CAE)*, 4, pp. 1–4.
- Jain, A. K., Ross, A., & Prabhakar, S. (2004). An Introduction to Biometric Recognition. *IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY*, 14(1), pp. 4–20.

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