# Review of Techniques Used for Human Gait Recognition

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## ABSTRACT
Human gait is an important biometric feature which is able to identify a person. Gait is an important biometric feature to identify a person at a distance. There are number of techniques used for recognition of person. A view transformation model (VTM). For side face, an enhanced side-face image (ESFI). For gait, the gait energy image (GEI). Fuzzy inference system (FIS) ,in that fuzzy logic was applied to detect gait phases with respect to fuzzy membership values. Kinematic gait generative model (KGGM) and the Visual gait generative model (VGGM). Human gait recognition is to identify a person from the pattern or style of walking, sometimes the pattern or style of walking becomes quite appealing when it is difficult to get other biometrics information at the specified resolution. All these techniques are used to detect a person.

## Keywords
Gait recognition; Biometrics fusion; face recognition; video-based recognition

## 1. INTRODUCTION
Gait is a useful biometric feature for identifying a walking person at a distance by using different techniques. It is difficult to recognize a person from arbitrary views when one is walking at a distance. These are perhaps the main challenges that prevent gait recognition technique from the techniques that we have seen.. The aim of this paper is to study robust gait recognition technique, which can tolerate viewing angle changes and also discuss other related challenges. In general, there are three types of gait recognition on the basis viewing angle, as shown below:[1]

1) **fixed view gait recognition** where actual gait and gallery gait are recorded from the same view.

2) **cross view gait recognition** where actual gait and gallery gait are recorded from two different views. And

3) **multi view gait recognition** where actual gait from single view is recognized by using gallery gaits from multiple views..

VTM aims to learn a mapping relationship between gait features observed across viewing angles. VTM is used to transform gait feature from one view (source) into another view (target). From observation we can say that better face features can be extracted from a constructed ESFI compared to those from the original side-face images (OSFIs). KGGM used to represents the kinematics of a gait by two variables, i.e., gait and pose, and VGGM used to characterizes the appearances of a gait by four variables, i.e., view, shape, gait, and pose[2]. The concept of fuzzy logic was applied to detect gait phases with respect to fuzzy membership values which are used in Fuzzy inference system (FIS**).**

## 2. BACKGROUND
### 2.1 Gait Energy Image (GEI)
GEI is used to represent global gait information under complete walking period. GEI is an appearance-based gait feature which has been called as an efficient for gait recognition. In order to get an efficient gait recognition system which is also robust to viewing angle change and the proposed view-invariant system is developed based on GEI using concept of generic VTM. From observation VTM is easy because it is trained using independent dataset and can be applied for view normalization of any known/unknown subject[3].

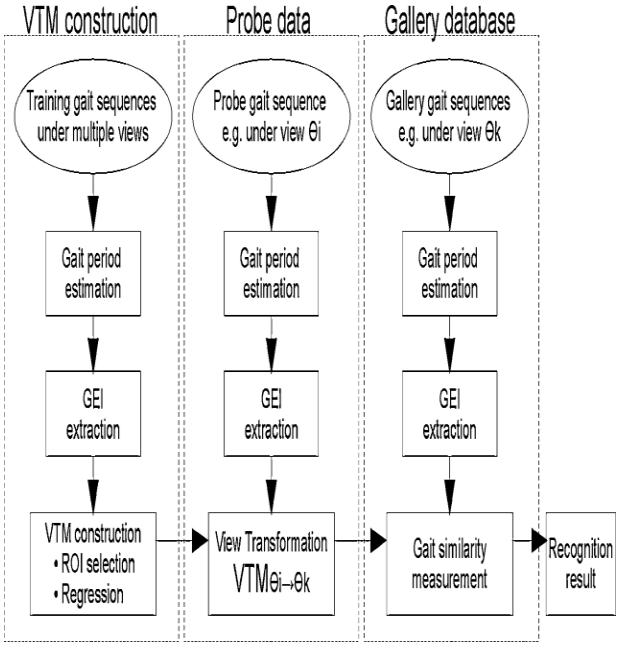


**Fig. 1. VTM-based gait recognition**

### 2.2 ESFI Construction
In ESFI Construction, Multiframe resolution enhancement used to develop a single high-resolution image from multiple low-resolution images. These low-resolution images must be of the same object and must be taken from slightly different angles. The images not so much as to change the overall appearance of the object. In ESFI technique, a simple background subtraction method for human-body segmentation. A human body is segmented into two parts according to the proportion of its body parts: first part from top of the head to the bottom of the chin, and second part from the bottom of the chin to the bottom of the foot. In ESFI technique, the original low-resolution side-face images are first localized and then extracted by cutting the upper 15% of the segmented human body obtained from multiple video frames.

**Fig. 2. Upper examples shows resized low-resolution face images and Lower examples shows constructed high-resolution face images**.

## 2.3 Fuzzy Inference System (FIS)

In Fuzzy inference system (FIS)[4], researchers have proposed systems based on fuzzy logic and reported key advantages in comparison to other methods as follows.

1) Ng and Chizek reported that gait-event classification based on artificial neural network was significantly poor in comparison to fuzzy-logic-based gait-event detection.

2) Fuzzy logic beneficial to obtain full information on gait patterns even at the presence of lower sensor signals.

3) Fuzzy logic allows smooth transitions also in the presence of rapid changes.

4) It has shown to accommodate relatively large step-to-step variability that observed in electrically stimulated gait.

Fuzzy logic is a knowledge-based algorithm that provides a platform to represent a system with an element of explanatory capability on expert rules, and present the data in a manner similar to human thought. Due to the good advantages, this paper presents the application of fuzzy logic to determine gait phases with increased simplicity.

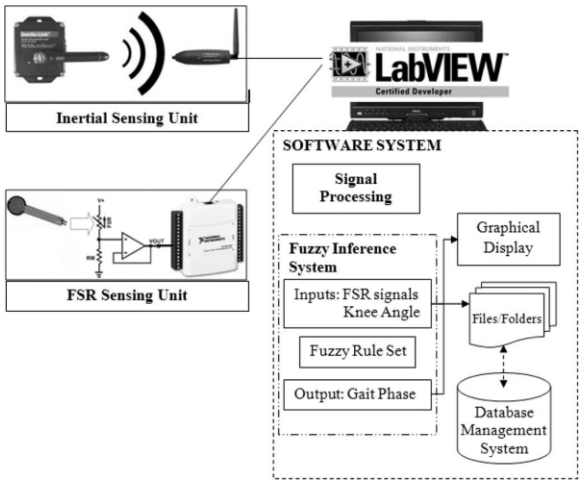


**Fig. 3. Overall Fuzzy inference system architecture**

## 2.4 Kinematic Gait Generative Model (KGGM)

Gait kinematics can be represented in different ways, as in the 3-D positions of all joints or the angles between two adjacent joints. In order to reduce the effect of skeleton variability, the gait kinematics can represented by a sequence of relative Euler angles between two adjacent joints. To learn KGGM[5], we requires a universal pose manifold shared by different gaits, on the basis of which we can develop a unified gait representation, the pose manifold varies from gait to gait. Inspired by the conceptual torus manifold proposed , we can represent a circular shaped conceptual manifold in a 2-D space to show a general pose variation in one gait cycle.

## 2.5 Visual Gait Generative Model (VGGM)

In VGGM, We use commercial 3-D animation software Motion Builder to produce a set of gait animations, which involves multiple 3-D human models and the same set of gait motion data used for learning KGGM. Each human model can be driven by gait motions to produce different animations, each of which can be captured under different camera views. Specifically, in VGGM we use a global feature-free representation to represent gait appearances that can be generated by the signed distance transform of the body silhouette extracted from an image[6].

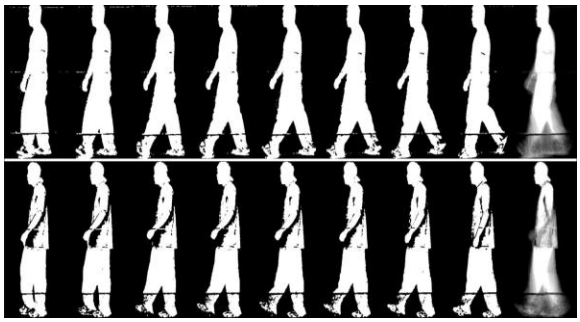

**Fig.4. Two examples of normalized and aligned silhouette images**

The rightmost images are representing the GEIs sequence. GEI is not more sensitive to incidental silhouette errors in individual frames. We can perform a controlled experiment on the basis of observation where GEIs of 16 people are constructed with two or three silhouette images delete. The result we get that with the deletion of frames, there is no effect on gait-recognition performance. According to 2-D template, we do not need to consider the time moment of each image frame, and the incurred errors can be therefore minimized.

# 3. REVIEW OF EXPERIMENTAL RESULTS

## 3.1 Experiments and Parameters

From 45 people name of 1 to 45, and each person has two video sequences. For each of the 45 people, some frames of his training sequence and some of testing sequence are shown. Since we develop two sequences of all technique, we totally obtain 90 as the gallery and another as the probe. After fusion, match scores are generated based on two face match scores and two gait match scores for one person from each video. Totally, we have 180 synthetic match scores corresponding to 45 people in the gallery and 180 synthetic match scores corresponding to 45 people in the probe. The dimensionality of PCA features is 72 for GEI, 56 for ESFI, 65 for OSFI, 70 for FIS.After MDA, the dimensionality of features is 17 for GEI, 35 for ESFI, 25 for OSFI, 27 for FIS. By using the performance of single biometrics and the performance of fusion using different combination rules, we can see that 73% people are correctly recognized by OSFI (12 errors out of 45 people), 87% people are correctly recognized by ESFI (four errors out of 45 people), 93% people are correctly recognized by GEI (three errors out of 45 people), 77% people are

correctly recognized by FIS (10 errors out of 45 people), Among the three people misclassified by GEI, the person name (26) has a backpack in the testing sequence, but not in training sequence. The difference causes the body shape can change enough to make a recognition error. The changes in the walking style for the other two people (4, 15) also cause the recognition errors. From observation, We show GEIs of the people who are misclassified by the gait classifier. Among the performances of fusion methods, ESFI and GEI performs the best at the recognition rate of 98% (one error out of 45 people), followed by VGGM and KGGM at 95% (two errors out of 45 people). From review of experimental results it is clear that the fusion based on ESFI and GEI always has better performance than the fusion based on OSFI and GEI, so that difference makes both the gait classifier and the fused classifier unable to recognize him[7].

# 4. CONCLUSION

This paper proposes video-based fusion system by using different techniques, all the techniques are used for recognizing noncooperating individuals at a distance in a single-camera. Databases from two biometrics sources, side face, and gait, is combined using different fusion methods.

This paper proposed regression-based VTM for gait recognition under various views. For ESFI and GEI, the information we get from two biometrics sources, side face, and gait, is combined using different fusion methods. Side face includes the entire side views of eye, nose, and mouth, possessing both shape data and intensity data. In FIS, from analysis of the system, most of the errors or changes as well as the variations occurred during the stance phase, indicating inaccuracies because of foot-pressure measurements. A new approach to video-based human motion estimation that involves two gait generative models, i.e KGGM and VGGM, which shows gait kinematics and gait appearances, respectively, by a few latent variables.

# 5. REFERENCES

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