2018 7th International Conference on Computer and Communication Engineering (ICCCE)

Human Gait Recognition System

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Abstract— **Biometric identification like fingerprints, retina, palm and voice recognition needs subject's permission and physical attention, but Human Gait recognition works on the gait of walking subjects to identify people without them knowing or without their permission. The purpose of this report is to summarize the research and related work done in the past on human gait recognition system and to solve algorithms which helps in identify walking subject from distance without any permission and interference of the walking subject. This can be achieved by making a database in which we record a video of the subject from a camera and then converting the video into frames of still images and later applying feature extraction techniques to get the silhouettes and training the silhouettes with principal component analysis. The input images are then matched with the one that already exist in the database used to identify walking subject.**

Keywords— Gait recognition, Human gait identification, feature data dimensionality reduction.

I. INTRODUCTION

The world security has always been at risk places like airports, train stations, shopping malls, national borders, public parks, national monuments and other public areas have always been at risk despite having several security measures. These places use several years old identification method which cannot be used now when the security level requires high technology which is unobtrusive. If considering the case of tube station which is very busy, use of old identification methods for verification is obviously infeasible. Therefore, for these issues the investment and development of biometric identification methods (eye, fingers, hand geometry and human gait recognition system) have attracted the attention of the government and leading development companies. Gait recognition system is a modern technology which does not require permission of the targets, it works on unobtrusive technology that detects by human gait gesture if a person is a thread to security or if he is behaving suspicious [1][2].

There are several biometric identifications but if those are compared to human gait/gesture identification/authentication, it has some exclusive characteristics. Gait is unobtrusive i.e. it works in such a way that it does not require permission of the observing subject and can work from a distance, whereas other biometric needs a physical response from the subject such as fingers, eyes, face and voice etc. Gait has several disadvantages as well at this platform of being an undeveloped field till now, there is a limitation to gait technology when it comes to human body for identification. Gait technology works on a basis of a video captured in busy or customized places but even after this its result cannot be accurate enough to take decisions. Therefore, by several researches done on gait it is concluded that human gait identification depends on clothes, the place of walking, stress and can change with different emotion feelings [3][4][5][6]. Thus, it is hard to deploy such an identification method and this is what that discriminates gait from other biometric identification methods. Gait when combined with other biometric identification method can be of great use in several identification applications due to its uniqueness. Therefore, gait is not used as the only identification method but some field which is unique and full potential in multi-biometric applications.

This paper presents human gait recognition system. In this research, we are only focusing on human tracking using background subtraction, gait feature extraction and recognition using Principle Component Analysis (PCA). The rest of this paper is organized as follows. Section 2 presents the definition of human gait recognition, background subtraction & PCA, Section 3 presents the related works, Section 4 presents the details of the proposed method, the Section 5 the experimental results and the last is conclusion.

II. DEFINITION OF HUMAN GAIT RECOGNITION, BACKGROUND SUBTRACTION AND PRINCIPLE COMPONENT ANALYSIS

Human Gait Recognition is a type of bio-metric identification system that identifies subjects based on their body posture known as 'Human Gaits'. The human gait is unique to every individual and therefore, a person can be detected by their gait.

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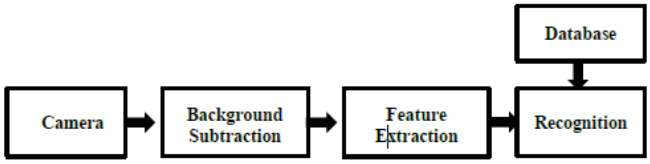

Fig 1: Human Gait Recognition Process

Current approaches to gait recognition can be divided into two categories: Appearance-based ones [2[[3] that deal directly with image statistics and Model-based ones[5-8] that first model the image data and then analyze the variation of its parameters. The majority of current approaches are the appearance-based approaches which are simple and fast. But the silhouette appearance information is only indirectly linked to gait dynamics. Figure 2. Block diagram of the gait recognition system.

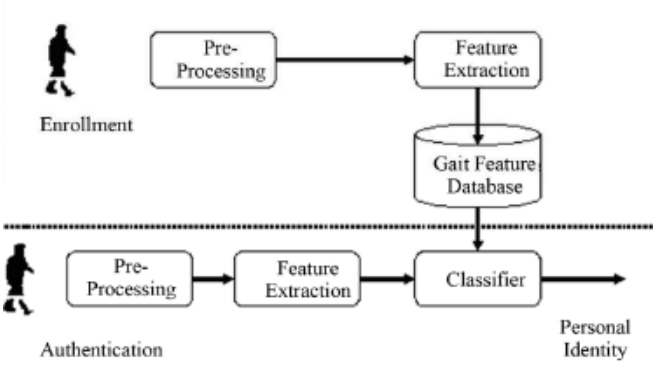

Figure 2 Block diagram of the Gait Recognition System

For Human Gait recognition process, background subtraction is very important step. If the system can't separate the human from the main background then, the whole system will fail to match or might fall into the false match category [8]. To decrease the false acceptance rate (FAR), we need to use the proper background subtraction method with noise filtering.

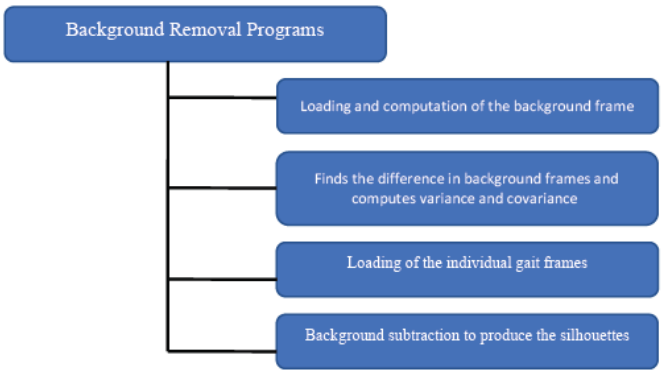

Fig 2: Background removal process flow

After segmenting the Human from the original background, we need to create the database of normalized feature from Silhouette images. Below is one of our Silhouette image after background subtraction process. Our process removed background very perfectly for tracking Human.

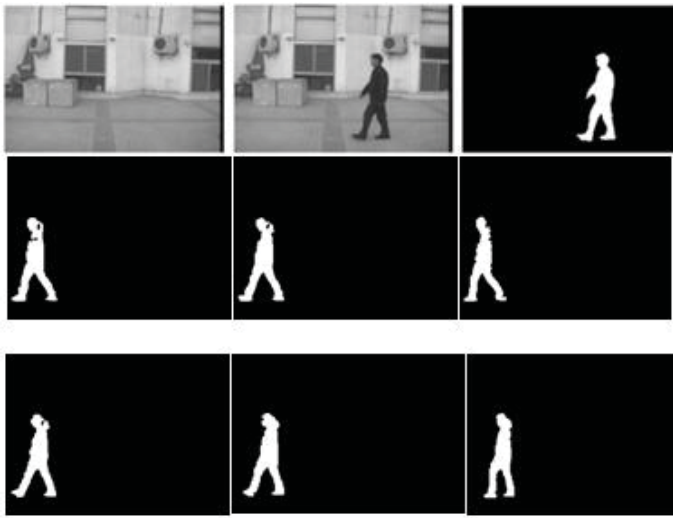

Fig 3: Example of final Silhouette image series [7]

For gait recognition or matching, we can't use template based matching. Because of scaling, rotating and skewing of image. These appearances will happen because of multiple viewpoints or camera sensors, illumination or lighting changes and the human itself for facial expression. To handle this issues, we need to increase the number of templates or we can represent the problem as multi-dimensional data of a single image or point. To solve the higher problem efficiently, we need to apply Principle Component Analysis (PCA) algorithm.

Below we can see how PCA can be formulate for N number of images into a matrix form to calculate eigen-space. Eigen-vectors span eigen-space like E_1, E_2, E_3, E_4 .... E_n.

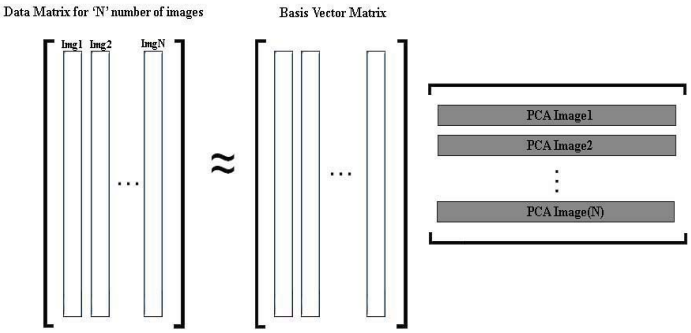

Fig 4: PCA representation of N number of images in matrix form

III. RELATED WORKS

Many researchers have studied the idea of an individual's gait being unique, particularly material that provides several different approaches to achieve a successful working gait recognition system. We

systematically analyzed the stages involved in a human gait recognition system and the components required in the process.

Model based approaches have a model in which the gait sequence is recorded under favorable parameters. The advantage of model approach over holistic approach is that model approach is view and scale invariant as it is very difficult to capture the image every time from the same view point as stored in the database for reference. There are specific parameters that are fed in the database, therefore in this approach only high quality selected gaits are chosen from the gait sequence. There is a lot of noise and other disturbance such as self-blockage is noticed which can destroy or disturb the parameters needed for gait sequence. Therefore, a different technique can be used in which a multi camera gait learning system should be used to obtain a better gait sequence. A similar process was used in [6] using a multi-view human gait learning method which depends on the retrieved static gait criterion that are the dimensions acquired from static gait sequence. Gait dynamics are not involved. The static specifications taken in [8][9][10] are the maximum difference between abdomen and feet, the length (height), the difference between head and abdomen and the difference between the feet. The static framework is not effected by the view i.e. its view invariant, which makes it most preferable for recognition feature.

Another approach which was motion based method. It used optical flow to detect moving objects and extract gait sequences [11][12]. Table 1. shows a summary of the most common approaches for Human Gait Recognition.

Table 1: Summary of the most common approaches for Gait Recognition

Author(s), Year(s)	**Approach**	**Limitations**
Nikolaos V. Boulgouris, Dimitrios Hatzinakos , Konstantinos N. Plataniotis (2005)	Gait Recognition: A challenging signal processing technology for biometric identification",	Recognition rate 58%, Motion of hip is fixed.
L. Wang , M.S. Nixon (2003)	Using modified ICA	Walking only in 0º, 45º, 90º to the fixed camera.
P. Huang. C. Harris, M. Nixon (1999)	Using Temporal Templates	Low quality camera, Interlacing in the video
Faustini Libent Ishabailu, Dr. Pei Zhijun, Abdalla Mohamed Hambal (2014)	Recognition System Based On Principal Component Analysis (PCA)	Walking only in 0º,45º,90º to the fixed camera on a tri-stand

IV. PROPOSED METHOD

The proposed approach is separating a moving person through a video from the background scene. Therefore, the collection of date is the first step. Then the method of background removal and reduce the noise to a certain level. The segmentation and tracking are the next stage. This phase is called Human Detection. The methodology has been shown in figure 5.

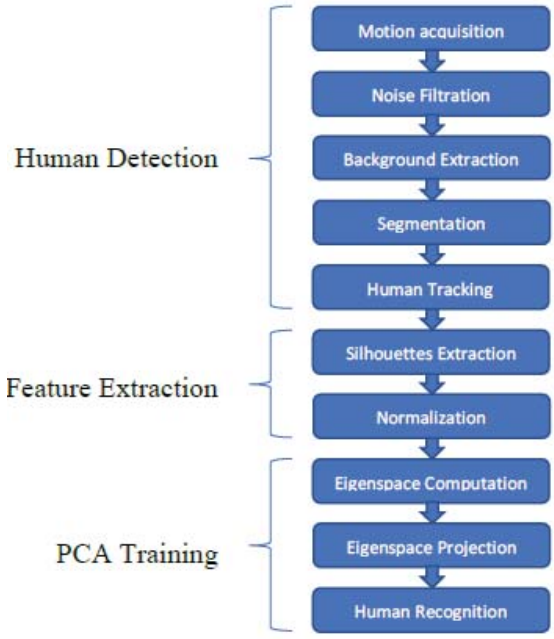

Fig 5: Flowchart of Methodology

In human detection phase, a typical video stream has several frames of background only, followed by many frames of a person walking across the scene, followed by several more frames of background only. An example may be ten frames of only background, 130 frames of the person walking, followed by fifteen frames of background. After the video is converted to jpeg files, the first task is to identify those frames in the beginning and at the end which contain only background. These files are identified in program which averages the red, green, and blue (RGB) intensities of each individual pixel across all these frames. For instance, if there are a total of twenty-five frames of only background. The RGB intensity of pixel 1, 1 in each of these twenty-five frames is averaged. This is done for each of the 345,600 pixels (image size 480x720). These average background pixels are then combined into a new image that represents the average background scene. The program also displays a subplot of the RGB intensities.

Then subtracts the average background frame from each of the background frames and produces a scatter plot of a select number of the differences. The reduced frames are used to compute the variance and covariance in the RGB intensities which will be used to determine whether the pixel is solely background or person.

At the end, compares the RGB intensity of each pixel to the average background intensity of the same pixel.

Those pixels within the covariance region are deleted and those pixels outside the covariance region are assumed to be the individual. Thus, the background of the picture has been removed from the person.

V. EXPERIMENTAL RESULTS

All the simulations where done using MATLAB. The silhouettes obtained where stored in the database of MATLAB. This subsection contains the results of few the trained samples from the database we employed PCA training and the results after the simulation by using MATLAB software are depicted in the table below.

Table 2: Results

Trail	Dataset	Match ID	Time (sec)	Feedback
1	00_1	1	26.2541	Positive Match
2	00_2	2	0.036601	Positive Match
3	00_3	3	30.505	Positive Match
4	00_4	4	35.104	Positive Match
5	45_1	5	41.5777	False Match
6	45_2	6	54.8304	False Match

VI. CONCLUSION

Human gait identification has gained attention of the researches recently. Biometrics such as fingerprints, retina, palm and voice needs physical permission of the subject whereas gait technology needs no authorization from the subject as it works from distance on human postures. The database used is National Gait, to which PCA training is applied. The noise filtration is applied to the silhouettes to get a better picture quality. For future, such a human gait recognition should be developed which can work in all kind of surrounding including places like metro stations and banks. The database also needs to be advanced by having larger database with more sequences and subjects. The algorithm applied above is very complicated, a better formula should be developed to ease the process of gait recognition. The camera should be used multi angle which can record a video of a walking subject from different angle at the same time, this will also help in making the algorithms easier.

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