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Research paper

Gait Feature Based on Human Identification & Classification by Using Artificial Neural Network and Project Management Approaches for Its Implementation

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Abstract

With the increased threat of terrorism and identity theft, human recognition is one of the basic elements of present era's security applications installed in commercial malls, banks, hospitals, military installations, airports, religious places etc. The basic aim of this research study is to design and implement an ANN based human recognition and monitoring system. This system uses Gait property of people to classify them through their age, gender, and group. Furthermore, the implementation and testing phase is conducted according to the principle and approaches of Project Management in order to tackle the constraint of both time and cost, also to make it a well implemented ICT project which can also follow the same approach as used commercially .Taking a tracking approach of the cost, time and quality made it easy to judge that this project is commercially viable.

Keywords: *Gait, Biometrics, Human Identification, Artificial Neural Network, Project management, PMP,PMIS,AC,BAC*

1. Introduction

A Biometrics can be used as a physiological or behavioral characteristic, which can be used to identify and verify the identity of an individual. Physiological biometrics are derived from a direct measurement of a person's physical characteristics which are assumed to be relatively unchanging, such as a part of a human body.
The most prominent and successful of these types of measures to date are:
Fingerprints: A fingerprint is formed by friction ridges and valleys on the surface of a fingertip. It has been proven that each single finger generates a different fingerprint [1].
DNA: DNA contains the genetic instructions of all living creatures. DNA matching is not available in real-time because it needs a physical sample, while other biometric systems only use an image or recording [2]
Iris: Iris is a pigmented portion of the eye, in which a pupil is situated centrally. Its visual texture is stabilized during the first two years of life. [4] The complex iris texture carries very distinctive information useful for personal recognition [3]
Face: The most popular approaches to face recognition are based on the location and shape of facial attributes (eyes, eyebrows, nose, lips and chin) [6].
Behavioral biometrics are an indirect measure of the characteristic of the human form. Based on (hopefully) unique ways people do things, we extract features from an action performed by an individual [7]. Gait refers to the way a person walks and is one of the few biometric traits that can be used to recognize people at a distance. Walking is a complex dynamic activity that is fast, animated, irreversible and rigid. Many components of the body are involved in moving and interact mutually with each other and with the environment.



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The term Gait recognition is used to signify the identification of an individual from a video sequence of the subject walking (see Figure 1.1). This does not mean that gait is limited to walking, it can also be applied to running or any means of movement on foot [9].

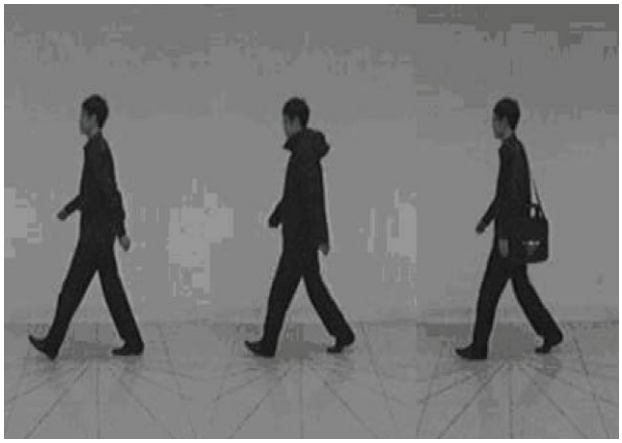


Figure 1.1: Contrast enhanced images in gait sequences of CASIA Gait Database (Dataset B) Three samples from left to right show the gait of normal walking, clothing and carrying condition changes.

All biometric traits have their own relative merits in various operational scenarios and their choice for a particular application depends on a series of conditions besides its match performance. No single biometric ever meets all the requirements (accuracy, cost, efficiency) imposed by all applications. Gait is a behavioral biometric which has several distinctive features as well as benefits as compared to physiological biometrics such as fingerprint, iris and face recognition. The key advantage of Gait for human identification is that it can operate from a distance and without subject cooperation. This makes Gait ideal for situations where direct contact with or cooperation from a subject is not possible, e.g. surveillance in a public space. However, having non-cooperative subjects also mean that Gait has the limitation to be used in various conditions, like circumstantial and physical conditions that can affect either Gait itself or the extracted Gait features. Some examples are clothing, surface, load carrying, view angle, walking speed, and shoe-wear type. [7]
Gait is better than other biometric traits because the information is captured without using any obtrusive body-invasive equipment or subject's cooperation. From a surveillance perspective, walk pattern biometrics is appealing because of its possibility to be performed at a distance, even surreptitiously. Together with high rate of collectability, these are the reasons why the method is preferably employed at human identification rather than authentication [8].

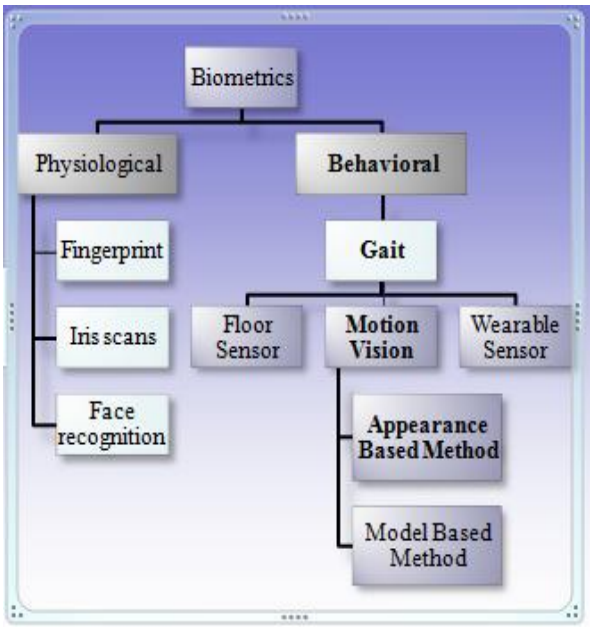
3. Literature Review

In recent researches many Gait Recognition Biometric has been developing some of them are model-based approaches and some are appearance-based. Biometric gait recognition refers authenticating and recognizing persons using their walking style is one of the recent attractive topics in biometric research.
Human recognition based on gait is relatively recent, compared to the traditional first-generation approaches such as fingerprint, iris, DNA recognition. Appearance based method establishes more reliable and accurate identification gait helps in refining the precision of the system. Along with uniqueness characteristics, another vital requirement for human. A physiological characteristic to be measured as a biometric is its heftiness against attacks. Earlier gait recognition studies showed promising results.

3.1 Security and Surveillance

In biometric gait recognition researches, most of the efforts are devoted in the directions of improving recognition precision and dipping the effect of influencing factors. In terms of performance, in recent works with larger sample size (more than 100 persons in the database) still indicate the likelihood of recognizing people from their gait [9].
For example, Sarkar et al. [9] with a data set consisting of 1870 gait sequences from 122 subjects obtained 78% recognition rate (identification probability at rank 1). This performance has been improved further to achieve 95% by others [10].
The primary benefit of gait biometric compared to other modalities is in being captured from the distance when other biometrics are not reachable.
Automatic gait recognition on public CCTV have been admitted as evidence in UK court for the first time.
http://www.am.sanken.osakau.ac.jp/ACPR2013/program/slide_yasushi_makihara.pdf
First packaged gait verification system Iwama et al. BTAS 2012, CVA 2013] [Muramatsu et al. ACPR 2013 Demo
In a bank robbery case prosecuted in Denmark, a law court found gait analysis from video to be a valued tool [18]. Typically, in robbery cases, the perpetrator uses a mask to hide his face and puts gloves on his hand, so that no face or fingerprints can be apprehended or left, but cameras can record the gait of the committer.
X.Huang and Boulgouris [13] proposed Gait recognition through six views of body motion while Guo and Tian [14] proposed a Gait recognition system which uses anatomical knowledge. Yet another method was developed by Sharmila and Kirubakaran [15] which based on which extract human gait feature automatically.
In this paper, we adopt the appearance-based approach to keep the computational complexity low. Our method exploits a less complex, yet effective approach to analyze and recognize the gait feature. We take the well-known average silhouette (also called Gait Energy Image, GEI) algorithm [7] which has been reported as a good feature robust to silhouette errors and image noise We first extract the binary silhouettes from the gait sequences. The reason we work on silhouette images is because silhouette images are invariant to changes in clothing colour/texture and lighting condition. After that, we extract contour width feature from the silhouette images.
Our proposed system uses four views of body motion. Although this is a limited system, but we must trade off cost with high technology system.

3.2. Literature Map



4. Problem Statement

The basic aim of this research is to recognize and classify people into, their age, gender, and group. Moreover, it also detects and reports any anomaly in a human gait in real time mode. This research paper presents a model of Gait used to recognize humans in their work-place and opens gate for such people who are authorized to come to the office.

4.1 Challenges and Limitations

The challenges involved in gait recognition include imperfect foreground segmentation of the walking subject from the background scene and variations in the camera viewing angle with respect to the walking subjects. there are several factors that may negatively influence the accuracy of such approaches. We can group the factors that influence a biometric gait system into two classes.

4.1.1 External factors

Unlike face recognition, which can be easily affected by low resolution, in Gait recognition, a video of reduced quality has been often enough. Moreover, Gait is difficult to disguise, and by trying to do so the individual will probably appear even more apprehensive, while face can easily be altered or hidden. Inspecting angles (e.g. frontal view, side view),
lighting conditions (e.g. day/night), outdoor/indoor environments (e.g. sunny, rainy days) which may lead to a failure in recognition. Gait can be affected by clothing (long cloak, shoes, carrying objects)

4.1.2 Internal factors

Physical changes (pregnancy, injury, weight gain/loss) Temporary stimulants (drugs and alcohol) e.g. foot injury, lower limb disorder, Parkinson disease etc.) or other physiological changes in body due to maturity, pregnancy, losing or gaining weight as well as mood can change a person's walking style.

5. Rationale of the Study

The capability to identify an individual efficiently and accurately is an important need. Controlled environments such as banks, military installations and even airports need to be able to quickly detect threats and provide differing levels of access to different user groups. The ability to identify a possible threat from a distance, gives the user a time frame in which to react before the suspect becomes a possible threat. Another motivation is that video footage of suspects is readily available, as surveillance cameras are relatively low cost and in-stalled in most buildings or locations requiring a security presence, the video just needs to be checked against that of the suspect.
As well as the inherent advantages of gait, the increase in processor power, along with the fall in the price of high-speed memory and data storage devices have all contributed to the increased availability and applicability of computer vision and video processing tech-niques.

6. Research Objectives

In this research, we make four contributions:

- To classify people into, their age, gender and group;
- To detect human gait for monitoring purpose;
- To achieve correct percentage of recognition;

- To improve security level by distinguishing different persons by the manner they walk
- To create our own data set having different classes.

7. Methodology

The Methodology of the proposed system is three-fold. First, we are required to either generate or adopt a dataset which comprises of gait descriptor and its corresponding output class. Secondly, this dataset enables to train the ANN for human classification and monitoring. Finally, the trained parameters of ANN will be deployed on a visual application tool which serves as a package for real time human classification and monitoring. The training process and its validating will be implemented in MATLAB. However, we will use visual application tools to demonstrate the overall system functionality.

7.1 Process

We applied MLP technique on CASIA dataset B and extract the features of the given GEIs,

$$G(x,y) = \frac{1}{N}\sum_{t-1}^{N} B_t(x,y)$$

but we faced the problem of class imbalance as CASIA dataset B contains 93 males and 31 females [11]. To solve lass imbalance problem, we use SMOTE Technique and oversample the female subject and by applying MLP back-propagation we get the following results.

Gender	Class	Recoginition Percentage (Training)	Recoginition Percentage (Testing)
Male & Female (88 subjects of both)	Normal walking	60%	80%

8. Technical Hurdles

The problem of data imbalance accrued because we had more images of males as compare to females, so this problem causes inefficiency in training;
The problem with finding the best suitable angles to record human gait by which we can easily recognized in less computation power;
After capturing the images, we apply our solution on every frame, but we still face problem after literature reviewing of many research papers, we found that we don't have to apply on every frame we have to convert those frames in gait energy images;
We have to create our own data set because the current data set that we are used for the purpose of training is of CASIA contains the Gaits of Japanese people and we have to deploy in Pakistan because every nation has different gait features [11]
So we have created our own data set which fulfils our needs.

9. Solution and Testing setup

Gait Energy Image (GEI) is an efficient and effective gait representation for individual recognition, GEI not only saves storage space and computation time for recognition, but it is also less sensitive to silhouette noise in individual frames. An experimental setup was arranged for capturing the videos of individuals to collect our dataset. Our setup contains four viewing angles, i.e. 0, 45, 90 and 135, and classes as female in gown, carrying bags, and male wearing coats, jackets and blazers and carrying bags. And the installed system was successful to capture the subjects according to the desired classes. Frames were generated from the video and then converted it into gray scale, Frames from a moving light display of a person walking. People can quickly identify that the motion is a gait from the moving sequence can be seen in the following image

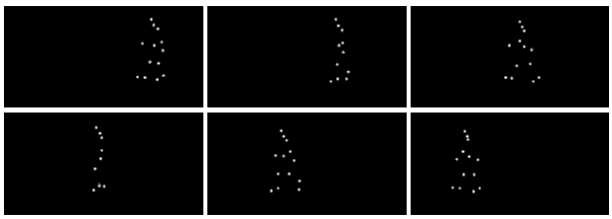


Fig 1.2: GAIT Frames

The proposed system has two phases, the training phase and the testing phase. The captured video is converted in frames, which are then converted into gray scale images. After applying background substitution, the silhouettes are obtained. The size of the silhouettes is not unique, and the silhouettes needed to be normalized to be the same size, so to obtain the GEI of silhouettes we take the average of all silhouettes. GEI is an efficient and effective gait representation for individual recognition. The shape and texture features of the GEI will be extracted from the images. It is then used to train ANN. Testing phase also follow the same procedure but in the last the result is classified.

10. Project Management Implementation Approach

By changing its approach to project management (PM), any implementational setup can improves on-time performance while lowering cost. Especially when a continuous tracking and project phase changing might involve.AC (Actual cost) is the actual expenditure made to acquire an asset, which includes the supplier-invoiced expense, plus the costs to deliver, set up, and test the asset. The above assessment was done initially, and a tracking loop was involved so that any increment or decrement can be determined and taken care of accordingly and it will directly affect the positive point of BAC (Budget at Completion) of the Project .The other thing which was taken in consideration closely was the iron triangle of cost ,time and quality of the project and this is the base od project management. Project to be successful there must, first, be an improved appreciation of the role of project management within project, and this role must be placed within the context of a wider project alongside other outside criteria and long-term expectations, so this make the implementation phase much smother then of any other approach , as the respective project is ICT bases so the scope of Project management is quite wider and can be expanded if need to implement it on commercial base .

Other than the above discussed PMP Principles there are Four main Project management characteristics which can be focused in implementation of such ICT projects which are as follows.

Visual Management is the ease in visualizing the progress and key performance indicators of the project which helps in understanding the daily tasks, responds quickly to problems and obstacles, and eliminates communication overhead waste

Coordination and communication are also one of the major character different phases within the process are connected. A change in one phase, due to internal or external factors is reflected in others (Gould, 2006).

Risk Management Analysis should always be on the checklist as risk consideration prior and during project execution is important to avoid failure. Adopting risk mechanism will highlight the critical path within the project activities.

Flow of Information: information availability in each phase must be sustained. This includes accurateness, easy admission and clear understanding. (Birk 2002).

10. Conclusion and Future Work

The proposed system is primarily a real time human classification and monitoring system using gait recognition, the final deliverable of the proposed system is a functional visual application that captures a real time image of human and classifies it based on Gender, Group using Ann, moreover the application detects an alarm any anomaly in human gait for security purpose without getting in contact with suspected human and implementing the respective ICT project with Project management principles and approaches made it cost effective and an well implemented project Management is a valuable discipline that allows developers to meet their clients' goals/targets. Not only in design and development of the prototype management but also implementation management of both testing and commercial phase by using a consistent project implementation methodology the tracking of a project implementation can be made smooth which directly affects the total allocated budget and budget at completion [17]. In future work, the system aims to implement more features that couldn't be implemented because the limitation of time, the system will be able to track face recognition to recognize persons using standard cameras under more difficult condition. Efforts will be made on Face appearance like eigenfaces and Face geometry that is feature-based method and uses an image or series of images either from a camera or photograph to recognize a person. We will also put our analysis on the unique shape pattern and positioning of facial features.

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