# Factors affecting identification of individuals by gait cycle

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#### Abstract

Biometrics has become an increasingly important area in the recent times and action specific biometrics is certainly an area which has been studied deeply. For automatic identification, gait cycle is an important parameter as it can be used for surveillance from a distance. The present study aims to identify if there are any specific feature of a human's gait cycle which can be utilized to identify them and to study which are the parameters which are used by humans while identifying other people by their walking style.

#### Introduction

A gait cycle is defined as the combined movement of human limbs which result in locomotion. It has been seen that every individual has a specific style of walking and this has been used for identification purposes since a long time. There are a number of features which are specific to a person's walking style. Some features may be too general like a limp in case of a physically challenged person whereas some can be easily tagged to certain people like the poster of a person who walks at an angle with respect to his lower body or someone who moves his hands in a specific way.

All the previous work which has been done in this area can be categorised into two types, one being the model-free approach and the other one the model based approach. In a model free approach, a silhouette data is collected for different individuals which is then segmented into various parts. Each of these parts are then fitted with some shape(normally an ellipse) whose parameters are calculated to generate a multidimensional vector varying with according to video. These vectors are then clustered to get the required data. On the other hand, in model based approach which is more of an explicit way, specific parameters are calculated to get the results. The two figures shown below will help to get a better picture:





Model-free



Model based

## Experiment

For the experiment, gait data was collected from five subjects. This data was collected with the help of a Kinect sensor. The data included a silhouette video of each subject walking and a text file containing all the joint information for the period of walking. The subjects were all male, 20-21 years old and were of a short height. This was done to have the maximum walking area which can be captured due to limitation of the hardware. The subjects were made to walk for a distance of approximately 2 meters at two different view angles of 0 degree and 20 degrees to the Kinect sensor. A snapshot of the videos is shown:



Snapshot of subject 1

These videos were named randomly and another set of 27 individuals were given the task of matching the 10 videos to match which two persons seemed to be the same.

Simultaneously, a computation model was created in MATLAB using the joint data. This was used for the model based approach for measuring specific parameters of motion. The main parameters measured were:

- Height
- o Speed
- Stride Length
- o Relative arm movement
- o Shoulder Width
- Movement of torso

## Results



The results obtained from the matching of videos in terms of accuracy are:

One particular thing observed in these results was that one subject was confused the most by all. He was confused by five of the six people who made two errors. He was confused with subject three, three times and subject four, two times. Three and four were confused by the last person.

The results from the computational model are tabulated as:

	Index	Height	Speed	Stride Length	Movement of Arms(left)	Movement of Arms(Right)	ShoulderWidth	Mean Torso	Std Torso
RiteshKumar0	1	0.6333	0.0218	0.8704	0.8584	0.725	0.3093	0.4102	0.0286
RiteshKumar1	2	0.6288	0.0265	0.9173	0.9227	0.8949	0.3068	0.1953	0.0566
RishabhNigam0	3	0.6287	0.0302	1.1688	1.08	1.3299	0.3244	0.2026	0.1106
RishabhNigam1	4	0.6258	0.0288	1.1651	1.0432	1.3368	0.3274	0.1967	0.0962
SandeepKumar0	5	0.6488	0.0296	1.2122	0.987	0.9993	0.2939	0.4448	0.1249
SandeepKumar1	6	0.6479	0.0291	1.1541	1.2739	1.1343	0.2994	0.3476	0.0806
ChetanLodhi0	7	0.6372	0.0342	1.2899	1.4544	0	0.2861	0.2943	0.0866
ChetanLodhi1	8	0.6362	0.024	1.0464	0.9739	0	0.2632	0.4733	0.0556
VishalDiwakar0	9	0.6755	0.024	1.2677	0.4323	0.7298	0.3176	0.4456	0.0623
VishalDiwakar1	10	0.6748	0.032	1.2639	0	0.6588	0.3144	0.2374	0.0842

Some of these data which are useful can be given by:









# Conclusions

- As it is clear from the about charts that there is no particular feature which is solely responsible for the identification but it is a mixture of features which are responsible.
- On talking to the participants, it was found that the main parameters were a combination of the relative arm movement, Body built, Stride length and poster of walking.
- Relative arm movement was an important distinguishing factor specially in the case of Subject 2 and 4. Although the results obtained from subject 5 do not match the actual observation by naked eye. As the ratio of movement by subject 3 and 1 are the almost similar, they were the ones who were confused by most of the participants.
- Body build was an important characteristic in case of subject 4.
- Another factor which was important but could not be captured by the present study was the movement of torso. This was the main distinguishing factor between subjects 1 and 3.

# References

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