Tracing Gesture and Extracting Gait Features to Recognize Parkinson's Disease Using Machine Learning Techniques

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5/14/2026

Outline

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- Classification using KNN and Back Propagation
- Result analysis
- Conclusion

What is GAIT?

Gait

- Gait refers to the manner in which a person walks, and is one of the few biometric traits that can be used to recognize people/disease at a distance.
- Therefore, this trait is very appropriate in detecting disease and gait recognition system.

Human gait

- Human gait analysis refers to the study of human locomotion.
- Applications are in a large variety of domains, including entertainment, healthcare, security like surveillance scenario and pedestrian navigation.
- The act of walking involves the coordination of different human body parts, such as the skeleton, the muscle and the neural systems.
- Various factors can affect the complex interaction between the body parts, for example any pathological nature will require a distinction between — **normal gait** and **pathological gait**.
- Normal gait refers to the general human walking parameters without differentiating the age, sex or physical parameters.
- Pathological gait refers to an abnormal gait, for example affected by pathologies such as muscle weakness or skeleton deformities or due to anxiety.

Problem Statement

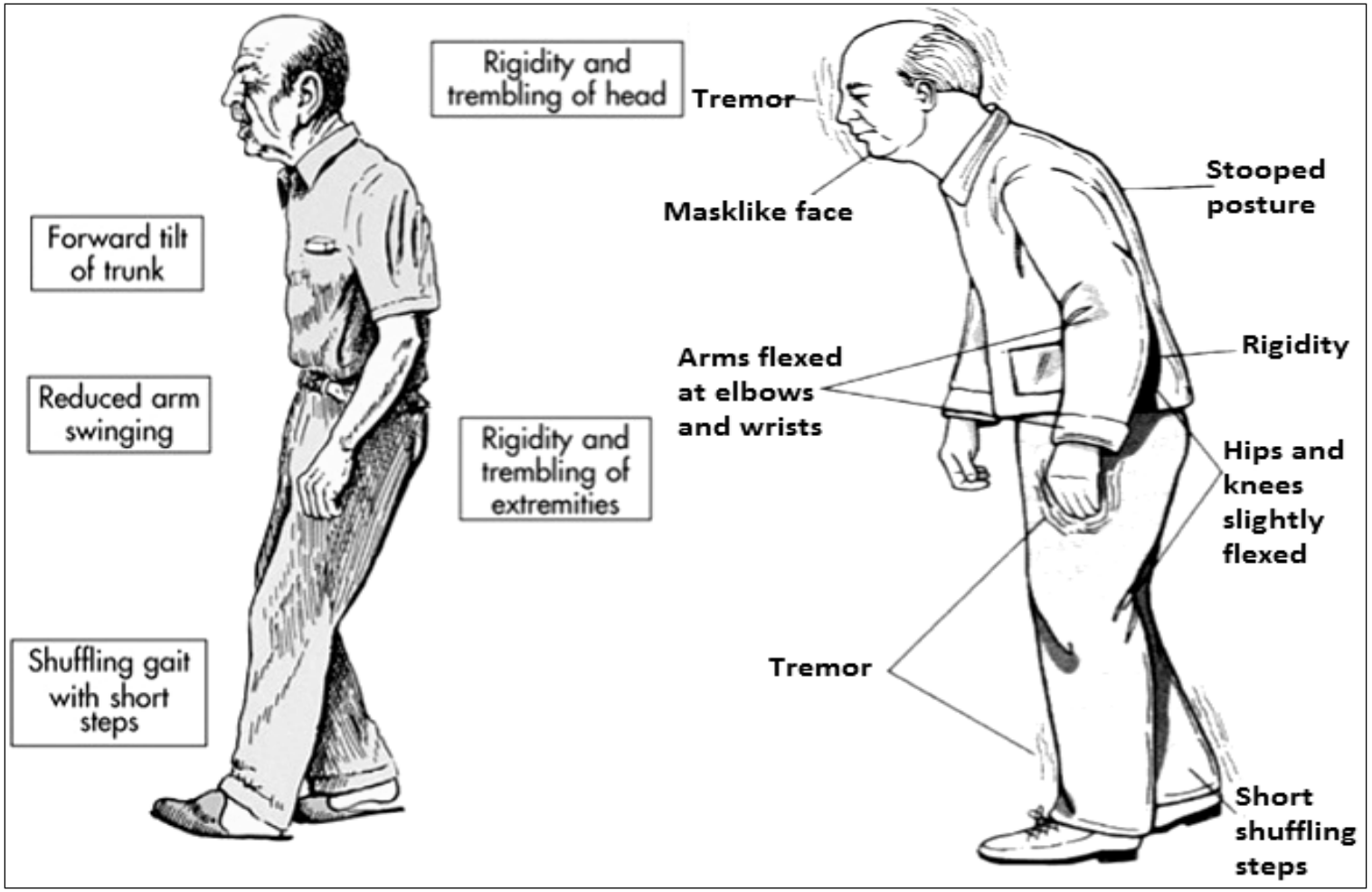
- By using gait data doctors can differentiate between a normal walking person and a person impaired with Parkinson's disease.

- When the treatment and medicines are given to the patient then analyzing the gait features can be one of the important activity to see whether the patient is recovering or not.

- Parkinson's is a very serious and inoperable disease. It is remediless.

- A person suffering from Parkinson's cannot be fully cured. But the agony can be minimalized or the growth rate of the disease can be slowed down if found in the premature stages.

Problem Statement



Proposed Solution

- Identifying normal or pathological human gait. Therefore a robust method for detecting and capturing the gait of each individual person has to be found.
- Human gait is supposed as unique biometric identification like thumb print.
- So in GAIT analysis to examine the human walking moment we collect and analyze the data.
- This can be done with the aid of biometric techniques. We can collect the human locomotion data and check if there is any sign of disorder.

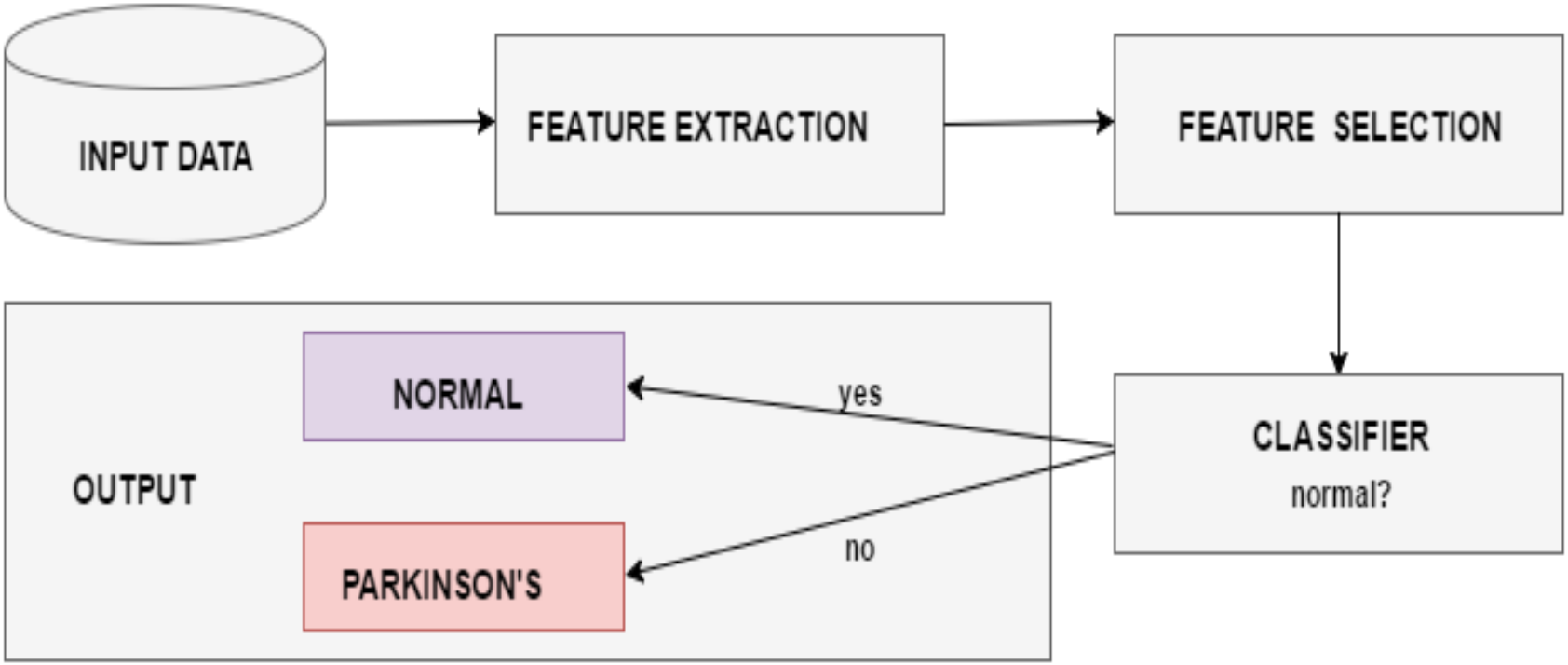
Proposed Solution

- We can find out whether the person is walking normally or not.
- If any disruption is found in the gait of the person we will get to know that there may be chances of disorder and then we can further diagnose the person based on the collected data to detect the disease.
- Medication can also be started to fix the disorder.

AIM

- The aim of the paper is to evaluate and implement robust and accurate method to identify whether it's a **normal gait** or **pathological gait** for healthcare and detect Parkinson disease at early stage.

Methodology


INPUT DATA
FEATURE EXTRACTION
FEATURE SELECTION
CLASSIFIER
normal?
yes
no
NORMAL
PARKINSON'S
OUTPUT

METHODOLOGY

- Firstly we collect the GAIT data then features are extracted and we classify the GAIT dataset.

- Training and testing of system is done.

- After the Classification is done result is shown as normal or pathological GAIT.

- Then 10 fold cross-validation test is also conducted to validate the statistical significance of the results.

Data Collection

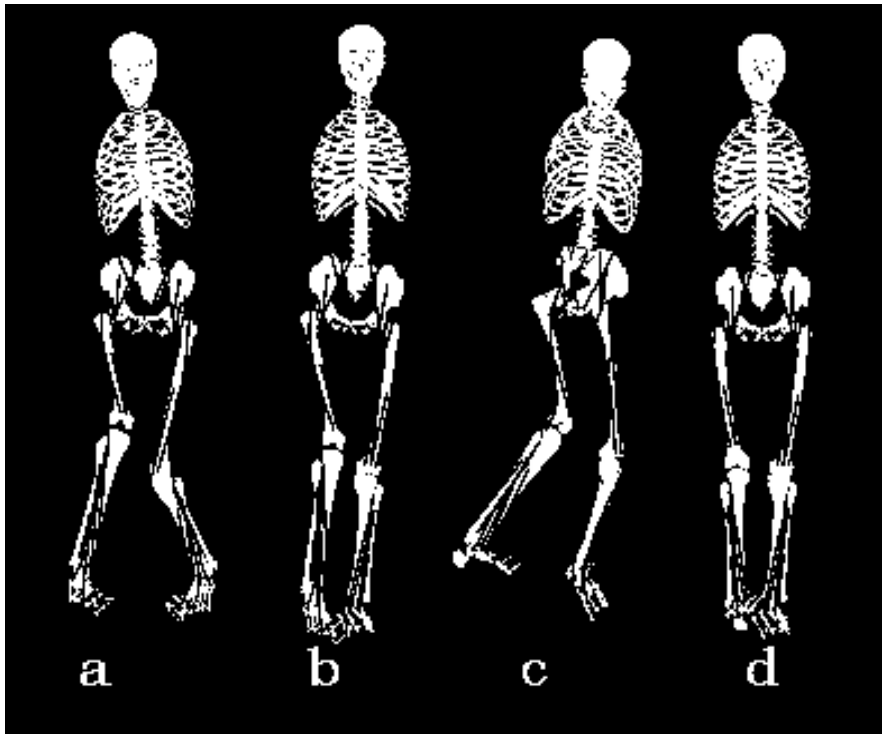
- **The data set is collected from following link**
- http://www.physionet.org/pn3/gaitpdb/.

- This is the gait dataset of 166 people.
- Out of which 93 patients are suffering from Idiopathic Parkinson's disease (63% men, average age is 66.3 years).
- The rest of the 73 people are healthy and average age of healthy people is found to be 66.3 years out of which 55% are men.
- 8 sensors have been put to practical use under each foot of the individual.
- The output recorded is based on the readings of 16 sensors (i.e. 8 of each foot) and is recorded as 100 samples per second. The final work is taken by 2 signals that mirror the tally of 8 sensors of each foot.

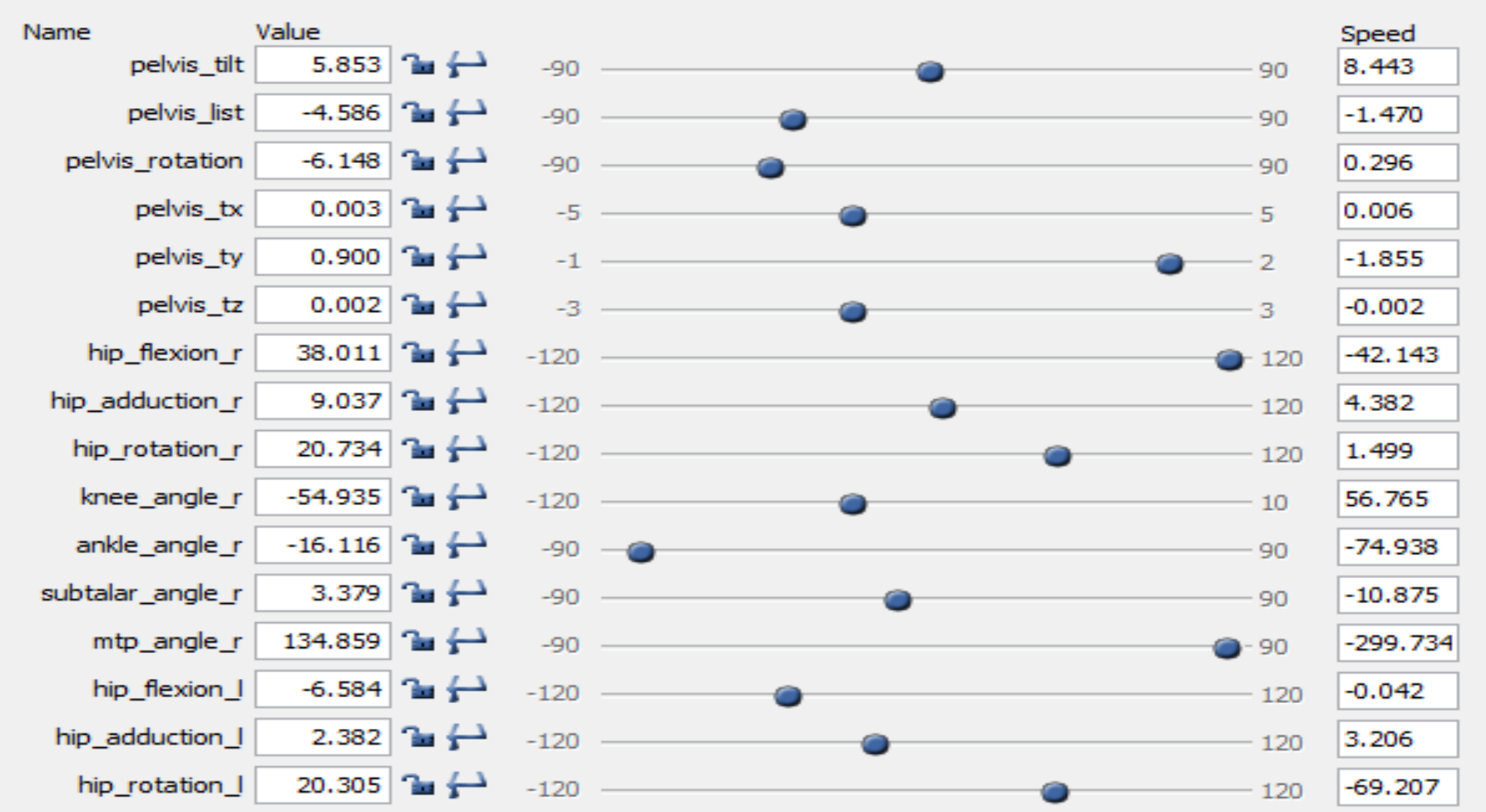
Feature Selection and Extraction

- It is quite difficult to work with collected data to classify whether a person is having a normal gait or having Parkinson's disease.
- So we extract required features from the gathered data and then classification is done on the extracted features.
- Various classification algorithms will be executed with the goal to classify whether a person is having a normal gait or having Parkinson's disease.
- The performance of classification algorithms will be analyzed.

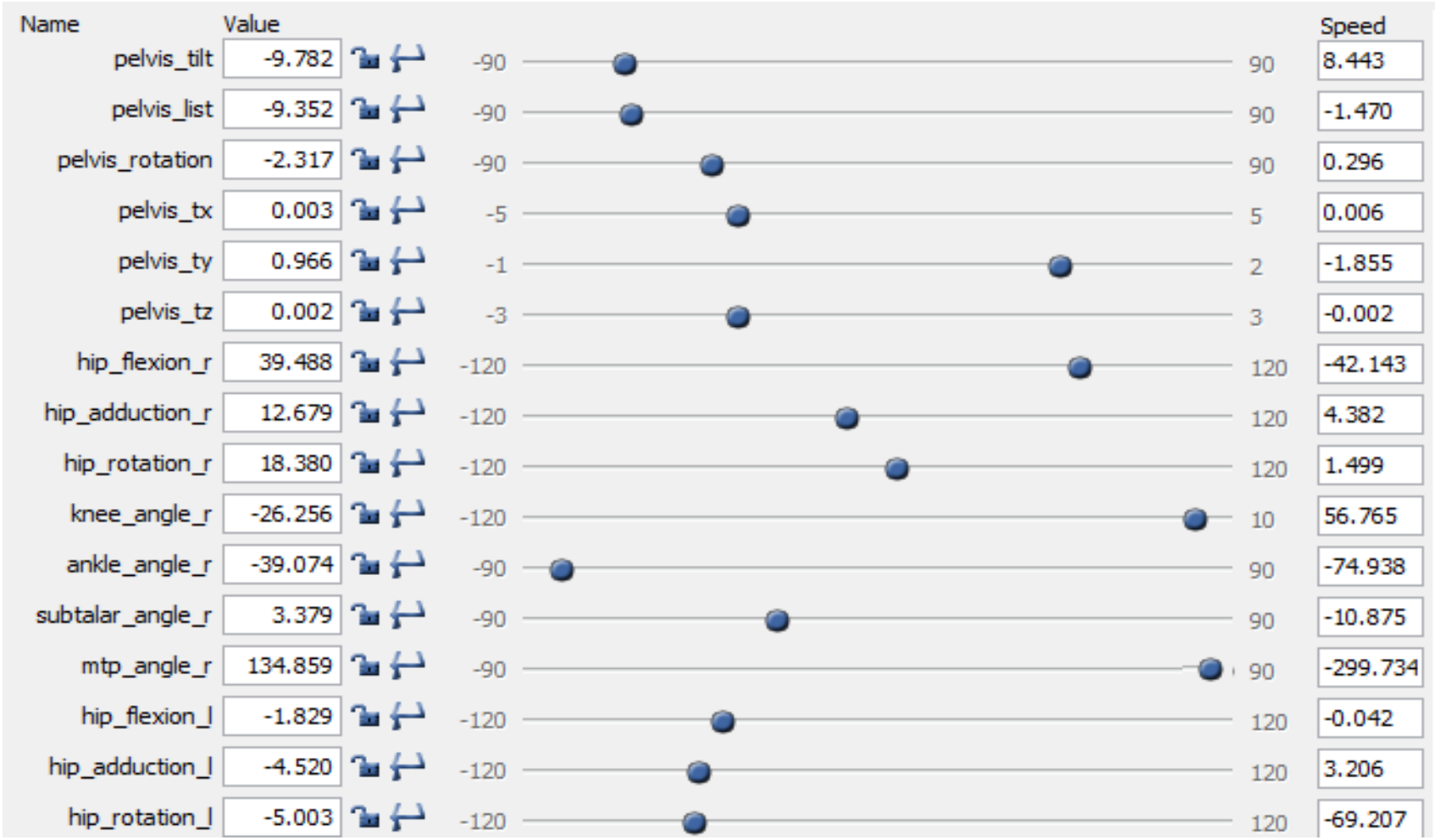
Simulation of dataset in openSim



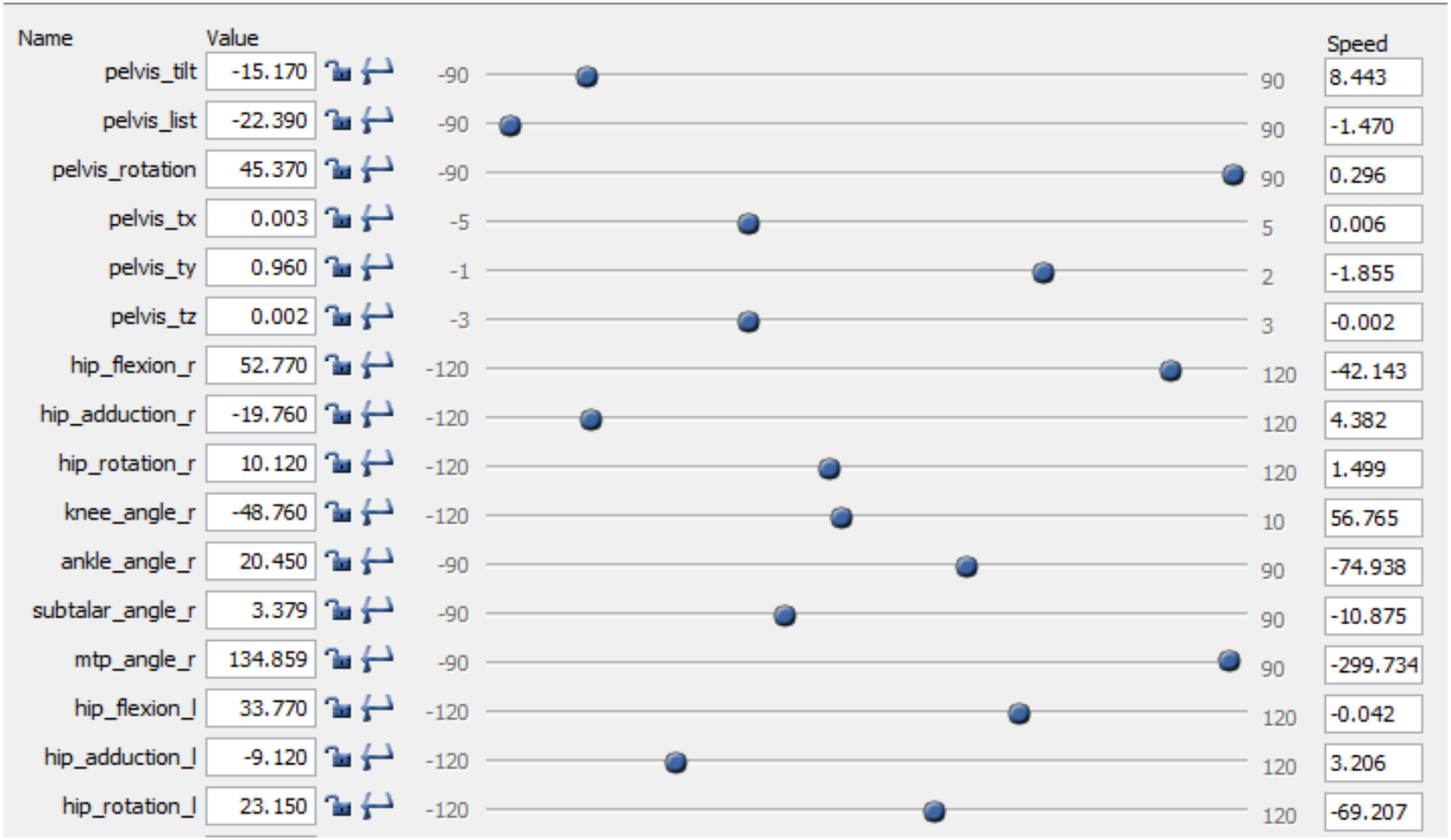
Values of abnormal dataset



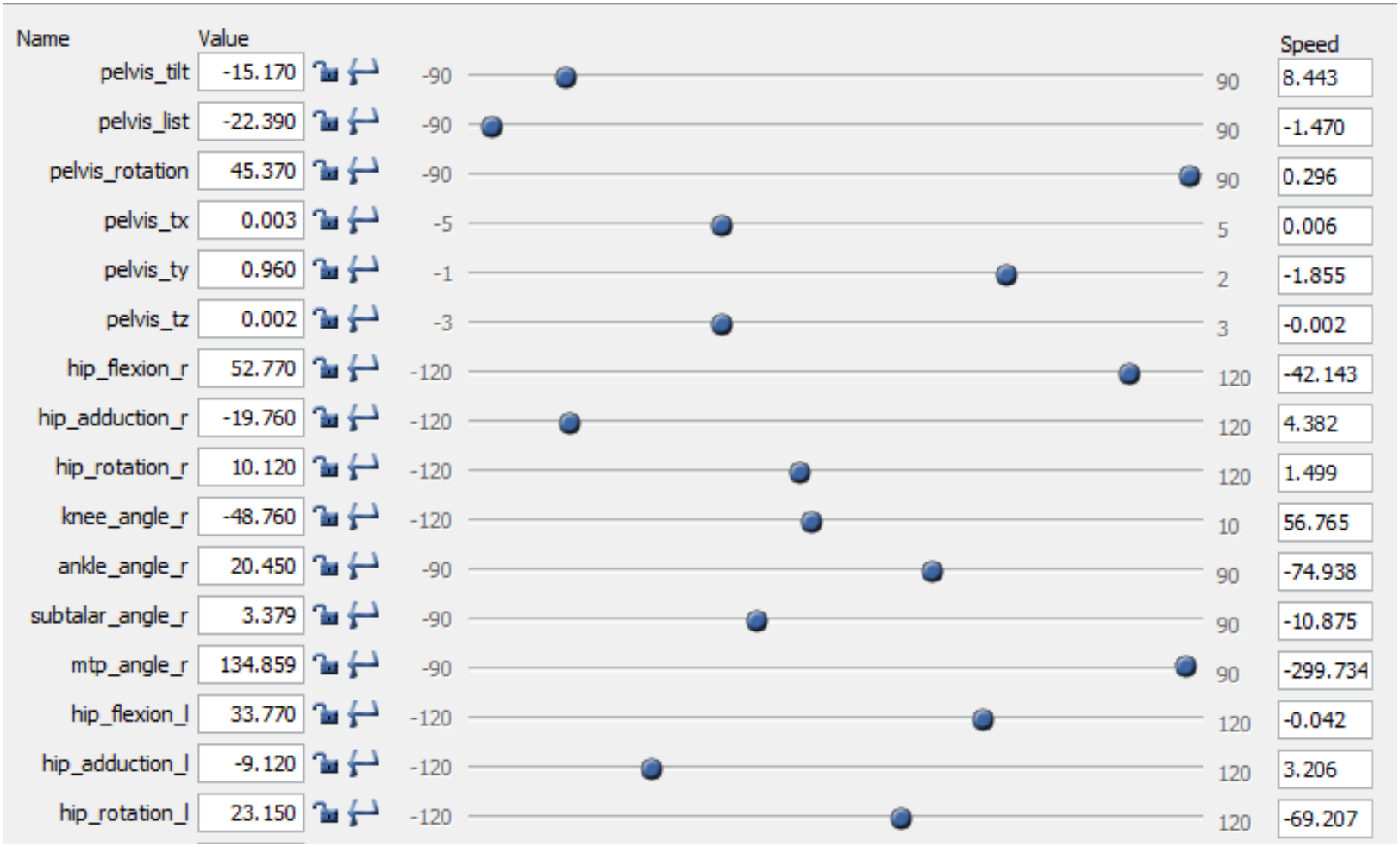
Values of abnormal dataset



Values of abnormal dataset



Values of normal dataset



Feature Selection

Feature Category	Feature Name
F1	Pelvis_tilt
F2	Pelvis_list
F3	Pelvis_rotation
F4	Pelvis_tx
F5	Pelvis_ty
F6	Pelvis_tz
F7	hip_flexion_r
F8	hip_adduction_r
F9	hip_rotation_r
F10	knee_angle_r
F11	ankle_angle_r
F12	ankle_angle_l
F13	knee_angle_l
F14	hip_flexion_l
F15	hip_adduction_l
F16	hip_rotation_l

CLASSIFICATION

K-Means, KNN, ANN

CLASSIFICATION

- **Classification** is the problem of identifying to which set of categories (sub-populations) a new observation belongs, on the basis of a training set of data containing observations (or instances) whose category membership is known.

CLASSIFICATION TECHNIQUES USED

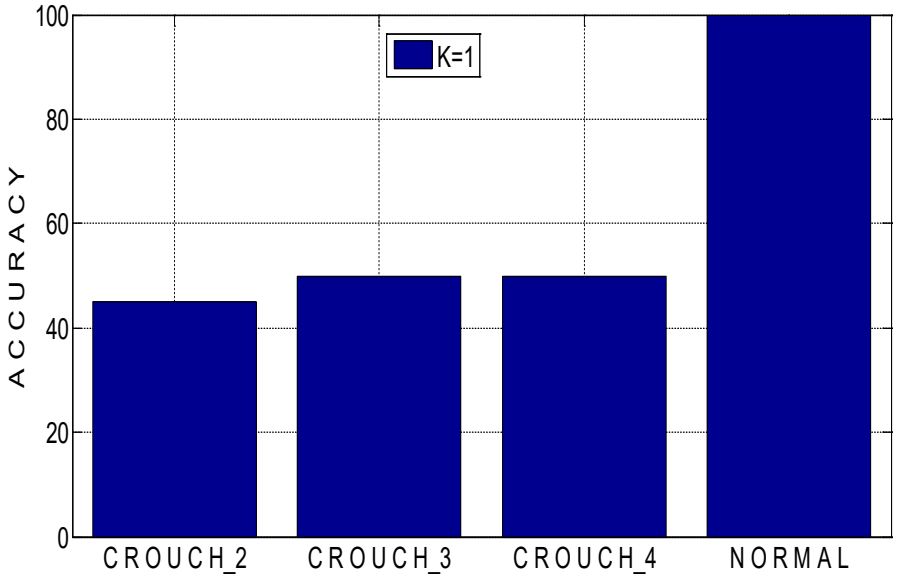
- CLASSIFICATION of GAIT data is done using following techniques:
- K-Means
- KNN
- ANN

K-Means

ACCURACY	Test accuracy (%)
	74.68 %

KNN

- KNN can be used for both classification and regression predictive problems [1].
- It is very much sensitive for outlier and noise.
- It is applicable only for numerical data.



KNN Result

ACCURACY	KNN(k=1,2,3,4,5)
	100,98,95,92,88

ANN Result

ACCURACY	ANN
	98.02

Results

Accuracy percentage of different GAIT data classification

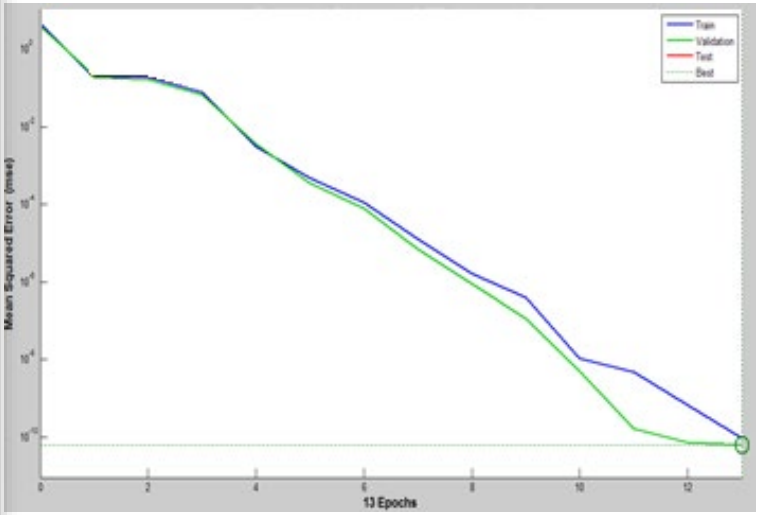
K-Means	KNN(k=1,2,3,4,5)	ANN
74.68	100,98,95,92,88	98.02

Comparison of success rate by different algorithms using 10–fold cross validation

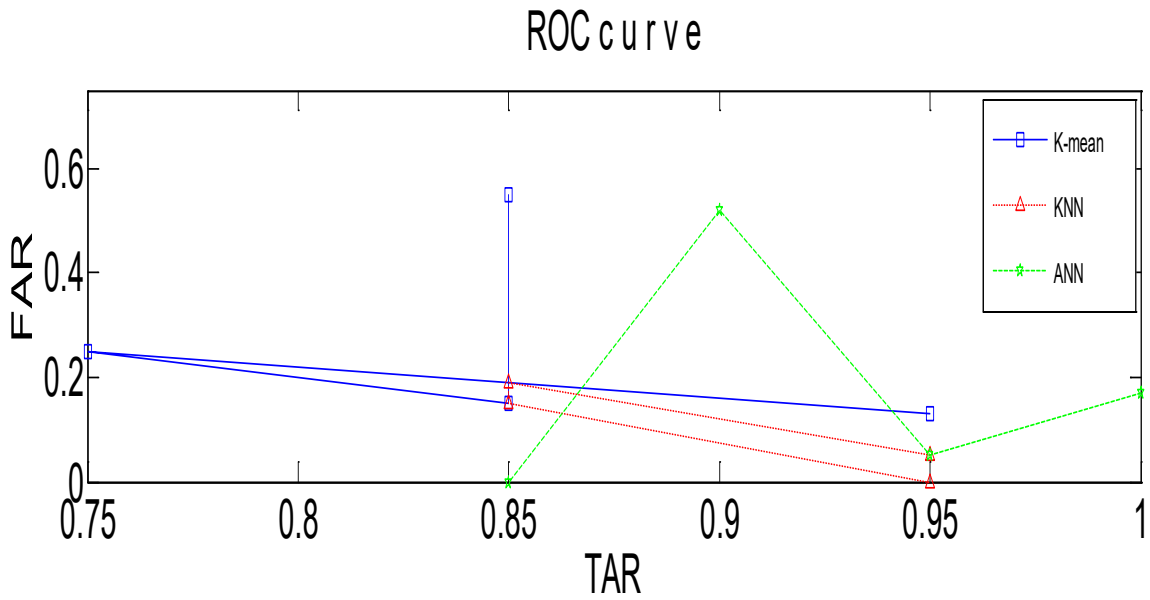
After this, 10-fold cross validation was used to check overall accuracy of the system.

FACTORS	ANN	KNN
Correlation coefficient	0.9955	1.232
Mean absolute error	8.2394	9.4324
Root mean squared error	117.3938	132.3233
Relative absolute error	0.741 %	0.841%
Root relative squared error	9.4381 %	10.4322%
Total Number of Instances	204	204

Classifier	Rate of Success (%)
KNN	87.32 %
Back Propagation	98.02 %



ROC CURVE



Conclusion

- The main concern of research has been identification of abnormality, disorder and upcoming disease at primary stage.
- The experimental result demonstrated that while maintaining a high recognition accuracy rate, the proposed method could accurately recognize various activities in both input and output scenarios.
- The GAITs are classified into two different classes- Normal and Abnormal gait, effectively by the novel classification.
- ANN, K-mean and KNN algorithms were used to compare the result and it has been shown that our classification surpasses the subsisting classifiers.

Cntribution to Research

- We have taken the accuracy to 98.02% which is 1.02% more times than Nielsen, Michael (2016) "*International Conference on Computational Intelligence and Natural Computing*" got 97% accurate results but our classification has better accuracy than this.

Questions?

Thank you

Have a great day ahead