Identification of Gait Data Using Machine Learning Technique to Categories Human Locomotion

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Outline

- GAIT/ Human GAIT
- Problem Statement
- Proposed Solution
- AIM
- Proposed work and Methodology
- Data Collection & Demos
- Classification using KNN and Back Propagation
- Result analysis
- Conclusion

What is GAIT?

Gait

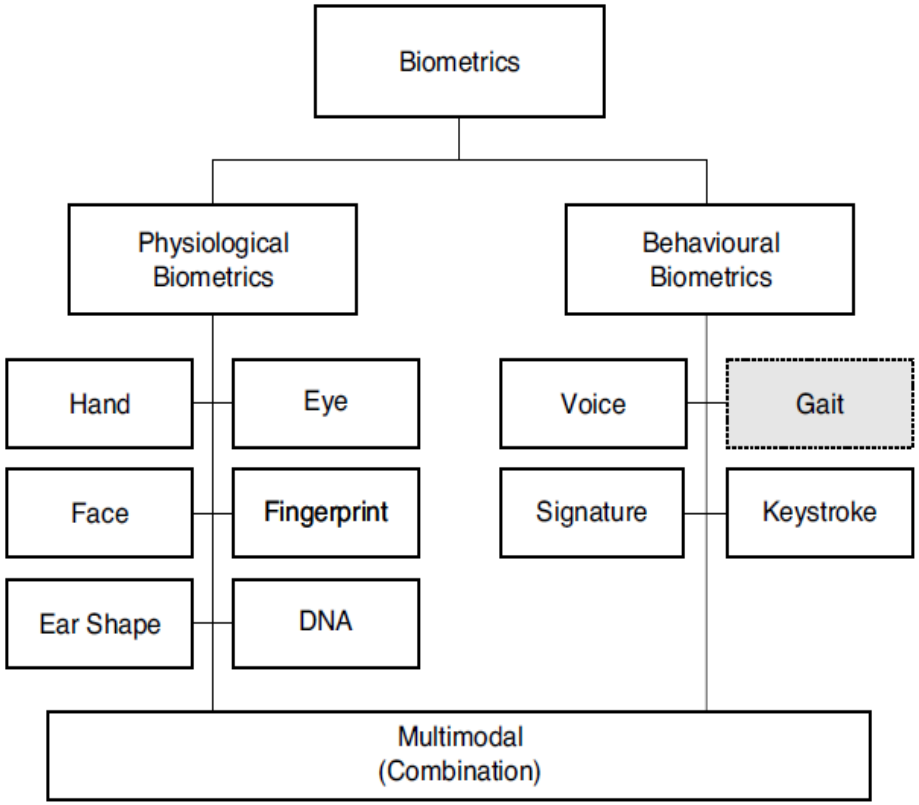
- Gait refers to the manner in which a person walks, and is one of the few biometric traits that can be used to recognize people at a distance.
- Therefore, this trait is very appropriate in surveillance scenarios and gait recognition system.

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

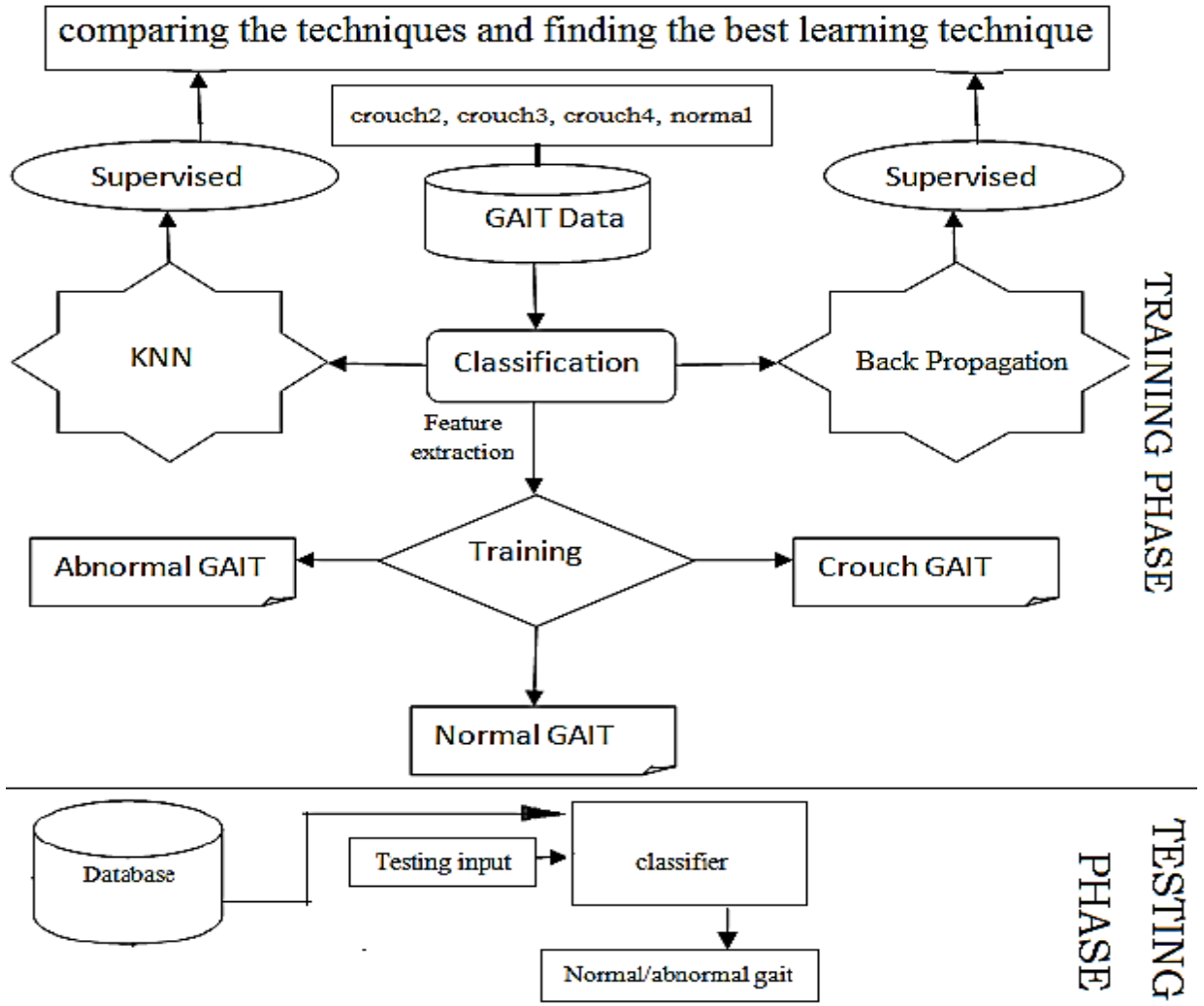
- To verify/validate the identity of people is called as authentication.
- And now a day's authentication is becoming very popular to check whether a person is authentic or not.
- Previously authentication was done with secret passwords or PIN codes. The disadvantage of such authentication systems was anyone could crack the password or PIN codes.
- So, biometric (in fig.) technology came to existence where authentication is done using a particular body part like fingers, iris etc. But now a days these biometrics are not user friendly as people dislike accessing finger print machine or avoid iris scanner as it may weaken or damage their vision.



Proposed Solution

- Identifying normal or pathological human gait. Therefore a robust method for detecting and capturing the body, face and/or 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.
- Human gait can be utilized to identify people for diverse security reason and exercised before to detect many abnormalities.

Proposed Solution



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 pedestrian navigation and for security purpose like surveillance.

Methodology

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

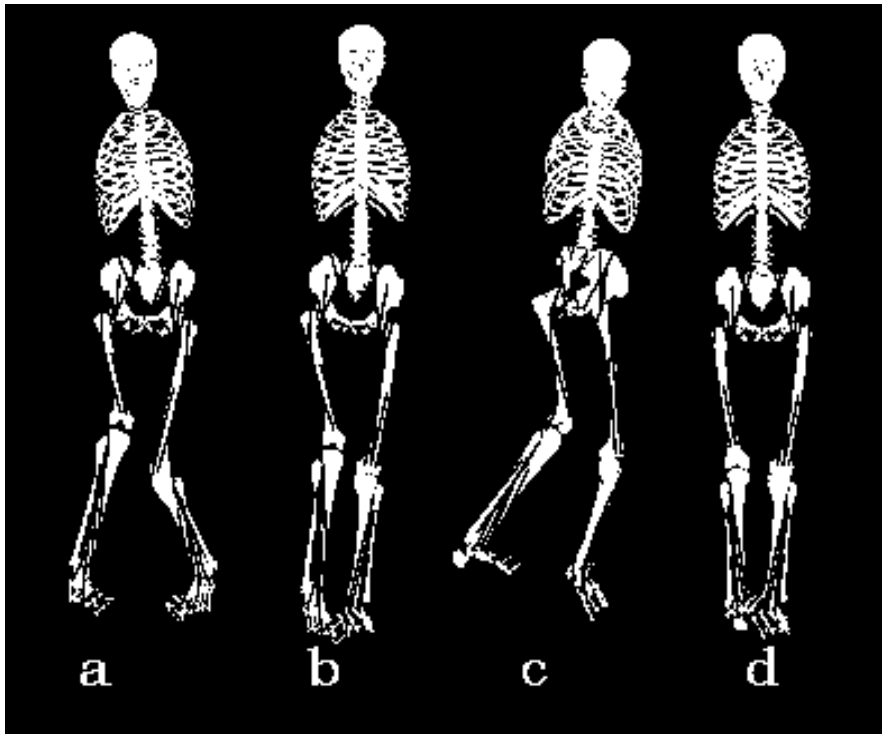
- The data set is collected from following link
- https://www.nist.gov/itl/iad/image-group/resources/biometric-special-databases-and-software

D	E	F	G	H	I	J	K	L	M	N	O	P	Q
24.61	1.09	-1.35	-3.94	-1.7	-0.79	3.11	-2.19	-16.56	2.68	1.28	-8.2	9.81	1
24.45	1.59	-0.37	-6.66	-3.25	-1.17	3.27	-2.1	-16.82	1.94	1.41	-11.29	8.26	1
24.13	2.22	1.36	-9.45	-4.68	-1.69	3.25	-1.98	-16.53	0.99	1.16	-15.19	5.52	1
23.68	3.01	3.02	-12.26	-5.08	-2.34	3.05	-1.81	-15.4	-0.19	0.41	-20.17	1.11	1
22.96	3.92	3.99	-14.76	-4.17	-3.01	2.81	-1.64	-13.44	-1.48	-0.48	-26.06	-4.36	1
21.78	4.78	4.23	-16.37	-2.5	-3.61	2.66	-1.52	-10.65	-2.69	-0.99	-32.67	-9.73	1
20.24	5.45	4.18	-17.04	-0.83	-4.07	2.68	-1.49	-7.15	-3.62	-0.66	-39.6	-13.37	1
18.41	5.85	3.83	-16.93	0.65	-4.35	2.87	-1.54	-3.16	-4.1	0.31	-46.16	-14.07	1
16.38	6.01	3.23	-16.24	1.92	-4.42	3.14	-1.63	0.95	-4.16	1.09	-51.68	-12.62	1
14.19	5.96	2.72	-15.15	2.98	-4.26	3.37	-1.74	4.93	-3.88	1.09	-55.66	-10.16	1
11.91	5.8	2.4	-13.87	3.88	-3.88	3.52	-1.84	8.63	-3.38	0.33	-57.83	-7.6	1
9.58	5.57	2.14	-12.46	4.64	-3.36	3.57	-1.94	11.96	-2.79	-0.74	-58.25	-5.28	1
7.22	5.31	1.83	-10.95	5.25	-2.78	3.54	-2.02	14.96	-2.18	-1.71	-57.28	-3.2	1
4.87	5.06	1.5	-9.42	5.78	-2.2	3.45	-2.09	17.62	-1.61	-2.48	-55.06	-1.34	1

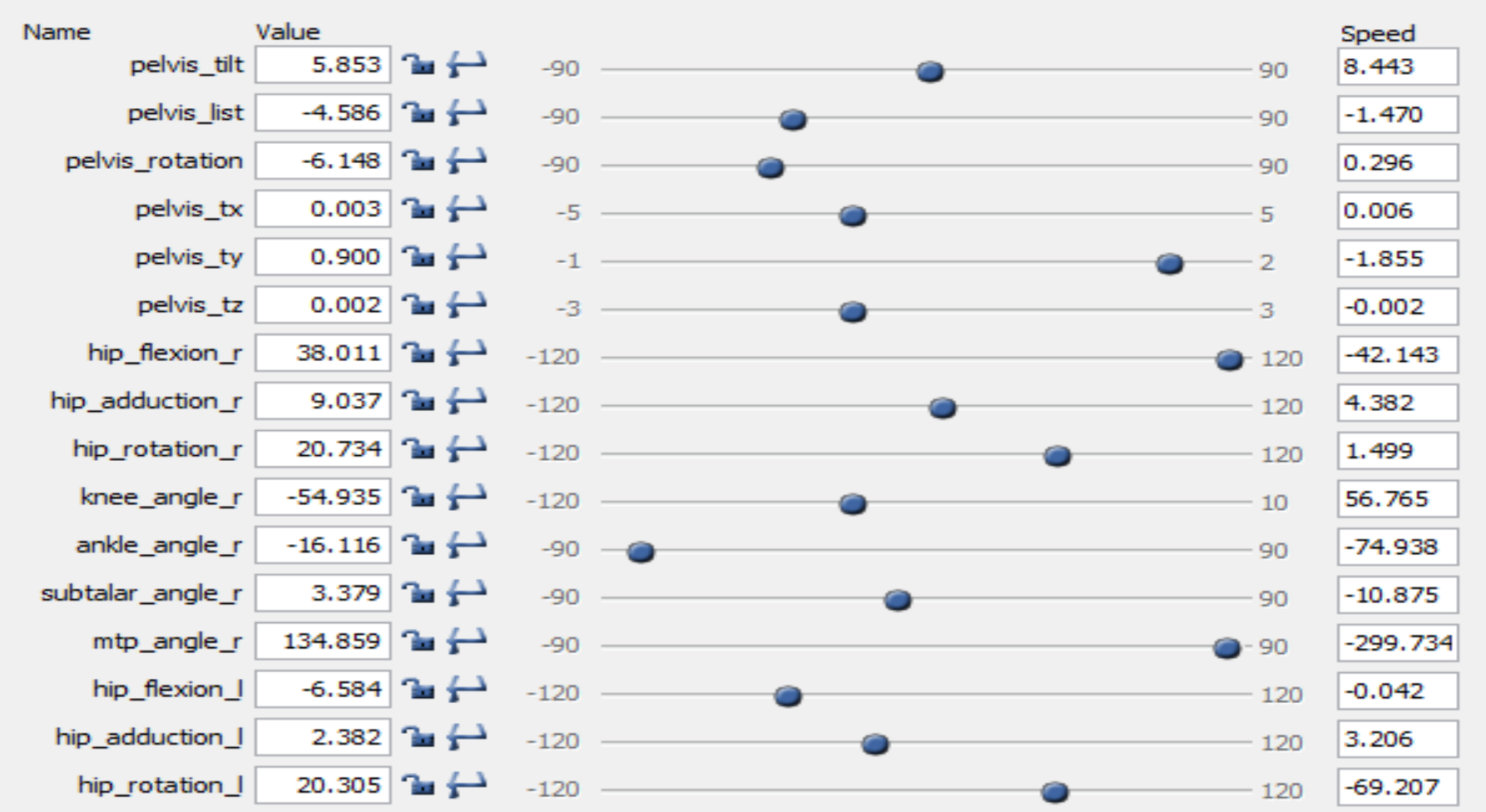
Analysis of dataset

When the dataset is simulated, then the coordinates of the human GAIT data set is captured and shown in figure for crouch2, crouch3, crouch4, normal datasets respectively.

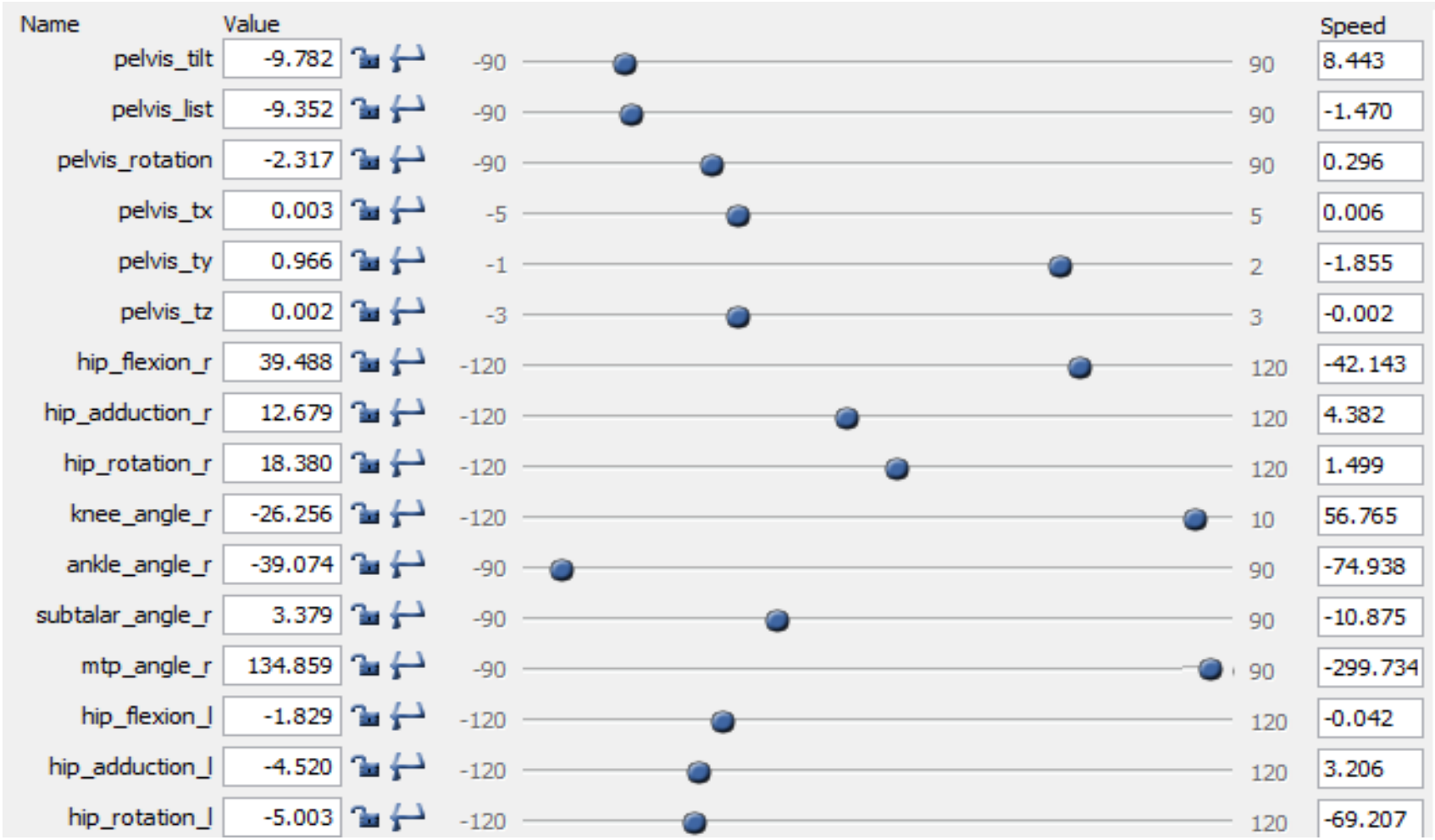
Simulation of dataset in openSim



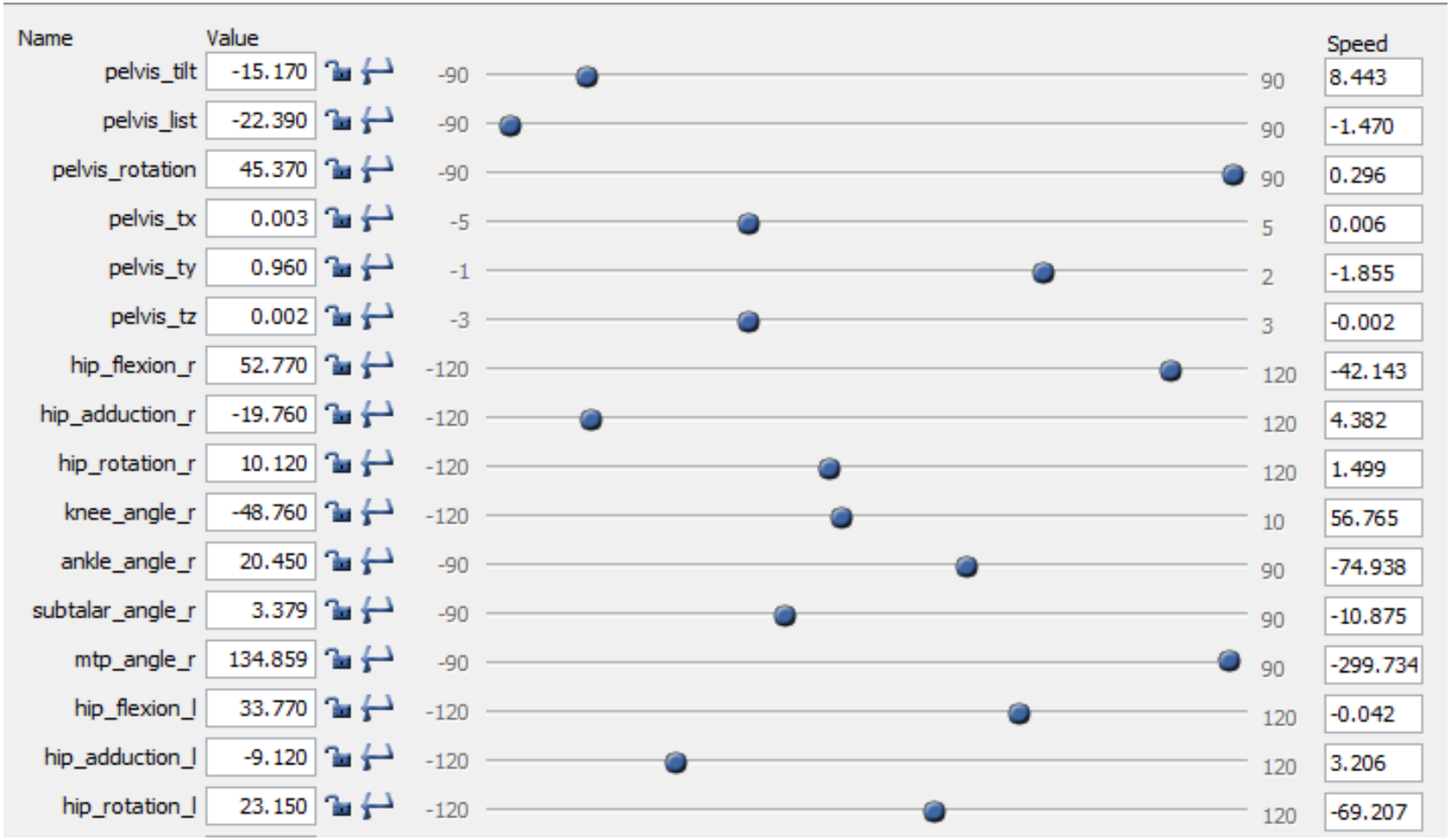
Values of crouch2 dataset



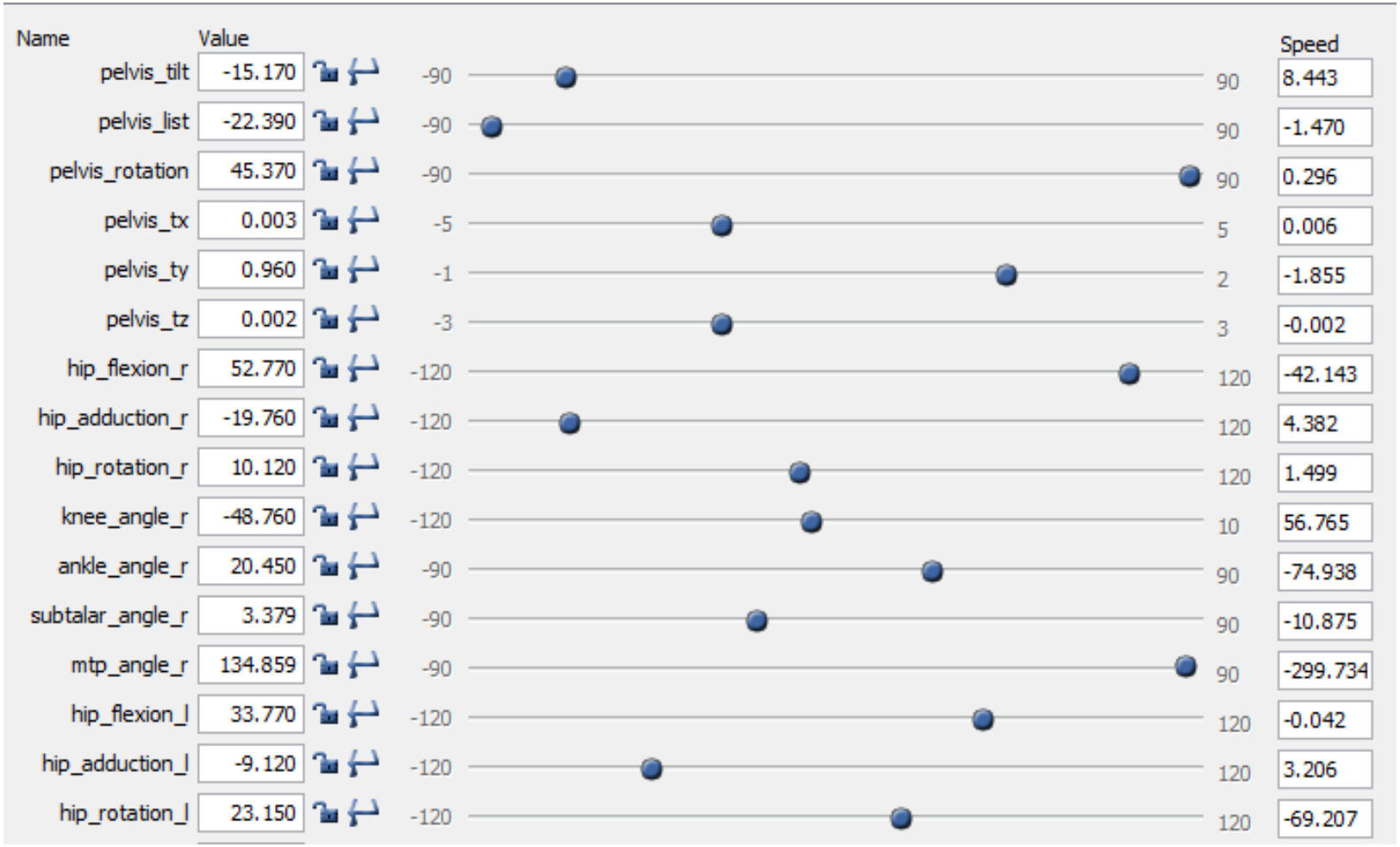
Values of crouch3 dataset



Values of crouch4 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

KNN, BACK PROPOGATION

CLASSIFICATION

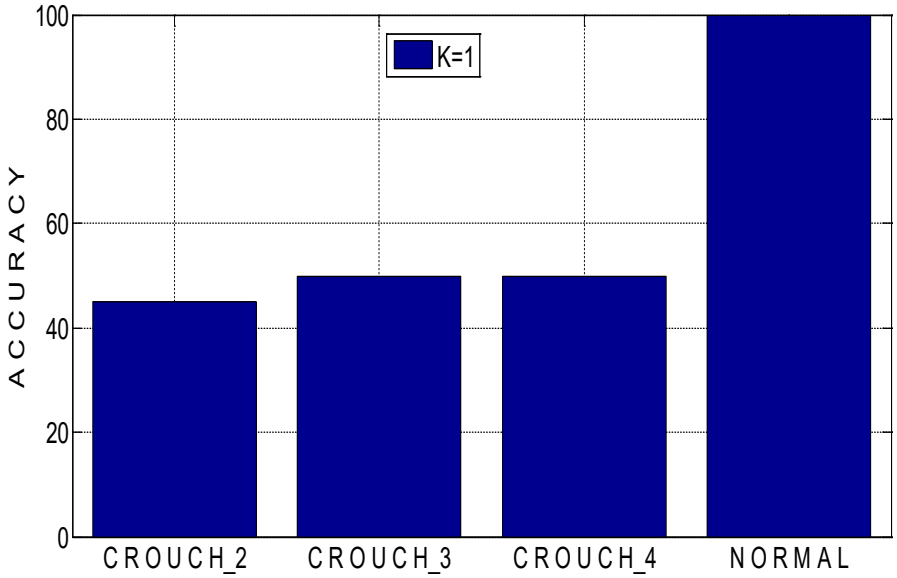
- **Classification** is the problem of identifying to which set of categories (sub-populations) a new observation belongs, on the basis of a training set of data containing observations (or instances) whose category membership is known.

CLASSIFICATION TECHNIQUES USED

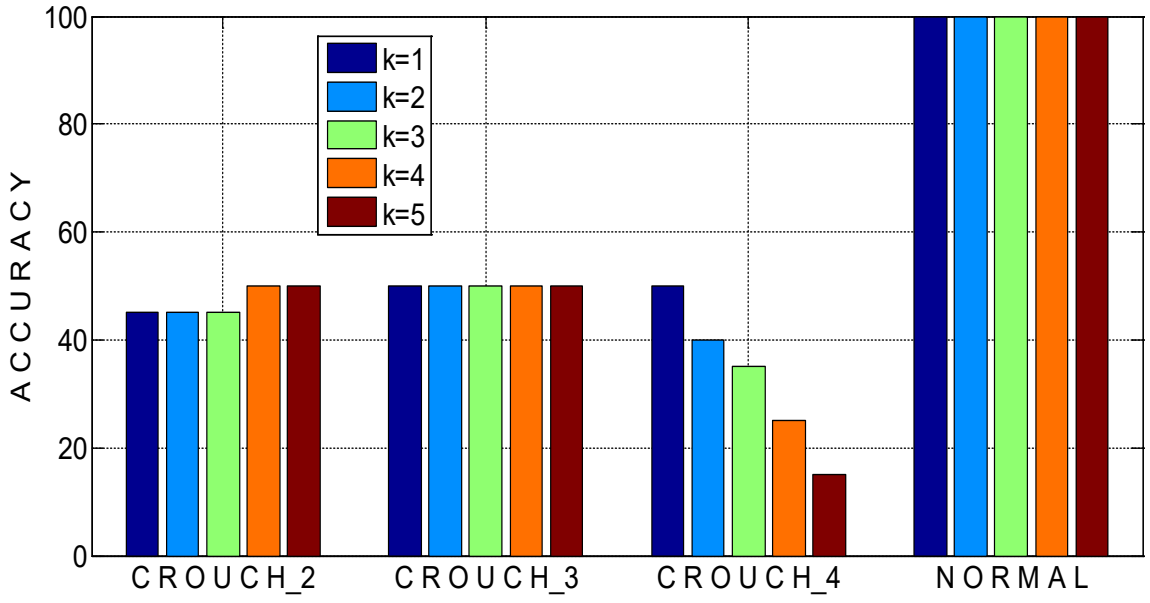
- CLASSIFICATION of GAIT data is done using two following techniques:
- KNN
- BACK PROPOGATION

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



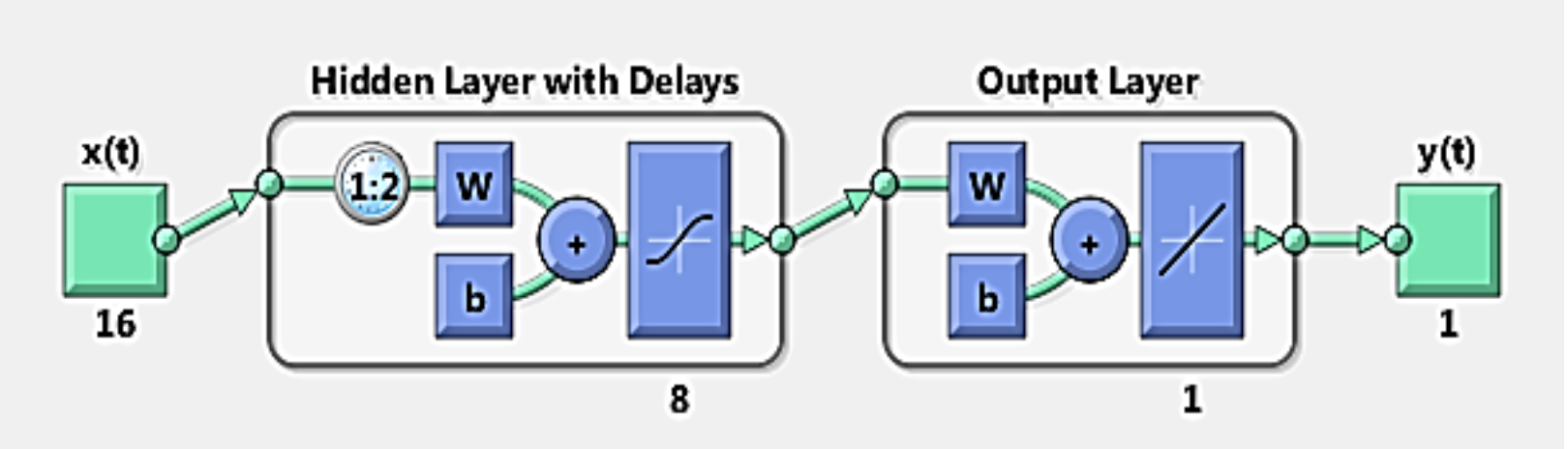
Accuracy of classification of KNN when k=1,2,3,4,5

ACCURACY	Training accuracy (%)	Test accuracy (%)
	100%	87.32 %

BACK PROPOGATION

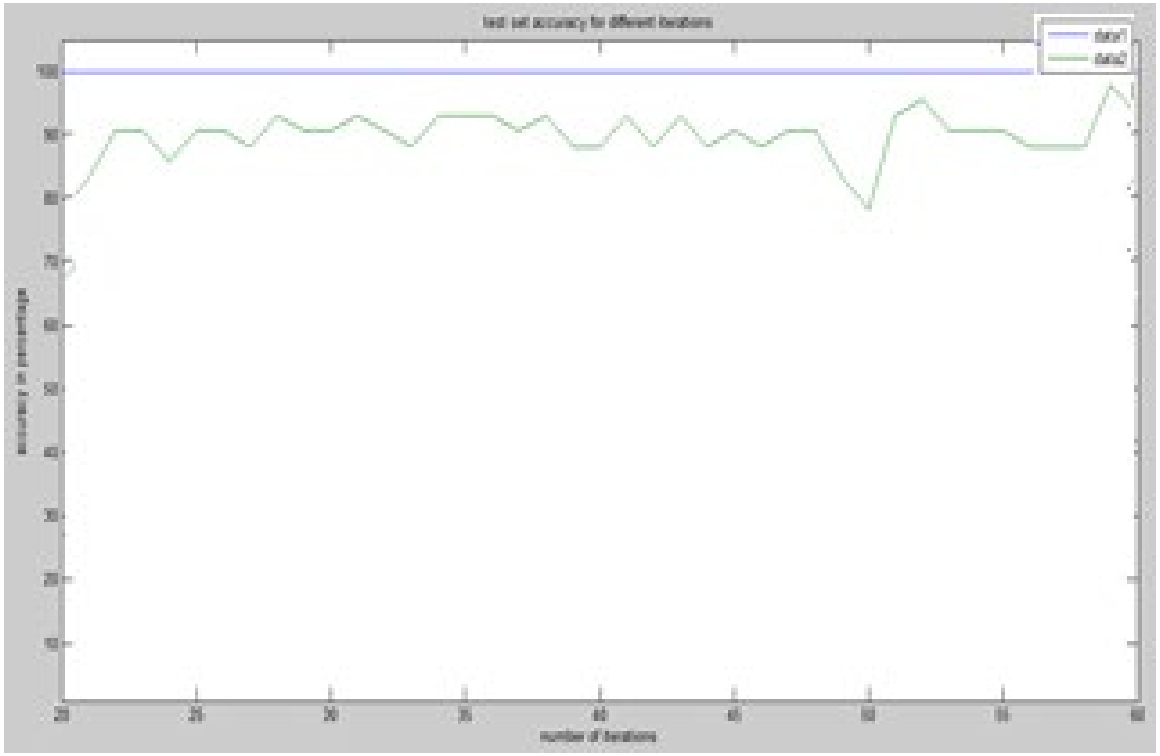
- **Backpropagation,** short for "backward **propagation** of errors", is an algorithm for supervised learning of artificial neural networks using gradient descent [2].
- Given an artificial neural network and an error function, the method calculates the gradient of the error function with respect to the neural network's weights.

BACK PROPOGATION



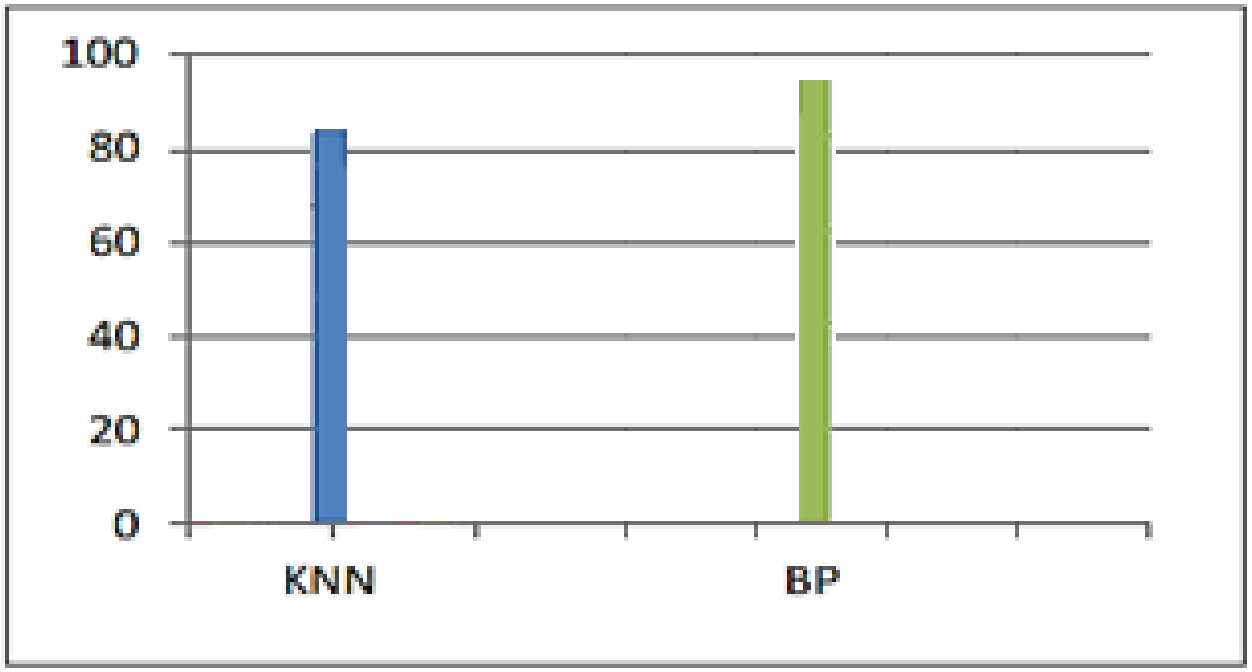
In this technique we train the system with 16 input neurons in the input layer and we get 4 neurons in the output layer. For adjusting the weights of the network, training is done by back-propagation algorithm.

Back Propagation Result



ACCURACY	Training accuracy (%)	Test accuracy (%)
	100%	94.01 %

Result



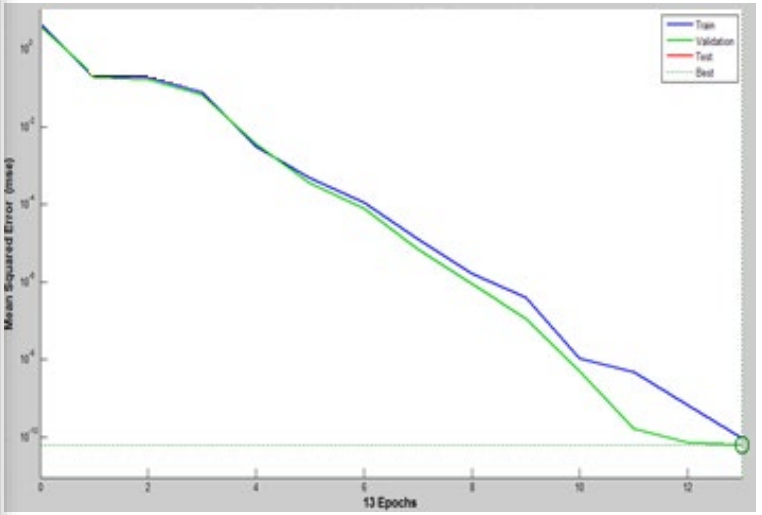
ACCURACY	BACK PROPAGATION	KNN
	94.01%	87.32%

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	BACK PROPAGATION	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

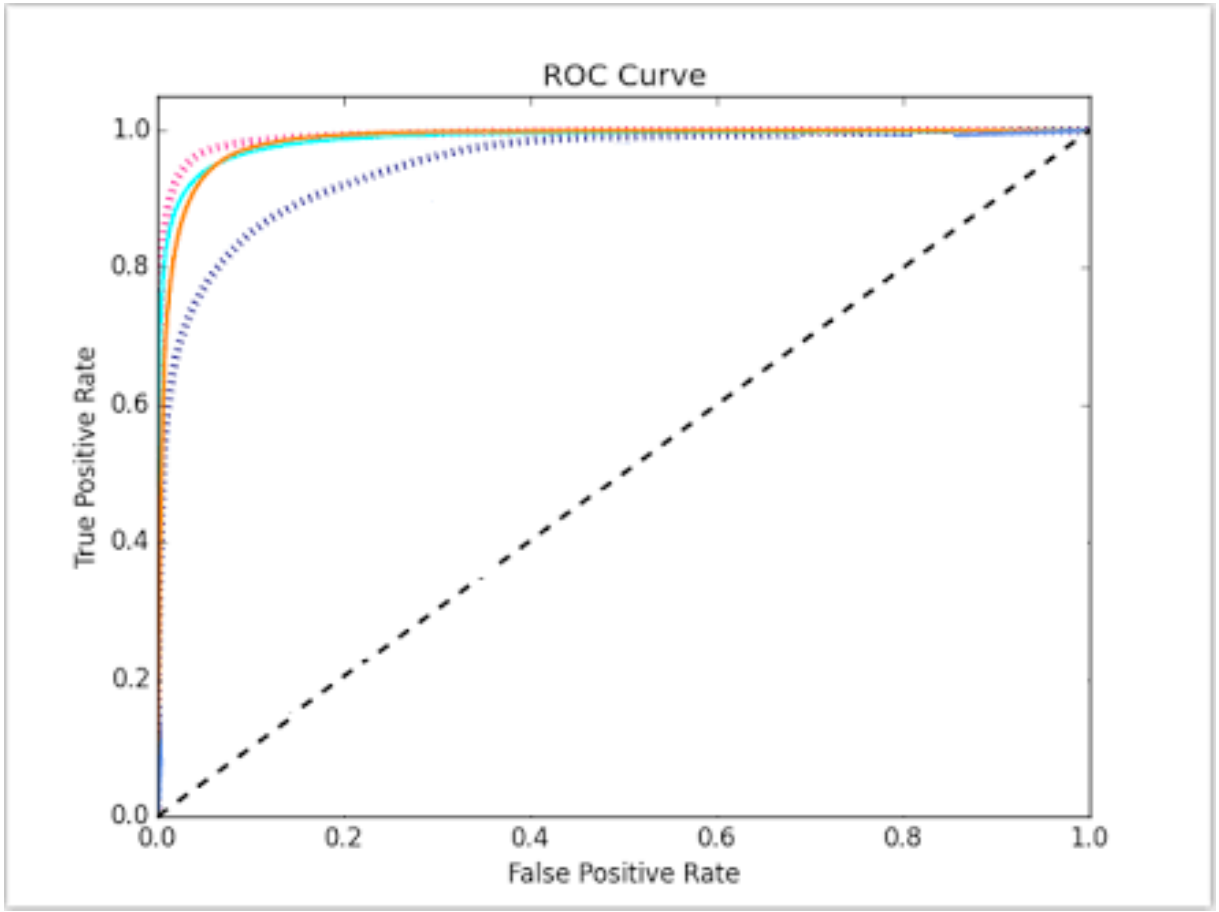
Classifier	Rate of Success (%)
KNN	87.32 %
Back Propagation	94.01 %



Classifier Fussion

Classifier Fussion	Rate of Success (%)
KNN → Back Propagation	93.82 %
Back Propagation → KNN	94.13 %

ROC CURVE


ROC Curve
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0

Conclusion

- The proposed system can be used for developing a gesture controlled hexadecimal keyboard making human-computer interaction easier, surveillance scenarios for security purposes, in detecting disease of sports person and gait recognition system.
- Overall accuracy was observed to be 94.01%, 87.32% using the KNN and Back Propagation.

References

[1]. https://en.wikipedia.org/wiki/Backpropagation
[2]. https://en.wikipedia.org/wiki/K-nearest_neighbors_algorithm

Questions?

Thank you

Have a great day ahead