Mouse Gesture Recognition using Back Propagation Neural Network

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Abstract— To Understand Mouse motions are often exhibit as a pattern recognition weakness. So as to convey pictorial messages to a receiver, a mouse expresses motion patterns referred to as gestures; these patterns area unit variable however dissimilar associated have an associated significance. The Pattern recognition by any processor or machine are often executed via varied ways like Hidden Markov Models (HMM), Linear Programming (LP) and Neural Networks (NNs). Every technique has its own advantages and disadvantages. This paper reviews why using ANNs particularly is best suited to analyzing mouse gesture patterns. All implementation work is carried out in MATLAB (Matrix Laboratory) could be a problem-oriented language and interactive surroundings for numerical computation, image, and programming. MATLAB is de facto normal for analyzing information, developing algorithms, and making models and applications. The research proposed work uses Techniques like Vector Quantization, Genetic Algorithms and Neural Networks; therefore such work is implemented using Neural Networks toolbox (NNTool).In certain scenarios, we have successfully demonstrated that Neural Networks can be used for the Gesture recognition in with more than 99.7% success rate.

Key words: Mouse Gesture Recognition, Artificial Neural Network, Gesture Recognition, practical implementation.

I. INTRODUCTION

An Artificial Neural Network [1] (ANN) may be delineated because the science model that is impressed by the biological nervous systems, as an example, the brain method data. The most component of this model is that the novel structure of the knowledge process system [14]. It composed of an oversized range of extremely reticular process components (neurons) operating in unison to resolve specific issues.

Artificial Neural Networks learn by example like humans. Associate degree ANN is configured for a specific application, as an example pattern recognition or knowledge classification, through a learning method [4]. Learning in biological systems involves changes to the conjugation connections that exist between the neurons. This is often true for Artificial Neural Networks similarly. Neural networks may be wont to model complicated relationships between inputs and outputs or to find predictable patterns in knowledge. After we name a neural network, we should always a lot of properly say "artificial neural network" rather than a neural network, as a result of that's the particular that means most of the time by neural networks. The biological neural networks area unit far more sophisticated than the mathematical models we have a tendency to use for Artificial Neural Networks [4].

There is no universally accepted definition of a neural network. however maybe the majority within the field would agree that associate degree NN could be a network of the many straightforward processors ("units"), every presumably having a tiny low quantity of native Memory (LM). The unit's area unit connected by communication channels ("connections") that sometimes carry numeric knowledge, encoded by any of varied means that. The layers operate solely on their personal knowledge and on the inputs they receive via the channel. The restriction to native operations area unit typically relaxed throughout training

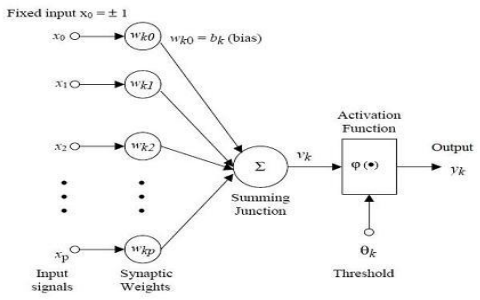

Fig.1: Architecture of a simple Neural Network

A. *ADVANTAGES OF USING NEURAL NETWORK:*

Neural networks, with their remarkable ability to derive meaning from complicated or data that is not precise and hence can be used to stipulate patterns and find trends that are too much complex to be noticed by humans or any other computer techniques. A Neural network which is trained can be thought of as an "expert" in the category of information it has been given to analyze [4].

Other Advantages include:

1) Adaptive learning:
An ability to learn how to do tasks based on the data given for training or initial experience.

2) Self-Organization:
An ANN can create its own organization or representation of the information it receives during learning time.

3) Real Time Operation:
ANN computations may be done in parallel and special hardware devices can be designed, so that these can take advantage of this capability.

4) Fault Tolerance via Redundant Information Coding:
Partial destruction of a network leads to the corresponding degradation of performance. However, some of the network capabilities can be retained even with major network damage.

B. *UNDERSTANDING A NEURON:*

A more sophisticated neuron is the McCulloch and Pitts model Neuron [19]. The main difference from the previous model is that the inputs are 'weighted'; the effect that each input has at decision making is dependent on the weight of the particular input. The weight of an input is a number which when multiplied with the input gives the weighted input. These inputs (weighted) are added together and if

they exceed a preset threshold value, the neuron fires. Else the neuron does not fire.

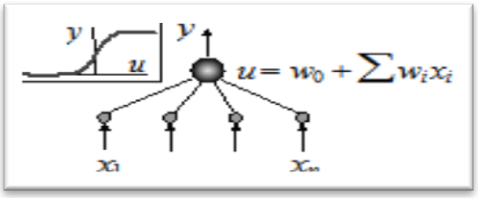

Fig. 2: ANN weighted inputs and the threshold values.

In mathematical terms, the neuron fires if and solely if; the addition of input weights and of the edge makes this nerve cell a really flexible and powerful one. The MCP neuron has the flexibility to adapt to a specific state of affairs by ever-changing its weights and threshold or the each. There are numerous algorithms that cause the neuron to adapt accordingly; the foremost common ones are the Delta rule and therefore the back error propagation.The first is employed in feed-forward networks and therefore the later in feedback Artificial Neural Networks [19].

C. GESTURE RECOGNITION:

For recognition of mouse gestures we tend to should press right button throughout moving a mouse. for instance for recognition "left" gesture, press right button and move a mouse to the left. If a neural network will acknowledge the gesture, then we are going to see the name, chance and ideal presentation of Gesture.

II. RESEARCH PROPOSED WORK

For the mouse based interaction, a mouse gesture is continues and directed sequence of the cursor movements with the clearly distinguished start and end. Gestures are marked by pressing the right button. Beginning of a gesture is signaled by pressing of the mouse button. From that moment, until the release of the button, each change in the location of the cursor is registered and added to a vector of points —the rough data. Time span of the sequence is not stored. The order of points in vectors defines directions.
Following are the Objectives of the work:

(1) Select a Recognition algorithm (Levenberg Marquardt Algorithm).
(2) Record and collect Multiple Gesture paths into a readable format for Training of ANN.
(3) Smooth the Recorded paths to base points.
(4) Transform points to angle vectors.
(5) Compute sines and cosines of the smoothed paths.
(6) Pass values (cosines and sines) to network's inputs with angle vectors.
(7) Apply softmax function on an output network vector.
(8) Train the Neural Network for recorded paths.
(9) Find MSE(Mean Square Error) and Regression for the Trained Neural Network.

Tools which are used in the work are:

(1) For Back propagating Artificial Neural Networks Library is used.
(2) The Training of Artificial Neural Networks and storing motion Vectors simple binary format is used.
(3) Standard pointing equipment for Collecting Gestures such as mouse.
(4) For GUI programming for Gestures and Target Vector collection we use the either Autoitv3 as an automation tool.
(5) Matlab 2012b for Interpolation of results, and for graphs and charts.

III. PRACTICAL IMPLEMENTATION AND RESULT

Firstly we collect mouse gestures as input and collect all gestures in .csv file for further processing done in MATLAB. After collecting inputs, Target Vector gestures are collected and collect all in .csv file for further processing.

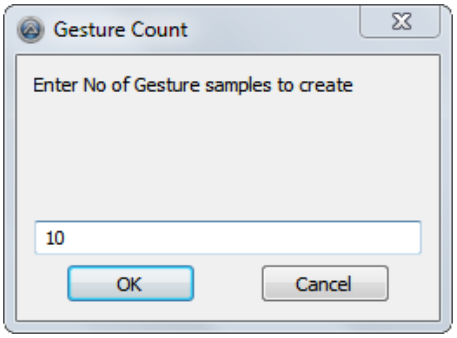

Fig.3: Initial Screen of Gesture Collection Procedure

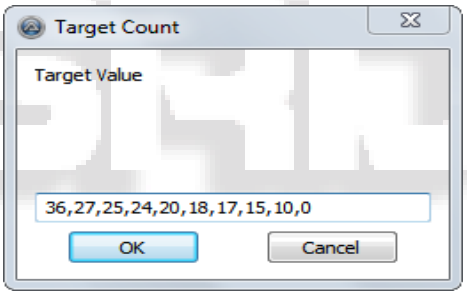

Fig. 4: Target Gesture input target vectors for the training procedure.

Then start MATLAB and import the data which is collect as input and target and run. On code window, write nftool and then select Input and Target follow and continue further steps as per requirement. Finally train the network.
The training process stop after achieving either of the conditions: maximum number of cycles or target error. During the training process keep an eye on error's graph, a current gesture (with noise) and 2D network presentation.

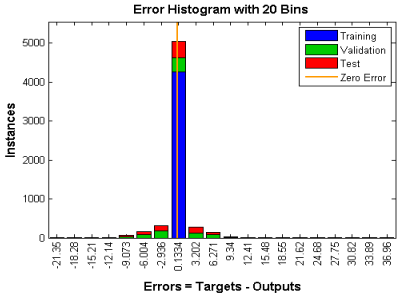

Fig. 5: Zero Error Histogram for Network Training

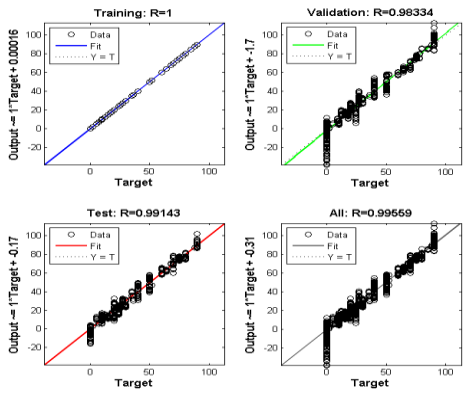

Fig. 6: Regression values per Gesture

IV. CONCLUSION

Gesture recognition systems typically contain many distributions patterns. A large number of compression and other parameters are associated with Gesture data. This makes them both slow to decode Gesture, and large to store. Techniques have been proposed to decrease the number of parameters and hence increase compression of Gestures. Gesture recognition with large data set is a computationally expensive task with models requiring a large amount of parameters to obtain good error rates.

In this paper we have discussed mainly about Gesture recognition and using Neural Networks for the same. We have successfully demonstrated that Neural Networks can be used for the Gesture recognition in with more than 99.7% success rate. As we concluded in our results that the system we devised using neural networks produced less error rates in gesture recognition as oppose to using only one method at a time.

V. FUTURE SCOPE

Researchers all over the world are trying to develop a perfect Gesture Recognition system. There have been many advancements in same and research in digital signal processing over the years but computer machines are unable to match the performance of their human utterances in terms of accuracy of matching and speed of response.

As we concluded in our results that the system we devised using neural networks produced less error rates in speaker recognition as oppose to using only one method at a time. This Process however is time consuming and resource intensive, it took us a lot of effort to produce significant results

Following areas are still remaining for further research

(1) Improving both CPU and Memory Resource consumed by the process
(2) Selecting Genetic algorithms instead of Neural Networks.
(3) Optimizing genetic algorithms in areas such as population selection algorithms, Genealogy, cross over and mutation of children generations.
(4) Using Improved Neural Networks if available or develop methodologies for better neural networks.
(5) Using Statistical techniques such Hidden Markov Models instead of Neural Networks.

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