RESEARCH ARTICLE OPEN ACCESS

Hand Gesture and Neural Network Based Human Computer Interface

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ABSTRACT
Computer is used by every people either at their work or at home. Our aim is to make computers that can understand human language and can develop a user friendly human computer interfaces (HCI). Human gestures are perceived by vision. The research is for determining human gestures to create an HCI. Coding of these gestures into machine language demands a complex programming algorithm. In this project, We have first detected, recognized and pre-processing the hand gestures by using General Method of recognition. Then We have found the recognized image's properties and using this, mouse movement, click and VLC Media player controlling are done. After that we have done all these functions thing using neural network technique and compared with General recognition method. From this we can conclude that neural network technique is better than General Method of recognition. In this, I have shown the results based on neural network technique and comparison between neural network method & general method.
Keywords **-** Hand Gesture, ANN, HCI, Mouse

I. INTRODUCTION

Everyone is dependent to perform most of their tasks using computers. The major input devices are keyboard and mouse. But there are a wide range of health problems that affects many people, caused by the constant and continuous work with the computer. Direct use of hands as an input device is an attractive method for Human Computer Interaction Since hand gestures are completely natural form for communication so it does not adversely affect the health of the operator as in case of excessive use of keyboard and mouse. The User interface has a good understanding of human hand gestures.

By using the gesture, Feelings and thoughts can also be expressed. Users generally use hand gestures to express their feelings and notifications of their thoughts. Hand gesture and hand posture are related to the human hands in hand gesture recognition. The difference between hand gesture and hand posture, hand posture is a static form of hand poses.

There are so many methods for recognizing gesture and postures of human being. These are PCA (Principal Component Analysis) , SVM (Support Vector Machine Learning), MSA (Mean Shift Algorithm), HMM (Hidden Markov Model), ANN (Artificial Neural Network), etc. These all methods have their own merits and demerits.

By making survey on all these methods, I knew that if human computer interaction is made by using ANN method then it will be more efficient than other methods. Neural Network is basically the method of learning. Using or without using the database in our system, system gives us output accordingly. The computation based on the Neural Network is more faster and accurate than other methods. We use back propagation algorithm in neural network for interfacing from human to computer. The back propagation refers to the fact that any mistakes made by the network during training get sent backwards to correct it and from that the network learns what is right and wrong. So in this project I am comparing HCI using general recognition method and HCI using ANN. In this project, We will implement a hand gesture recognizer which is capable of detecting a moving hand with its gesture in webcam frames. In future, human being may use their hands to interact with machines without any mediator (keyboard and mouse).

II. HAND GESTURE & HUMAN COMPUTER INTERFACE

II.I Gesture

Gesture is a physical movement of the fingers, hands, arms, or other parts of the body, to convey information or meaning for the environment interaction. Gesture recognition needs a good interpretation of the hand movement as effectively Meaningful commands.

II.I.I Gesture Classification Gestures can be classified into two types:

1) static gestures - described as hand shapes
2) dynamic gestures – described as hand movements

II.I.II Two approach

For human computer interaction (HCI) interpretation system there are two commonly approaches.

A) Data Gloves Approaches:

These methods employs mechanical or optical sensors which are attached to a glove. This glove transforms finger flexions into electrical signals to determine the hand movement. In this one or more data- glove instruments which have different measures for the joint angles of the hand and degree of freedom (DOF) that contain data position and orientation of the hand used for tracking the hand.

Figure 2.1 Data Glove based[2][11]

B) Vision Based Approaches:

These techniques are based on how the person realize information. In this method data is captured by camera(s).To create the database for gesture system, the gestures should be selected with their meaning and each gesture may contain more samples for increasing the accuracy of the system.

Figure 2.2 Vision based[2][11]

3)

II.II Human computer Interface

Human computer interaction (HCI) is the study, planning, and design of the interaction between people (users) and computers (machines). It is also known as the intersection of computer science and behavioural sciences. Human computer interaction is the study of a human and a machine and gives knowledge of both the machine side and the human side.

We can interface with computer (machine) using keyboard and mouse which are touch devices as shown in figure 3.9. Now by using speech recognition, face movement, eye detection, hand gestures, etc. We can interface with computer. But there are some limitations in face movement, speech recognition, eye detection so we use hand gestures.

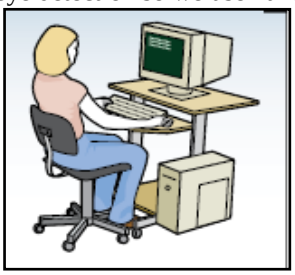

Figure 2.3 Human Computer Interface[15]

III. NEURAL NETWORK

III.I Types of neural Network

There are two types of Neural Network:

1) Biological Neural Network
2) Artificial Neural Network

1) Biological Neural Network:

- Natural neurons receive signals through synapses located on the dendrites or membrane of the neuron.
- When the electrical signals which are received are enough strong, the neuron activates by itself and emits an electrical signal though the axon. This signal are sent to other synapse and activate the other neurons.

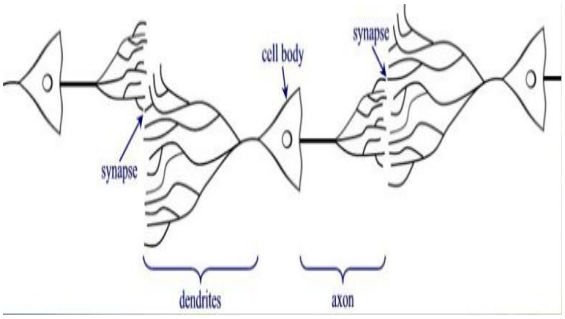

Figure 3.1 biological Neural Network[14]

2) Artificial Neural Network:

The ANN consist of inputs (synapses), weights(strength of signals) and activation function of neurons(nodes) and outputs.

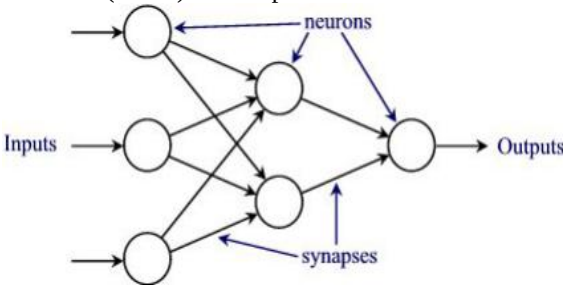

Figure 3.2 Artificial Neural Network [14]

III.II Artificial Neural Network & Its Algorithm

ANNs are based upon the neural structure of the brain in our body. our brain learns from experience which we are faced in our routine life. Basically, In ANN , some of the neurons interfaces with the real world to receive its inputs. Some neurons gives the output to the real world with the network's outputs. This output might be the particular character that the network thinks that it has scanned or the particular image it thinks is being viewed. All the other neurons are hidden from view in the network.

III.II.I NN Back Propagation Algorithm

Neural Network uses the back Propagation algorithm. The back propagation refers to the fact that any mistakes made by the network during training get sent backwards through it in an attempt to correct it and the network can learn what is right and wrong. This BPN uses the gradient descent learning method. In this the gradient represents the error function as it tries to find the minimum of the error function and by doing this it can decrease the error.

The back propagation algorithm can has two main parts:

1) Propagation and
2) Weight update.

Phase 1: Propagation

1) Forward propagation of a training patterns of input through the neural network to generate the output.
2) Backward propagation of the propagation's output through the neural network to generate the deltas(errors) of all output and hidden neurons.

Phase 2: Weight update

Multiply its output delta and input to get the gradient of the weight.

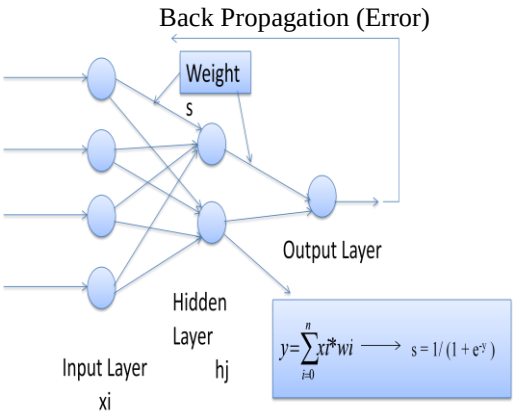

Figure. 3.3 Function of Neural Network

Output of Neural Network is : $y=\sum_{i=0}^{n} xi*wi$

Error is : $e=(yd-y)(yd-y)$

Updated Weight is :

$$\Delta wi = -\eta * \partial e / \partial wi$$

Sigmoid Function: $\mathbf{s = 1/ (1 + e^{-y})}$

where xi = Input to the NN
yd = Desired output
η = Constant value 0.2(output Neurons) and 1.5(Hidden Neurons)

In the back propagation algorithm the artificial neurons are organized in layers and send their signals in the forward directions and then the errors are propagated in the backward direction. The back propagation algorithm uses supervised learning. In this, we give the inputs and the network computes the output and then the resulting error (difference between actual and expected results) is generated. The task of the BP algorithm is to minimize this resulting error. The training starts with random weights and after that the main aim is to adjust them so that the resulting error will be minimal

IV. BLOCK DIAGRAM & FLOW CHART OF SYSTEM

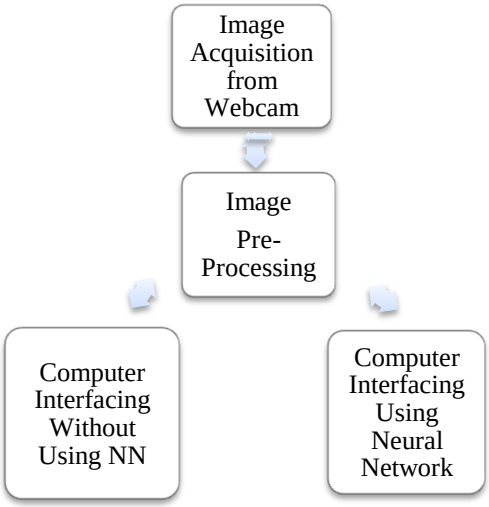

Figure. 4.1 Block diagram of system

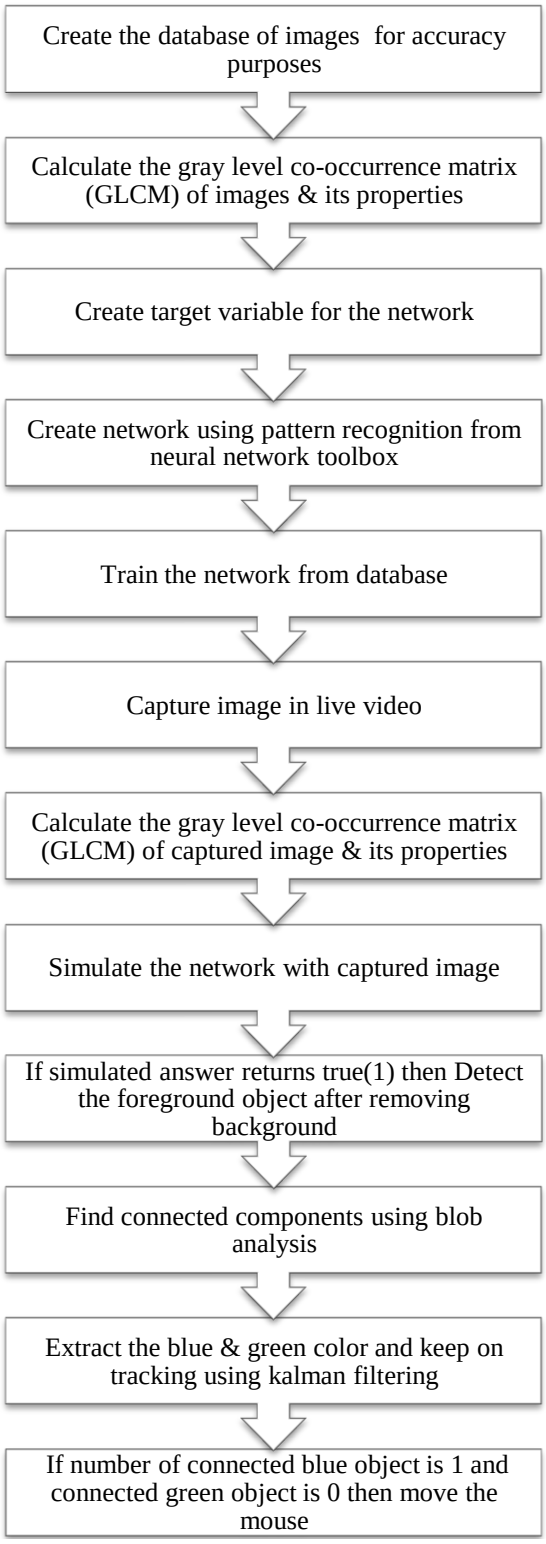

Figure 4.2 Flow chart of mouse movement

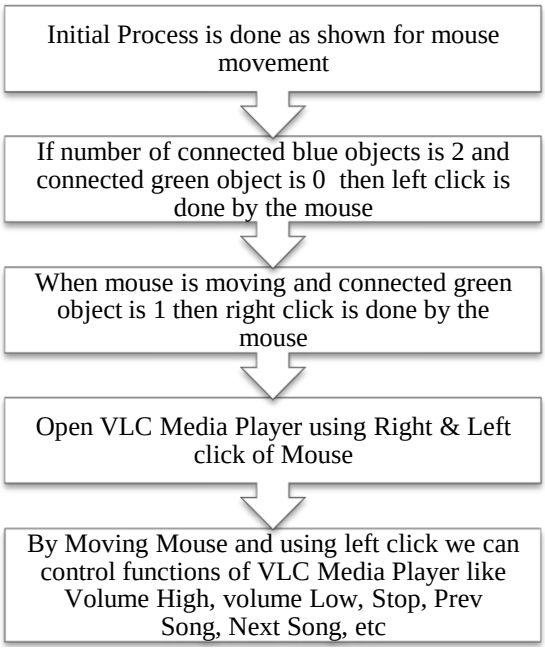

Figure 4.3 Flow chart of Click & VLC Media Player Controlling

V. SIMULATION RESULTS

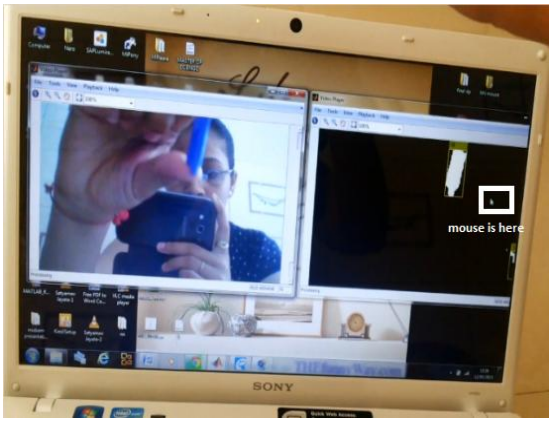

Figure 5.1 Right Movement of Mouse

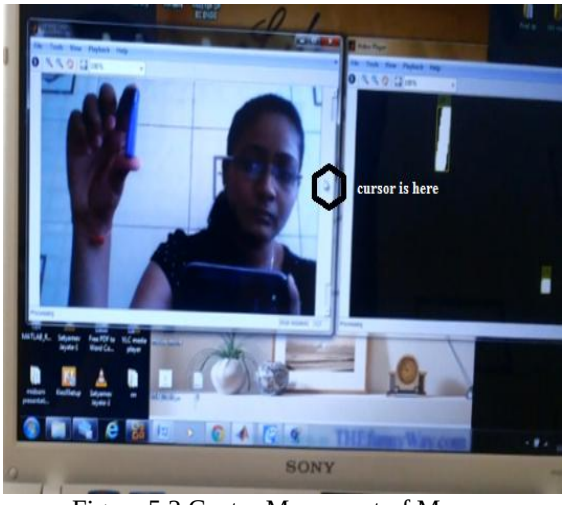

Figure 5.2 Centre Movement of Mouse

Figure 5.3 Bottom (Left) Movement of Mouse

Figure 5.4 Click on Desktop Icon

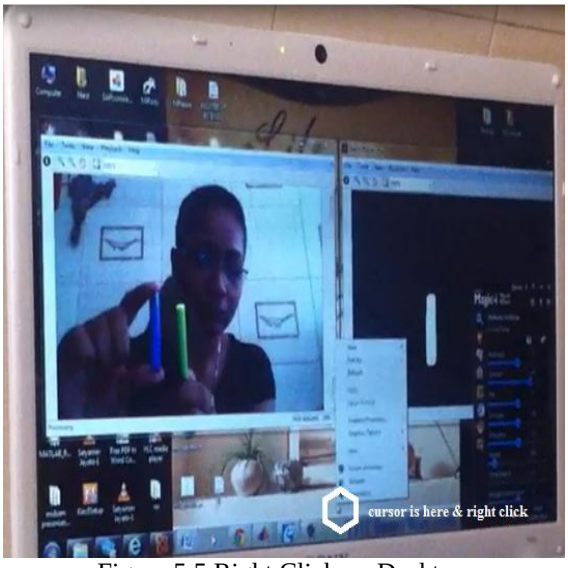

Figure 5.5 Right Click on Desktop

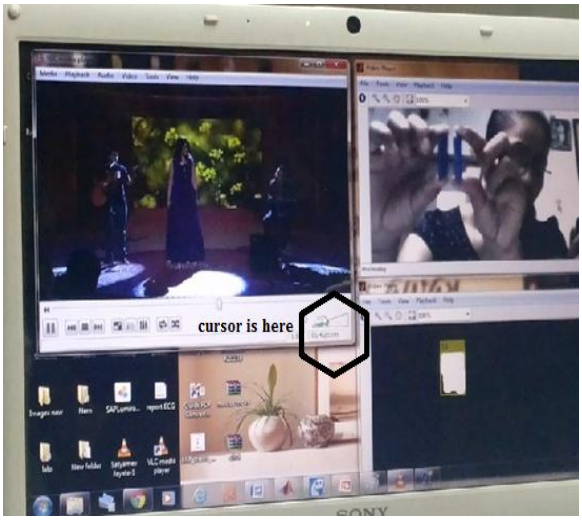

Figure 5.6 Volume Low(42%)

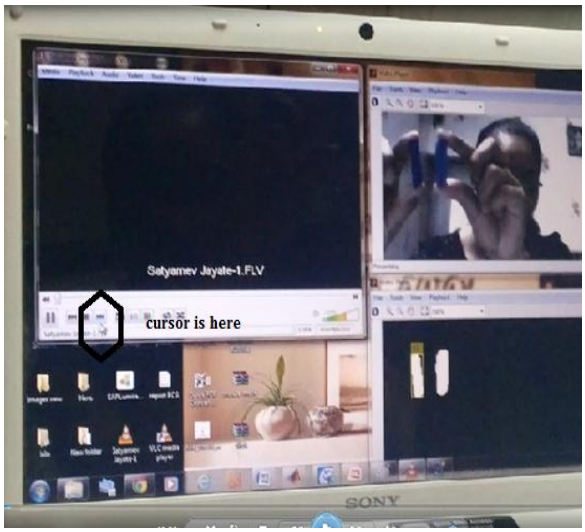

Figure 5.7 Next Song

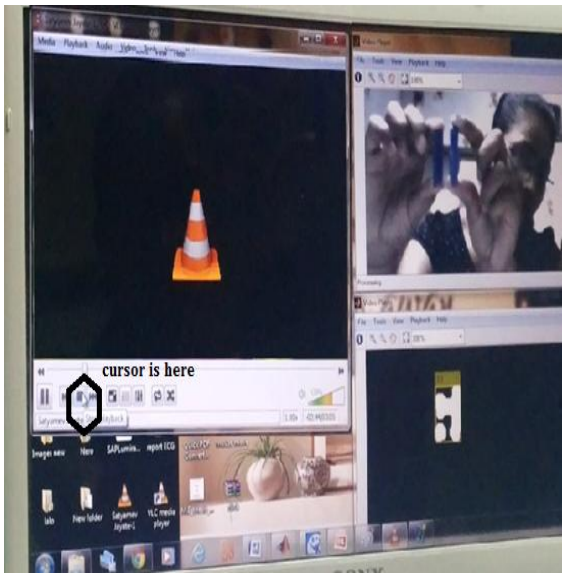

Figure 5.8 Stop Current Song

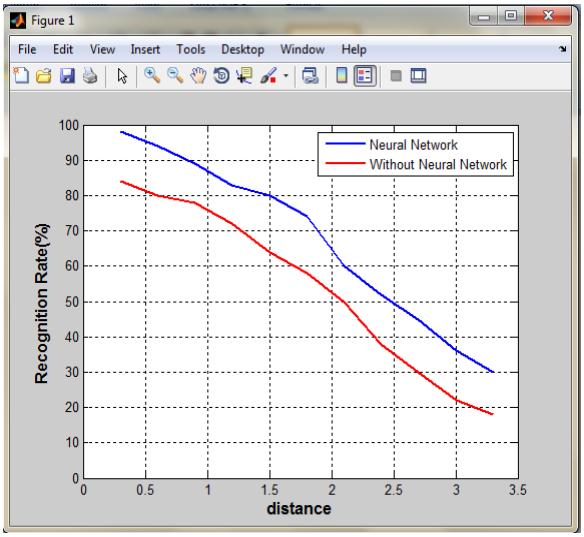

Figure 5.9 Comparison of Recognition Rate with distance in both methods

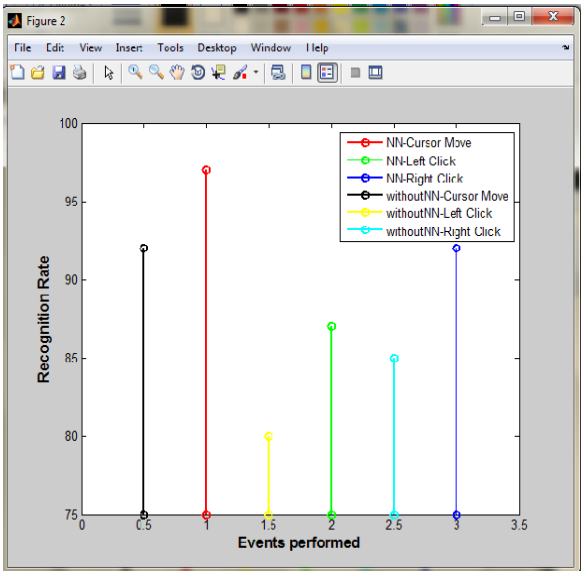

Figure 5.10 Comparison of Recognition Rate of Events in both methods

VI. CONCLUSION

Using Artificial Neural Network and general method, I have done detecting and recognizing of the moving object (blue object movement). I have done that how mouse operation is done with the use of hand gesture (In this I have chosen blue object). I have also done click operation and VLC media Player Controlling (Next Song, Previous Song, Volume High and Volume Low). In this, I have shown results based on only neural network based method and comparison between these two methods based on recognition.

Finally I can say that by using Neural Network Method, the computation speed increases and we can get accurate recognition result than other technique. In future, We can also interface with computer by using human hand instead of color marker

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