

## Back propagation Neural Network Proposed Algorithm to learn deaf a Computer Commands by Hand Gestures

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**Abstract:** Sign language Plays important role in activating the relation between people and computers , through the activation of the concept of hand movements and provide easier way for people with disabilities (deaf) to express what they want and replace it with their hands. This paper give the overview of proposed backpropagation neural network algorithm to construct a method to identify some of computer tools through hand sign (gesture).

**Keywords;** Gesture language (GL); Backpropagation Neural Network; Arabic Letters ; Finger Spelling .

### Introduction

Sign Language is extremely important in the world of the deaf. It's one of the many methods of communication between the deaf and the members of the community, not to speak of a minor on the process of developing a dictionary for these signs , it may forget where the deaf and signs its own without consulting him, because these signs, which handles the deaf with his peers or with those around him who heard, or even based on his education and care as they vary from one environment to another, and deaf not to provide educational services to last reached a high degree of education.

Sign Language has a set of functions which serve the individual as well as serve the community, including: (1) communication between people and the exchange of knowledge, feelings, and lay the foundations of mutual understanding and common life. (2) the expression of the different needs of the individual. (3) growth associated with the mental growth of language and language learning oral or indicative of an individual generates the concepts and mental images. (4) link language frames of reference civilized strike deeper in history and society. (5) psychological function: Language is blown on the rights and ease the internal pressures that hinder it, and it seems that the positions of emotion and vulnerability.

### IMAGE DATA

There are a variety groups available of data image , including medical images, industrial images and natural images. All of these images intended for training purposes and to extract the required results. Other group of photos of the hand gestures are used to training in neural networks to obtain realistic results, or is closer to reality where they are taking these pictures through the internet

or high-resolution digital cameras in different sizes and angles. Two processes operation are made on the training images: first convert images to grayscale, and the second uniform the background images. The database of training images contain a huge variety of image constantly updated, this means that the database is a dynamic, not static, due to, training the network on different images it would decide the robustness of the algorithm , "figure (1)".



Figure 1. Hand Gestures for some Computer Tools

### METHODS OF COMMUNICATIONS

Communication systems with deaf based on communicate with the deaf or oral communication indicative, but there are many methods of communication emanating from these two systems, namely:

(1) *The Oral Method (OM)*: a deaf is learning and training without the use of GL or FS' just using oral reading and writing. (2) *Hand Gestures (HG)*: forms of a spontaneous movement of the hands aims to help and teach the deaf spoken language by putting the hands on the mouth or nose to express the way a particular character director of the verbal. (3) *Lips Read (LR)*: depend on lips movement and during the pronunciation of

words.(4) *Hint Language (HL)*: it's a manual tools that support the spoken language. The speaker uses in a series of hand movements carried out near the mouth with all the voices of speech and these tips provide the reader with the language of the lips and the information that describes what confused in reading this and make the units un clear sound is visible.(5) *Indicative Finger Alphabet (IFA)*:a communication technique based of representation of the alphabet.(6) *Pronunciation Tuned (PT)*: based on a set of principles that the most important words are not limited to the exit of the votes in the abstract, but the words is expression a comprehensive interfere with the body movements like Gestures and facial features.(7) *Full Contact (FC)*: this means use all possible and available ways and integrate all communication and audio systems, manual , oral Gestures , Gesture and movements of hands and fingers, lips reading and writing to facilitate communication and facilitation.

LITERATURE REVIEW

Human tongue-speaking is an important method to activate the interaction between peoples. These words have become over time difficult to understand and comprehend especially for people who suffer from a permanent disability such as deaf. So it was replaced by verbal expression to express by pantomime and hand movements in various forms to express what the speaker and the listener wants to say and understand. The extent of hand movements are in all directions from a certain point is not fixed to tell a specific event for deaf people in specific way addition to movements related to express the feelings of a person turn from joy or grief or other . Many methods for hand gesture recognition using visual analysis have been proposed for hand gesture Signs : Sebastian Marcel, Oliver Bernier, Jean Emmanuel Viallet and Danieal Collobert have proposed the same using Input-output Hidden Markov Models [1].

Xia Liu and Kikuo Fujimura have proposed the hand gesture recognition using depth data [2]. For hand detection, many approached uses color or motion information [3, 4]. Attila Licsar and Tamas Sziranyi have developed a hand gesture recognition system based on the shape analysis of the static gesture [5]. Another method is proposed by E. Stergiopoulou and N. Papamarkos [6] which says that detection of the hand region can be achieved through color segmentation. Byung-Woo Min, Ho-Sub Yoon, Jung Soh, Yun-Mo Yangc and Toskiaki Ejima have suggested the method of Hand Gesture Recognition using Hidden Markov models [7]. Another very important method is suggested by Meide Zhao, Francis K.H. Quek and Xindong Wu [8]. They have used AQ Family Algorithms and R-MINI Algorithms for the detection of Hand Gestures. There is another efficient technique which uses Fast Multi-Scale Analysis for the

recognition of hand gestures as suggested by Yikai Fang, Jian Cheng, Kongqiao Wang and Hanqing Lu [9], but this method is computationally expensive. Rotation Invariant method is widely used for texture classification and recognition. Timi Ojala et. al. have suggested the method for texture classification using Local Binary Patterns [11].

Signs language is the process by which make gestures are made by the user are clearly to the system [13].This language is important and useful for developing the interaction between human and computer . This tools are enables human to interface with computer in a more natural way . [14]

ARTIFICIAL NEURAL NETWORKS

A. BACKPROPAGATION NEURAL NETWORKS

Backpropagation “figure (2)” is a supervised learning technique used for training artificial neural networks “Eq. (1)”. It was first described by Paul Werbos in 1974, and further developed by David E. Rumelhart, Geoffrey E. Hinton and Ronald J. Williams in 1986. It is most useful for feed-forward networks (networks that have no feedback, or simply, that have no connections that loop). The term is an abbreviation for "backwards propagation of errors".

$$net_{pj}^h = \sum_{i=1}^N w_{ji}^h x_{pi} + \phi_j^h \dots\dots(1)$$

The basic backpropagation procedure for training the network is embodied in the following description: (1) Apply an input vector to the network and calculate the corresponding output values.(2) Compare the actual outputs with the correct outputs and determine a measure of the error.(3) Determine in which direction (+ or -) to change each weight in order to reduce the error.(4)Determine the amount by which to change each weight.(5)Apply the corrections to the weights.(6) Repeat items (1) through (5) with all the training vectors until the error for all vectors in the training set is reduced to an acceptable value.

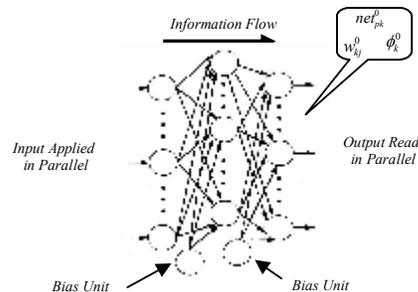


Figure 2. General Backpropagation Network Architecture

B. WHAT IS BACKPROPAGATION NEURAL NETWORKS OPERATIONS?

A summary description of the network operation is appropriate here, to illustrate how the

backpropagation neural network can be used to solve hand sign (gesture) problem . It is important to note that backpropagation neural networks using in this paper are necessary multilayer (four inputs, one hidden layer and four outputs). Multilayer networks must have non-linear activation functions for the multiple layers: a multilayer network using only linear activation functions is equivalent to some single layer, linear network. To begin with, the network learns a predefined set of input-output example pairs by using a two-phase propagate-adapt cycle. After an input pattern has been applied as a stimulus to the first layer of network units, it is propagated through each upper layer until an output is generated. This output pattern is then compared to the desired output, and an error signal is computed for each output unit.

The error signals are then transmitted backward from the output layer to each node in the intermediate layer that contributes directly to the output. However, each unit in the intermediate layer receives only a portion of the total error signal, based roughly on the relative contribution the unit made to the original output. This process repeats, layer by layer, until each node in the network has received an error signal that describes its relative contribution to the total error.

Based on the error signal received, connection weights are then updated by each unit to cause the network to converge toward a state that allows all the training patterns to be encoded. In proposed artificial network, the information moves in only one direction, forward, from the input nodes, through the hidden nodes and to the output nodes. There are no cycles or loops in the network. If any error found, the weights must be adjusted and the neural networks learn by changing these weights (backpropagation) to go on to complete training to getting the desired output .

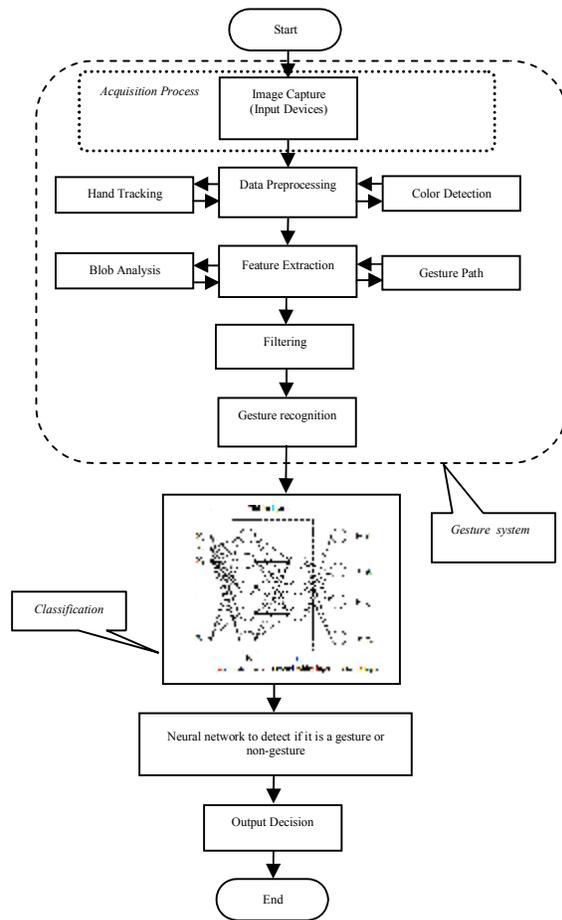
**APPLIED MATLAB TO HAND GESTURES:**

MATLAB is a high-performance language for technical computing especially those with matrix and vector formulations, in a fraction of the time it would take to write a program in a scalar non-interactive language such as C++ or so on. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. By using MATLAB Tools , Hand Gestures System “figure (3)” have the below steps :

- Step1. Read image from input device (Camera).
- Step2. Resize all the images to fit 150x140 pixels ( optimal size).
- Step3. Find the edges (boundaries).For this two filters were used. For the x direction  $x=[0 \ -1 \ 1]$ . For the y direction  $y=[0 \ 1 \ -1]$ .

[0 1 -1]. “figure (4) shows two images of the result with the x-filter and y-filter” .

- Step 4. Dividing two resulting matrices (images) dx and dy element by element and then taking the atan (tan<sup>-1</sup>) to get gradient orientation.
- Step 5. (An optional step) Re-arrange the blocks of image into columns by Calling MATLAB function im2col . This is not a necessary step but it has to be done if we want to display the orientation histogram.
- Step 6. Converting the column matrix with the values to degrees. This way we can scan the vector for values ranging from 0o to 90o. This is because for real elements of X, atan(X) is in the range. This can also be seen from the orientation histograms where values come up only on the first and last quarter.



**Figure 3. Simple Hand Gestures System Proposed**

**CLASSIFICATION**

Actually, there are set of input patterns through the trained artificial neural network which classifies the gesture signs in one of several predefined categories that can be identified by the proposed system.

## CONCLUSION

Signs language is a dynamic visual symbols used and the order of a particular system depends mainly on the use of hands in the expression of ideas . Human tongue-speaking is an important method to activate the interaction between peoples. These words have become over time difficult to understand and comprehend especially for people who suffer from a permanent disability such as deaf. So it was replaced by verbal expression to express by pantomime and hand movements in various forms to express what the speaker and the listener wants to say and understand. The extent of hand movements are in all directions from a certain point is not fixed to tell a specific event for deaf people in specific way addition to movements related to express the feelings of a person turn from joy or grief or other .



Figure 4. Shows two images of the result with the x-filter and y-filter.  
"Display Command"

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خوارزمية مقترحة باستخدام تقنية الانتشار العكسي في الشبكات العصبية لتعليم الصم اوامر الحاسوب باستخدام لغة الایماء

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## الخلاصة :

تلعب لغة الإشارة دوراً مهماً في تفعيل العلاقة بين الأشخاص والآلة وذلك من خلال تفعيل بعض الاشارات اليدوية التي تؤدي الى توصيل فهماً اسهل للاشخاص الذين يعانون من مشكلة في السمع(الصم) ومحاولة ايجاد المعبر للشخص المعاق مايريد قوله بالاشارة اليدوية بدلاً من الكلام. تركز هذه الورقة خوارزمية مقترحة باستخدام الشبكات العصبية ذات الانتشار العكسي لبناء طريقة مثالية لتعليم اوامر الحاسوب وتعليمها للصم باستخدام لغة الایماء وهي اللغة المثالية لتعليم الصم .