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Gesture Recognition Using Artificial Neural Network

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Abstract- Information communication between two people can be done using various medium. These may be linguistic or gestures. Gestures recognition means identification and recognition of gestures originating from any type of body motion but only originate from face or hand. It is a process by which gestures made by users are used to convey the information. It provides important aspects of human interaction, both interpersonally and in the context of human - computer interfaces. There are several approaches available for recognizing gesture, some of them being MATLAB, Artificial Neural Networks, etc. This paper is a comprehensive evaluation of how gesture can be recognized in a more natural way using neural networks. It consists of 3 stages: image acquisition, feature extraction and recognition. In first stage the image is captured using a webcam, digital camera in approximate frame rate. In the second stage features are extracted using input image. The features may be angle made between fingers, no of fingers that are opened or closed or semi closed and identification of each finger. Finally neural network is used for recognition of the image.

Keywords: Gesture Recognition, Artificial Neural Network, MATLAB, Image Acquisition, Feature Extraction

I.INTRODUCTION

In the present day framework Communication is defined as exchange of thoughts and messages either by speech or visuals, signals or behavior. But people who are impaired (i.e. deaf-dumb) have problem in communicating with anyone. So deaf and dumb people use their hands to express their ideas. They make different gestures to communicate with people. The gestures include the formation of English alphabets. This is called sign language. When they communicate through the computer; the gestures may not be comfortable for the person on the other side. Therefore for them to understand easily, these gestures can be converted to messages and also to spoken words. Gesture Recognition means identification and recognition of gestures originates from any type of body motion but commonly originate from face or hand. Gesture language identification is one of the areas being explored to help the deaf integrate into the community and has high applicability.

Gesture recognition is the process by which gestures made by the user are used to convey the information or for device control. In everyday life, physical gestures are a powerful means of communication. A set of physical gestures may constitute an entire language, as in sign languages. They can economically convey a rich set of facts and feelings. This seminar makes the modest suggestion that gesture-based input is such a beneficial technique to convey the information or for device control with the help of identification of specific human gestures. [1]

Varied approaches for hand gesture recognition have been proposed, ranging from mathematical Hidden Markov chains to tools, or approaches based on soft computing. Sebastiean Marcel, Oliver Bernier, Jean Emmanuel Viallet and Danieal Collobert have proposed the same using Input-output Hidden Markov Models. Jianjie Zhang et al. proposed a new complexion model has been proposed to extract hand regions under a variety of lighting conditions for hand detection,[3] many approached uses color or motion information. Attila Licsar and Tamas Sziranyi have developed a hand gesture recognition system based on the shape Analysis of the static gesture. Another method is proposed by E. Stergiopoulou and N. Papamarkos 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 ToskiakiEjima have suggested the method of Hand Gesture Recognition using Hidden Markov models.

Huang et al. use 3D neural network method to develop a Taiwanese Sign Language (TSL) recognition system to recognize 15 different gestures.

Different from, this paper introduces a hand gesture recognition through Neural Network, which captures gesture from the webcam and produce a text and speech out of it.

A. TYPES OF GESTURE RECOGNITION

Gesture Recognition is the act of interpreting motions to determine such intent. The specific human gestures can identify using the gesture recognition technology and used to convey the various information or for various applications by controlling devices. It is the mathematical interpretation of a human motion by a computing device.

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Gesture recognition, along with facial recognition, voice recognition, eye tracking and lip movement recognition are components of what developers refer to as a perceptual user interface.

Gestures can be static (the user assumes a certain pose or configuration) or dynamic (with prestroke, stroke, and poststroke phases). Gesture recognition can broadly of following types:

Hand and Arm Gesture Recognition: Hand gesture recognition consists of hand poses and sign languages. It acts as a highly adaptive interface machines and their users. For example waving hand in front of camera. Hand gesture technology allows operations of complex machines using only a series of fingers and hand movements, eliminating the need for physical contract between operator and machine.[4]

Head and Face Gesture Recognition: Face gesture recognition creates an effective non-contact interface between users and their machines. They are direct, naturally preeminent means for humans to communicate their emotions.

The goal of face gesture recognition is to make machines effectively understand human emotion, regardless of the countless physical differences between individuals. Some examples are a) nodding or shaking of head, b) raising of eyebrows, c) lip movement, d) emotions such as happy, sadness, shocked, anger, fear and etc. Facial expressions involve extracting sensitive features from facial landmarks such as regions surrounding the mouth, nose, and eyes of a normalized image.[9]Like hand gesture recognition, this technology faces its own set of unique problems, caused by physical differences in human faces.

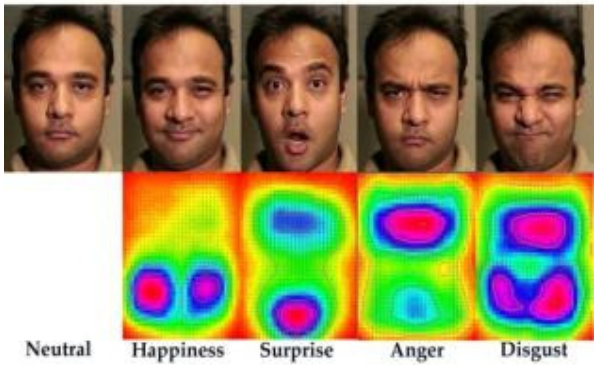


Fig 1. Types of Face gesture

Body Gesture Recognition: Body gesture involves of full body motionrecognizing body gestures, and recognizing human activity. Recognizing body gestures, and recognizing human activity. Such as a)tracking movement of two people interacting outdoors, b) recognizing human gaits for medical rehabilitation and athletic training.

Hand Gesture Recognition uses two techniques:
a) Glove - based hand gesture recognition
b) Vision - based hand gesture recognition

A glove-based system requires the user to be connected to the computer. It require the user to wear a cumbersome device and carry a load of cables connecting the device to a computer. The user has to wear a glove to and make gestures in front of the camera. This hinders makes the user's interaction with the computer very easily and natural.[4]
Vision-based system uses one or more camera to record images of human hand gestures and lighting conditions that enhance gesture classification accuracy. It is fast and can easily detect movements of the fingers when the user's hand is moving. A vision-based device can handle properties like texture and color of gestures. It depends upon the :

a) Number of camera used;

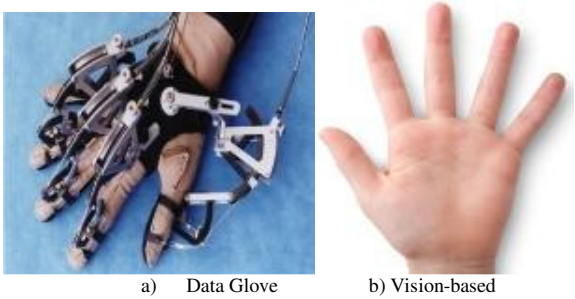
b) Their Speed and latency;

c) 2-D or 3-D

d) User requirement;

e) Time

A vision-based system will at best get a general sense of the type of finger motion. In order to create the database for gesture system, the gestures should be selected with their relevant meaning and each gesture may contain multi samples for increasing the accuracy of the system.



a) Data Glove b) Vision-based

Fig 2. Examples of Data Glove and Vision-based

II. ARTIFICAL NEURAL NETWORK

The concept of ANN is basically introduced from the subject of biology where neural network plays a important and key role in human body. All the work in our body is done through neural networks which consists of billions of neurons connected to each other that work in parallel. Each neuron receives inputs from other neurons in the form of tiny electrical signals and, likewise, it also outputs electrical signals to other neurons. These outputs are weighted in the sense that the neuron does not 'fire' any output unless a certain threshold/bias is reached. These weights can be altered through learning experiences.[7]
Similar to human brain artificial neural networks consist of artificial neurons called perceptrons that receive numerical value and then after the inputs are weighted and added, the result is then transformed by a transfer function into the

output. The transfer function may be anything like Sigmoid, hyperbolic tangent functions.[6]

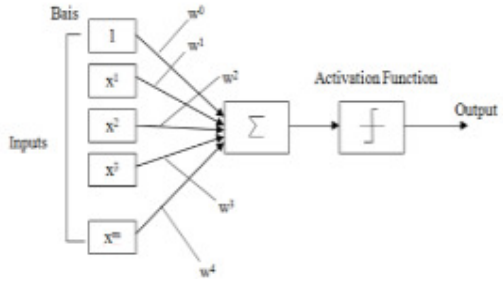


Fig 3. Representation of an Artificial Neuron

$$F=\Sigma(X_i * W_i)+bias$$

Today neural networks can be trained to solve problems that are difficult for conventional computers or human beings. The supervised training methods are commonly used, but other networks can be obtained from unsupervised training techniques or from direct design methods

A. BACKPROPOGATION LEARNING ALGORITHM

Backpropagation , first described by Paul Werbos in 1974, and further developed by David E. Rumelhart, Geoffrey E. Hinton and Ronald J. Williams in 1986,is a supervised learning technique. It requires a differentiable activation function. Backpropogation neural networks use Delta Rule for learning.[2] With delta rule, 'learning' is a supervised process that occurs with each cycle or 'epoch' ,through a forward activation flow of outputs, and the backwards error propagation of weight adjustments. More simply, when a neural network is initially presented with a pattern it makes a random 'guess' as to what it might be. It then sees how far its answer was from the actual one and makes an appropriate adjustment to its connection weights. Backpropogation works well in a multilayer feedforward network.

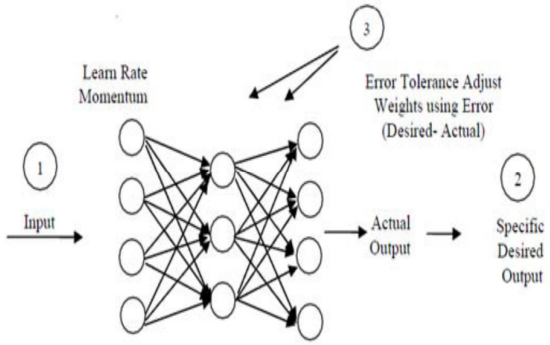


Fig 4. Backpropogation network

B. FFEDFORWARD MULTILAYER NEURAL NETWORK

Feed-forward ANN allow signals to travel one way only; from input to output. There is no feedback (loops) i.e. the output of any layer does not affect that same layer. Feed-forward ANNs tend to be straight forward networks that associate inputs with outputs. They are extensively used in pattern recognition. In computing, feed-forward normally refers to a multi-layer perceptron network in which the outputs from all neurons go to following but not preceding layers, so there are no feedback loops.[2]

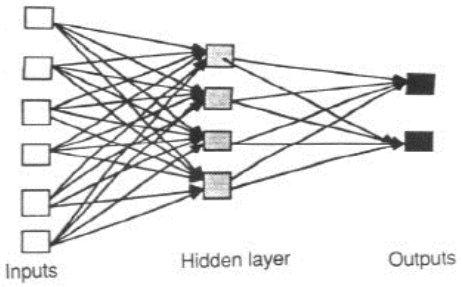


Fig 5. Feedforward Multilayer Network

III. METHODOLOGY

In this paper, a new method for gesture recognition is defined. The presented system is based on one powerful hand feature in combination with a multi-layer neural-network based classifier.[12] Flow diagram below explains clearly about the phases involved in the process. The webcam is used to capture the gesture made by the person in front of the computer. The input video is converted into frames and segmentation is applied on each frame. After segmentation, a contour of hand image is used as a feature that describe the hand shape. After the phase of extraction, is the recognition phase where the extracted features are fed into the neural network to recognize the particular character.

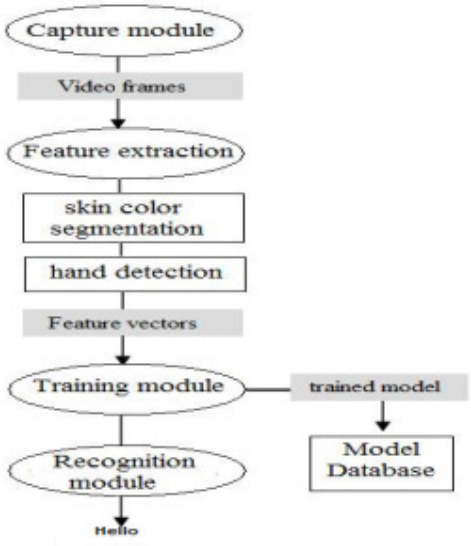


Fig 6. Flow Diagram of Recognition System

Generally speaking this method contains 4 main steps:
1. Gesture modeling
2. Segmentation
3. Feature Extraction
4. A classification

A. GESTURE MODELLING

By gesture modeling, one means selection and formation of proper gesture. In Human-Computer Interaction, this forms an essential aspect to best design appropriate gesture

vocabulary for Human-Computer Interaction. One purpose of Human-Computer Interaction is to make a computer tasks controlled by a set of commands in the form of hand gestures.[11]

B. SEGMENTATION

Segmentation is based using the skin color. It is used to separate the skin area from the background. [11]The effect of luminosity should be segregated from the color components. This makes HSI color model a better choice than RGB.
The input RGB gesture is converted to HIS form to reduce the burden on the network and also for accuracy. After segmenting, the hand region is assigned a white color and other areas are assigned black.

C. FEATURE EXTRACTION

The feature extraction aspect of image analysis seeks to identify inherent characteristics, or features of objects found within an image. These characteristics are used to describe the object, or attribute of the object. Feature extraction produces a list of descriptions or a ‗feature vector. For static hand gestures features such as fingertips, finger directions and hand‘s contours can be extracted. [12] Feature extraction is a complex problem, and often the whole image or transformed image is taken as input. Features are thus selected implicitly and automatically

IV. CONCLUSION AND FUTURE SCOPE

Gesture Recognition provides the most important means for non-verbal interaction among people especially for impaired people (i.e. deaf-dumb). In this paper we have presented an idea of hand gesture recognition using Neural Networks, one of the most effective technique of software computing for hand gesture recognition problem.

Neural Network is efficient as long as the data sets are small and not further improvement is expected. Another advantage of using neural networks in our research is that you can draw conclusions from the network output. In this paper we have also used Back propagation algorithm and Feedforward network.[2]

Gesture could be identified from the input hand gesture video by identifying the fingers and their postures. The segmentation of the hand and the fingers play a crucial role in such process. Accuracy was increased when neural networks were used. In our paper we have proposed neural networks with sigmoid transfer function which gave better results compared to other architectures. The detection capability of the system could be expanded to body gestures as well.

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