AN APPROACH TO SIMULATE THE BRAIN SIGNAL OF PARALYZED PEOPLE

[1]Mrs. D.Renuka Devi D.B Rena

[1] D.Renuka Devi First Year [M.E] Department of Computer and Communication.
renuka1011@gmail.com
[2] D.B.Rena First Year [M.E] Department of Computer and Communication.
rena.engg@gmail.com
M.A.M College of Engineering, Siruganor, Tiruchirappalli-621105

ABSTRACT

Paralysis is often caused due to damage of central nervous system or brain especially the spinal cord, through some fatal accidents and due to some disease like stroke, trauma, and multiple sclerosis. Many diseases that paralyze people leave their brains unaffected. These people can think about moving or talking but can't because they have problems in their spinal cord, nerves, muscles, or maybe they don't have a limb. [2]Brain-computer interfaces (BCIs) provide a connection. They record electrical activity in the brain and translate it into real commands such as moving a computer cursor or controlling an electric wheelchair. BCIs, already implanted in humans and animals, have potential to change lives. The human thoughts are converted into signals and these signals are converted into actions that the paralyzed people want to do. The process is being tested by Simulation in our project work. The human thoughts normally arise in the Motor Cortex (part of cerebral cortex) of the brain. The thoughts are converted into four types of EEG (Electroencephalogram) signals namely Alpha, Beta, Theta, and Delta by fitting tiny electrodes in the human brain. Among these EEG signals, Beta signal is associated with thinking so we choose beta wave as an input to our project. Then these Beta waves are converted into binary data. These binary data is then fed as input to the Back propagation network which produce the final output.

Keywords : Paralysis, Beta wave, EEG, Brain Computer Interface.

I. INTRODUCTION

Paralysis is the loss of the power to move a part of the body due to injury or disease of the nerves that supply the muscles involved in moving the part of the body. In this paper we will deal with the conversion of human thoughts into signals. The cortex which was a part of cerebral cortex is associated with thinking. The thoughts can be converted into (EEG) electroenceplogram signals by fitting electrodes inside the brain. There are four types of [5]EEG signals generated which are alpha, beta, theta and delta.

Alpha – The alpha waves are associated with meditation state.

Beta – Beta waves emitted by human brain are often associated with active concentration and busy thinking.

Theta – Theta waves occur during emotional stress adults particularly during disappointment and frustration.

Delta – Delta waves occur during the state of deep sleep.

Neurofeedback (NFB), also called neurotherapy, neuro biofeedback or EEG biofeedback is a type of alternative medicine, more specifically a type of biofeedback that uses real time displays of electroencephalography to illustrate brain activity, often with a goal of controlling central nervous system activity. Sensors are placed on the scalp to measure activity, with measurements displayed using video displays or sound. Neurofeedback is a type of biofeedback that uses electroencephalography to provide a signal that can be used by a person to receive feedback about brain activity.

The beta signal was associated with thinking so we have chosen beta signal as an input. After gathering the features of beta signal, it is given as input to the data compression which will compress the features and give 0's and 1's as the output, which is then fed as input to the back propagation algorithm which produce the final output.

PROPOSED WORK

Modules of our paper includes

(i) Renovation of thought to signal.

(ii) Conversions of signal to binary data.

(iii) Training and testing BPN network.

MODULE IMPLEMENTATION

In this module the input beta signal was generated in the MATLAB (Version 7.0) using the SIN function. The signal co-efficient are then viewed and saved from the workspace window. After that the signal is loaded into the wavelet tool box (one dimensional) and was analyzed during this analyzing process. The loaded signal was split down into various types of signals. The feature of the analyzed beta signal is then saved and is given as input to the next module.

The co-efficient of analyzed signal is loaded and converted into 0's and 1's using the zeros and ones function in mat lab. The 0's and 1's are then saved in workspace and is given as input to back propagation algorithm. Back propagation network was trained by giving various binary data with the frequency range of [13-30HZ]. Then the network is tested by giving the same binary data as given for training and also with different binary data. If the input to the network lies with the frequency range of [13-30HZ] the output will be one [i.e., there is arm movement] for the other frequencies the output will be zero [i.e., there is no arm movement].

II EXISTING SYSTEM

In the previously existing system a person implanted with Prosthetic arm moved a cursor, opened e-mail, played a simple video game called Pong and drew a crude circle on the screen. He could change the channel or volume on a television set, move a robot arm somewhat, and opens and closes a prosthetic hand.

In the Already [8] existing system, 100 tiny electrodes are implanted in the motor cortex responsible for arm movement and was connected to a pedestal that protruded from the top of his skull. When the device was to be used, technicians plugged a cable connected to a computer into the pedestal. So the person was directly wired to a computer, somewhat like a character in the "Matrix" movies. The person would then imagine moving his arm to hit various targets. The implanted sensor eavesdropped on the electrical signals emitted by neurons in his motor cortex as they controlled the imaginary arm movement.

With this implantation the person can control the computer cursor was not particularly smooth. When the person's goal was to guide the cursor from the center of the screen to a target on the perimeter, he hit the target 73 to 95 percent of the time. When he did, it took 2.5 seconds on average, but sometimes much longer. And the second patient tested with the implant had worse control than the first person.

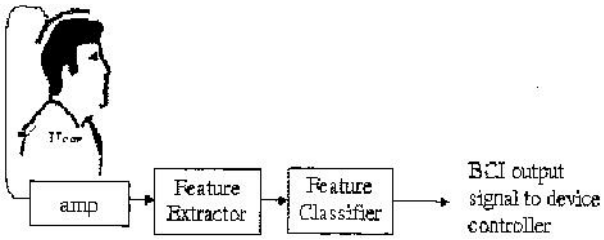
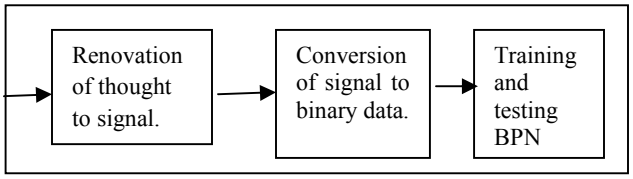


Fig.1 Existing System

III PROPOSED SYSTEM

In the preceding implementation they expend huge machines external wires for altering the human thoughts to deeds by means of which the paralyzed people can do their day-to-day activities by themselves. The act of simulating something generally entails representing certain key characteristics or behaviors of a selected physical or abstract system. In my paper I suppose to simulate the renovation of thought to action.



RENOVATION OF THOUGHTS INTO SIGNALS

Recent advances in computer hardware and signal processing have made possible the use of EEG signals or "brain waves" for communication between humans and computers. [1]Locked-in patients have now a way to communicate with the outside world, but even with the last modern techniques, such systems still suffer communication rates on the order of 2-3 tasks/minute. In this module the Beta signal is generated in between the frequency range of 13-30HZ and with a voltage range of 3-13μv. Various form of beta signal is generated by giving the frequency and voltage in the above specified range.

The signal co-efficient are then viewed and saved from the workspace window. After that the signal is loaded into the wavelet tool box (one dimensional) and was analyzed during this analyzing process.

The loaded signal was split down into various types of signals. The feature of the analyzed beta signal is then saved and is given as input to the next module.

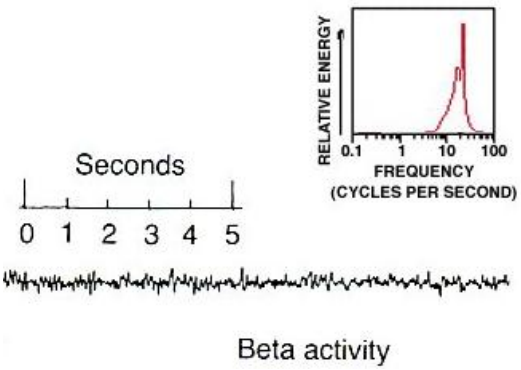
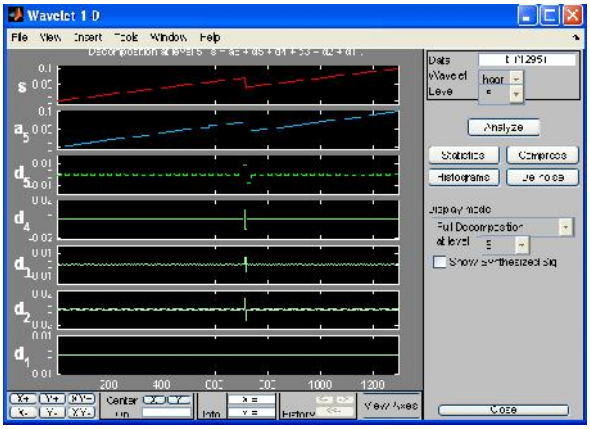


Fig.2 Beta Signal

Result of this module



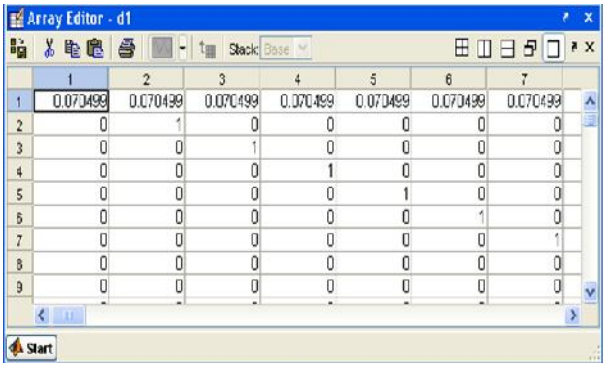
Result .1

CONVERSION OF SIGNALS INTO BINARY DATA

The coefficients of analyzed signal is stored in an array editor, it is loaded and converted into binary data values using zeros and ones function. The binary data I then stored in the array editor in the form of rows and columns.

Zeros - Create an array of all 0's
Ones - Create an array of all 1's

Result of signal to binary data



Result.2

BACKPROPAGATION NETWORK

In neural network there are so many algorithms like Boltzmann algorithm, Counter propagation network algorithm, self organizing map algorithm, Adaptive resonance theory algorithm, Spatiotemporal network algorithm, Back propagation algorithm etc…, Among these we have chosen the Back propagation algorithm because of it's simplicity and reasonable speed (though there are several modifications which can make it work faster

Working of Back propagation algorithm:

Training a network by Back propagation involves three stages

- The feed forward of the input training pattern.
- The back propagation of the associated error.
- The adjustment of weights.

After training application of the net involves only the computations of the feed forward phase. Even if training is slow, a trained net can produce its output very rapidly. Numerous variations of back propagation have been developed to improve the speed of the training process. Although a single layer net is severally limited in the mappings it can learn, a multi layer net (with one or more hidden layers) can learn any continuous mapping to an arbitrary accuracy. More than one hidden layer may be beneficial for some applications, but one hidden layer is sufficient. During feed forward, each input unit (x_i) receives an input signal and broadcasts this signal to each of the hidden units. Each hidden unit then computes its activation and sends its signal to each output unit. Each output unit (z_k) computes its activation to form the response of the net for the given input pattern. During training, each output unit compares its computed activation with its target value (t_k) to determine the associated error for the pattern with that unit.

Based on this error the factor δ_k (k=1, 2,….., m) is computed. δ_k is used to distribute the error at the output unit z_k back to all units in the previous layer (the hidden units that are connected to z_k). It also used (later) to update the weights between the output and hidden layer. In a similar manner the factor δ_j (j= 1, 2,……., p) is computed for each hidden unit. It is not necessary to propagate the error back to input layer, but δ_j is used to update the weights between the hidden layer and the input layer. After all of the δ factors have been determined the weights for all layers are adjusted simultaneously.

The adjustment to the weight is based on the factor δ_k and the activation of the hidden unit. The adjustment to the weights is based on the factor δ_j and the activation x_i of the input unit.

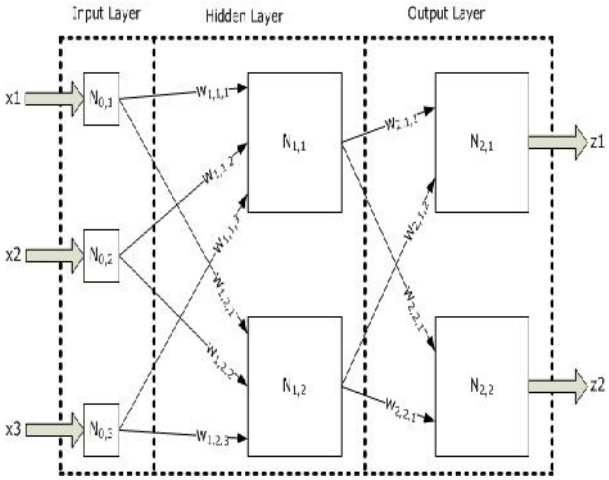


Fig.3 BPN architecture

Back propagation network was trained by giving various binary data with the frequency range of [13-30HZ]. Then the network is tested by giving the same binary data as given for training and also with different binary data. If the input to the network lies with the frequency range of [13-30HZ] the output will be one [i.e., there is arm movement] for the other frequencies the output will be zero [i.e., there is no arm movement].

CONCLUSION

The prosthetic arm was devised with an investment of $18,000 pesos ($1,800dlls). Also more research work is going on to design a low cost and low weight prosthetic arm. In this paper a simulation is done for the thought of arm movement alone and in future the work will be applied for all types of thoughts like picking pen, glass, writing and etc.,

REFERENCES

[1] S.G. Mason and G.E. Birch. A General Framework for Describing Brain-Computer Interface Design and Evaluation, revised and resubmitted to IEEE Trans. Rehab. Engineering, 2000.

[2] Brain Computer interfaces: Communication and restoration of movements in paralysis, Birbaumer N, Murguialday AR, Cohen L. J Physiol. 2007 Mar15: 579 (pt 3)621 – 36 Epub 2007 Jan 18.

[3] Turning thoughts into action Mar 1, 2007 12:00 PM, By Victoria Reitz, Senior Editor

[4] Jonathan R. Wolpaw et al., "Brain-computer interface technology: A review of the first international meeting", IEEE Transactions on rehabilitation engineering, vol. 8, no. 2, pp. 164-173, June 2000.

[5] William N. Kuhlman, Functional topography of the human mu rhythm, Electroencephalography and Clinical Neurophysiology 44, 1978. pg. 83-93

[6] P. Sovka, P. Pollák. Selected methods for Signal Processing (Vybrané metody číslicového zpracování signálů). CTU Publishing house, 2nd ed., 2003

[7] Roman Čmejla. Criterions for AR model order selection, Acoustic Letters No.22, pg. 4-7, 2000.

[8] D. J. McFarland, L. M. McCane, S. V. David, and J. R. Wolpaw, \Spatial ¯lter selection for EEG-based communication," *Electroencephalography and Clinical Neurophysiology.*, vol. 103, pp. 386{394, September 1997.

[9] Doležal J.,Šťastný J, Sovka P. Recognition Of Direction Of Finger Movement From EEG Signal Using Markov Models. In Proceedings of the 3rd European Medical & Biological Engineering Conference EMBEC´05. Prague, Czech Republic, volume 11 of IFMBE Proceedings, pages 336-341, 20-25.11.2005.

[10] Wolpaw *et al.*, "Brain-computer interfaces for communication and control," *Clin. Neurophysiol.*, vol. 113, p. 767, 2002.

BOOKS

[1] Neural Networks Algorithms, Applications, and Programming Techniques **"James A. Freeman/David M. Skapura**".

[2] EEG Signal Classification for Brain Computer Interface Applications "**Jorge Baztarrica Ochoa".** March 28th, 2002

[3] Fundamentals of neural networks **"Laurene Fausett".**

[4] Time-frequency toolbox Matlab, CNRS (France) and Rice University (USA), 1995-1996.

[5] S. Mallat, "Wavelet tour of signal processing", Academic press, 1999, ISBN 0-12-466606-X.