Implementation Of Brain Computer Interface

NIDHI BEHL*, LECTURER
*DEPARTMENT OF CSE, M.M.College of Engineering(Mullana)Ambala

VIKRANT MANOCHA, LECTURER
DEPARTMENT OF CSE, M.M.College of Engineering (Mullana)Ambala

KESHVI CHAUHAN,LECTURER
DEPARTMENT OF CSE,M.M.College of Engineering(Mullana)Ambala

ABSTRACT:
The Brain Gate Neural Interface System is grounded on Cybernetics podium technology to sense, transmit, analyse and apply the language of neurons. The System consists of a sensor that is entrenched on the motor cortex of the brain and examines brain signals. The principle behind the Brain Gate system is that, signals are generated in the motor cortex and they cannot be sent directly to the arms, hands and legs due to spinal cord injury, stroke or other condition. The brain signals are construed and translated into cursor movements, offering the user a substitute pathway via the Brain Gate System to control a computer simply by thinking, in the same way as individuals who have the ability to move a computer mouse using their hands.

KEYWORDS: Brain–Computer Interface, Electroencephalography, Functional Model

1. INTRODUCTION TO BRAIN:-
Body's voluntary movements are controlled by the brain. The brain area is also involved in controlling these voluntary movements i.e. motor cortex. The motor cortex is situated in the rear portion of the frontal lobe, just before the central sulcus that divorces the frontal lobe from the parietal lobe. The motor cortex is divided into two main areas, Area 4 and Area 6. Area 4, also known as the primary motor cortex, forms a thin band along the central sulcus. Area 6 lies immediately forward of Area 4. Area 6 is wider and is further subdivided into two distinct sub-areas.(fig.1)

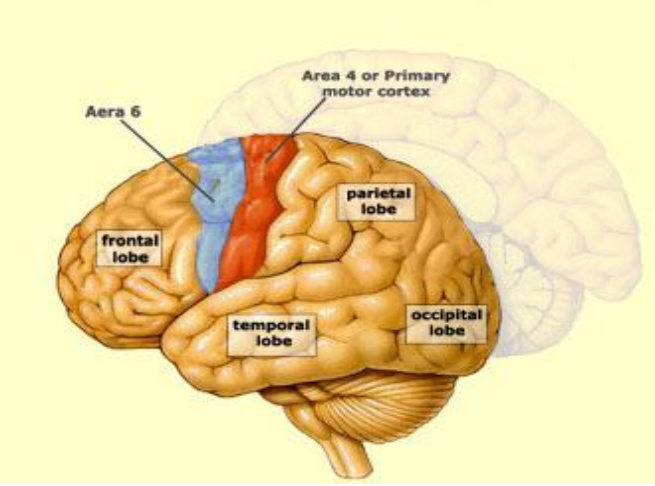

Fig.1 Sturcture of Brain

The motor cortex receive information from various lobes of brain and information about the body's position in space, from the parietal lobe; about the goal to be attained and an appropriate strategy for attaining it, from the anterior portion of the frontal lobe, about memories of past strategies, from the temporal lobe.

For a movement as picking up a glass of water, one can barely imagine to specify the sequence, force, amplitude, and speed of the contractions of every muscle concerned. The decision to pick up a glass of water is escorted by increased electrical activity in the frontal region of the cortex. The neurons in the frontal cortex send impulses down their axons to activate the motor cortex itself. The motor cortex plans the ideal path for the hand to follow to reach the glass. The motor cortex then calls on other parts of the brain, such as the central grey nuclei and the cerebellum, which help to initiate and co-ordinate the activation of the muscles in sequence. The axons of the neurons of the primary motor cortex descend all the way into the spinal cord, where they make the final relay of information to the motor neurons of the spinal cord. These neurons are connected directly to the muscles and cause them to contract.

2. BRAIN GATE

It is an electrode chip. The chip contains 96 hair-thin electrodes that intelligence the electro-magnetic sign of neurons firing in specific areas of the brain. For example the area that panels arm crusade. When it is applied in brain, the electrical signal bartered by neurons within the brain. These signals are sent to the brain and it apparatuses body movement. All the signalling is touched by special software. Eg (Custom Decoding Software, algorithms are written in C, JAVA and MATLAB).The signal guides to the computer and then the computer is skilful by patient. When a man forgotten about his past due to certain accidental matter or he had lost his part of his body, at that time this electrode chip can be understood on his brain and vigorous the man as well.[1]

2.1 Types of Brain Computer Interface

2.1.1 One way BCI :-
Computers either accept commands from the brain
2.2.2 Two way BCI:-
Allow brains and external devices to exchange information in both directions.

2.2 PRINCIPLE:

The system consists of a device that is implanted on the motor cortex of the brain. The principle is that the complete brain functions, brain signals are generated even though they are not sent to the arms, hands and legs. The signals are unspoken and deciphered into cursor movements, offering the user an alternate “BRAIN GATE TRAJECTORY” to control a computer with supposed, just as societies who have the ability to move their fingers.

2.3 Challenges Faced By Brain Gate:

1. It is very luxurious.
2. Curb in information transform rate. The latest technology is 20 bits/min.
3. Difficulty in adaptation and learning.

In 2008 the bio-tech company Cyber kinetics grows a system i.e. brain gate in aggregation with the Department of Neuroscience at Brown University. The brain gate system is intended to those patients who have lost control of their limbs, bodily functions, such as patients with amyotrophic lateral sclerosis (ALS), spinal cord injury. The activity is deciphered into electrically charged signals and is then sent and decrypted using a program which can move a unresponsive arm.

2.4 Side effect:

The firm has inveterate that one patient (Matt Nagle) has a spinal cord injury whilst another has advanced amyotrophic lateral sclerosis. A potential use of this feature would be for a neurologist to study appropriation patterns in a patient with epilepsy.

Brain Gate study side is to create a scheme i.e.

1. Quite literally turns thought into action.
2. Neurological disease.
3. Injury
4. Limb loss.

Currently, the system consists

1. **Sensor**: - A device entrenched in the brain that records indications directly related to imagine limb crusade.
2. **Decoder**: - A set of computers and rooted software that turns the brain indications into a useful command for an exterior device.
3. **External Device**:-Which could be a standard computer desktop or other communication device, a motorized wheelchair, a prosthetic or mechanical limb or a functional electrical stimulation expedient that can move paralyzed limbs straight.

When a person becomes paralyzed, neural signals from the brain is terminated. The brain continues to send out these signals although they do not reach their endpoint. Brain gate system picks the indications and they must be present in guidelines. [2], [3]

1. BCI system may use occurrence features i.e. is μ, β in the area of brain.[4],[5],[6],[7]
2. Each BCI uses a specific algorithm to interpret its input into output control signals.
3. The dissimilarity between a feature as a image of a precise aspect of nervous system functioning and anatomy and a practice as a technique for measuring the feature is more clear for some features (e.g., the shooting rate of a single cortical neuron, which is seemingly the same however it is unhurried) than for others (e.g., autoregressive strictures, which depend on the details of the analysis procedure.
4. Brain computer interference shows specific features like time-domain features (such as action possible of neurons).[8],[9],[10],[11]

3. MODEL OF BRAIN COMPUTER INTERFERENCE:

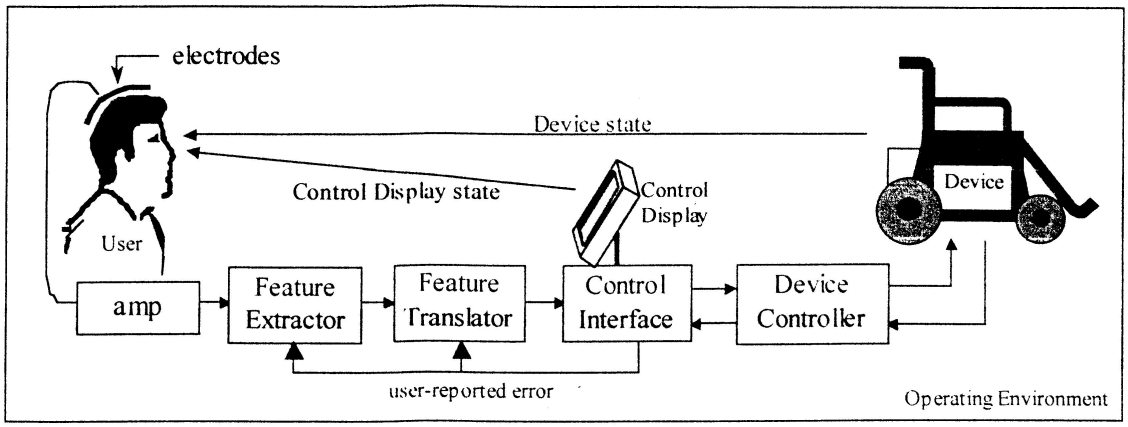

Fig.2- Functional BCI System model

In this fig a wide-ranging BCI System in which a person boards a device in an functioning environment through a series of practical machineries [12]. The User displays the expedient state to regulator the result of his or her control efforts. The User may also be obtainable with a Control Display, which exhibitions his control inputs within a semantic proposal. The User and the Device Supervisor will be considered BCI interface technology. BCI technology is developed to help a board populace with precise abilities perform certain tasks with a Device within an operating situation. The component definitions and the functional boundaries between machineries were nominated to meet numerous design objects.(fig.2)

1) The machineries in the model should be a minimal but sufficient set to effectively represent existing and future BCI Systems.
2) The boundaries between the functional components should align as much as possible with existing research disciplines (such as pattern recognition, assistive technology development, and HCI) to maximize the use of existing knowledge and technology.
3) The boundaries between the functional components should align as much as possible with existing interface technology to facilitate comparisons between BCI technologies and non-BCI user-interface technologies. The model in Fig. 1 does not show the external sensory stimulator used by some BCI Systems to evoke brain activity in the User. It was left out of this diagram to simplify the presentation. In some systems, the stimulator may be integrated into the Control Display. The functional model will be presented without the external stimulator.

4. DIRECT INTERFERENCE SCHEME:

4.1 Invasion

Direct BCIs include invasive procedures to implant electrodes in the brain. Apart from ethical fears, a major trouble is to obtain dependable long-term footages of neural activity. Recent advances have made possible to develop direct BCIs with faunas and even human beings [13]. It has implanted a singular conductor into the motor cortex of numerous paralyzed patients. These electrodes contain a neurotropic issue that persuades growth of neural tissue within the resonating electrode tip. By exercise, patients study to control the gunfire rates of the multiple recorded neurons. One of them is able to energy a pointer and communications have logged the action of bands of neurons with micro wire collection entrenched in multiple cortical areas involved in motor switch, as monkeys performed arm movements[14]. From these signs they have got precise real-time forecasts of arm routes and have been able to copy the routes with a robot arm. Though these hearings do not

label an actual BCI, they deliver the capability of regulatory intricate prosthetic appendages directly by brain activity.
Nicolelis and colleagues showed that neural predictors can be derived for rats implanted with the same kind of microelectrodes [15].The rats were trained to media a saloon to move a simple device bringing water and later learned to operate this device through neural activity.

4.2 Non Invasion

There have also been hearings in humans using non-invasion neuron imaging skills as interfaces. Indications logged have been used to power muscle grafts and reinstate incomplete crusade in a new assistant. When electromagnetic breakers shaped by the neuron, non-invasive insert scrounger privileged indication resolve since the skull diminishes gestures, disbanding and obscuring. Electroencephalography is the most considerate possible non-invasive interface, mainly due to its acceptable temporal, comfort of usage, portability and low set-up cost. When technology's vulnerability to noise, additional considerable barrier to using EEG as a brain-computer interface is the wide exercise required before users can work the technology. Neil's Braymer used EEG footages of slow cortical imaginable to give paralyzed patients incomplete change over a processor pointer [16].Birbaumer's has engrossed on emerging knowledge that would allow users to choose the brain signals they found coolest to function a BCI, counting and beta whitecaps. Additional limit is the method of response used and this is shown in studies of P300 signals. Patterns of P300 surfs are generated unwillingly. When people recognise and may allow BCIs to interpret groups of thoughts without exercise patients first. In 2000 Jessica Bayliss showed that volunteers tiring computer-generated reality hats could control elements in a computer-generated biosphere using their P300 EEG readings, including turning lights on and off and transporting a replica wagon to a stop. Electric neural have been organized which change the information point from the user to the computer. Fraunhofer Society 2004 using neural nets led to obvious improvements inside 30 notes of workout [17].Eduardo Miranda use EEG footages of cerebral action related with tune to allow the debilitated to fast themselves tunefully through an encephalophone [18].Magneto encephalography and functional magnetic resonance imaging have both been used successfully as non-invasive BCIs. It allowable two users being skimmed to production Pong in actual by changing their hemodynamic response or intellect gore movement through biofeedback techniques[19].It also been used to control robot weapons with a seven extra rescheduling among thought and drive.

5. APPLICATIONS:

1. In classification of EEG signal.
2. In hypermedia communiqué.
3. Activated control of mobile robot by human EEG.
4. As a brain controlled switch for asynchronous control.
5. In evaluating the machine learning procedures.
6. The Brain Gate Neural Interface System is a new medical device that is being developed to improve the quality of life for physically disabled people by allowing them to quickly and reliably control a wide range of devices.
7. The Brain Gate System may allow those with severe motor disabilities to use their own arms and hands again.
8. It may be able to provide an individual with the ability to control devices that allow breathing, bladder and bowel movements.
9. The Brain Gate System is designed to restore functionality for severely motor-impaired individuals.

6. CONCLUSION

Version to the Cyber kinetics binary patients have been entrenched with the Brain Gate system. Using this system the patient can read e-mail, play videogames, turn lights on or off and change channels or adjust the

volume of a television set. The results are remarkable and almost unbelievable. Brain Gate can help paralyzed people move by controlling their own electrical wheelchairs, connect by using e-mail and Internet-based phone systems, and be independent by controlling items such as televisions and thermostats. Finally Brain Gate has showed to be a godsend for paralyzed patient.

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