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Brain Computer Interface Technology

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Abstract— **Brain computer Interface Technology is a interface between computer and brain. Brain computer interface used in Brain gate system which is brain implant system developed by bio tech company cyberkinectics in conjunction with the Department of Neuroscience at Brown University. The development of the Brain computer interface system brain computer interface is to enable those with severe paralysis and other neurological conditions to live more productively and independently When a person becomes paralyzed, neural signal from the brain no longer reach their designated site of termination. However, the brain continues to send out these signals although they do not reach their destination. It is these signals that the Brain computer interface system picks up and they must be present in order for the system to work. It is found that people with long standing, severe paralysis can generate signals in the area of the brain responsible for voluntary movement and these signals can be detected, recorded, routed out of the brain to a computer and converted into actions enabling a paralyzed patient to perform basic tasks.**

Keywords: *- Brain computer interface, cyber kinetics, Neuroscience, Quadriplegic Neuroprosthetic , BrainGate.*

I INTRODUCTION

Brain computer interface technology connects human brain to the computer .BCI also called as Machine interface on the basis of communicative pathway there are two types of BCI which are as follows

1.1 One way BCI: Computers either accept commands from the brain or send signals to it.

1.2 Two way BCI: Allow brains and external devices to exchange information in both directions but have yet to be successfully implanted in animals or humans. In this definition, the word brain means the brain or nervous system of an organic life form rather than the mind. Computer means any processing or computational device, from simple circuits to silicon chips (including hypothetical future technologies such as quantum computing). Research on BCIs began in the 1970s, but it wasn't until the mid-1990s that the first working experimental implants in humans appeared. Following years of animal experimentation, early working implants in humans now exist, designed to restore damaged hearing, sight and movement. The common thread throughout the research is the remarkable cortical plasticity of the brain, which often adapts to BCIs, treating prostheses controlled by implants as natural limbs. With recent advances in technology and knowledge, pioneering researchers could now conceivably attempt to produce BCIs that augment human functions rather than simply restoring them, previously only the realm of science fiction.

II BRAIN COMPUTER INTERFACE BACKGROUND

Research on BCIs began in the 1970s at the University of California, Los Angeles (UCLA) under a grant from the National Science Foundation, followed by a contract from DARPA. The papers published after this research also mark the first appearance of the expression brain–computer interface in scientific literature.

The field of BCI research and development has since focused primarily on neuroprosthetics applications that aim at restoring damaged hearing, sight and movement. Thanks to the remarkable cortical plasticity of the brain, signals from implanted prostheses can, after adaptation, be handled by the brain like natural sensor or effector channels.[4] Following years of animal experimentation, the first neuroprosthetic devices implanted in humans appeared in the mid-1990s..

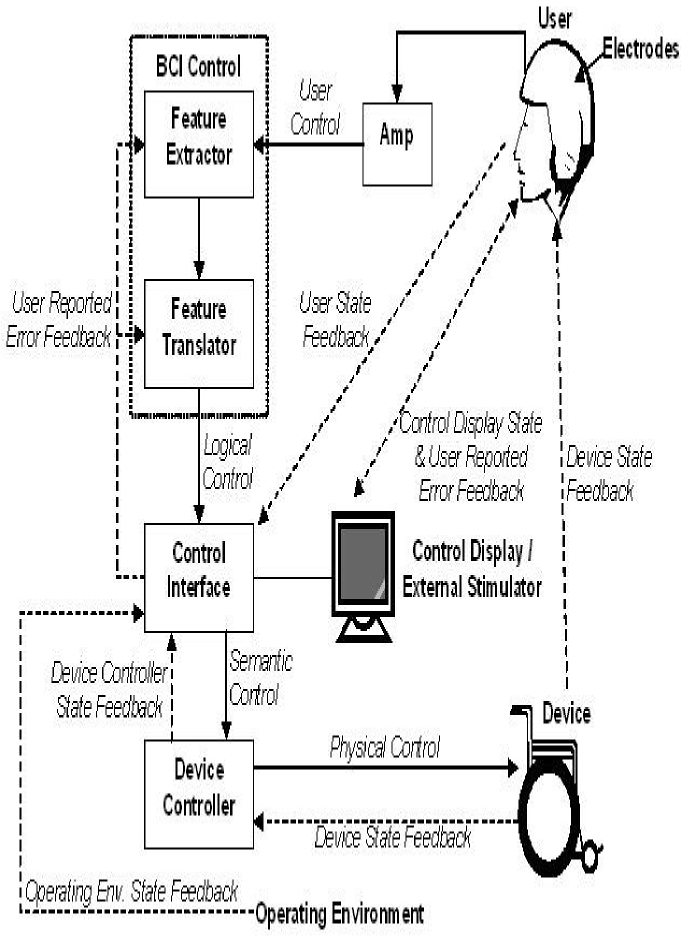

Figure 1 Schematic Architecture of BCI

III ANIMAL BCI RESEARCH

Figure No. 2 Experiment on Monkey by BCI

Several laboratories have managed to record signals from monkey and rat cerebral cortices to operate BCIs to produce movement. Monkeys have navigated computer cursors on screen and commanded robotic arms to perform simple tasks simply by thinking about the task and seeing the visual feedback, but without any motor output.In May 2008 photographs that showed a monkey at the University of Pittsburgh Medical Center operating a robotic arm by thinking were published in a number of well-known science journals and magazines.Other research on cats has decoded their neural visual signals.

IV HUMAN BCI RESEARCH

Tetraplegic Matt Nagle became the first person to control an artificial hand using a BCI in 2005 as part of the first nine-month human trial of Cyberkinetics's BrainGate chip-implant. Implanted in Nagle's right precentral gyrus (area of the motor cortex for arm movement), the 96-electrode BrainGate implant allowed Nagle to control a robotic arm by thinking about moving his hand as well as a computer cursor, lights and TV.One year later, professor Jonathan Wolpaw received the prize of the Altran Foundation for Innovation to develop a Brain Computer Interface with electrodes located on the surface of the skull, instead of directly in the brain.

More recently, research teams led by the Braingate group at Brown University and a group led by University of Pittsburgh Medical Center, both in collaborations with the United States Department of Veterans Affairs, have demonstrated further success in direct control of robotic prosthetic limbs with many degrees of freedom using direct connections to arrays of neurons in the motor cortex of patients with tetraplegia.

Figure 3 Clinical Trial

V COMPONENTS USED BY BCI:

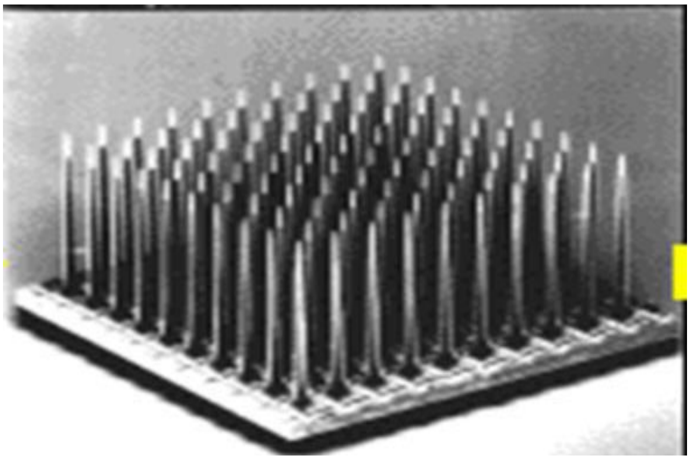

Figure 4 Neuro chip

Chip:

A 4-millimeter square silicon chip studded with 100 hair-thin, microelectrodes is embedded in brain primary motor cortex. The chip, about the size of a baby aspirin, contains 100 electrode sensors, each thinner than a human hair. The sensors detect tiny electrical signals generated when a user imagines.

The connector:

It is attached firmly to the skull of the patient and it passes the signals received by the chip to the converter. Most handicap people are satisfied if they can get a rudimentary connection to out side the world .Brain computer interface enables them to achieve for more then that controlling the cursor, patient can access internet TV entertainment and control light application with just their thought.

Figure 5 Connector

The converter:

The signal travels to an amplifier where it is converted to optical data and bounced by fiber optic cable to a computer.

The computer:

The computer translates brain activity and creates the communication output using custom decoding software.

How information is transmitted?

- When a work is done through any part of body then a potential difference is created in the brain.
- This potential difference is captured by the electrodes and is transmitted via fiber optic to the Digitizer (external processor).
- The digitizer converts the signal into some 0's and 1's and that is feed into the computer.
- Thus a new path for propagation of brain commands from the brain to the computer via Brain computer interface is created.
- Now when external devices are connected to the computer, then they work according to the thought produced in the motor cortex.

Advantages:

- Controlling remote devices.
- Making and receiving telephone calls.
- Turn on or off the lights.
- Control robotic arm.
- Watch and control television.
- Use the pc.
- Locking or unlocking doors.

Disadvantages:

- Expensive.
- Risky Surgery.
- Not Wireless yet.
- Difficulty in adaptation and learning

VI CONCLUSION

The invention of Brain computer Interface is such a big revolution in medical field. Brain-computer interfaces (BCIs) allow their users to communicate or control external devices using brain signals rather than the brain's normal output pathways of peripheral nerves and muscles. Motivated by the hope of restoring independence to severely disabled individuals and by interest in further extending human control of external systems, researchers from many fields are engaged in this challenging new work.

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