Real Time Brain Computer Interface System

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Abstract: Brain System Interface (BSI) innovation is a part of science characterizing how PCs and the human cerebrum can work together. It is a mind embed framework. The sensor, which is embedded into the mind, screens cerebrum action in the patient and changes over the expectation of the client into PC directions or to the subject's coveted development. It is intended to encourage individuals or patient who has lost control of their appendages or the individuals who have been deadened by extreme spinal-string wounds. It is possessed by Cyber kinetics and is a work in progress and in clinical preliminaries. The PCs interpret mind movement and make the correspondence yield utilizing custom deciphering programming. Vitally, the whole Brain System Interface (BSI) framework was particularly intended for clinical use in people and subsequently, its produce, get together, and testing is planned to meet human wellbeing prerequisites. In this paper, we discuss on the development, components, working principle, advantages, drawbacks and solid association between the cerebrum of an extremely crippled individual and a PC.

Keywords: Brain System Interface, Sensor, Cyber Kinetics, Cerebrum, PCs.

I. INTRODUCTION

It is a mind-to-mind movement system that allows a quadriplegic man to control a computer using his *Thoughts.* [1] The system is to help those who have lost control of their limbs, or other bodily functions, such as patients with spinal cord injury to operate various gadgets such as TV, computer, lights, fan etc. It monitors brain activity in the patients and converts the intention of the user into computer commands. This can be used to control a robot arm or a cursor on a screen.

1.1. Braingate Technology

The 'Brain Gate' contains tiny spikes that will extend down about one millimeter into the brain after being implanted beneath the skull, monitoring the activity from a small group of neurons [2]. It will now be possible for a patient with spinal cord injury to produce brain signals that relay the intention of moving the paralyzed limbs, as signals to an implanted sensor, which is then output as electronic impulses. These impulses enable the user to operate mechanical devices with the help of a computer cursor. Matthew Eagle, a 25-year-old Massachusetts man with a severe spinal cord injury, has been paralyzed from the neck down since 2001.After taking part in a clinical trial of this system, he has opened e-mail, switched TV channels, turned on lights. He even moved a robotic hand from his wheelchair. This marks the first time that neural movement signals have been recorded and decoded in a human with spinal cord injury [3]. The system is also the first to allow a human to control his surrounding environment using his mind.

1.2. Principle

"The principle of operation of the Brain Gate Neural Interface System is that with intact brain function, neural signals are generated even though they are not sent to therms, hands and legs. These signals are interpreted by the System and a cursor is shown to the user on a computer screen that provides an alternate "Brain Gate pathway" [4]. The user can use that cursor to control the computer, just as a mouse is used. "Brain Gate" is a brain implant system developed by the boo-tech company Cyber kinetic sin 2003in conjunction with the Department of Nero science at Brown University. The device was designed to help those who have lost control of their limbs, or other bodily functions, such as patients with thyrotrophic lateral sclerosis (ALS) or spinal cord injury. The computer chip, which is implanted into the patient and converts the intention of the intention of the user into computer commands.

II. BASICS OF BRAINGATE SYSTEM

2.1. How DOE Braingate System Works

The brain is "hardwired" with connections, which are made by billions of neurons that make electricity whenever they are stimulated. The electrical patterns are called brain waves. Neurons act like the wires and gates in a computer, gathering and transmitting electrochemical signals over distances as far as several feet. Fig 1 shows that the brain encodes information not by relying on single neurons, but by spreading it across large populations of neurons, and by rapidly adapting to new circumstances. Motor neurons carry signals from the central nervous system to the muscles, skin and glands of the body, while sensory neurons carry signals from those outer parts of the body to the central nervous system. Receptors sense things like chemicals, light, and sound and encode this information into electrochemical signals transmitted by the sensory neurons. And inter neurons tie everything together by connecting the various neurons within the brain and spinal cord. The part of the brain that controls motor skills is located at the ear of the frontal lobe. How does this communication happen? Muscles in the body's limbs contain embedded sensors called muscle spindles that measure the length and speed of the muscles as they stretch and contract as you move. Other sensors in the skin respond to stretching and pressure. Even if paralysis or disease damages the part of the brain that processes movement, the brain still makes neural signals.

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They're just not being sent to the arms, hands and legs.

Fig 1: Working Principle of BCI

III. THE COMPONENTS IN THIS SYSTEM

3.1. The Nero Chip

A 4-millimeter square silicon chip studded with 100 hair thin micro electrodes is embedded in the primary motor cortex the region of the brain responsible for controlling movement as described in fig 2.

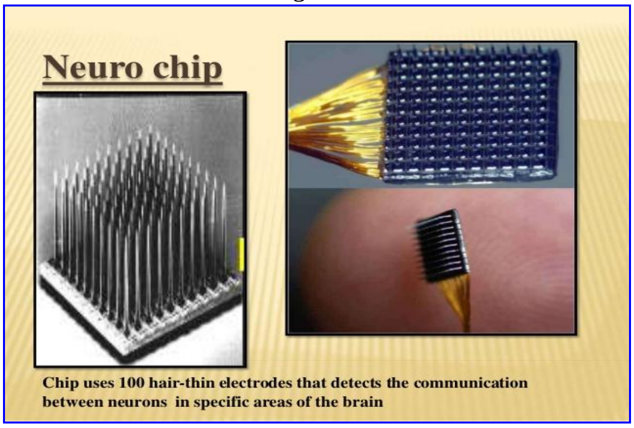

Fig 2: Neuro Chip

3.2. The connectors:

When the user thinks “move cursor up and down”, the cortical neurons fire in a distinctive pattern : the signal is transmitted through the pedestal plug attached to the skull.

3.3. The converter:

The signal travels to a shoe box- sized amplifier mounted on the user's wheelchair, where it is converted by fiber-optic cable to a computer.

3.4. The computer:

The computer translates brain activity and creates the communication output using custom decoding software in fig 3.

Fig 3: Brain Gate Devices

IV. TYPES OF BCI

BCI stands communication pathway between a brain or brain cell and a device (computer).

4.1. One way BCI

Information pass from brain to computer or computer to brain.

4.2. Two way BCI

Information is exchanged between brain and computer.

V. HOW INFORMATION IS TRANSMITTED

When a work is done through any part of body then a potential difference is created in the brain. The potential difference is captured by the electrodes and is transmitted via fiber optic to the Digitizer (external processor) in fig 4. The digitizer converts the signal into some 0's and 1's that is feed into the computer. Thus a new path for propagation of brain commands from the brain to the computer via brain gate is created. When external devices are connected to the computer, then they work according to the thought produced in the motor cortex.

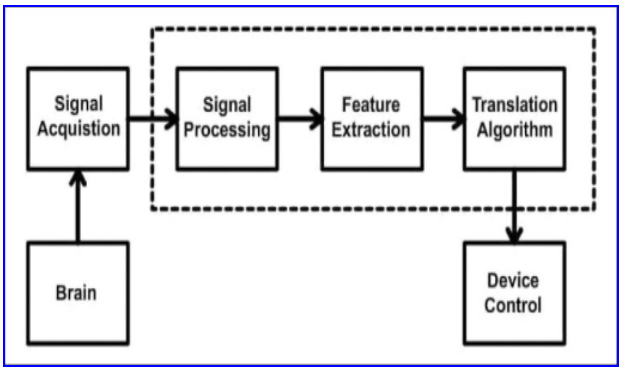

Fig 4: BCI Transmission

VI. FIRST RESEARCH AND REVIEWS

6.1. Braingate Research in Animals

In fig 5, first rat were implanted with BCI. Signals recorded from cerebral cortex of rat to operate BCI to carry out the movement. Researchers at the university of Pitts burgh had demonstrated on a monkey that can feed itself with a robotic arm simply by using signals from its brain.

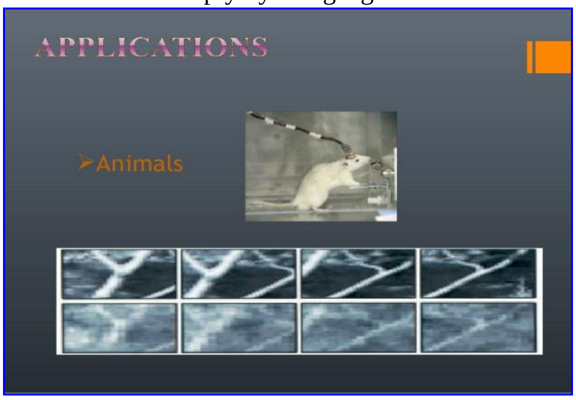

Fig 5: Application of BCI

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6.2. Brain Gate Research in Human

Mathew-Nigel the first person to use the brain computer interface to restore the functionality lost to paralysis in fig 6. During which the implanted brain gate sensor recorded activity in his motor cortex region while he imagined moving his paralyzed limbs and then used that imagined motion for several computer based tasks such as, moving a computer cursor to open e-mail, draw shapes and play simple video games.

Fig 6: BCI Functionality

Advantages

- Controlling remote devices.
- Making and receiving telephone calls.
- Turn on or off the lights
- Accessing the INTERNET.
- Control robotics arms.
- Watch and control television.
- Use the PC.
- Locking or unlocking door.
- Motorized wheelchair.

Disadvantages

- Expensive
- Risky surgery
- Not wireless yet
- difficulty in adaptation and learning
- Limitation transform rate. The latest technology is 20 bits/min.

VII. CONCLUSION

The Brain Gate device can provide paralyzed or motor-impaired patients a mode of communication through the translation of thought into direct computer control. Normal humans may also be able to utilize Brain Gate technology to enhance their relationship with the digital world provided they are willing to receive the implant. Current new advance include a second-generation interface software M*power controller that will enable user to perform a wide variety of daily activities without assistances of technician. The user will have an improved control of respiratory system, limbs with muscle stimulation or robotics.

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