NEURAL INTERFACING

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Abstract

Neural Interfacing is a powerful means which can develop a robust bridge between humans and machines. In this paper we emphasize on neural interfacing as an evolving trend in wireless communications by taking into account one of its important application i.e. cyborgs. The ultimate goal of neural interface research is to create links between the nervous system and the outside world either by stimulating or by recording from neural tissue to treat or assist people with sensory, motor, or other disabilities of neural function. Although electrical stimulation systems have already reached widespread clinical application, neural interfaces that record neural signals to decipher movement intentions are only now beginning to develop into clinically viable systems to help paralyzed people. We begin by reviewing state-of-the-art research and early-stage clinical recording systems and focus on systems those record single-unit action potentials. We then address the potential for neural interface research to enhance basic scientific understanding of brain function by offering unique insights in neural coding and representation, plasticity, brain-behavior relations, and the neurobiology of disease. Finally, we discuss technical and scientific challenges faced by these systems before they are widely adopted by severely motor-disabled patients.

I. INTRODUCTION

Neural interfacing is a power full system which can develop a robust bridge between human and machines. In this paper we emphasize on neural interfacing as an evolving trend in wireless communications by it is not only in the medical field this neural interfacing have made incredible advances. With the popularity of microcomputers (present in many households now) the refinement of input devices, (it's still not easy to use your computer in the bath, in bed or while knitting) now receives much attention. This type of interfacing with its intuitive, convenient input method shall be the way of the future. Virtual reality systems in particular will benefit from this technology. Most of my research was done online on the World Wide Web where there is a surprising amount of information on this research. There are several innovative companies that already market devices, software and games and also university and company (and military) research groups that are looking at this emerging field. The ultimate goal of neural interface research is to create links between the nervous system and the outside world either by stimulating or by recording from neural tissue to treat or assist people with sensory, motor, or other disabilities of neural function. Although electrical stimulation systems have already reached widespread clinical application, neural interfaces that record neural signals to decipher movement intentions are only now beginning to develop into clinically viable systems to help paralyzed people. We begin by reviewing state-of-the-art research and early-stage clinical recording systems and focus on systems those record single-unit action potentials. We then address the potential for neural interface research to enhance basic scientific understanding of brain function by offering unique insights in neural coding and representation, plasticity, brain-behavior relations, and the neurobiology of disease.

Finally, we discuss technical and scientific challenges faced by these systems before they are widely adopted by severely motor-disabled patients.

II. HISTORY

Hans Berger's innovation in the field of human brain research and its electrical activity has a close connection with the discovery of brain computer interfaces. Berger is credited with the development of electroencephalography, which was a major breakthrough for humans and helped researchers record human brain activity – the electroencephalogram (EEG). This was certainly a major discovery in human brain mapping, which made it possible to detect brain diseases. Richard Canton's 1875's discovery of electrical signals in animal brains was an inspiration for Berger. As one of the first common use of brain computer interface technology, EEG neurofeedback has been in use for several decades.

The year 1998 marked a significant development in the field of brain mapping when researcher Philip Kennedy implanted the first brain computer interface object into a human being. However, the BCI object was of limited function. The only benefit from this development was the use of a wireless di-electrode.

John Donoghue and his team of Brown University researchers formed a public traded company, Cyber kinetics, in 2001. The goal was to commercially design a brain computer interface, the so-called BrainGate. The company has come up with NeuroPort ™- its first commercial product. Columbia University Medical Center researchers have successfully monitored and recorded electrical activity in the brain with improved precision. According to researchers, NeuroPort™ Neural Monitoring System enabled them to identify micro-seizure activity prior to epileptic seizures among patients.

June 2004 marked a significant development in the field when Matthew Nagle became the first human to be implanted with a BCI, Cyberkinetics's BrainGate™.

In December 2004, Jonathan Wolpaw and researchers at New York State Department of Health's Wadsworth Center came up with a research report that demonstrated the ability to control a computer using a BCI. In the study, patients were asked to wear a cap that contained electrodes to capture EEG signals from the motor cortex – part of the cerebrum governing movement.

A number of developments have been taking place in the field. By 2050, it is has been suggested that BCI could become a magic wand, helping men control objects with their mind. The day isn't far off when man may be able to guide an outside object with their thoughts in order to consistently execute both natural and complex motions of everyday life.

III. CURRENT USES

Neural interfacing is currently used in the fields of medicine, physical therapy, music, games and as an interesting new input device. It is currently most utilized in helping the disabled in various ways. As previously discussed, neural implants is being used to help the blind and deaf. EOG signals has been used to diagnose and train patients with Strabismus, which is a misalignment of the eyes, causing gaze direction to stray. Neural interfacing is the only method of communication for some disabled people, particularly those with neuromuscular disorders and spinal injuries. Some people can only blink or move the muscles of their faces. These people can use EMG or EOG signals to select letters or move basic objects on a computer screen. EEG signals also have a lot of promise in this area, but their complexity makes them difficult to use in this manner and work is continuing in these areas. Physical therapists use neural interfacing to monitor and collect biological signals for analysis. Uses range from monitoring how much progress a recovering muscle is making by monitoring the EMG signals it causes to checking that back or wrist muscles are not being stressed unduly by posture (ergonomics). Custom exercise programs with hardware and software equipment that monitors heart rate and respiration rate and other signals and reports on your progress can also be found in clinics and on the market (for extremely high prices).

IV.FUTURE PROJECT

BCI research and development is a multidisciplinary effort involving neuroscientists, engineers, applied mathematicians, computer scientists, psychologists, neurologists, and clinical rehabilitation specialists. Although most of the published BCI literature to date concerns development of improved signal processing or other engineering facets of BCI technology, incorporation of professionals from all the above mentioned disciplines is critical for success .

As a field of practice and a subject of study, BCI technology is still in its infancy. Further research on different components of BCI development is ongoing and challenging. These include explorations of: useful brain signals; signal recording techniques; feature extraction and translation methods; methods for engaging short- and long-term adaptations between user and system so as to optimize performance; appropriate BCI applications; and clinical validation, dissemination, and support.

Efforts have recently begun to translate laboratory-validated BCI technologies into home systems for severely disabled individuals. These home systems are currently limited to applications for simple communication (e.g., word processing, speech synthesizing, and email, etc) and simple environmental control (e.g., TV, room temperature, etc.) Widespread dissemination of these BCI systems may be difficult, since the fact that the limited capacities of current BCIs make them useful to only relatively small populations of users means that they are unlikely to attract significant commercial interest. In response to this problem, a new noncommercial option for BCI dissemination has recently been initiated (www.braincommunication.org). Other BCI applications, such as restoration of motor function, have been confined mainly to laboratory settings or limited lab-based demonstrations, and are not yet being used in everyday life. Further work in all these areas is needed for BCIs to be validated and shown to be practical for the real-life environments of home-bound users. The use of BCI applications in neurorehabilitation is another promising area that is as yet still in its infancy.

V. ADVANTAGES

- Allow paralyzed people to control prosthetic limbs with their mind.
- Transmit visual images to the mind of a blind person, allowing them to see.
- Allow games to control video games with their minds.
- Transmit auditory data to the mind of a deaf person, allowing them to hear. .
- Allow a mute person to have their thought displayed and spoken by a computer.

- New method of interfacing with machines, computer where no physical touch is required.
- No conduction gel required for the electrodes.
- Relatively cheap compared to other EEG devices.

VI. DISADVANTAGES

- Research is still in beginning stages.
- The current technology is crude.
- Electrodes outside of the skull can detect very few electric signals from the brain.
- Ethical issues may prevent its development.
- Electrodes placed inside the skull create scar tissue in the brain.
- Hard to market since not many people are known to the idea of BCI.

VII. CONCLUSION

Certainly the applications for BCI devices discussed in this paper is long reaching and BCI devices are not currently powerful enough to perform the tasks mentioned above. But possibility of thought control machines would elimination of a bottleneck in data processing and computer interaction including communication that would improve not just the environment but people themselves.

VIII. REFRENCES

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