Brain-Computer Interfaces
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BME 281 First Presentation, September 25, 2012 <jamie11@my.uri.edu>

Abstract—Summarize what this paper is about in less than 50 words. Try to be succinct but self-contained, addressing the “what,” “why,” and “how” questions, if possible.

I. INTRODUCTION

Brain-computer interfaces (BCI) are used in a variety of applications from stroke victim rehabilitation and severe trauma rehabilitation to communication with patients with locked-in syndrome or conscience related dysfunctions to future technologies for the general public. Research into this field first began with mapping of rodent and ape mammalian motor cortices in the early 1970s, although the tools for brain mapping and scanning had been around for almost fifty years by this point (Electroencephalography was developed in 1924). The vast majority brain-computer interface technology is still in its infancy stage in research laboratories and experimental settings, but they are expected to burst into the medical field (rehabilitation machines/techniques and prosthetics) for everyday patient use as well as general life within the next two decades.

BCI have at least two essential components: “modality used for acquiring brain signals and the mental control tasks used for regulating this activity[1],” meaning a computer/transceiver for conversion of the brain patterns into control of the device and the brain and its functions.

II. METHODS

The majority of studies have been on mammalian animals as their anatomy and physiology are the most similar to humans, specifically different varieties of monkey. Research with both implantable electrodes into the brain as well as joysticks have been done in tandem for mapping control centers of the brain. This is then followed with the creation of a closed feedback loop where the device to be controlled in question (usually a robotic arm) is either controlled directly by the brain through translations of neural patterns or by a joystick.

The main two categories of BCI are invasive, which require surgery to implant the electrodes into the skull and onto the brain, and non-invasive, which requires electrodes to be planted on the outside of the subjects skull.

III. RESULTS

Results from experiments have led to refinement in BCI hardware designs, alternative methods into retrieving electrical impulses from the brain (for example, invasive and non-invasive procedures), and advances in software used in the system, including adaptive learning software, better algorithms for reading and predicting movements and electrical signals from the brain, and general increases in efficiency.

IV. DISCUSSION

In its current state, we are still many years away from seeing BCI in more common place settings. However, it is my belief that BCI will become the future for medical rehabilitation that causes brain damage, control of devices in everyday life, and everything in between.

The main setback to invasive BCI is the risk of harm to the patient. Parts of the skull must be removed in order to access the brain in order to insert the electrodes. This leads to increase vulnerability to the brain in the general life of the patient due to a weakened skull in general. Also, during the time that the brain is exposed to the outside atmosphere, it is possible that it can coe under attack from infections, outside bacteria, and other agents that would cause it harm.

One would think that the answer would be the non-invasive BCI. However, this method is less effective or accurate and therefore can lead to problems with controlling the device in question, incorrect interpretation of signals not as strong as with invasive BCI, and the electrodes aren’t as secure.

I think a possible way to solve these problems would be to look into the growth of a normal skull and determine an age where one could implant wireless electrodes in a patient before the bones of the skull grow together. Therefore, the Fontanels would allow for access to the brain without permanent damage to the skull. That way, these electrodes could be used in the future to control, for example, a motorized wheelchair for a disabled individual.

REFERENCES


