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Brain Machine Interface - Moving Chair According to Human Brain Signals

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Abstract - Origin of the Research/Product Development Problem: Stroke is the leading cause of long-term disability in adults and affects approximately 20 million people per year. Five millions remain handicapped and dependent on assistance in daily life. Nearly 30% of all stroke patients are under the age of 60. Other diseases resulting in paralysis at such early age include Multiple Sclerosis (MS), affecting more than 2.5 million people worldwide, or spinal cord injury (SCI) with 12.1 to 57.8 cases per million. BPI, the disruption of the upper limb nerves leading to a flaccid paralysis of the hands, affects millions of people every year. Paralytic patients are also called as "locked-in" patients. Because of a stroke brain injury, cerebral degenerative neurological disease such as amyotrophic lateral sclerosis their entire system is paralyzed. The only ray of hope is currently the development of brain-computer interfaces (BCI), a direct communication pathway between the brain and an external device that records neural processes. To a certain extent BCI can be created with non-invasive techniques. EEG recordings are the most thoroughly studied potential interface and have the advantage of excellent temporal resolution ease of use and portability.

Keywords - *BCI, EEG, EPOC, Device Control.*

1. Introduction

Electroencephalography (EEG) is the recording of electrical activity along the scalp. EEG measures voltage a fluctuation resulting from ionic current flows within the neurons of the brain.In conventional scalp EEG, the recording is obtained by placing electrodes on the scalp.The goal of our interactive BCI multimedia system was to use brain signal input to provide computer interaction.Our interactive BCI multimedia system was developed according to the process flow in Figure 1 for the Windows platform in C# using the .Net framework.

BCI system overview Our BCI system consists of six parts where the Bluetooth interface and the Mindset Interface are provided by Emotive. The Mindset interface consists of libraries that handles the connection, disconnection, and receives a container with data consisting of raw data which

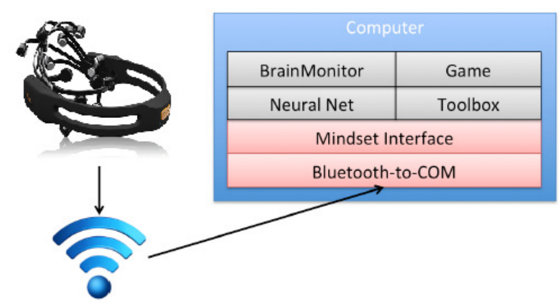

Fig1. Signal Process Flow

is updated every 10 milliseconds and the rest of the data updated every second. The rest of the data consists of signal strength, various bands (Delta, Theta, Alpha, Betaand Gamma), attention value, mediation value and eye blink signal.An overview of our BCI system is shown in Figure 2.

2. Methodology

Emotiv EEG wireless neuroheadset: The EEG neurosheadset provides access to raw electroencephalography data. The EPOC brain helmet has eighteen sockets and can hold sixteen nodes or sensor

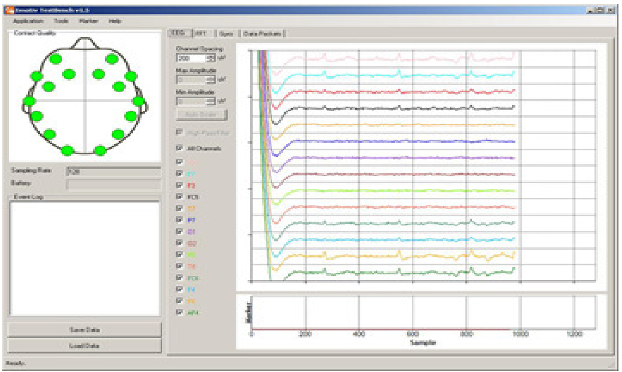

Fig2. Signal Acquisition and Processing

pads. The remaining two sockets usually hold rubber pads, and are known as the secondary reference sensors, which are located immediately below and behind the ears. The primary reference sensors, which generally hold a normal sensor pad, are located immediately above and behind the ears. The sensors pads detect electrical activity on the surface of the brain. Open-source Matlab toolboxes such as EEGLAB, Fieldtrip, and the Neurophysiologic Biomarker Toolbox (NBT) can be used to process data from the electroencephalography.

- **Conscious thoughts (Cognitiv suite):** The device detects 13 kinds of movement - six directions (left, right, up, down, forward, and "pull/zoom") and six rotations (anti-clockwise rotation, turn left and right, and sway backward and forward), plus one other visualization ("disappear").

- **Emotions (Affectiv suite):** "Excitement", "Engagement/Boredom", "Meditation", and "Frustration" can currently be measured.

- **Facial expressions (Expressiv suite):** Individual eyelid and eyebrow positions, eye position in the horizontal plane, smiling, laughing, clenching, and smirking can currently be detected. Other expressions may be added prior to release. The expressions are detected by the EEG sensors picking up signals to facial muscles, rather than by reading brainwaves. Unlike reading mental activity, these detections are very fast conveying a decisive advantage and rendering them suitable for fast paced games in the FPS genre.

Figure 3.1 Output

- **Head rotation:** The angular velocity of one's head can be measured in the yaw and pitch (but not roll) directions. This is detected by gyros, and isn't related to the EEG features.

3. Procedures

A brain–computer interface (BCI) is a direct communication pathway between the brain and an external device. BCIs are often directed at assisting, augmenting, or repairing human cognitive or sensory-motor functions the long-term objective of this research is to create a multi-position, brain-controlled switch that is activated by signals measured directly from an individual's brain. We believe that such a switch will allow an individual with a severe disability to have effective control of devices such as assistive appliances, computers, and neural prostheses in natural environments. This type of direct-brain interface would increase an individual's independence, leading to a

Figure 3.2 Procedure

dramatically improved quality of life and reduce social costs. Most often the greatest failing of technical aids for persons with severe physical disabilities (as above) is the inadequacy of the human-machine interface. With a universal, effective and efficient interface, current technology has the capability of providing substantial independence and hence, a greatly improved quality of life for even the most severely disabled persons. In pursuit of such an ideal interface, researchers have been studying the feasibility of utilizing electrical brain potentials to directly communicate to devices such as a ***personal computer system, robotic, humanoid arm and UI applications.***

4. Result Analysis

Table 1: Signal Values

Delta	Measure and track your focus	0.5Hz to 3.5 Hz
Theta	Engagement	3.5Hz to 7.5Hz
Alpha	Interest	7.5Hz to 12Hz
Beta	Affinity	12Hz to 30HZ
Gamma	Stress level	31 Hz an up

5. Conclusions

In this project, it consists of six parts where the Bluetooth interface and the Mindset Interface are provided by Emotive. Simple BCI applications include systems for answering Yes/No questions, managing basic environmental control (e.g., lights, temperature), controlling a television, or moving a wheel chair .The proposed array has been designed for physical disable patient and person who are paralyzed.

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