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Development of Multipurpose Wheelchair Using Wireless BCI with SSVEP

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***Abstract*— This paper presents a wheelchair movement control by wireless BCI with SSVEP. In SSVEP (visual stimuli) we used the 5 types of signals which directs the wheelchair in their different respective directions. In this system we try to eliminate complex methodology using maximum sample signals iterations to control the wheelchair. We also introduce collision avoider for better safety of the patient.**

***Index Terms*— BCI, EEG, SSVEP, WIRELESS**

I. Introduction

Brain computer Interface (BCI) system is a interface system which allows the user to control the device by the brain signals. BCI system specially helpful for the person or patient who suffers from the physical disability and having limited physical motions. In BCI system, there are various method to detect the brain activity signals like activity Magneto-encephalography (MEG), Functional Magnetic Resonance Imaging (fMRI), Electrocortico-gram(ECoG) which are very expensive and invasive methods but Electroencephalogram (EEG) is less expensive and non-invasive method.

A. SSVEP

The steady state visual evoke potential is a signal which response to visual stimulus. Eye are excited by the flickering of light and generates signals in the brain. The flickering of light having frequency ranging between 6Hz to 100Hz will effectively produce the signals in the brain. This is a best technique useful for attention related aspects. This gives high resolution signals for analysis .The analysis is quite simple, reliable and robust response if you get The steady state visual evoke potential is a signal which response to visual stimulus. Eye are excited by the flickering of light and generates signals in the brain. The flickering of light having frequency ranging between 6Hz to 100Hz will effectively produce the signals in the brain. This is a best technique useful for attention related aspects. This gives high resolution signals for analysis .The analysis is quite simple, reliable and robust response if you get the stimulus and setup right. Inside the appropriate range, SSVEP is an excellent Brain-Computer Interface (BCI) tool because it has a very low signal to noise ratio, i.e. even if an individual shifts and disrupts the EEG signal slightly, the SSVEP signal is still likely to come through. The amplitude of SSVEP signals in left and right parietal occipital are low. At time of task performance, amplitude exhibits the load-dependent increases in the center and front occipital while amplitude exhibits the load-dependent decreases in left and right occipital.

The SSVEP networks having differ4ent frequency band low (5-12Hz), medium (12-30Hz) and high (30-50Hz) frequency. To avoid maximum noise the narrow frequency band should be select. Performance can affect by several factors such as the distance between stimulating device and eye, single eye or double eye stimulation condition and response of retina human to human difference.

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II. Methodology

In this experiment total five stages included, the first stage is module of LED panel i.e. we get SSVEP signals from panel which generates the EEG signals in brain. Second stage is to acquire EEG signals from brain, third stage is to preprocess that EEG signals. Fourth stage is to converting the preprocessed signals into command and the last stage is another Hardware module i.e. wheelchair which will follow the command. Fig.1 shows the flowchart of the system

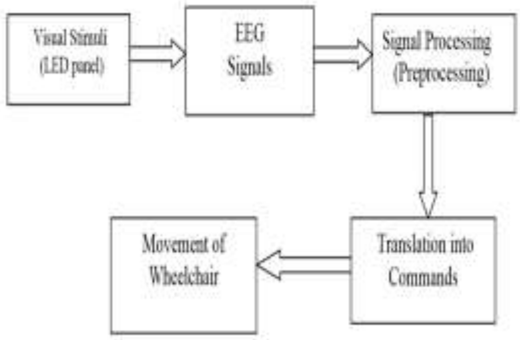

Fig. 1. Flowchart of System

Each side of panel shows their respective direction and each directions have the group of four LED lights. Generally forward signals indicate GREEN light and for stop signals we use RED light which is at the center of panel. The panel have five types of light and blinking at five different frequency for five different commandwhich are Forward-Left-Right-Backward-Stop. Fig.2 shows the SSVEP LED light module.

Fig.2. SSVEP LED light Module

BCI system may be wired or wireless. Here we use a wireless BCI system to acquire EEG signals which is B-Alert x10 BCI machine. This machine have the 10 channel system. For all the tasks data was recorded for around 3 minutes with sampling frequency of 256 Hz. X10-Standard system is a ten channels system. The ten channels are ECG, F3, Fz, F4, C3, CZ, C4, P3, POz and P4. Among them, 8 channels have been considered which are F3, Fz, F4, C3, CZ, C4, P3 and POz. Fig.3 shows the subject with B-Alert wireless BCI system.

Fig.3. Subject with B-Alert Wireless BCI System

B-Alert Live Software (BLS) acquires, presents, and stores physiological signals from the following ABM EEG devices: X10 with Standard sensor strips, X4 with B-Alert, Stat, APPT, and Sleep Profiler sensor strips. In addition, BLS provides other functionalities such as Computing electrode impedances, Transmitting data to a remote computer, Computing and displaying real-time cognitive metrics, Administering metric benchmarking tasks, Replaying data offline, Generating summary report, and processing data offline. The data outputs are saved in EDF+ format compatible with all standard EDF+ readers.

For control and connectivity we have a GUI system which is develop in MATLAB software system. In GUI the command buttons which whole system will start and stop and also check the status of connectivity. At the time of executing command the respective signal image will show in small display panel in GUI. Fig.4. shows the GUI of the System.

Fig.4. shows the GUI of the System

In this experiment we take 3 subjects and each having 5 similar tasks. The session of each task of 180 seconds. To get better accuracy every task have 10 repetitions. As we mention earlier we eliminate the further calculations required for the processing signals.

Instead of the various method we use the maximum repetitive data for every task. These repetitive sessions gives the common data for each task. During training session, the patient should be calm and focus to every task. After getting that data, we just set them as a standard data for that patient. At real time of performance each data will compare with the standard data and respective task will be perform.

Device can come with the addition of the collision detector. In collision Detector, during moving of the wheelchair if any object like wall, table, etc. are in the path. The wheelchair will stop automatically and move backward slightly to take next command from the patient.

Another extra addition in this experiment, we can use the accelerometer when patient become mentally or physically tired and not able to concentrate on lights then, he can easily give the command through the accelerometer device but here the accelerometer device will always have the secondary priority.

Here we use the small prototype of wheelchair instead of actual wheelchair. Fig.5. shows the prototype of the Wheelchair.

Fig.5. Prototype of Wheelchair

The signal image and movement of wheelchair are shown in Fig.6

Fig.6.1. Moving Forward Command and Signals

Fig.6.2. Moving Left Command and Signal Pattern

Fig.6.3. Moving Right Command and Signal Pattern

Fig.6.4. Moving Down Command and Signal Pattern

III. Conclusion

Repetitive training technique successfully implemented and removes complicated method with the accuracy 65 % - 75%. Some other assisted function can be implemented with SSVEP.

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