Design and Implementation of Brain Computer Interface for Wheelchair control

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Abstract - ***This paper presents a design and implementation of Brain computer Interface (BCI) for wheelchair control. In this paper, the Electroencephalogram signals (EEG) have been used to provide new ways for communication and control. Brain Computer Interface (BCI) technology is a powerful communication and control option in the interaction between user and system. This technology enables signals from brain to directly some external activity.BCI system is also known as "Brain- Machine Interface (BMI)". In BCI system signals are acquire from the human scalp by the electrode. The experimental results confirmed that EEG signals acquire from the dataset and after acquiring that signals we process that signal and control the wheelchair.***

Key Words: *EEG Signals, BCI system, Wheelchair,*

1. INTRODUCTION

The paralyzed patient or patients who are suffering from severe physical disabilities have their limited motion in environment. BCI system allows the communication between the brain and controlling device using the brainwave. Brain - Computer Interface (BCI) can assist the patient who has their limited motor imagery movement or damages to their organ. BCI also allows the users to communicate with the multimedia devices through brainwave signals. To acquire Electroencephalograph (EEG) signals have some basic process, the small electrode which are placed on the scalp. The signals generated in the brain are sense by the electrode and map it on the output device.

The wireless BCI system, analyzed signals and recognizes that signals and pass for further preprocess and translate into specified command and that commands control the wheelchair movement and decide where to move the wheelchair similarly the other controls like multimedia or other useful control can be operated by using this technique.

These feasibility of using a Brain- computer interface (BCI) for the control of the Wheelchair as been under recent Investigation at UTS. Initial work using a simple of 2 Channel EEG recorder, attempting to classify 3 different classes of mental commands in order to allow the control of the wheelchair. The main advantages of this method is that it requires no motor skills whatever in order to achieve wheelchair control. However it also has some rather main disadvantages when used as the sole method of wheelchair control, for instance of a 2 second classification window makes the eventual control quite slows.

2. SYSTEM OVERVIEW

To achieve the goal, the following additional technical arrangements are implemented in the BCI system. Multiple devices are controlled and processed by BCI. BCI is a novel communication system which enables users to translate brain activity, measured by Electroencephalography (EEG), into control signal and sending to computers. BCI have been exposed as a promising tool for paralyzed people in several computer applications such as a promising tool for paralyzed people and healthy people in several computer applications such as medical assistant devices[8] and video game[9]. Fig.1 shows schematics of a BCI system. This system involves EEG acquisition, signal processing, and an application interface together with the applications. The block of signal processing includes preprocessing, feature extraction, and classification.

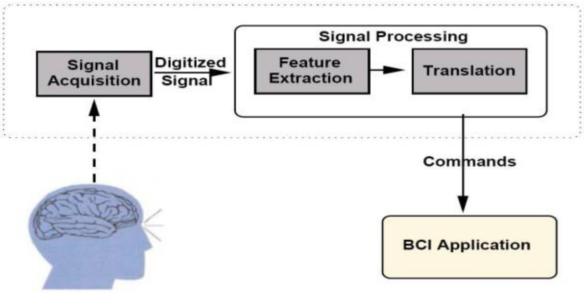

Fig- 1: Block Diagram of Proposed system

3. FREQUNCY OF HUMAN EEG SIGNAL

The electroencephalogram (EEG) is a recording of the electrical activity of the brain from the scalp. The recorded waveforms reflect the cortical electrical activity. EEG activity is quite small, measured in microvolt (mv). The main frequencies of the human EEG waves are:
Delta: waves (below 4 Hz) occur during sleep.
Theta: waves (4-7 Hz) occurs during sleep, deep relaxation (like hypnotic relaxation), and visualization.
Alpha: waves (8-13 Hz) occur when we are relaxed and clam.
Beta: waves (13-38 Hz) occurs when we are actively thinking, problem-solving.
Gamma: brain waves (39-100 Hz) occur we have higher mental activity and consolidation of information.

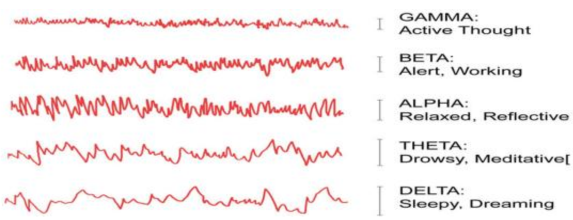

Fig-2: Different frequencies of human EEG wave

4. ELECTRIC WHEELCHAIR CONTROL

Using the generated recognition patterns, 20 control trials (the 10 right goal trials) for each subject are performed. Fig. 6 shows an experimental result. Table I shows the success rates for reaching the target positions. The average success rates of reaching the target positions. The average success rate is about 80%. This shows the viability of EEG-based control for an electric wheelchair.

The expectation if the low successful rate of Right for Subject B. Research is ongoing to further improve the success rates Subject B. Research is ongoing to further improve the success rates of all subjectsFigs.3 and 4 show the experiment workspace. The experiment workspace consists of 28 regions. Each region is 60 cm_90cm.The colored regions in Fig. 4 show the target positions(LEFT goal and RIGHT goal).According to the pattern matching results shown in section III-A, the electric wheelchair is moved to region B (the right direction) from the initial position (start). The subjects are required to approach the target positions by

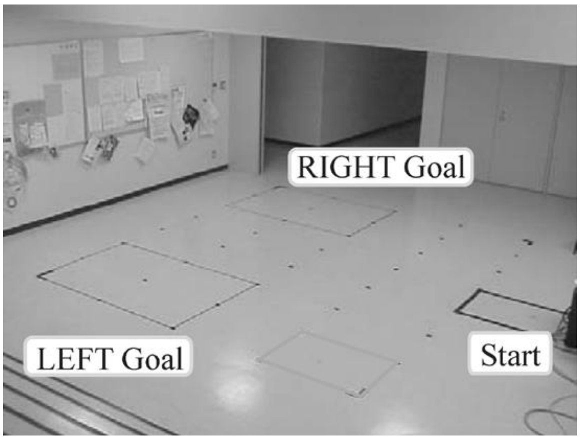

Fig -3: Photograph of the experiment workspace.

repeating the movement. The subjects are required to approach the target positions by repeating the movement, The electric wheelchair can arrive at the target positions when the number of incorrect direction decisions is less than or equal to one and the number of correct direction decision is three. Therefore, the success rate of reaching the target positions is about 31.2% if direction (left or right) decision is random.

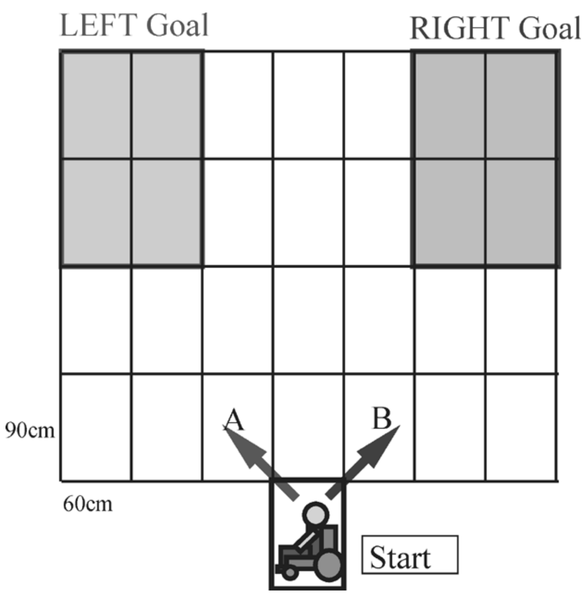

Fig-3: Experimental workspace

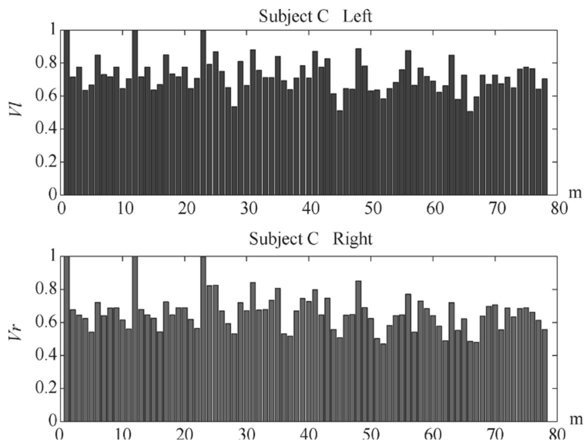

Figure 5. Generated recognition pattern (subject D)

In the experiment, the wheelchair is stopped during the EEG detection and the pattern matching since the processing time is several seconds. According to the pattern matching result, the electrical wheelchair is moved to the next region. The procedure is repeated until the wheelchair reaches at the target position or until the number of incorrect directions is more than one.

Fig. 4 and 5 show the recognition patterns for the left and right thinking of the subjects C and D, respectively. In the figures, the horizontal and vertical axis denote the element number m and the elements (V lm (E) and V rm (E)), respectively. These patterns are generated through the recursive training described in section III. The patterns of subjects C and D are quite different. This fact shows that it is quite reasonable to generate an individual recognized pattern for each subject.

Table -1: Success rates

Subject	Success rate % Left	Right
A	80	90
B	90	20
C	100	100
D	80	100
E	80	80
F	70	90
Avg.	83(%)	80(%)

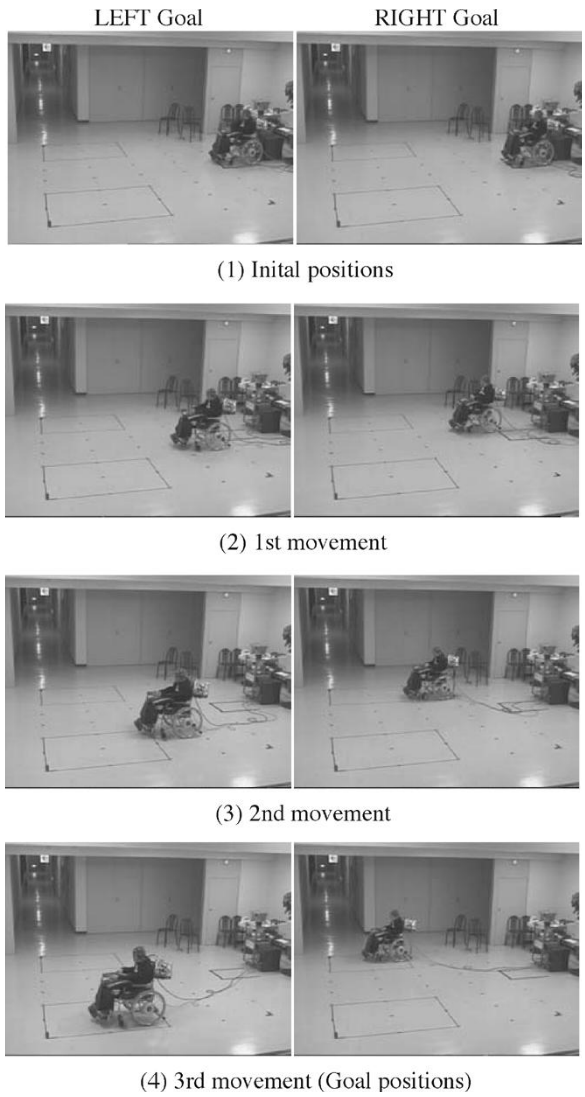

Fig -1: Experiment results

4. CONCLUSION

This paper investigates control of an electric wheelchair by EEG signals. This represents an attempt to control machines via brain signals. In this research, the goal is to control the direction (left or right) of the electric wheelchair by EEG signals. This paper investigates control of an electric wheelchair by EEG signals. In situations without obstacles both measures are not impeded by assistance module. Hence, in normal situations the advantage of collision-free driving remains, while the drawbacks nearly disappear.

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