A Review on Brain Machine Interface with AI for a Person with Disability

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ABSTRACT

Brain machine interface (BMI) system is very useful technique for the disabled that is handicapped & paralyzed person to express their emotions & feeling to other with the help of EEG signal of brain without any muscle activity, as human brain is developed by billions of interconnected neurons. BMI's are the system which convert the brain signal to electrical signal to control the external devices by using person thoughts. By using this system, it allow disabled patients to improve & recover their mobility for communicate in surrounding environment. In this paper EEG (electroencephalogram) is used (non-invasive method) to capture a brain signal used for BMI to control any electronic devices like mouse cursor, wheel chair, robotic arm, etc. The research in this area of BMI system uses the sequence of 256 channels for capturing EEG signals coming out from brain by using traditional gel based on multi sensor system which is not convenient for real time applications. So this work improves the system to analyze EEG signals. The goal of this research is to improve the quality of life & speed of communication for those with severe disabilities

Key words: Brain machine interface, BMI, EEG signals, brain signals, disability.

1. INTRODUCTION:

There is growing interest in the use of brain signals for communication and operation of devices particularly for physically disabled people. BMI is a technology enabling an individual sending messages or commands to external world through the brain waves. Many patients with physiological disorders such as paralysis or quadriplegia disease suffer from disruption of the communication path between brain and body. The disabled people with the above mentioned problems are forced to accept reduced quality of life , to improve such problems BMI's are used. Electrophysiological signals generated from the brain can be used to command different devices such as mouse cursor, robotic arm, wheelchair etc. provided that the person who will control the device should also be able to control the generation of these signals which used in BMI's. EEG is one the most popular BMI signal capturing method with 10- 20 international system for EEG recording which improves the speed of communication with accurate output. BMI includes signal acquisition, EEG measurement, preprocessing, feature extraction & classification.

2. REVIEW ON BMI:

In this paper we review the performance of different models for classification of models for classification of BMI based EEG signal regarding their real time application. BMI model was implemented using a two layer approach. First layer (upper layer) dealt with signal acquisition and generation of control signals from the acquired EEG signals. The second layer (lower layer) contained the commanding and controlling the robotic devices, such as mouse cursor, robotic arm, wheelchair, etc.

2.1. Signal Acquisition Method

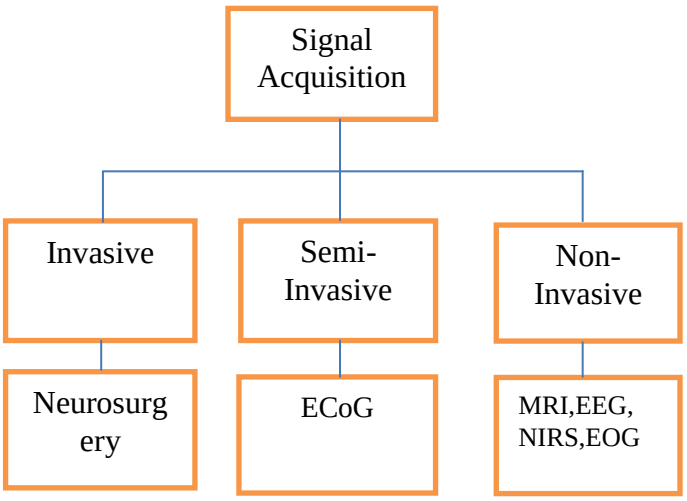

Fig.1. Classification of signal acquisition method

2.2. EEG Signal Classification

EEG signal classified into different categories according to the different mental states and frequency range, detailed in below table 1.

Sr. no.	Brain wave type	Frequency range(Hz)	Mental states & conditions
1.	Delta wave	0-3.5 Hz	Deep, dreamless sleep, non- REP sleep, unconscious
2.	Theta wave	4-7.5 Hz	Intuitive, creative, recall, fantasy, imaginary, dream
3.	Alpha wave	8-12 Hz	Relaxed, but not drowsy, tranquil, conscious
4.	Beta wave	12-30 Hz	
4.1	Low Beta wave	12-15 Hz	Formerly SMR, relaxed yet focused, integrated
4.2	Midrange Beta wave	16-20 Hz	Thinking, aware of self and surroundings
4.3	High Beta wave	21 to 30 Hz	Alertness, agitation
5.	Gamma wave	30 to 100 Hz	Motor functions, higher mental activity

Table 1.1: EEG Signal Classification

2.3. Artifacts

When measuring the EEG, all the signals do not come from the electrical activity of brain. Many potential changes seen in the EEG may be from other sources. These changes are called artifacts and their sources may be the equipment or person.

The artifacts includes :

- **Technical artifacts**
  - *Mains interruption*. The surrounding electrical equipment may induce 50 to 60 Hz component in the signal.
  - *Electrode artifacts*. If electrodes are improperly attached or in poor condition, their impedance may vary
- **Physiological artifacts**
  - *Motion artifacts*. Person movement causes electrodes or electrode cable to move.
  - *EMG artifacts*. The tension of muscles causes EMG artifacts.
  - *Cardiac artifacts*. The heart causes different artifacts such as ECG, pulsation artifacts, pacer artifact and respiration artifact.
  - *Oculographic artifacts*. It includes eye movement, eye blinking artifacts.
  - *Sweating*. This can affect the impedances of electrodes.

3. PROPOSED SYSTEM

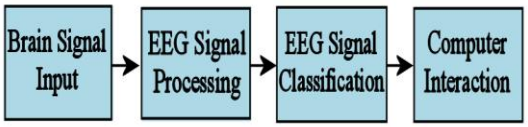

Fig2: Brain-Computer Interface process flow

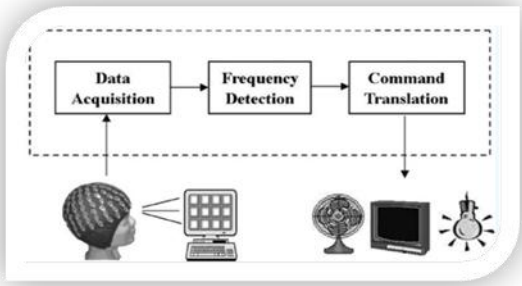

Fig 3: Block diagram of BMI system

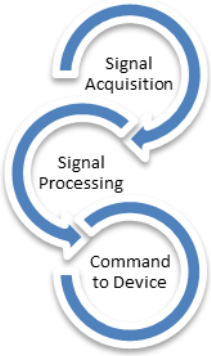

Fig 4: Simple steps of BMI system

The above figures shows the simple block diagram of Brain Computer Interface System which can be established in three simple steps as shown in Figure 3.Signal Acquisition; the signal acquisition means reading and recording of brain waves by the different methods. These methods can be Invasive, Semi-Invasive or Non-Invasive. Here in this project we are using the simplest method of capturing brain wave i.e.; a wireless EEG Neuro Headset. Currently, new wireless headsets that meet consumer criteria for wear ability, price, portability and ease-of-use are coming to the market. It makes possible to spread the technology to the areas such as

entertainment, e-learning, virtual worlds, cyberworlds, etc. Automatic emotion recognition from EEG signals is receiving more attention with the development of new forms of human-centric and human-driven interaction with digital media.

4. OBJECTIVE OF PRESENT WORK

The main objective of project is to design and develop th system "Brain machine interface with AI for disable person". Use of Emotive EEG headset to capture EEG signals of brain improves the system accuracy with increase in speed and reducing artifacts.

5. WORK PLAN AND METHODOLOGY

The first step of my project is to capture the different EEG brain signals by the use of EMOTIV EEG headset and transit these signals wirelessly on PC. A internet is connected on PC which receives the digital signals from headset and display this signals on the Emotive test bench software. After this, the work is to analyze the raw signals captured by headset with respect to different activity of face, eye etc. Next step will be , use these signals to send different commands to system.

6. CONCLUSION

This project deals with developing BMI system using EEG based on specific sensor which is controlled by uniform way and not depend on analog signal which is totally non-invasive method. This paper focuses the different methods of signal acquisition, different types of EEG brain waves i.e. non- invasive which is good for engineering aspects. EEG based BMI system is faster, more accurate with low artifacts system. This system work to improve the quality of life and speed of communication for disabled person.

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