Development of Brain-Computer Interface Based on Stimuli for the Movement of Robot Joints

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Abstract— This paper presents a brain computer interface (BCI) to control a robotic arm by brain signals. BCI establishes a channel of communication for the purpose of interaction between brain and controller. It helps paralyzed patients to move their robotic limbs just with their brain signals. The following signal processing steps were established; acquisition of brain signals by electroencephalography (EEG) electrodes; noise reduction; extraction of signal characteristics and signal classification. Electroencephalograms (EEGs) have been used to estimate human emotions. In this project, we developed an emotion analyser and applied it in a robotic arm system that changes its movement based on the user's emotion.

Key words: Electroencephalogram, BCI (Brain Computer Interface)

I. Introduction

The brain computer interface based on stimuli for the movement of robotic joint is a novel method to help paralysed people to do their day to day works without any support from other.

Now a days, most of the industrial works are carried out by the support of robots. So the next phase of development will be replacement of vital organs by artificial ones. People who lost limb during accident, people who are partially paralyzed can be supported. First of all to make this possible a there should be communication between the human brain and artificial body part. This can be done with the help of BCI (Brain Computer Interface) which forms a channel for interaction between brain and controller. The controller in term gives command to the robotic part. Many neuro-prosthetic devices, such as artificial limb attached to the human body and computer applications are developed by designing an interface that translates brain signals to appropriate control signals. 7D movement of robotic arm has been done by the correlation of EEG maps with the brain machine interface. Non-invasive neural signals based integrated robotic arm driven by three-dimensional hand trajectories has also proved to be a feasible tool for paralyzed people. It is a latest EEG tool that is used for the measurement of level of attention, conscious thoughts, and facial expressions to wirelessly control the physical or software devices. The EEG signals acquired through Muse Headband are then modified, filtered, digitized, and processed.

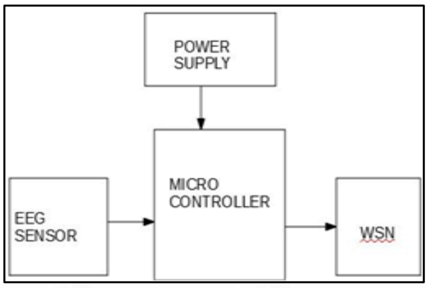
II. Related works

In [1] the authors have proposed a BCI based robotic arm control with Degree Of Freedom 3. In [2] authors have proposed a method to control robotic arm by EEG and EMG sensors with the Degree Of Freedom 3. In [3] authors have proposed a method to use cameras to get visual feedback with the Degree Of Freedom 6. In [4] the authors have proposed a method to move robotic arm with EEG sensors with DOF of 2.

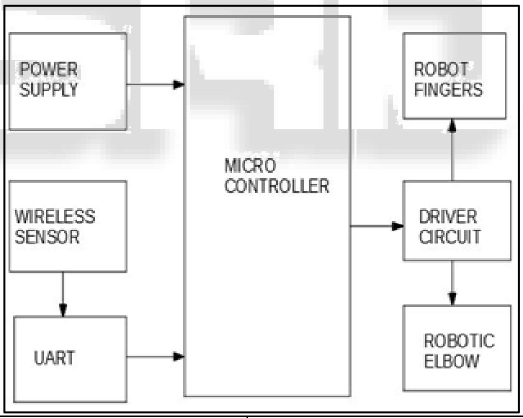
III. System design &implementation

It consists of both user section and robotic arm section. Both the sections are interfaced through WSN (Wireless Sensor Network).It is controlled by the concentration of the brain The user section consists of microcontroller, EEG sensor and power supply and the robotic section has UART as an excess.

A. User Section



B. Robotic Arm Section



TYPE OF THE SYSTEM	DRAWBACK
Joy stick based	Requires manual movement.
wired	Movements are restricted.

Table 1: Comparison Of various BCI S

C. Hardware Requirements

- POWER SUPPLY
- MICROCONTROLLER
- WIRELESS SENSOR NETWORK
- ROBOTIC FINGER MECHANISM
- ROBOT ELBOW MECHANISM
- DRIVER CIRCUIT
- EEG SENSOR

D. Software Requirements

- MPLAB IDE
- EMBEDDED C
- POWER SUPPLY

IV. EXISTING SYSTEM

In the existing system, we use joy stick based robot arm to control but the major drawback in that is robot will act only in the pre assigned movements only and extra movements will not be available. Manual operation is also required to control the robot and due to this chance of error is high. We are overcoming this problem by controlling robotic arm with the EEG signals.

V. PROPOSED SYSTEM

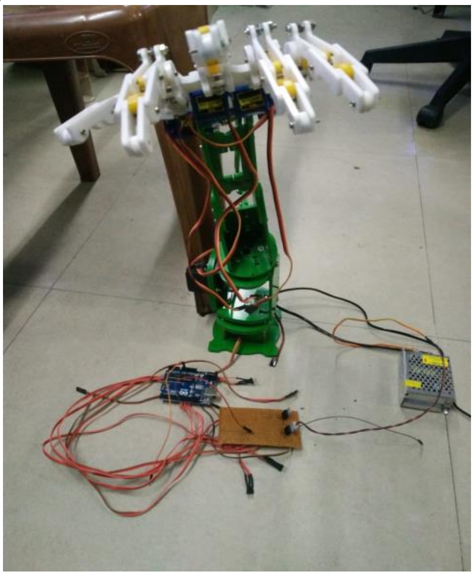
In proposed system, we are overcoming the drawback of the existing system where there are two sections 1) user section and 2) robotic section. In user section EEG electrode is used to read the brain wave signal of the user and the received signal will be continuously monitored by the microcontroller. Then the microcontroller will send the readings to the robotic section through the WSN nodes. In the robotic section the received WSN signals are send to the microcontroller and according the received signals from the user EEG signals. The robotic elbow and the robotic finger mechanism will act according to the EEG signals. By this method we are able to control the robotic elbow and elbow finger mechanism with the user’s brain waves.

A. Database Development

Database is developed by receiving various forms of EEG signals from different people. For this first the people is informed to imagine the work which the arm has to perform and the related EEG signals are stored. Similarly, for various works range of EEG signals are collected and the most repeated signal is used as control for robotic arm.

B. System Accuracy

System accuracy can be improved by taking large number of experimental results. Longer the duration of the input signal higher the accuracy. The accuracy can also be increased by using MRI scans. The patient is informed to imagine the defined activity. With the help of MRI scan the particular part of the brain which is active can be identified. Placing the electrode directly above the active surface increases the accuracy.



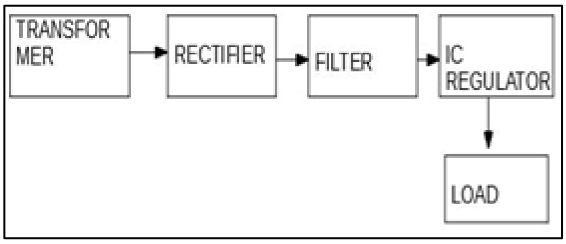
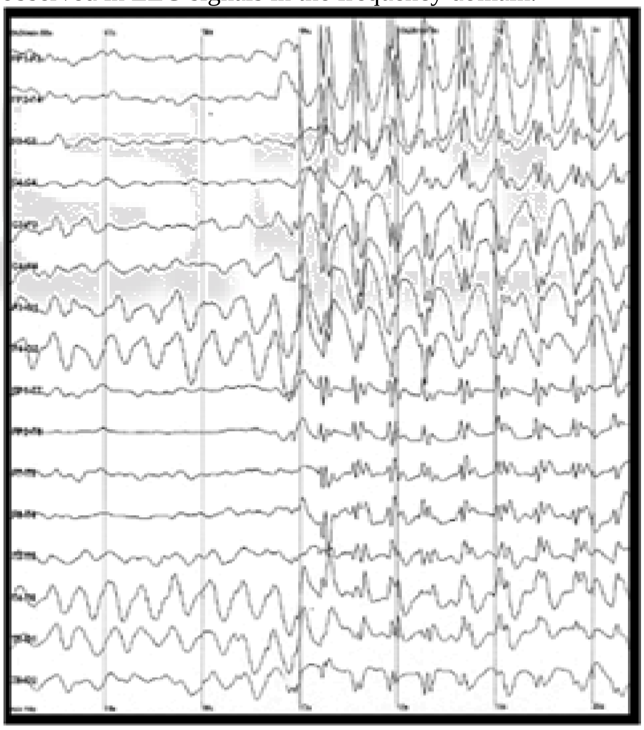


Fig. 2: Block Diagram of Power supply

Electroencephalography (EEG) is an electrophysiological monitoring method to record electrical activity of the brain. It is typically non-invasive, with the electrodes placed along the scalp, although invasive electrodes are sometimes used, as in electrocardiography. EEG measures voltage fluctuations resulting from ionic current within the neurons of the brain.[1] Clinically, EEG refers to the recording of the brain's spontaneous electrical activity over a period of time, as recorded from multiple electrodes placed on the scalp.[1] Diagnostic applications generally focus either on event-related potentials or on the spectral content of EEG. The former investigates potential fluctuations time locked to an event, such as 'stimulus onset' or 'button press'. The latter analyses the type of neural oscillations (popularly called "brain waves") that can be observed in EEG signals in the frequency domain.



VI. EXPERIMENTAL RESULTS

The robotic arm picks and places the object according to the brain waves. It depends upon the frequency at which the arm receives which is based on the concentration of the brain .It ca hold things of light weight and it can place the objects at a particular place. It can even move horizontally to both left and right sides.

VII. CONCLUSION AND FUTURE WORK

The current work is based on the 7 degree of freedom robotic arm .The future work is to enhance accuracy and to make a prosthesis robotic arm. It cannot hold objects of heavy weight. This drawback can be eradicated in the future work and also it can be developed to help many industries also.

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