EEG BASED BRAIN CONTROLLED PICK AND PLACE ROBOTIC ARM

[1]Dipali Pansare , [2]Prof. Puranik V.G.

[1]Student of University Of Pune, [2]Professor,
[1] Electronics & Telecommunication Engineering,
[1]JSPM ,BSIOTR, Pune, India.

Abstract : BCIs Brain computer interface are systems that can bypass conventional channels of communication to provide direct communication and control between the human brain and physical devices by translating different patterns of brain activity into commands in real time. This system describes about EEG based brain controlled pick and place robot .The robotic arm is controlled through egg sensor .The key lies in the mapping of the EEG signal to the robotic arm to achieve the objective .This system demonstrates the application for disabled people and Industry automation.

***IndexTerms* - EEG Sensor, Embedded platform, communication module, image acquisition module, BCI-Brain computer interface.**

I. Introduction

Controlling a computer with one's mind may sound like science fiction, but brain-computer interfaces currently exist, and innovative research is rapidly expanding the level of control that is achievable. Researchers, psychologists, artists, and others have been experimenting with non-invasive brain- computer interfaces that read brain signals with an electroencephalogram (EEG). EEG-based brain- computer interfaces use sensors placed on the head to detect brainwaves and feed them into a computer as input. EEG-based interfaces are being used for a wide range of applications. Clinical psychologists employ brain interfaces to treat a number of conditions, including attention deficit hyperactivity disorder (ADHD), epilepsy, and alcoholism. Researchers are creating brain-interfaces to aid disabled users who are unable to use typical computer interfaces.

ROBOTS have been not only widely used in industry, but also gradually entering into human life. Assistive robots can provide support for disabled people in daily and professional life, thus creating a growing demand for them. In general, healthy users can operate the robots with a conventional input device such as a keyboard, a mouse, or a joystick. These devices are, however, difficult to use for elderly or disabled individuals. The brain controlled robot basically works on the principle of capturing the brain wave signals utilizing it for the movement of robot. Two main classes of brain-controlled robots to assist disabilities are brain-controlled manipulators and mobile robots. One representative work of brain controlled manipulators is the manipulator used within the FRIEND system developed by Graser which is able to show the brain controlled capabilities of robots out of a controlled laboratory situation. Brain-controlled mobile robots can be divided into two categories according to their operational modes. One category is called "direct control by the BCI," which means that the BCI translates EEG signals into motion commands to control robots directly. The basic idea of BCI is to translate user produced patterns of brain activity into corresponding commands.

A typical BCI is composed of signal acquisition and signal processing (including preprocessing, feature extraction and classification). Although some BCI systems do not include all components and others group two or three components into one algorithm, most systems can be conceptually divided into signal acquisition, preprocessing, feature extraction, and classification The brain signals that are widely used to develop EEG-based BCIs include P300 potentials, which are a positive potential deflection on the ongoing brain activity at a latency of roughly 300ms after the random occurrence of a desired target stimulus from non-target stimuli the stimuli can be in visual, auditory, or tactile modality SSVEP, which are visually evoked by a stimulus modulated at a fixed frequency and occur as an increase in EEG activity at the stimulus frequency and the event-related de synchronization (ERD) and event-related synchronization (ERS), which are induced by performing mental tasks, such as motor imagery, mental arithmetic, or mental rotation.

II. METHODOLOGY

2.1 System Overview

The sensor is use for sensed brainwave signal. Different image processing step is performing in Matlab software. USB to serial converter is used to connect signals from PC to microcontroller. The Data transmitted by the Mindwave headset will be received by the Computer's Bluetooth receiver. And then all these data will be analyzed by the Matlab. The Matlab will help in extracting the raw data. In the MatLab the data will be received from the port pin which they are giving the same port number for the Bluetooth receiver and Matlab in the back panel. After the analysis of this data, this data will be sent to the robot module for perform pick and place operation.

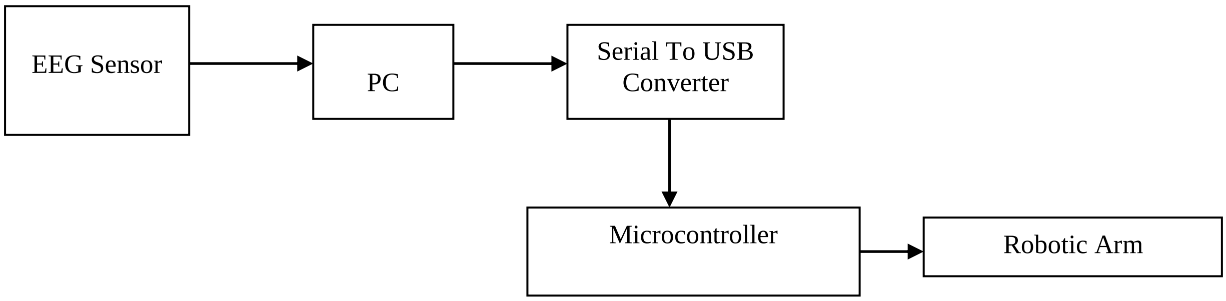


Fig1. Block Diagram of system

2.2 Image Processing

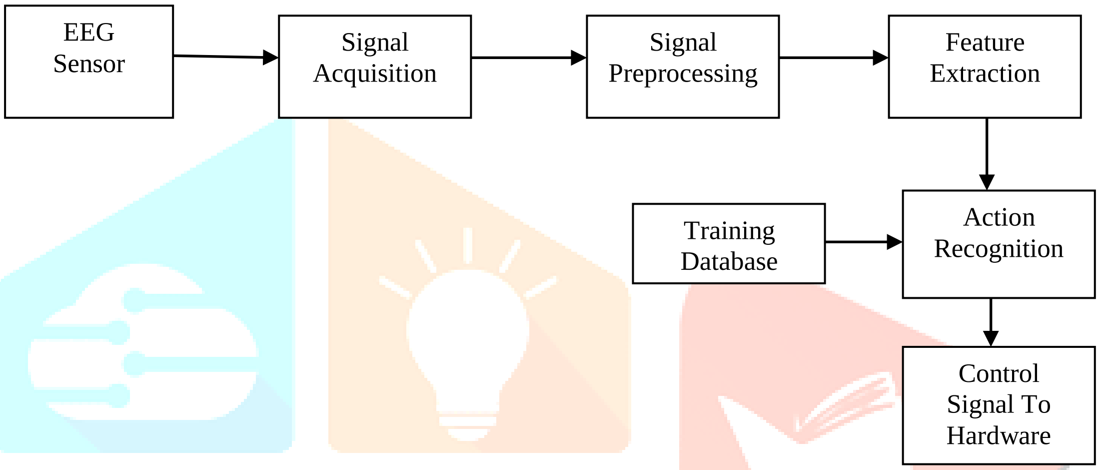


Fig.2.Image processing Part

3.2.1 Signal Acquisition

Signal Acquisition is first step in signal processing. Here one is brainwave headset provided by Neurosky , is used to sense the brainwave signal. This EEG signal is passed to the signal preprocessing step.

3.2.2 Signal Preprocessing

The acquired signals are first preprocessed in order to remove artifacts such as power line noise, electromyogram (EMG), electrocardiogram (ECG), electrooculogram (EOG), and body movement. Features, such as the inputs to the classifier, are then extracted from the preprocessed signals. Finally, the classifier translates these extracted features into commands that subjects desire to output .The simplest and most widely used method to remove artifacts is filtering including low-pass, high-pass, band-pass, and notch filtering, which is appropriate to remove line noise and other frequency-specific noise such as body movement.

3.2.3 Feature Extraction

Feature extraction starts from an initial set of measured data and builds derived values (features) intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps, and in some cases leading to better human interpretations. Feature extraction is related to dimensionality reduction.

When the input data to an algorithm is too large to be processed and it is suspected to be redundant (e.g. the same measurement in both feet and meters, or the repetitiveness of images presented as pixels), then it can be transformed into a reduced set of features (also named a features vector). This process is called feature selection. The selected features are expected to contain the relevant information from the input data, so that the desired task can be performed by using this reduced representation instead of the complete initial data .To make classifiers of BCI systems have good performance, features that can significantly distinguish different classes are extracted. Features that are applied to BCI systems of brain-controlled robots can be divided into two main categories: features in time domain, which are typically amplitudes of event-evoked potentials, and features in frequency domain, which are typically frequency power spectra of EEG signals that can be estimated.

III. IMPLEMENTATION

3.1 Hardware Used

3.1.1 EEG Sensor

The MindWave Mobile headset turns your computer into a brain activity monitor. The headset safely measures brainwave signals and monitors the attention levels of individuals as they interact with a variety of different apps. This headset is useful for OEMs and developers building apps for health and wellness, education and entertainment. The Mindwave Headset which is provided by Neurosky Technologies and those signals will be transferred by using Bluetooth which is there in the Mindwave headset, for this Mindwave headset need to give power using a battery.

Fig 3.Mindwave Headset provided by Neurosky

3.1.2 PIC Micro-controller

PIC is a family of modified Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to Peripheral Interface Controller. The rst parts of the family were available in 1976; by 2013 the company had shipped more than twelve billion individual parts, used in a wide variety of embedded systems.

3.1.3 Robotic Arm

Robotic arm consist of 5 servo motors used to move the fingers of the arms. The PIC microcontroller will help to control the servo motors. The fingers are controlled by attention and meditation levels. When the predefined levels are acquired the microcontroller will take the respective actions to move the fingers of the robotic arm.

3.1.4. USB to Serial converter

A superior minimal effort USB to UART interface permitting you to speak with TTL serial gadgets, for example, microcontroller UART's utilizing your PC. The module has a silicon labs CP2102 based gadget and a helpful pin header which incorporates a 5V and 3.3V supply. TX and RX information pins are at 3.3V TTL levels. Virtual COM port drivers are accessible for Windows, Mac, Linux, and Android working frameworks.

3.2 SYSTEM SOFTWARE

MATLAB‟s Graphical User Interface Development Environment (GUIDE) provides a rich set of tools for incorporating graphical user interfaces (GUIs) in M-functions. Using GUIDE, the processes of laying out a GUI (i.e., its buttons, pop-up menus, etc.)and programming the operation of the GUI are divided conveniently into two easily managed and relatively independent tasks.

Matlab Platform:

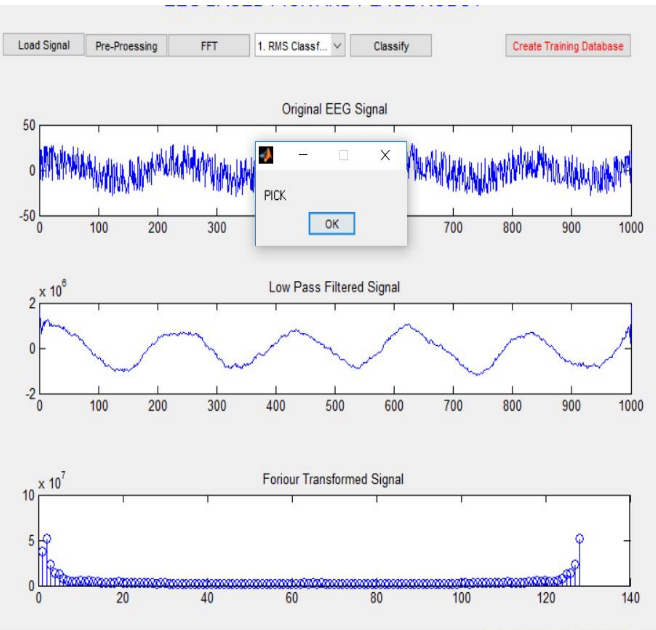
The MATLAB allows to include thinkgear.dll. This environment has broad support in toolbox, which makes it ideal for a scientific research. This paper presents how recording and processing the raw EEG signal in MATLAB environment using Mind Wave sensor. The Communication Protocol, shows a system of digital rules for message exchange between MATLAB environment and MindWave device

The Communications Protocol:

The proposed communications protocol is a system of simple rules for message exchanges between MATLAB and the EEG device. It consists of 7 basic steps, which are presented in following steps.

1) Load ThinkGear library into MATLAB
2) Get a connection ID handle to ThinkGear
3) Attempt to connect the connection ID handle to serial port "COMx"
4) Waiting to establish the connection
5) Read packets from the connection
6) Close the connection
7) Unload ThinkGear library.

III. RESULT



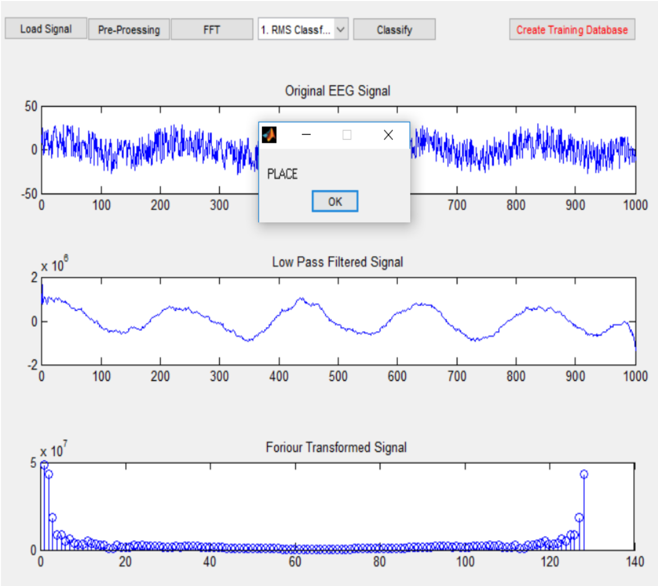


Fig 4 Screenshot of the recorded data is for PICK Signal

Fig 5 Screenshot of the recorded data is for PICK Signal

V. ACKNOWLEDGMENT

This project discussed about a brain controlled robot based on Brain–computer interfaces (BCI). BCIs are systems that can bypass conventional channels of communication (i.e., muscles and thoughts) to provide direct communication and control between the human brain and physical devices by translating different patterns of brain activity into commands in real time. With these commands an object can be picked and placed in any environment. This project will become an assistive technology for disabled people in future.

VI. REFRANCES

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