ISSN No:-2456 –2165

Deploying P-300 EEG Based Signals for Mobile Robots

God'spower Pius Agbulu, Elamaran.E
[1]Department of Electronics and Communication Engineering,
SRM University, Chennai-603203, Tamil Nadu, India.

Abstract—The aim this study is to analyze the different brain wave signals based on a non-invasive brain computer interface called electroencephalogram (EEG) and however use the generated output for control of a robotic car in different directions. The Brain - computer interface is a communication scheme that may well evade distinctive communication channels to provide a platform linking the devices and the human brain in real-time by converting diverse brain activity patterns into instructions. However, by this generated signal a robot can be controlled in different directions. Motivated by risingneed for disabled people, the goal of this paper is to make available and intelligent non-invasive brain computer interface solution, which acquires different brain signals without direct contacts; incisions and surgeries as involved in invasive and partially invasive BCIs, resulting in scar tissues as well as weaker signal generation. Meditation, attention and blink signals aremade for which the generated outputs are used for control of the robotic car in different directions. The generated results can on the other hand be used for control of other devices such as robotic-arm, wheel chairs and cursors on the computer screen.

Keywords:- BCI, Invasive, Non-invasive, Partially- invasive, EEG.

I. INTRODUCTION

For decades, there has been an escalating significance in the control of our computer systems using brain signals. BCI schemes have prospective application in diverse in real cutting across neuroprosthetics, gaming as well as practical realismand a communication intermediary for paralysis, patients. A practicable and eminent approach for brain signal acquisition is the non-invasive electroencephalogram BCI scheme having a comparatively low cost in comparison to other brain signal recording techniques. A brain-computer encompasses signal processing, acquisition, classification and extraction of features. Though several systems of brain computer interfacing don't clinch every cluster element into a single rule, the majority of systems is basically separated into signal classification preprocess, extraction of features acquisition, and feature extraction [1-4].A focus on Electroencephalogram extracted features for brain computer interfacing mind tasks is made here. Neuronal action at definite spatial location leads to specific psychological tasks. Knowledge of the state of user's alongside the tasks carried out gives the necessary sequence for design background susceptible systems that adapt themselves for user optimization. The extensively used brain signals for electroencelogram based brain-computer interfacing incorporates a P300-speller abilities, which rate of occurrence is not relative to the physical features of a stimulus, but human's response. This loom towards the possibility for control of a robot which must accurate movements in various directions using the acquired brain wave signals [6-10].

II. PROPOSED METHODOLOGY

This system comprises of extraction of features, classification of brain signals, pre-processing Interfacing and the production of Control signal. The proposed system is imposed in a proficient way. It has a propensity to mind controlled robot mobile robots in a dual class dependable with their modes of operation.A part of the class involves "express running by the brain-computer interface," which implies that the brain computer interface scheme translates graphical recorded brain signals into command actions.]. The illustrated module uses based motor imagery for control of the robot in different directions, combining, blinks, and meditation and attention signals for control of the robot in forward, reverse, left, right directions as well as device control using a neurosky mind wave headset for the acquisition of the brain wave signals.

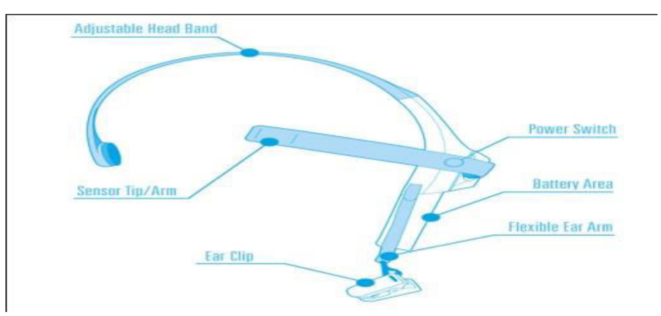
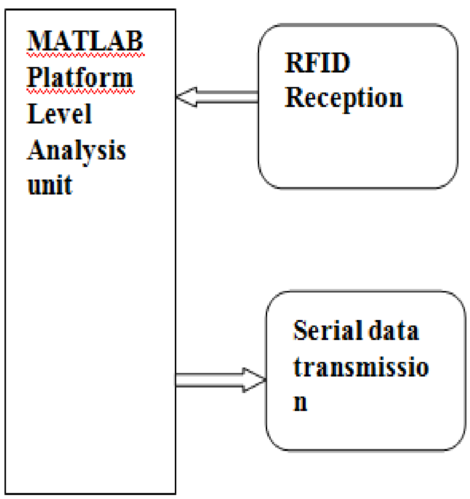


Fig1 Neurosky Mind wave Headset

As depicted in figure 1 above, the neurosky mind wave headset transmits the generated brain wave signals using Bluetooth. It has a Bluetooth dongle for reception of the transmitted brain waves at the receiving end. The mind wave headset incorporates a power switch, flexible ear clip, sensor Tip/Arm and has an adjustable headband. It has sensors which detect the brain signals in a noninvasive wave without a direct contact with the brain, which may result in scar tissue or weaker signal acquisition when the body reacts with external objects. When powered a red LED glows and when connected, a blue LED glows indicating it's been paired.



RFID Processing Unit

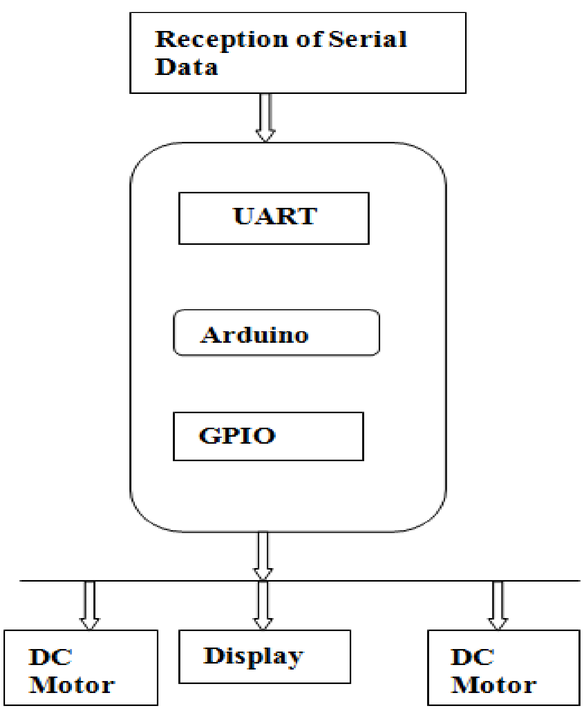


Fig 2.System Block Diagram

When the mindwave headset is paired with the Bluetooth dongle, the generated brainwave signals are received at the level analyzer unit, where a graphical representation of the various frequencies of the brain signals which triggers the movement of the robot in various directions is shown in the MATLAB environment. The serial is transmitted from the level analyzer unit and received by the robot via a Zigbeetransceiver for the control of the robot in the differential directions. Frequencies of Brain WavesThe electrical activities in the human brain changes, depending on the specific activity carried out by the person. A specific brainwave will be dominant depending on the person's mental state.

Brainwaves	**Frequency(HZ)**	**Amplitude(Micro Volts)**
Alpha	8-13	20-200
Beta	13-30	5-10
Delta	1-5	20-200
Theta	4-8	10
Gamma	40-70	0.5-2

Table 1: Five Types of Brain Waves

A. Positioning of Electrodes

The position of the electrode is named corresponding to the area of the brain beneath the scalp area, namely; parietal, sulcus, frontal, occipital and temporal. The electroencephalogram signal is acquired from scalp electrode pair in bipolar area. The electrode pairs read the potential difference above the brain, while the third electrode is positioned on the ear lobe as a reference ground.

B. P300-Based Event

It is a stimulus occurring at irregular intervals, however important when stimulated induces a distinctive response in a person electroencephalogram. BCI's recognize a Succession of choices chosen by a user through the use of this signal. A user's preferred choice user evokes an immense P300. The existence, timing and topography, of this signal are often deployed as metrics in the process of decision making after stimuli the P300 wave occurs at an interval of 250-800millisecond.

III. HARDWARE IMPLEMENTATION

For implementation of the hardware, an Arduino UNO microcontroller based on the Atmega 328p is used. Its functionality is based on the downloaded sketch writing in the integrated development environment. For the system prototype two 12V, 1000rpm DC motors are incorporated driven by LD293D driver IC, each having the capabilities of driving each of the DC motors in both clockwise and anti-clockwise directions simultaneously. A wireless Zigbee transceiver is interfaced for transmission of the generated output from the level analyzer unit(LAU) and reception by the robot for its movements in various directions. The robot can be controlled in the range of 100meters outdoor and 30meters India at a standard frequency of 2.4GHZ.

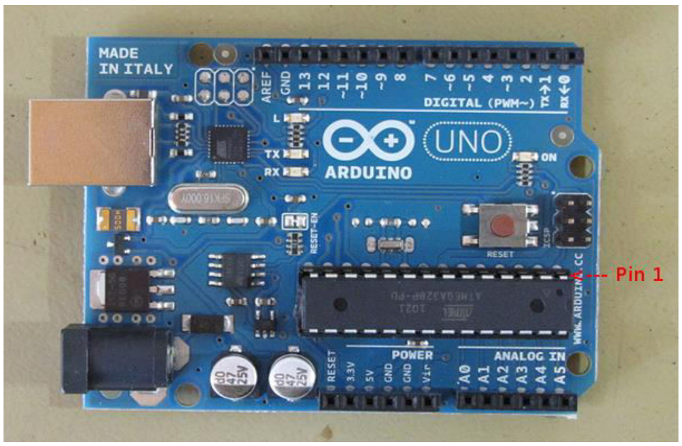


Fig 3.Arduino Microcontroller

IV. SOFTWARE IMPLEMENTATION

For the software Implementation of the system, the process's signal from the MATLAB, for the control of the robot is controlled in different directions using Arduino microcontroller and the open source integrated platform. The movement of the robot in various directions is dependent on the MATLAB output. As shown in table 1, the motion of the robot is dependent on the BCI action.

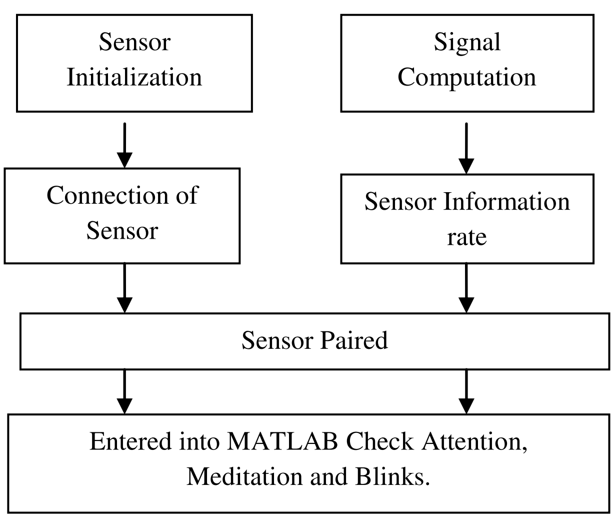


Fig 4. Flow Diagram of the Design

V. EXPERIMENTAL RESULTS

A presentation of the results generated is made in this section. The motion of the robot has controlled a person's mental state. The attention and meditation levels increase for higher blinks resulting in increased motion, but prone to increased error rates. By varying the reference level, optimum accuracy can be achieved. As shown in table 2,The motion of the robot ids dependent upon the BCI activities.

Control Outputs	Motion of Robot	BCI Activities
0	Forward Direction	Inactive
1	Right Direction	Right Wink
2	Left Direction	Left Wink
3	Device Control	Blink

Table 2: Robot Controls and Commands

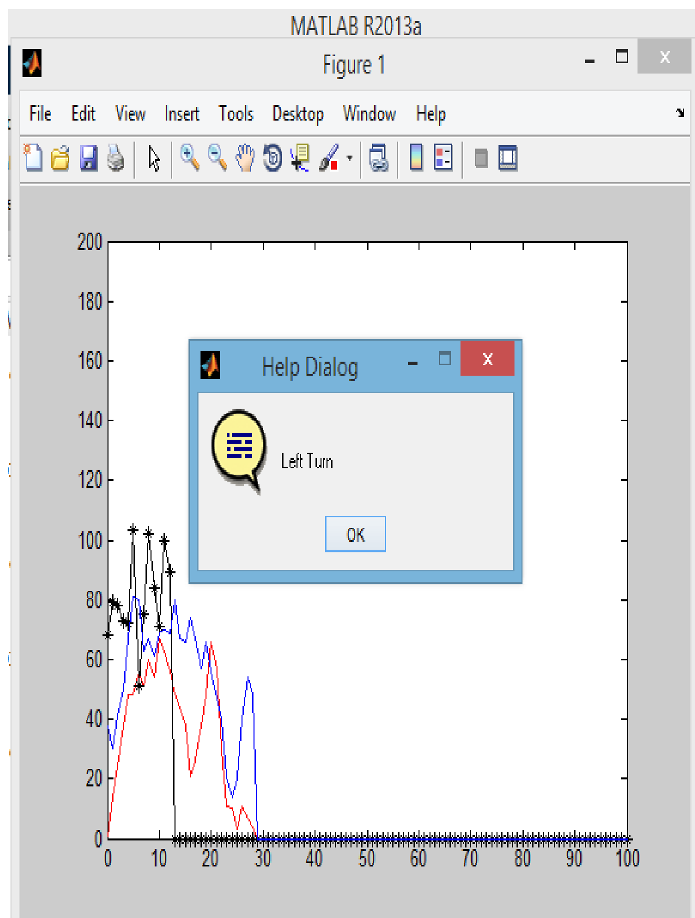


Fig 5. Robot Left Movement

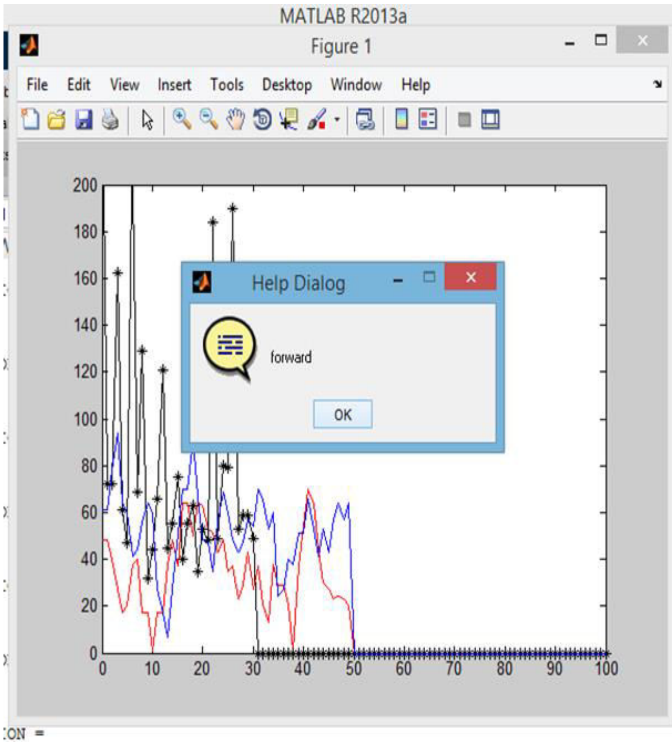


Fig 6.Robot Forward Movement

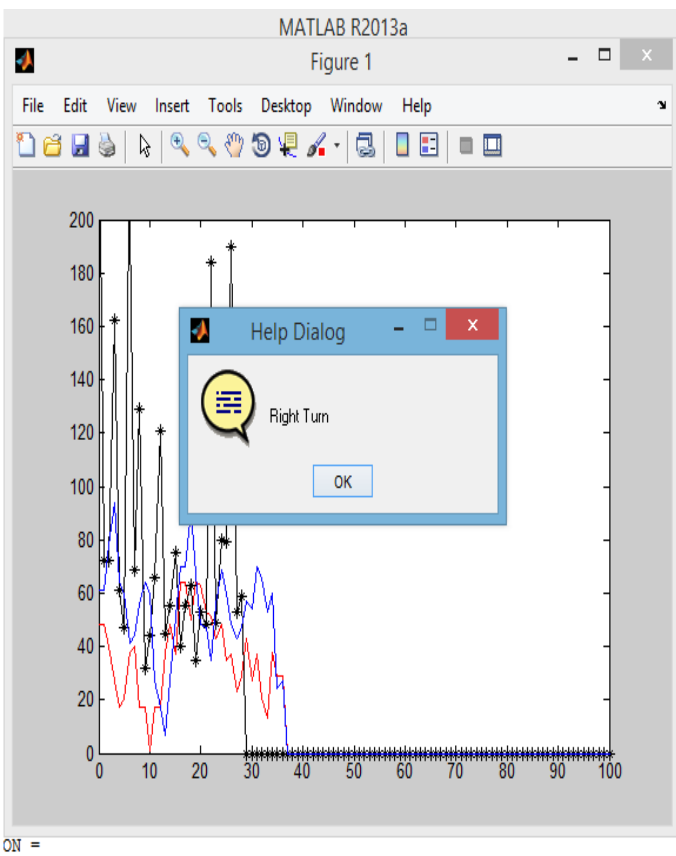


Fig 7 .Robot Right Movement

Fig.8. System Prototype

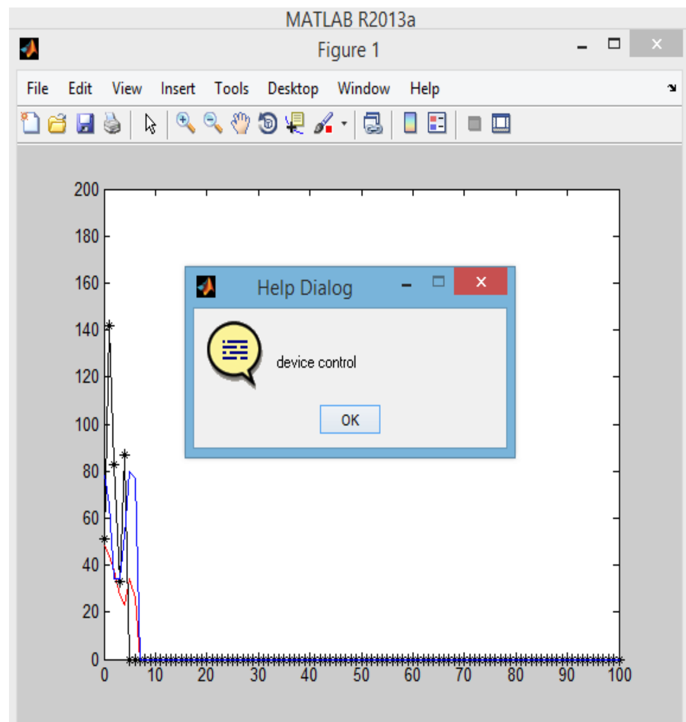


Fig 9.Device Control

VI. CONCLUSION

In this work, a non-invasive brain computer interface based on P-300 electroencephalogram was presented and implemented to control of a robot in various directions. It was shown that stronger brain signals can be acquired without incisions or sufferers prone to scar tissues and the generation of weak signals. The generated results can be used for control of other devices including wheelchairs to assist people with disabilities as well as control of cursors on our computer screen. The developed system shall be advanced for control of multiple robots.

VII. ACKNOWLEDGMENT

I would like to express my special gratitude to Mr. Elamarn. E, for his guidance and constant supervision as well as providing necessary information regarding the project also for his support in completing this project.

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