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DRIVING USING BRAIN COMPUTER INTERFACE

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ABSTRACT

This paper covers the execution of a non-invasive electroencephalography-based brain computer interface to con- trol the movements of a simulated vehicle. The system consists of a Neurosky EEG headset, a node js backend server which connects to the headset using bluetooth and a simulated car for showing the results on a web browser. The possibilities of BCI systems are addressed in this research, as well as a survey on how to extend and improve the reliability and accuracy of BCI systems. A organised review of the data collecting, feature extraction, and classification algorithm methodologies employed by various researchers in recent years was presented. Adaptive classifiers, tensor classifiers, transfer learning method, and deep learning, as well as some other approaches, are some classification algorithms for EEG-based BCI systems. Based on our findings, we believe that, as compared to static classification approaches, adaptive classifiers provide more accurate results. [1]. A simulated car will be used to demonstrate the progress.

Keywords: Brain Computer Interface (BCI), Electroencephalography (EEG), Convolutional Neural Network (CNN).

I. INTRODUCTION

Ongoing advancement in human-PC correspondence frameworks has shown that controlling articles with the brain is suitable past the sci-fi antique. Progressed electrophysiological recording methods currently consider observing of the actual cycles inside the mind, opening boundless open doors in the field of mind PC interfaces (BCIs).

Driven to some extent by developing cultural acknowledgment for the requirements of individuals with actual in capacities, mind PC interfaces permit for errands that would customarily rely upon fringe nerves and muscles to rather be performed utilizing mind action a few models exist that empower clients to control wheelchairs, consoles, and PC games exclusively through cerebral exercises detected with electroencephalography.

Specific examples of mind movement in a client's EEG signs can be ordered utilizing signal handling and example acknowledgment methods, permitting an individual activity to be performed in light of the application.

II. LITERATURE REVIEW

The BRAIN-COMPUTER INTERFACE (BCI) technology allows physically impaired persons to interact with the outside world by using brain impulses instead of peripheral muscles and nerves. Because of its cheap cost, portability, and ease of use, electroencephalography (EEG) is the most often used technique for recording brain waves in practical BCI. Several types of EEG-based BCI applications have been established to operate a wide range of devices in order to make impaired people's lives easier. One of the most intriguing applications is BCI-based transportation, which may be implemented by operating various mobile robots using brain signals. Several aspects of EEG signals have been employed as control instructions in BCI, including steady state visual evoked potentials (SSVEPs), P300 event related potentials (ERPs), and motor imagery (MI) potentials.

III. PROBLEM STATEMENT

BCIs provide a way to assess consciousness and re-establish communication. BCI is vital and effective for people with ALS, spinal cord damage, and brain-stem stroke, among other conditions. As a result, quicker, more reliable BCI systems that function for a wider range of prospective users are required. Individuals with severe motor limitations require an easy-to-use, cost-effective machine interface. Existing systems are either very complicated, require surgery, or aren't yet completely developed.

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IV. SCOPE

Brain interface technologies utilised now need explicit conscious thought, but anticipated future applications are intended to function seamlessly. In contrast to the classic BCI concept, which entails inserting a mechanical system in the brain, which further tries to control it asa normal part of the body, research has been focused on non-invasive BCI. Empowering individuals with serious engine impedances admittance to everyday gadgets like telephones, PCs, wheelchairs, prosthetics by making a modest, simple to utilize Brain Machine Interface .BCIs are intended to supplement, help, or restore sensory-motor or human cognitive processes. It brings together technology from electrical engineering, computer science, biomedical engineering, and neurology.

V. OBJECTIVES

- Our objective is to explore various non-invasive brain computer interfaces and propose potential new techniques and improvements to existing systems.
- To demonstrate our work we will be applying the knowledge we gain during this study to make a Brain controllable car.

VI. EXISTING SYSTEM

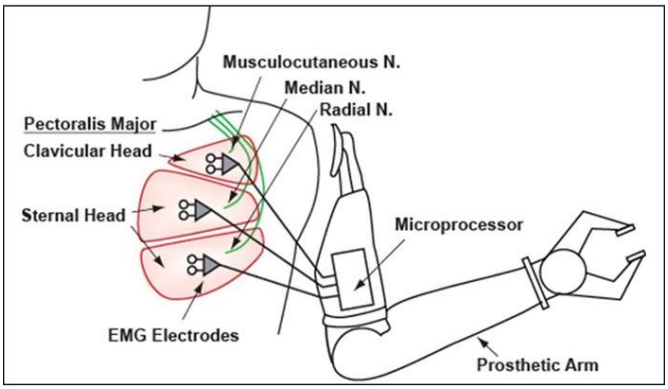

Fig 1: Prosthetics, EMG reading devices

In this existing system, This is a diagram of an existing system, in EMG(Electromyography Sensor), electrodes are placed on major muscles to read the neural activity the signals are send to a onboard microprocessor to process and then an onboard microcontroller will move the prosthetic arm.

Existing system drawbacks:

1. It is only used on the superficial muscles.
2. There is no conventional electrode positioning.
3. User's movement patterns may be affected.
4. The detection region may not reflect the complete muscle.

VII. PROPOSED SYSTEM

We propose to make wearable headset with 3 contact points:

1. Forehead - Great location to read frontal lobe activity of the brain
2. Side of the brain (near the ear) - Ideal to read temporal lobe activity
3. Ear lobule - to detect pulse

Memory, emotions, impulsive behavior, problem solving, social interaction, and motor performance are all controlled bythe frontal lobe. [3] The temporal lobe is primarily important for the formation and maintenance of both conscious and long-term memory. [4] Pulse is used to calculate concentration and meditation levels.

1. Headset will have 3 metal electrodes as contact points to catch minute brain activity in the form of electric signals. Thisdata will be amplified by an onboard amplifier chip.
2. This data will be cleaned upon amplification by an onboard filter circuit.
3. The filtered data will be segmented into various channels.

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4. The headset will have an onboard arduino microprocessorto do these operations.
5. It will generate up to 8 channels of raw EEG data with 12bit Raw-Brainwaves (3 - 100Hz) at up to 512 Hz sampling rate.
6. This headset will then send the raw data to a computer (raspberry pi) via Bluetooth.
7. The computer will apply classification and detect the actionintent.
8. Lastly the detected action will be forwarded to the simulatedcar.

VIII. METHODOLOGY

Electroencephalography - Electroencephalography (EEG) is an electrophysiological monitoring method to record electrical activity of the brain. [5] Electrodes are usually placed along the scalp; however intrusive electrodes are occasionally used, such as in electrocorticography, often known as intracranial EEG. EEG estimates voltage changes coming about because of ionic flow inside the neurons ofthe brain. Clinically, EEG alludes to the recording of the cerebrum's unconstrained electrical action throughout some undefined time frame, as recorded from numerous terminals put on the scalp. Indicative applications frequently focus on either event-related possibilities or the phantom material of EEG.

CNN (Convolutional Neural Network) - A CNN is a type of artificial neural network designed specifically to analyse pixel input and utilised in image identification and processing. A Convolutional Neural Network is a Machine Learning algorithm that can take in an information image, assign importance (learnable loads and predispositions) to distinct angles/objects in the image, and then distinguish one from the other. When compared to alternative arrangement computations, the pre-handling expected in a ConvNet is significantly reduced. While channels in crude approaches are hand-designed, ConvNets can learn expertise with these channels/qualities with enough preparation.

IX. IMPLEMENTATION

In the implementation of this project we constructed a node js backend server for this project, which connects directly to our headgear, which detects signals straight from the brain. These signals are divided into eight channels, after which theyare divided into two categories: meditation and attentiveness. Signals received by attentiveness show how focused we areon our job, whereas signals received by mediation show how peaceful and lazy we are. As a result, when we considerdriving a car, our attention level rises. When the simulated car's attentiveness level hits 80, it is given the instruction togo ahead.

X. SOFTWARE AND HARDWARE REQUIREMENTS

Hardware Requirements:

EEG Headset - Mindwave Mobile 2 : An EEG headset isa wearable gadget for electroencephalography, an observing technique to record the electrical action of the cerebrum. EEG sensors in headsets place cathodes along the scalp to recognize mind movement. Breaking down EEG information upholds the investigation of mental cycles. Specialists can utilize EEG to analyze clinical issues. Specialists can utilize this technique to comprehend cerebrum processes. People can utilize EEGto work on their usefulness and health by means of checking their dispositions and feelings.

Raspberry Pi: We have used Raspberry Pi 3B for controllingthe car which will get instructions directly from EEG Headset.

Fig 2: EEG Headset

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Hardware Requirements:

NodeJS : Node.js is a back-end JavaScript runtime environment that runs on the V8 engine and executes JavaScript code outside of a browser. Developers may use Node.js to construct command-line tools and server-side scripting, which entails running scripts on the server before transmitting the page to the user's browser.

Web Browser: A web browser is a piece of software that lets you access information on the internet. Whenever a client requests data, the web browser accesses a web server and presents it on the client's screen. When a client requests a page from a website, the internet browser requests the material from a web server, which is subsequently displayed on the client's device. An internet browser is not the same as a web index, yet the two are frequently confused. A online search tool isa website that links to other websites. However, in order to connect to a website's server and view its website pages, a client must have an internet browser installed.

XI. RESULTS

Fig 3: Brain Drive Application

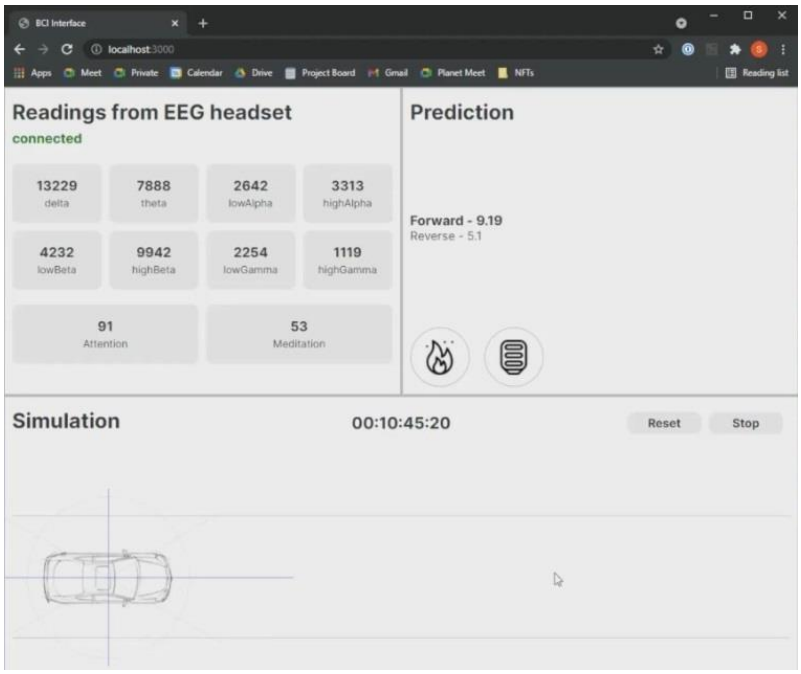

Fig 4: Brain Drive Application

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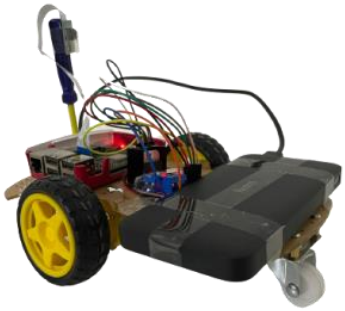

Fig 5: Raspberry Pi Car

The figure 3 depicts the connection between EEG headset and node js back-end server through Bluetooth. Here eight channels of brain signals are received and shown in real-time using web-socket. There is a meditation meter which calculates meditation levels and attention meter which calculates attention levels. There is a section showing which shows prediction and direction. Bottom section represents the simulated car which is moved.

The Figure 4 depicts the values of the 8 channels of data received from using EEG Headset and attention as well as meditation values. As attention value reaches above 80 the simulated car is given the command to move forward.

XII. FUTURE SCOPE

1. This system can be improved; more intents can be added with a higher resolution sensor.
2. We can pair this system with an AI assistant where the AI will avoid any errors, inaccuracies.
3. Medicine: BCIs (brain-computer interfaces) are becoming more and more dependable, altering the lives of patients, particularly those with paralysis or comparable disorders.
4. BCI technology can be used to control movements of a prosthetic limb or to translate thoughts to text.
5. It's the next generation of User Interface after Touch and Voice.

XIII. CONCLUSION

Brain Computer Interface is a growing technology with a lot of potential in medical applications. Non-invasive BCI in particular can become a cheap alternative to controlling prosthetic devices. Though this technology is still in its initialstages it has promising results. After referring various IEEE papers and research articles on Brain Machine Interfaces we come to the conclusion that Electroencephalography can satisfy our need for an easy to use, cheap to produce Brain computer Interface technique.

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