International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 04 | Apr 2021 www.irjet.net p-ISSN: 2395-0072

NEUROCONTROLLED WHEELCHAIR USING ARDUINO UNO*i*

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Abstract*—This paper describes the concept of a Smart, Motorized, Brain controlled wheelchair. Improving the quality of life of seniors and persons with disabilities and ensuring proper care for them is one of our most important tasks, as we all are members of the society. The manner in which a mechanical wheelchair is generally used for locomotion it is not easy for disabled people. Therefore, the design of a smart and easy manoeuvrable wheelchair is important. Hence, there is a need for designing a wheelchair that is intelligent and provides easy manoeuvrability. A progress has been put to propose a thought-controlled wheelchair that uses the brain and eyes recorded signals and processes them to operate the wheelchair. The brain–computer interfaces (BCIs) offer a promising solution to this interaction problem and in this article we present a shared control architecture that couples the intelligence and desires of the user with the precision of a powered wheelchair. Electroencephalographic (EEG) technology deploys an electrode cap mounted on the user's scalp for the purchase of EEG signals which the arduino microcontroller captures and transforms into commands for movement, and moves the wheelchair as well.*

***Keywords*— Brain Computer Interface (BCI), Neurons, Brainwave sensor, Wheelchair, Electroencephalogram (EEG), NeuroSky and Arduino. +**

I. INTRODUCTION

There are many issues faced by disabled people in accessing disability support services. When undertaking a clinical assessment of a wheelchair user's performance in a certain environment, all factors that influence wheelchair mobility must be carefully considered and recognized as having a potentially significant impact on the wheelchair provision. We have generally noticed that mobility of a disabled person is a big challenge in hospitals and even in their homes. There is no such provision till date for disabled people to move around. So we decided to make an "BRAIN / NEURO CONTROLLED WHEELCHAIR." [1]

Many patients are unable to control the powered wheelchair using conventional interface and also, they are deemed incapable of driving safely. Paralysis is the acute and chronic inability to use part of the body. In vast majority of cases, paralysis is due to damage to the nervous system and not due to damage to the affected area. Injury in the central or lower parts of the spinal cord can affect basic functioning. For example, it disturbs function below the injury, even if the actual structures are safe enough to move the feet or feel their movements, even if they are completely intact. One of the following signs resulting in patients is that brain cannot transfer signal to a body portion because of the brain injuries. Signals can be transmitted to the body only when the brain is stable. The BCI can provide the user's brain with a clear connection, communication and interaction with the computer.

BCI offers a new way of creating an interactive device which will allow the user to communicate with the outside world in a free movement manner based on the human channel brain waves and muscles. A BCI device can only convert EEG signals through system hardware and software from a representation of brain activity into user behaviour.[2]

The Objectives of the project are to reduce user afford in controlling the wheelchair:-

1 To make sure the movement is safe.

2 Low-cost wheelchair with open source software.

3 Webcam recording of the person's behavior in real time.

4 The device design should be user portable.

5 To assemble a wheelchair with best safety system to avoid accidents and protect user from injuries.

II. PROBLEM STATEMENT

Disabled individuals face many obstacles when it comes to receiving disability support services. When conducting a clinical assessment of a wheelchair user's success in a certain environment. All factors influencing wheelchair mobility must be carefully identified and considered as potentially having a major effect on wheelchair provision. In general, we've found that a disabled person's mobility is a major obstacle in hospitals and even at home. Even if an individual is physically impaired but mentally capable, he can use his thinking capacity to shift the wheel chair to his/her liking.

III. PROPOSED SYSTEM

The system proposed is a wheelchair system that can be freely controlled via electroencephalogram signals.

1. NeuroSky Mind wave Mobile 2(BCI)
2. Arduino UNO
3. Ultrasonic Sensor
4. L298 Motor Driver Module

5. REES52-HC-05(Bluetooth Module)
6. Motor
7. Battery(Power Source)
8. Switch
9. GPS

The brain signals are classified based on their frequency EEG signal acquisition is done with the help of a specially designed non invasive bio sensor which is shown in Figure 1. And the acquisition part shown in Figure 2 consists of Nuerosky mindwave, Arduino and Bluetooth module

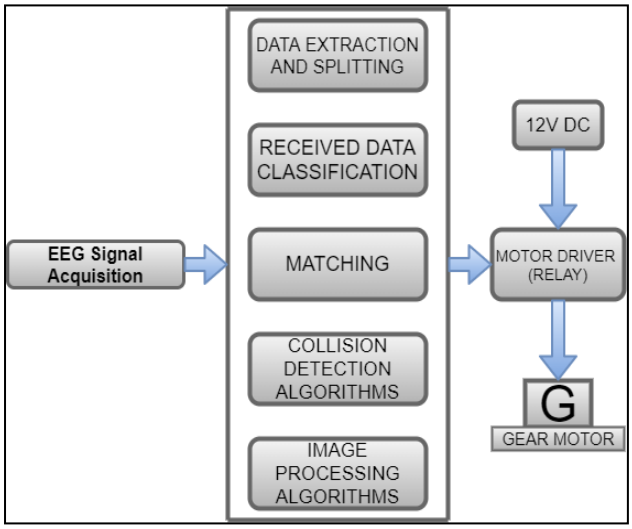

Figure 1. Basic Block diagram of Brain controlled wheel chair

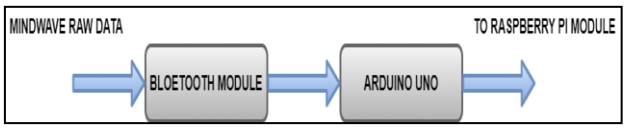

Figure 2. Acquisition part

IV. BRAIN COMPUTER INTERFACE

BCI-basedcontrol of wheelchair.

The BCI system contains an Emotiv headset connected to a computer. Sensors provide information on a computer. The computer uses signal processing and classification which is connected to a microcontroller that controls the movement of the wheelchair. A wheelchair can move in four directions. The speed of the wheelchair is considered constant and the wheelchair can be turned on and off if necessary. Considering the above performance, the BCI system uses the following commands: go forward, go backwards, turn left, turn right, and then turn on and off the button. Adoption unit, signal development unit, feature output unit, split unit, and action unit that controls wheelchair engines.

The main units of the decision-making system are represented in Figure 3. In the signal acquisition block, EEG signals are taken using the Emotiv headset. Emotiv EPOC is an EEG headset that provides EEG data for 14 channel .Our system uses high-end face-to-face command instructions; as most Emotiv sensors are located in the frontal cortex, they are the most reliable signals one may find. The EEG input signals are sent to the filtering and measurement signal development unit and further sent to the feature block. In this block, the basic features are extracted and sent to the segmentation system. The partition block processes input signals and issues control commands. Later, these control orders are sent to the wheelchair.[3]

The NeuroSky EEG Headset has to be placed on the patient's head.[4] Different parts of the headset is shown in Fig.1

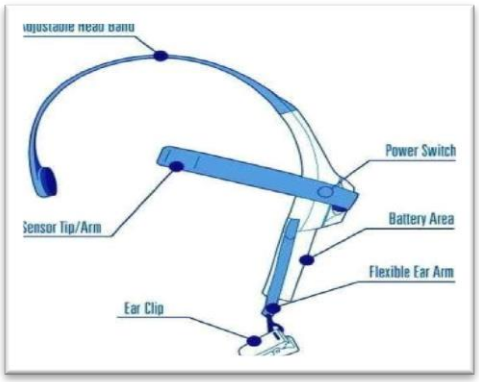

Figure 3. Neurosky headset.

This non-invasive BCI system implemented here collects the brain waves using dry electrodes placed on the forehead of the patient, exactly at the FP1 location of the 10-20 electrode system as in the way shown in Figure.4

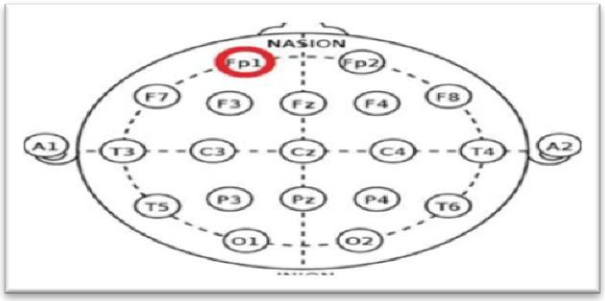

Figure 4. Single dry electrode (Fp1) placement of NeuroSky headset.

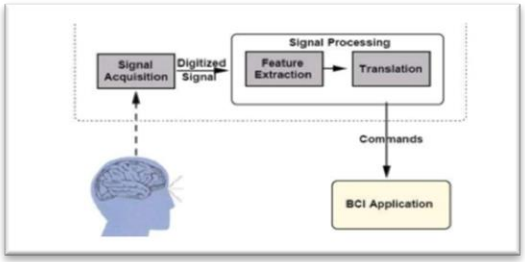

Figure 5. Block diagram of BCI

V. SAFETY SYSTEM

• Ultrasonic Braking System

The main implication of the ultrasonic braking system is that, the wheelchair must be braked automatically when the sensors feel an obstacle. This is an automotive technology to detect impending collisions with another vehicle or obstacle, and to disassemble the vehicle properly, made by the brake circuit. This system includes two ultrasonic viz sensors. Ultrasonic wave emitter and Ultrasonic wave receiver. An ultrasonic wave emitter, delivers to the front part of an automatic braking system, generates and emits ultrasonic waves at a predetermined distance in front of the vehicle. Ultrasonic wave receiver is provided in front of the wheelchair. It receives the ultrasonic wave signal reflected from the obstacle. The reflected wave (heart detection) is measured to find the distance between the vehicle and the obstacle. According to the pulse detection details, The PIC microcontroller is then used to control the servo motor and the servo motor which automatically controls the vehicle. Therefore, this new system is designed to solve a problem where drivers will not be able to brake directly by the time required, but the car will still be able to stop automatically by perceiving obstacles to avoid an accident.

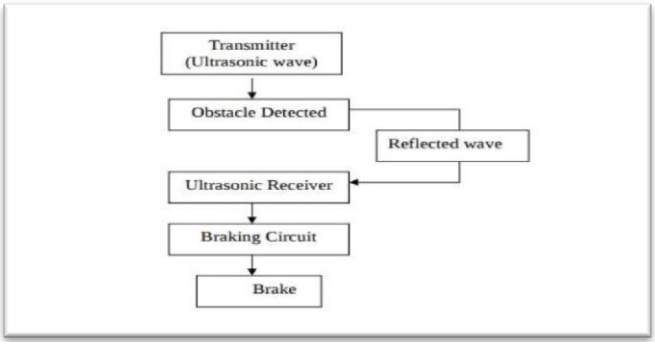

Figure 6. Ultrasonic Braking System

• GPS Tracker

A GPS tracking unit is a device, usually carried by a moving vehicle or person using the Global Positioning System (GPS) to track the movement of an app, from time to time, and determine its location, and its controller. Recorded location information can be stored within the tracking unit, or it can be transferred to a central location database, or a computer connected to the Internet, using mobile phones (GPRS or SMS), radio, or satellite modems installed on this unit. This allows the location of the asset to be displayed on the back of the map in real time or at the time of track analysis, using GPS tracking software. Data tracking software is available for smart phones with GPS capability.

Figure 7. GPS

VI. IMPLEMENTATION PLAN

The construction and implementation component can be classified as-

• Capture brain signal using NeuroSky head set.

• Establishment of Blue-tooth interface HC-05 with head set and Arduino.

• Car control method- To scan the brain signal using the NeuroSky head.

• To control the robot traffic, EEG signals are required. This paper describes the EEG signals using the NeuroSky interface. In this system, we have signal strength: provides EEG power, low and supplied with small volts (μV).

• Signal frequency: The different types of frequencies in the EEG brain are: Delta, Theta, Alpha, Beta and Gamma with different frequencies and these are produced in distinct parts of the brain.

An EEG signal from the brain is used to produce the Brain-Computer Interface (BCI) of the key component that controls the robot car via Bluetooth HC-05. We use a Neurosky headset that gives us signals like meditation and attention. EEG signals from the brain are sent using If the sensors detect any obstacle or vehicle within this range the brake is applied automatically and the speed is reduced. A family member of a wheelchair user can see the person's location or location using his/her cell phone.

VII. FUTURE SCOPE

1. Instead of a single channel in architecture, multiple channels may be used to make more effective decision.

2. In future a display can be interfaced, most likely a monitor. The display has a pre-programmed slideshow and animation that depicts a disabled person's everyday needs. It will have different sliding options such as water, hunger, medication, and sleep.

3. Processing times can be minimized by using specialized processors. The system is simple to set up and can be designed in a user-friendly manner. The user only needs to pick a destination and deal
with any unexpected circumstances that might occur.

4. The wheelchair travels along the same path over and over, and its motion is predictable, allowing the user to relax during the movement.

5. Research should be carried out with disabled people who require this form of technology because they can respond differently to the healthy users.

6. Artificial Intelligence, Machine Learning along with Sensors Can be used to design a self driving wheel chair.

VIII. CONCLUSIONS

EEG can monitor brain changes over the course of a person's life without disrupting them. We face many health issues in our everyday lives as a result of environmental changes, for which we often depend on hospitals. EEG can identify and diagnose the majority of neural disorders. The mind wave headset monitors the electric movement of the brain, and the wheelchair moves in accordance with the level of mind concentration or meditation. The aim of this project is to create an interface between the human brain and an electric wheelchair using a portable EEG brainwave headset and firmware signal processing and filtering. This project aims to create a low-cost solution that will ultimately be sold as an add-on conversion unit for a traditional wheelchair. The technology of "mind powered wheelchairs" has progressed. Mind efficiency Controlled wheelchairs have proven to be a successful method of providing independent mobility to a wide variety of users who are unable to operate a powered wheelchair system independently. This paper summarized some of the results from EEG studies. Sequential combination has many benefits when one BCI is used as a switch or multiple BCIs are sequentially used for various tasks. Combined sequentially, complex tasks may be delegated to a number of levels. A particular BCI can be used for each level. A virtual environment framework is an example of this approach.[6]

IX. Acknowledgements

We thank all the volunteers for their participation in the study. The Success and final outcome of this project required a lot of guidance and assistance from many people and we thankful to them. Thank You.

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