International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

EEG Based Brain Controlled Wheelchair with Emergency Assistance for Physically Challenged People

Chandana N S[1], Punyashree M[2], Sahana S[3], Dr. Babu N V[4]

[1,2,3]Students, Department of Electrical and Electronics Engineering, SJB institute of Technology Campus, Kengeri Bengaluru-560060, Karnataka, India. [4]Professor and Head, Department of Electrical and Electronics Engineering, SJB institute of Technology Campus, Kengeri, Bengaluru- 560060, Karnataka, India.

ABSTRACT

Brain-Computer Interfaces (BCIs) have become a rapidly growing area of research, offering a unique opportunity for individuals to communicate and interact with the environment using their brain signals. This work proposes a BCI system that utilizes advanced signal processing algorithms to extract relevant features from EEG signals, allowing accurate and reliable control. The goal of this work is to develop a brain-controlled wheelchair system that allows individuals with mobility impairments to operate a wheelchair using their brain signals. The system will use a Neuro-Sky EEG sensor to detect the user's brain signals, which will be processed using signal processing algorithms to extract relevant features. These features will then be used to classify the signals into specific commands for the wheelchair, such as "move forward" or "turn left". The system will be designed to be user-friendly and easy to operate, with a simple interface and intuitive controls. The effectiveness of the system will be evaluated based on its accuracy, response time, and user satisfaction. By developing a brain-controlled wheelchair system, the aim of this work is to provide individuals with mobility impairments greater independence and mobility, enhancing their quality of life.

Keywords: BCI, EEG signals, signal processing algorithm

1. INTRODUCTION

Brain-Computer Interfaces (BCIs) have emerged as a promising technology that enables individuals to control external devices using their brain signals. BCIs can provide a means of communication and control for individuals with motor disabilities, such as those with spinal cord injuries, cerebral palsy, or amyotrophic lateral sclerosis. In addition, BCIs can be used for other applications, such as cognitive enhancement, neuro-rehabilitation, and entertainment.

EEG signals, which are the electrical signals generated by the brain, are the most common type of signals used in BCI systems. EEG signals reflect the biological and physiological characteristics of the brain and are the result of the electrical activity of the brain's neurons. EEG signals are non- invasive and can be acquired using sensors placed on the scalp.

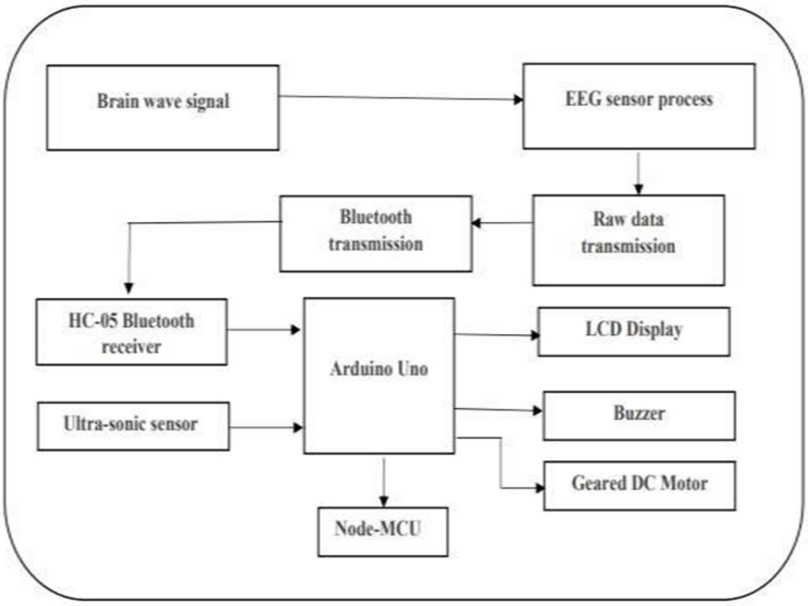
The Neuro-Sky EEG sensor is a widely used sensor for BCI applications due to its low cost, portability, and ease of use. The Neuro-Sky sensor is a single-channel EEG sensor that measures the electrical activity of the brain at the forehead using dry electrodes. The Neuro-Sky sensor provides real-time raw EEG signals and has been used in various BCI applications, such as controlling a wheelchair, playing a video game, and typing on a virtual keyboard.

2. COMPONENTS

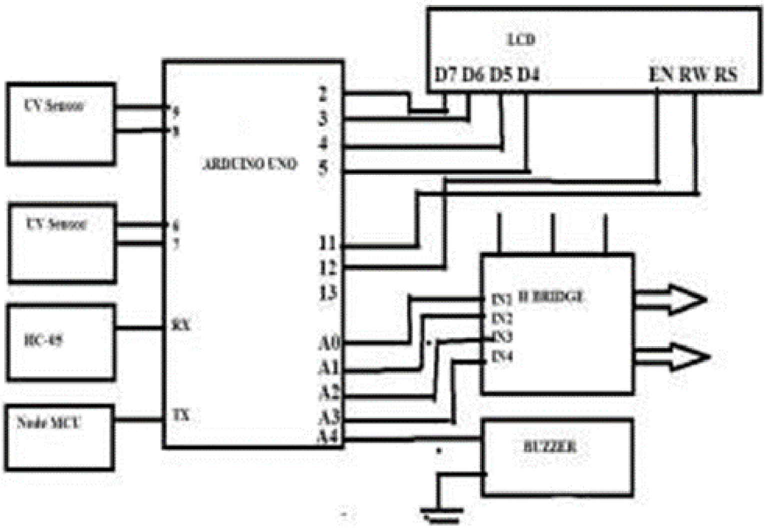
SL.NO	COMPONENTS	QUANTITY
1	EEG Sensor	1
2	Arduino Uno	1
3	Jumper wires	50
4	Geared DC Motor	2
5	H-Bridge	1
6	LCD Display	1
7	Node MCU	1
8	Buzzer	1
9	Regulated Power Supply	1
10	Lead acid battery	1

11	Ultrasonic sensor	2
12	HC -05 Bluetooth module	1

3. BLOCK DIAGRAM



4. CIRCUIT DIAGRAM



5. MODEL DESCRIPTION AND WORKING

In the developed intelligent brain-controlled wheelchair system, the acquired brain signal is classified using frequency range as a feature. For the classification purpose, the well-known) Brain visualizer is application is used to obtain frequency. The signals are classified into four features: less than 40 Hz, 41 - 50 Hz, 51 – 60 Hz, 61 -70 Hz ,71 – 80 Hz and greater than 81 Hz to indicate stop, left ,right, forward, and reverse, respectively. Therefore, the classified signals in the form of four directions are used for controlling the wheelchair direction movement. The wheelchair also equipped with two ultrasonic sensors (one in the front of the wheelchair and one in the back if the wheelchair). If any obstacle is detected with in a range of 30cm the wheelchair stops. The node MCU is used to send message to caretaker via telegram in case of emergency. After few seconds of delay if the signals are obtained the process is continued.

The results of the image classification are denoted as a type of intelligent brain controlled wheelchair. As shown in Block diagram. The developed Arduino as a main controller is employed to identify whether there is a serial data sent. If the sent data is existing, then the command in the data variable will be read. Finally, both the command on Data1 and Data2 are executed in to a PWM signal that serves to specify the geared DC motor rotation speed of the intelligent brain-controlled wheelchair.

The developed Arduino as the main controller periodically receive the distance information from two ultrasonic sensors to maintain a safe distance between brain-controlled wheelchair and wall in addition, definite interrelations exist between α and γ to observe continuous changes in the mental state of human brain, the frequency range α and γ activities is calculated.

The data of alpha wave and beta wave obtained from Neuro-sky headset is sent to the Bluetooth module interfaced with the wheelchair. In this work, HC-05 Bluetooth module has been used for receiving data and for processing data and sending command for operation of the wheelchair Arduino Uno development board has been used. HC-05 Bluetooth module and Arduino Uno development board.

When the patient wants to move, the Arduino on the wheelchair checks the state of the attention level of patient by analysing the brainwave data received from headset through Bluetooth wireless communication. If the attention level is from 0% to 40% the wheelchair will stop, if from 41% to 50% it will turn left, if from 51% to 60% it will turn right if from 61% to 70% it will turn forward, and if the attention level is greater than 71% the wheelchair will move backward.

A. TANSMITTER SIDE

EEG (Electroencephalogram): EEG sensors are used for recording signals from our brain. During the procedure, electrodes consisting of small metal discs with thin wires are pasted onto the scalp. The electrodes detect tiny electrical charges that result from the activity of the brain cells. The electrode consists of positive, negative and neutral electrodes as in Figure 1.

Figure 1. Single electrode (Neuro sky)

HC-05 Bluetooth Module: It is used to obtain and process information and send the instructions to function the wheelchair. The baud rate of Bluetooth in EEG is paired with baud rate of HC-05 Bluetooth module, to 57600 baud rate.

Brain computer interface: It is a computer based system that acquires brain signals, analyze them and translate them into command that are relayed to an output device to carry out the desired action. During the brain computer interface, the charges are amplified and appear as a graph on the computer screen. By using brain wave visualizer.

B. RECEIVING SIDE

Arduino UNO: An Arduino is a small microcontroller platform with a USB serial interface. In this case, it serves as a bridge between the Wheelchair and the interface circuit. Set of instructions are given to Arduino using Arduino IDE software. Certain frequency values have beenset in the program to move the wheelchair in forward, backward, right, left direction and stop.

L293d motor driver shield: Motor driver shield is interfaced with Arduino UNO to control the motor direction of a DC motors. It can drive 4 DC motors at the same time, H-bridge principle is used for the direction control of the DC motor.

6. AT COMMANDS

AT + UART = 57600, 0, 0 AT + ROLE =1

AT + PSWD = 0000 OR 1234 AT + CMODE = 0

AT+ BIND =ADDRESS OF BRAIN WAVE SENSOR 0000, 00, 000000 (UNIQUE NUMBER)

AT + IAC = 9E8B33 AT + CLASS =0

AT + INQM = 1,9,48

7. RESULT AND APPLICATIONS

To control the electric wheelchair in different directions (forward, reverse, left and right) by using brain signals obtained from the EEG sensors Figure 2. This project is user friendly design to meet real world target reaching tasks, where users may need to turn the wheelchair in left or right direction in steps and then moves to forward. In the typical setting as moving forward, turning left/right, there is a good chance of examining all combinations of commands, such as non- control & control, move forward & stop, turn & move forward, just as in real wheelchair control. When the patient wants to move, the Arduino on the wheelchair checks the state of attention level of patient by analyzing the brain wave data received from the headset through Bluetooth wireless communication. We are proposing the attention level of the wheelchair from 0% to 40% - wheelchair does not move as show in Figure 3; 41% to 50% - it will turn left; 51%to 60% - it will turn right; 61%-70% - it will turn forward; 71%-100% - it will move backwards.

APPLICATIONS

The advantages of thought-controlled wheelchairs are that they respond to commands much faster and that patients who have lost the ability to speak may utilize them. Users wear an EEG cap, which monitors their brain activity. Helpful for completely paralyzed person and does not depend on others to operate, No conduction gel required for the electrodes, Wireless control, less interference due to encoding techniques.

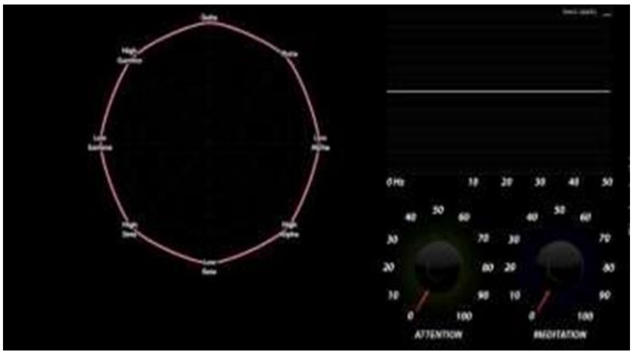


Figure 2. Brain wave signals during attention

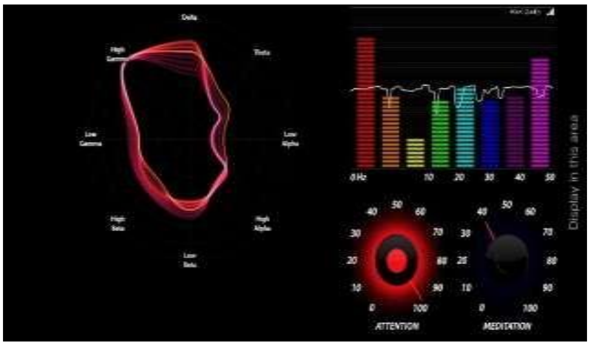


Figure 3. Brain wave signals for stop.

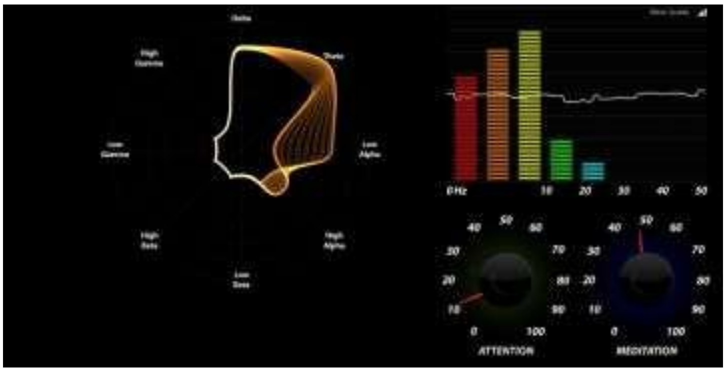


Figure 4. Brain wave signals for backward direction.

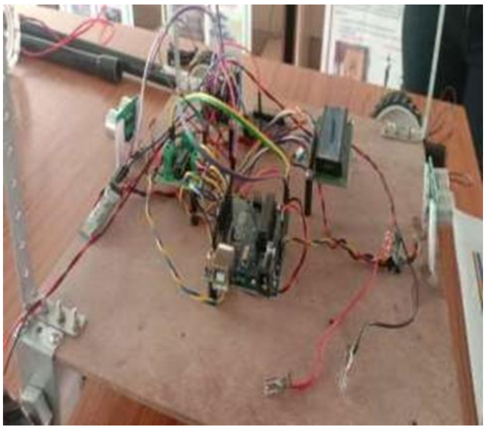


Figure 5. connection of circuit of wheel chair

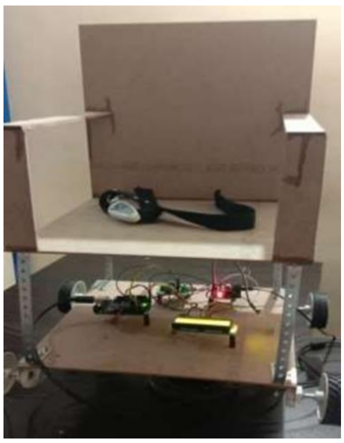


Figure 6. Prototype of wheel chair

CONCLUSION

Assistive technology: EEG-based brain-controlled wheelchairs are a type of assistive technology that can greatly improve the mobility and independence of individuals with physical disabilities. Brainwave detection: These systems use an EEG headset to detect electrical signals from the user's brain, which are then translated into commands that control the wheelchair's movement. Control schemes: There are different control schemes for EEG-based brain-controlled wheelchairs, including machine learning algorithms that predict the user's intended movements, and simpler schemes that allow the user to move the wheelchair in specific directions by focusing on certain mental tasks.

REFERENCES

1) M. Sumit Desai, S.S. Mantha, V.M.Phalle, “Advances in smart wheelchair technology” IEEE Published in: 2017 International Conference on Nascent Technologies in Engineering (INCTE). https://ieeexplore.ieee.org/document/7947914.

2) Maryam Amur Khalfan AI Shabibi ,Suresh Manic Kesavan,”IOT Based Smart Wheelchair for Disabled People”. IEEE Published in 2021 International Conference on system, Computation, Automation and Networking(ICSCAN). https://ieeexplore.ieee.org/document/9526427.

3) Keerthi Kumar M ,Chaitra Rai, Manisha R, Priyanka C B, Syeda Saniya Anis,” EEG Controlled Smart Wheelchair for Disabled People”. IJERT Published in 2019 Conference Proceedings.

4) Gagandeep Singh Siledar , Prof. Sarita Verma,”Brain Controlled Wheelchair using EEG Headset “ IJERT Published in Dec 2021 ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429 Volume 9 Issue XI.

5) Dabosmita Paul and Moumita MukherjeeAutomation of wheelchair using brain computer interface(BCI). https://doi.org/10.1063/1.5090244.

6) Noelle Marie D. Espiritu, Senrong AinsleyC. Chen, Tiffany Ann C. Blasa, Francisco Emmanuel T, Munsayac Rebecca P Arenos, and Renann G. Baldovino, Nilo T. Bugtai and Homer S. “Design of an EEG-based Brain Controlled Wheelchair for Quadriplegic Patients.”

7) Ahmed Maksud, Rakibul Islam Chowdhury, Tanima Tasmin Chowdhury, Shaikh Anowarul Fattah, Celia Shahanaz, Sayeed Shafayet Chowdhury Department of Electrical and Electronics. “Low-cost EEG Based Electric Wheelchair with Advanced Control Features.”

8) Sharbafi M. A., Lucas C., Daneshvar R. Motion control of omni-directional three-wheel robots by brain-emotional-learning-based intelligent controller. IEEE Transactions on Systems, Man and Cybernetics. doi: 10.1109/tsmcc.2010.2049104. – DOI.

9) Shi T., Wang H., Zhang C. Brain Computer Interface system based on indoor semi-autonomous navigation and motor imagery for Unmanned Aerial Vehicle control. Expert Systems with Applications. 2015;42(9):4196–4206. doi: 10.1016/j.eswa.2015.01.031. - DOI.

10) Carlson T., Leeb R., Chavarriaga R., delR Millan J. The birth of the brain-controlled wheelchair. Proceedings of the 25th IEEE/RSJ International Conference on Robotics and Intelligent Systems (IROS '12); October 2012; Vilamoura, Portugal. pp. 5444–5445.

11) DOI.Rebsamen B., Guan C., Zhang H., et al. A brain controlled wheelchair to navigate in familiar environments. IEEE Transactions on Neural Systems and Rehabilitation Engineering. 2010;18(6):590–598. doi: 10.1109/TNSRE.2010.2049862. - DOI – PubMed.

12) Iturrate I., Antelis J. M., Kübler A., Minguez J. A noninvasive brain-actuated wheelchair based on a P300 neurophysiological protocol and automated navigation. IEEE Transactions on Robotics. 2009;25(3):614–627. doi: 10.1109/TRO.2009.2020347. – DOI.