IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁘ Peer-reviewed & Refereed journal ⁘ Vol. 13, Issue 4, April 2024

DOI: 10.17148/IJARCCE.2024.134219

MUSCLE SIGNAL CONTROLLED WHEEL CHAIR

ANGEL V [1], BHAVANA [2], CHINNA NAIK [3], HARICHANDANA MADINENI [4], SRIDEVI MALLIPATIL [5]

Student, Department of Computer Science and Engineering, Rao Bahadur Y Mahabaleswarappa Engineering College, Ballari-583103 [1-4]

Assistant Professor, Computer Science and Engineering, Rao Bahadur Y Mahabaleswarappa Engineering College Ballari-5831035 [5]

Abstract: This project discusses about a brain controlled wheel chair based on Brain–computer interfaces (BCI). BCI"s 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. The intention of the project work is to develop a robot that can assist the disabled people in their daily life to do some work independent of others. Here, we analyze the brain wave signals. Human brain consists of millions of interconnected neurons, the pattern of interaction between these neurons are represented as thoughts and emotional states. According to the human thoughts, this pattern will be changing which in turn produce different electrical waves. A muscle contraction will also be generating a unique electrical signal. All this electrical waves will be sensed by the brain wave sensor and the different pattern is used for controlling a wheel chair.

Keywords: Brain-computer interfaces (BCI), Wheelchair control, Brain wave signals, Real-time control ,, EEG sensor technology.

I. INTRODUCTION

Paralysis is the inability whether temporary or permanent to move a part of the body. In almost all cases, paralysis is due to nerve damage, and it is not because of injury to the affected region. For instance, an injury in the middle or lower regions of the spinal cord is likely to disrupt function below the injury, including the ability to move the feet or feel sensations, even though the actual structures are as healthy as ever. Because of this in patients at least one of the following symptoms results. The brain is unable to relay a signal to an area of the body due to injuries to the brain. Brain-Computer Interface (BCI) also known as "direct neural interface" can provide a direct communication and interaction channel between the user"s brain and the computer. BCI helped to direct in assisting, augmenting, or repairing human cognitive or even sensory-motor functions. BCI provides a new direction to construct an interactive system which can translate human Channel based on brain waves and muscles to allow users to communicate without movement with the external world. A BCI system is just to translate EEG signals from a reflection of brain activity into user action through system's hardware and software.

II. LITERATURE SURVEY

1) The paper "Brain computing interface for wheel chair control" by R. S. Naveen; Anitha Julian, published in 2013 Fourth International Conference on Computing, Communications and Networking Technologies (ICCCNT) and the publisher was IEEE. Brain-computer interfaces (BCIs) or mind machine interface (MMI) is the direct communication path between brain and external devices. Currently it is difficult for the persons suffering from stokes, amyotrophic lateral sclerosis (ALS) can lead to complete paralysis. Therefore the BCI system may be used to improve the quality of life of such patients. In this paper we overcome this challenge by introducing a BCI system which helps the patient to navigate the wheelchair from one place to another based on motor imagery model to control a brain actuated wheelchair. This allows the user to control the direction for four movements left turn, right turn, forward and backward movement, of the simulation or real wheelchair. Experimental trials are to be conducted to assess the BCI control; both a simulated

International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.102 ⫶ Peer-reviewed & Refereed journal ⫶ Vol. 13, Issue 4, April 2024
DOI: 10.17148/IJARCCE.2024.134219

wheelchair in a virtual environment and a real wheelchair were tested. The system will be realised as a standalone hardware unit and will be tested in the field.

2) The paper " Extracting and discriminating selective brain signals in non-invasive manner and using them for controlling a device: A cost-efficient approach to brain computer interface (BCI)" by Md. Arif Abdulla Samy; Md. Mirazur Rahman; Tafsir Ahmed Khan published in 2016 3rd International Conference on Electrical Engineering and Information Communication Technology (ICEEICT) and the publisher was IEEE. The interface through which a human brain establishes links with external devices is generally called Brain Computer Interface. Although there are some significant amounts of ongoing researches on how an overall efficient BCI can be developed are going on, making a cost-efficient approach while dealing with limitless brain patterns is found to be more challenging. In this work, feasibility of a cheaper but appropriate way of extracting and discriminating of several non-invasive EEG signals and using those for controlling devices such as a wheel chair has been proved. To assist the argument of this project, numerous experimental data has been processed to produce several signals, such as, right turn, moving forward, stop etc. for the wheel chair. In the experiment the above mentioned three signals were well distinguished from each other. A microcontroller has been used for processing the signals collected from the brain and hence sending to the wheel chair controlling motors. Despite the challenges of dealing with very low but noise sensitive brain signals, their limitless patterns, and limited scope of necessary circuitries, this work has opened up the scope of feasibility of BCI technology in practical life with a simpler and easier approach.

3) The paper "Scheming Electrical Wheel Chair by Sensing Brain GDTAB Waves of Physically Challenged & Hamstrung People" by M. Suresh Kumar; P. Shanmugapriya; Naveen Kumar S; Aouthithiye Barathwaj SR Y; Sai Ganesh CS, published in 2020 International Conference on Power, Energy, Control and Transmission Systems (ICPECTS) and the publisher was IEEE. Communication have paved a long way towards Human Brain interfacing or interpretation with computers. This can be used especially by people facing disability problems, who are dependable for their movement. By using EEG to record Brain wave signals based on GDTAB and transcoding them for the movement of the disabled person which enhances independency for their motion. The main aim is to develop quick and authentic connection between Human brain and the wheel chair based on Zigbee module and Non-Invasive brain computer interface (BCI).

4) The paper "EMG-based Control of Wheel Chair" by M Wajahat Sohail Gondal; Noman Naseer; Afzaal Ahmed Khan; Ayesha Salman; Qasim Nisar; published in 2022 13th Asian Control Conference (ASCC) and the publisher was IEEE. According to statistics, 18.93 % suffer from physical disabilities out of 3.28663 million disabled people in Pakistan. Also, studies around the globe indicate that most of the world‟s population has physical disabilities. Researchers proposed the wheelchair as an efficient solution to assist these individuals in conducting daily life activities. This paper focuses on processing electromyography (EMG) signals to control the wheelchair. A braincomputer interface (BCI) based system is developed following the conventional steps of data acquisition, signal processing, feature extraction, and classification to generate control commands. Data collection is done from six subjects, followed by signal pre-processing and feature extraction in the time and frequency domain. Finally, the extracted features are classified using linear discriminant analysis, support vector machine, decision tree, and quadratic discriminant analysis. The maximum accuracy of 81.5 % is achieved using quadratic discriminant analysis. The control commands are then used to control the wheelchair.

5) The paper " Towards a Brain-Computer Interface based control for next generation electric wheelchairs" by S-.Y. Cho; A. P. Winod; K.W.E. Cheng, published in 2009 3rd International Conference on Power Electronics Systems and Applications (PESA) and it was published by IEEE. This paper presents an idea of building a brain-computer interface (BCI) based control for next generation electric wheelchairs. The aim is to explore the area of research on BCI based control to potentially develop a next generation of electric wheelchair which is able to benefit to paralyzed patients. This EEG interfacing development controls a wheel chair through a skid steering method. The mechanical part including the conventional steering can be eliminated. It also uses differential speed that controls the propulsion and turning. The system is neat, low cost and high dynamic performance; it can be used for stoke patent or disabled patents.

6) The paper "Optimal channel selection using covariance matrix and cross-combining region in EEG-based BCI" by Yongkoo Park; Wonzoo Chung, published by IEEE. The EEG-based brain-computer interface (BCI) requires removal of irrelevant channels to improve performance. In this paper, we propose the optimal channel selection using EEG channel covariance matrix and cross-combining region. First, the discriminative H channels and target channel are selected by difference of EEG channel covariance matrix between two classes. Second, we configure several subchannel regions to cover the H channels. Then, we extract FBCSP features from cross-combining regions which are combination of the sub-

DOI: 10.17148/IJARCCE.2024.134219

channel regions and target channel. We select the best one cross-combining region and the optimal channels which are included in selected cross-combining region are finally selected. The features of selected region are used as input of LS-SVM classifier. The simulation results show the performance improvement of proposed method for BCI competition III dataset IVa by comparing the conventional channel selection methods.

7) The paper " Changes in Fatigue and EEG Amplitude during a Longtime Use of Brain-Computer Interface" by Seung-Pyo Seo; Min-Ho Lee; John Williamson; Seong-Whan Lee, was published in IEEE. Long duration usage of BCI systems may induce a loss of attention in the participant and result in a decrease of system performance. Therefore, investigation of fatigue during longtime usage and its effect on the signal quality are necessary for the use of BCI systems in daily life. In this study, 54 participants used BCI systems for about five hours, and it included the three major BCI paradigms. Participants conducted each paradigm once again at the end of the experiment. We investigated how fatigue changes as the experiment progresses and report the effect of fatigue on signal quality by comparing the first and second sessions. In the result, a significant increase was seen in questionnaire scores as well as in alpha-band power in the resting state. The signal quality decreased slightly in the MI and SSVEP paradigms, but the amplitude of the P300 in the ERP paradigm increased.

III. CONCLUSION

This project discusses about a brain-controlled wheel chair based on Brain–computer interfaces (BCI). BCI‟s 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. The intention of the project work is to develop a robot that can assist the disabled people in their daily life to do some work independent of others. Here, we analyze the brain wave signals. Human brain consists of millions of interconnected neurons, the pattern of interaction between these neurons are represented as thoughts and emotional states. According to the human thoughts, this pattern will be changing which in turn produce different electrical waves. A muscle contraction will also be generating a unique electrical signal. All these electrical waves will be sensed by the brain wave sensor and the different pattern is used for controlling a wheel chair.

IV. FUTURE RESEARCH DIRECTION

Future research directions for the brain-controlled wheelchair project could involve enhancing the robustness and adaptability of the BCI system to accommodate varying brain wave patterns and individual differences. Additionally, exploring advanced signal processing techniques and machine learning algorithms could improve the accuracy and efficiency of real-time control. Integration of additional sensors, such as EMG sensors for muscle activity detection, could further enhance the system's capabilities and user experience. Moreover, investigating ways to optimize the design and usability of the wheelchair interface for seamless integration into the daily lives of disabled individuals remains a promising avenue for future research.

REFERENCES

[1] M Eidel and A. Kübler, "Wheelchair Control in a Virtual Environment by Healthy Participants Using a P300-BCI Based on Tactile Stimulation: Training Effects and Usability", Frontiers in Human Neuroscience, 2020.

[2] A. Kübler, "The history of BCI: From a vision for the future to real support for personhood in people with locked-in syndrome", Neuroethics, pp. 1-18, May 2019.

[3] R. Xu et al., "Continuous 2D control via state-machine triggered by endogenous ensory discrimination and a fast brain switch", J. Neural Eng., vol. 16, no. 5, Jul. 2019.

[4] Y.-H. Liu, S. Huang, H.-C. Huang and W.-H. Peng, "Novel motor imagery-based brain switch for patients with amyotrophic lateral sclerosis: A case study using two-channel electroencephalography", IEEE Consumer electronics Mag., vol. 8, no. 2, pp. 72-77, Mar. 2019.

[5] N. Kaongoen and S. Jo, "An auditory P300-based brain-computer interface using Ear-EEG" , 2018 6th International Conference on Brain-Computer Interface(BCI), 2018.

ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 4, April 2024

DOI: 10.17148/IJARCCE.2024.134219

[6] N. S. Kwak, K. -R. Müller and S. W. Lee, "A convolutional neural network for steady state visual evoked potential classification under ambulatory environment", Plos one San Francisco, vol. 12, pp. 1-20, Feb. 2017.

[7] N. Kaongoen, M. Yu and S. Jo, "Two-Factor Authentication System Using P300 Response to a Sequence of Human Photographs", IEEE Transactions on Systems Man and Cybernetics: Systems , 2017.

[8] A. Fernández-Rodríguez, F. Velasco-Alvarez and R. Ron-Angevin, "Review of real brain-controlled wheelchairs", Journal of neural engineering, vol. 13.6, 2016.

