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# RESEARCH ARTICLE

# HUMAN MACHINE INTERFACE FOR COMPUTER USING BRAIN WAVES

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**ABSTRACT**

Traditional Human-Machine Interface (HMI) devices have generally used human motor movements as source of input to perform corresponding output commands and functions. Keyboards and mice have long been the de facto writing and pointing input devices respectively, but these are not very friendly towards people with motor disabilities, motor impairment, diseases such as Paralysis, Muscular dystrophy, Polio, Cerebral palsy, et cetra. Since these devices are being used since inception of computers, they have potential to be replaced by far more convenient methods that can improve the HMI experience and ultimately quality of life. These new methods can either completely replace the existing methods or supplement the current ones or stay as alternatives or else they could also be used as backup when a preferred HMI system fails. We can utilize new and emerging technologies such as Brain-Machine Interface (BMI) and Machine Learning (ML) to design a far better solution for HMI than current existing ones. Using BMI and ML we can also ensure that these are friendly towards the aforementioned people who are not able-bodied.



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# INTRODUCTION

New and developing technology such as Brain-Machine Interface (BMI) utilize Electroencephalogram headset to read the brain waves being produced in brain of a human (Becker, 2022), this can then be analyzed using advance techniques such as Machine Learning (ML) or other AI techniques to find out correlation between a brain wave pattern produced by a person and the actions that they performed when the brain wave pattern was recorded. Every human is unique and so are their thinking patterns so there exists chances of our implementation failing to function properly with some people but with enough training of an ML model with help of Neural Network (NN) we can generate a generalized model that may prove to be accurate for most people. The classification of EEG signals is done in thefollowing bands: α, β, δ, θ, and γ.These are to classify and name the signals from various areas of the head which are recorded by each Electroencephalography (EEG) electrode. There are various artifacts like Electrocardiogram (ECG), Electromyography (EMG), and eye movement artifacts present in the EEG. We need the pre-processing of raw brain signals, extraction of significant features and classification as it plays an important role in the performance of the BMI system (Wankhade, 2021). Thinkgear chip facilitates signal processing and sending the data collected towards an open network socket (Jadon and Natarajan, 2020). Thus, we will be choosing an EEG headset equipped with it for our system for the convenience it provides.

Such an implementation should prove to be very friendly towards the people suffering from neurogenic diseases, motor impairment or disabilities while providing a greater deal of convenience than the traditional HMIs to the rest, i.e. able-bodied people.

## LITERATURE SURVEY

II (A). Wireless Gyro-mouse for Text Input on a Virtual Keyboard, 2022 45th International Spring Seminar on Electronics Technology (ISSE), 2022. Rares Pogoreanu and Radu Gabriel Bozomitu designed a HMI system that utilized a 3D axis Gyroscope sensor, microprocessor and Opti Key on-screen keyboard to be used as a pointing device with the intent that it can be utilized by people with disabilities (Pogoreanu, 2022). The drawback with this implementation was that it can't be used by people suffering from upper body paralysis. Since it uses OptiKey keyboard which only runs on Windows platform, this system can only work as a pointing device for devices having Windows installed, it is not portable.

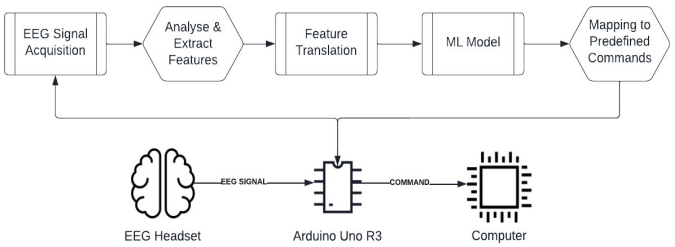
II(B) A Single Electrode Blink for Text Interface, 2020 IEEE International Conference for Innovation in Technology (INOCON), 2020. Dr. Natranjan, *et al*. implemented a system that detected blink using single electrode electroencephalogram (EEG) headset and processed it to trigger keypress on default Windows on-screen keyboard (Jadon and Natarajan, 2020).

This implementation has the drawback that latency is high, it takes too long to type sentences. Also, since they used OpenVibe which runs only on Windows and Windows built-in keyboard, this implementation is limited to run only on Windows Operating System, hence it is not portable. Eye blinks can also be easily detected with the help of Camera inputs and Machine Learning models without needing to invest on an expensive EEG headset.

II(C). Wearable Multifunctional Computer Mouse Based on EMG and Gyro for Amputees, 2020 2nd International Conference on Advanced Information and Communication Technology (ICAICT), 2020. Md. Rokib Raihan, *et al*. implemented a single supply portable. Electromyogram (EMG) detection circuit which worked as a dual supply circuit. They also introduced an auto thresholding algorithm and muscle contraction detection algorithm which helped amputees to control the mouse cursor and use its facilities (Raihan, 2020). The main drawback of this system is that it can't be fully utilized by amputees or handicapped people that have lost either their biceps or triceps muscles and in case they have lost both, they can't use this at all. People suffering from muscular dystrophy or muscle atrophy also may find this difficult to use. For people suffering with paralysis in their upper body (spine and/or arms) this system cannot be utilized properly as without neck movements the gyros would fail to produce any discernible output and EMG is dependent on signals from motor neurons which are absent if a person is suffering from any neurogenic disease. Furthermore, during inflammatory and dystrophic muscle diseases this system might not function as intended.

## PROPOSED SYSTEM

We are proposing a system that would utilize Brain-Machine Interface (BMI) that would be used to take input in form of brain waves of the user and then it would be fed to a trained Machine Learning model that would be used to evaluate whether the user is trying to focus on something and if it evaluates to true, it will trigger a mouse click or key press depending on the context on screen. To emulate functions of a pointing device, we will be using gyroscope and eye based tracking as a backup for the main system wherein brain wave patterns will be mapped to discrete pointer movements. Our main goal with proposing such a system is to create a HMI system that is portable, convenient to use and is friendly to the disabled people.




## ADVANTAGES

- Hands-free HMI experience
- Friendly towards people with disabilities
- More convenient than traditional HMIs
- Comparatively more portable than the earlier implementations that are mentioned in the Literature Survey section.

## DISADVANTAGES

- Requires comparatively more computational power as compared to traditional HMIs
- Costs more than traditional HMI systems
- Feels like it is still in its infancy when compared to traditional and time-tested HMI systems.

## FUTURE SCOPE

When cost of EEG headsets is reduced and more advancements are made in the field of manufacturing of such headset, their size can get reduced, and this can be integrated with other devices that may get worn in head such as headphone, earphone or other headsets. EEG headsets having high number of channels can be used to extract more data out of a person's brain and then this newly found data can be used to find new patterns and correlations between the person's action and brain activity. It can also be expanded and branched out to be used with other animals with similar brain structure to humans such as Chimpanzees, monkeys and other such primates first, after which we can venture out to redesign and use it on any organism with noticeable brain activity.

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## CONCLUSION

As discussed, we aim to design a new HMI system for Computers that will redefine HMI experience by combining Brain Machine interface (BMI) with Neural Network (NN). We have proposed to create a HMI system that is friendly to the people suffering from neurogenic diseases, motor impairment or disabilities and provides a greater deal of convenience than the traditional system to the rest, i.e. able-bodied people and boosts their quality of life. Thanks to advancements in field of science and electronics, it might finally be possible to create a potentially new mainstream HMI system.

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