# Unmanned Aerial Vehicle Remote Control using Brain Computer Interface

Pooja Pradeep Salvi [1], Prasad Anant Lad [2], Mandar Nitin Gangnaik [3], Vinay Santosh Kumbhar[4],

Prof. Prajakta Santosh Rane [5]

Computer Engineering Department
SSPM's College of Engineering,
Kankvali, India

[1]poojasalvi1009@gmail.com
[2] prasadlad1998@gmail.com
[3] mandar1599@gmail.com
[4] veenay.kumbhar@gmail.com
[5] praju1978@gmail.com

***Abstract*— Brain Computer Interfaces enable the use of brain waves to control computer-based external devices. It can, however, be difficult to trigger a specific brain wave, and it might not be repetitive enough to be used in such a manner. EEG is used to record brain waves, where the parts of the recorded signal that is related to raw data of brain are normally considered to be artifacts (undesired). In this work, however, EEG having raw data of brain are used to create datasets for training a machine learning algorithm, used for controlling a drone in real time. The drone operates just based on the though fits operator who wears an electroencephalogram (EEG) headset. "The focused thought of the brain or the electrical activity of the brain is captured by a head-mounted EEG device and the signals are wirelessly sent to a laptop. Algorithms residing in the laptop convert these signals into command inputs for the drone (quad copter) for suitable action.**

***Keywords*— BCI, quad copter, flytsim, EEG, Virtual Reality.**

## I. Introduction

The Expansion of BCI (Brain Computer Interface) and EEG (Electroencephalograph) headsets have advanced the creation of technological tools that are available to a greater number of researchers at different levels. In fact, the development of BCI Systems, over time, has focused mainly on medical research on assistance to people with disabilities. However, the growing development of BCI and EEG technologies has brought with it innumerable applications that are not limited to medical issues, but also to "non-medical" applications just like technological, psychological, cognitive applications, market research, interactive games, etc. In this sense, focusing on the technological aspect it is possible develop applications within one of the current innovate technologies: Unmanned Aerial Vehicles (Drones). The work developed below presents the design and implementation of a Computational Brain Interface (BCI) to control the flight of an Unmanned Air Vehicle (Drone) using electroencephalographic signals (EEG), acquired from a user through the Emotive Insight Headset. This headset features 14 EEG sensors and 2 reference sensors means total 16 that provide high spatial resolution and provides information on brain activity.

## II. Applications of BCI

### *A. virtual reality*

Virtual Reality is the latest innovative technology. Controlling the drone with mind can be used in virtual reality and provide a feeling to the user that he/she is present at that particular place.

### *B. Video games*

Video games have started to use EEG technology, equipping gamers with sleek headsets that claim to read the gamer's mind and translate their thoughts into machine-readable instructions. Gamers can use their minds to drive a virtual car and create musically-inspired brain-wave art.

*C. search and rescue*

In search and rescue operations the drones can be controlled with mind and monitor the affected area. When firefighting, for example, you can determine the proportion of particular gas present using sophisticated measuring equipment and react appropriately.

*D. Drone racing*

Drones are controlled with the thoughts of user and racing competitions can be arranged for entertainment purposes

*E. security*

Protect the public with MC-Drone! Many authorities worldwide are already using our aerial platform e.g. to help coordinate security operation.

*F. Inspections*

The expenditure spent on inspection by sending employee's at sites can be saved with a MC-Drone by inspecting Wind turbines, power lines, and pipelines. No need to engage an external contractor.

## III. Brain Computer Interface

### A. *Invasive Brain Computer Interfaces:*

Invasive Brain Computer Interface devices are those implanted directly into the brain and have the highest quality signals. These devices are used to provide functionality to paralyzed people. BCIs are also used to restore vision by connecting the brain with external cameras and to restore the use of limbs by using brain controlled robotic arms and legs. As they rest in the grey matter, invasive devices produce the highest quality signals of BCI devices but are prone to scar-tissue build-up, causing the signal to become weaker or even lost as the body reacts to a foreign object in the brain.

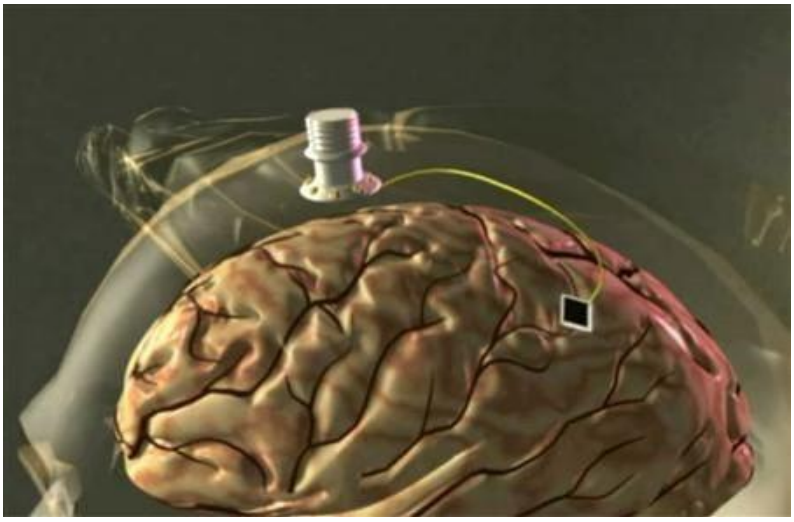

Fig 1. Invesive BCI

### B. *Partially Invasive Brain Computer Interfaces:*

Partially invasive BCI devices are implanted inside the skull but rest outside the brain rather than within the grey matter. Signal strength using this type of BCI is bit weaker when it compares to Invasive BCI. They produce better resolution signals than non-invasive BCIs. Partially invasive BCIs have less risk of scar tissue formation when compared to Invasive BCI. Electrocorticography (ECoG) uses the same technology as non-invasive electroencephalography, but the electrodes are embedded in a thin plastic pad that is placed above the cortex, beneath the dura mater.

### C. *Non Invasive Brain Computer Interfaces:*

Noninvasive brain computer interface has the least signal clarity when it comes to communicating with the brain (skull distorts signal) but it is considered to be very safest when compared to other types. This type of device has been found to be successful in giving a patient the ability to move muscle implants and restore partial movement. Non-Invasive technique is one in which medical scanning devices or sensors are mounted on caps or headbands read brain signals. This approach is less intrusive but also read signals less effectively because electrodes cannot be placed directly on the desired part of the brain.

Fig 2 . Non Invasive Brain Computer Interfaces

## IV. COMMUNICATION BETWEEN BCI AND DRONE

Pixhawk communicates with raspberry pi 3B using MAV Link protocol. Raspberry pi 3B have flytos installed which will contain MAV link. We are creating an application for sending commands to the raspberry pi 3B, this software will also receive data from EEG headset and compare with few conditions and come to a decision for movement.

## V. ADVANTAGES

A. BCIs will help creating a direct communication pathway between a human or animal brain and any external devices like computers.
B. BCI s has increased and possibility of treatment of disabilities related to nervous system along with the old technique of Neuroprosthetics.
C. Techniques like EEG,MEG and neurochips have come into techniques like EEG,MEG, and neurochips have come into discussions since the BCI application have started developing.
D. this has provided a new work area for scientists and researchers around the world.

## VI. DISADVANTAGES

A. In case of invasive BCI there is risk of formation of scar tissue.
B. There is need of extensive training before user can use technique like EEG.
C. BCI techniques still require much enhancement before they can be used by users as they are slow.
D. Ethical implecations of BCI will arise in future.
E. BCI techniques are costly.It requires a lot of money to set up the BCI environment.

## VII. WORKING SYSTEMS

Fig. shows a general block diagram of the actual Communication between drone and mind based system which includes following process as mind controller gets input means raw EEG data then pass to pc for compute then after it sends signals to drone by Wi-Fi communication. Drone contains pixhawk and raspberry pi 3B. EEG Sensors accepts data from pc with the help of Bluetooth and drone accepts data from pc with the help of Wi-Fi connection.

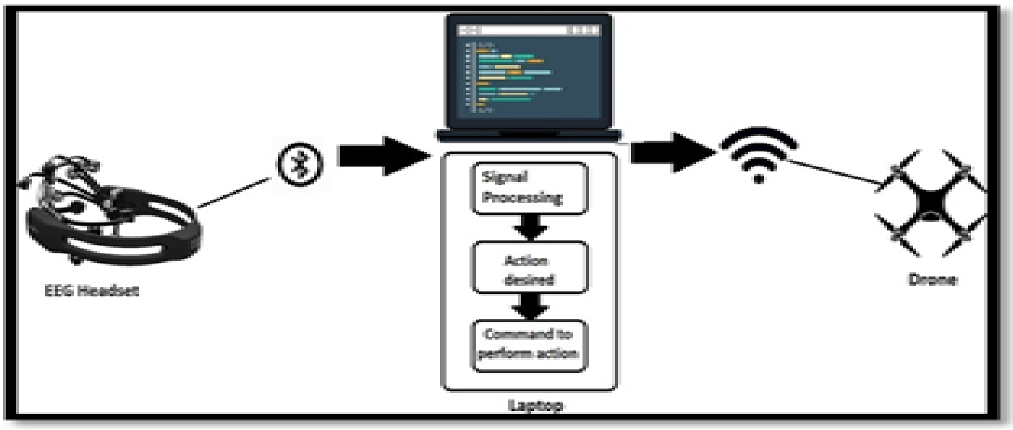


Fig 3 . System Diagram

## CONCLUSION

A BCI system was implemented based on the Headset Epoc+ Emotive to control the fight of the drone. The SDKs of the manufacturers allow the development of varied applications, this facilitates the research work. The more trained the user with the Headset the more successful the mental commands detected. For a better identification and classification of the trained mental commands, automatic learning algorithms could be applied. Variations in user thinking did not affect drone control.

## ACKNOWLEDGMENT

We would like to express our deep sense of gratitude to Prof. Mrs. Rane P. S. And Prof. Mr. Mhapsekar D. P., for their invaluable help and guidance for IEEE paper. We are highly indebted to them for constantly encouraging us by giving their critics on our work. We are grateful to them for having given us the support and confidence.

## REFERENCES

[1] Budiyon, “unmanned aerial vehicles technologies,” vol. 29, no. 7, pp. 1645– 1660, 2014.
[2] K. McAndrew, “The challenges of flight-testing unmanned air vehicles,” vol. 68, pp. 2177–2180.
[3] https://www.emotiv.com/product/emotiv-epoc-14-channel-mobile-eeg/#tab-description
[4] Atheer L. Salih, M. Moghavvemil, Haider A. F. Mohamed and Khalaf Sallom Gaeid. Flight PID controller design for a UAV Quadcopter. Scientific Research and Essays Vol. 5(23), pp. 3660-3667, *2010*.
[5] Torsten Felzer, ―On the Possibility of Developing a Brain-Computer Interface (BCI)‖, Technical Report, Technical University of Darmstadt, Department of Computer Science, Alexanderstr. 10,D-64283 Darmstadt, Germany, 2001
[6] Simple GUI Wireless Controller of Quadcopter Dirman Hanafi1 , Mongkhun Qetkeaw1 , Rozaimi Ghazali1 , Mohd Nor Mohd Than1 , Wahyu Mulyo Utomo2 , Rosli Omar1 1 Department of Mechatronic and Robotic Engineering, Faculty of Electrical and Electronic Engineering, University Tun Hussein Onn Malaysia, Batu Pahat, Malaysia 2 Department of Power Engineering, Faculty of Electrical and Electronic Engineering, University Tun Hussein Onn Malaysia, Batu Pahat, Malaysia.