Using BCI Devices to Harness the Power of Controlling Drones with your Brain

Kerollin Francois

Introduction:

With the advancement of technology, having full control of a drone using just someone's brain has gone from a slim chance to a major possibility. Researchers are getting closer and closer to this each day with the use of Brain Computer Interfaces (BCIs). BCI devices have been around for years, dating back to the 1970s [2]. Although the technology has been around for so long we are just now putting them into use in the world of research. BCI devices can capture brain activity using several different methods, spectroscopy, including magnetic resonance imaging (MRI), and the most readily accessible method electroencephalography (EEG) [3]. EEG uses sensors to measure the electrical current produced by the brain [3]. Hence, making EEG BCIs are more effective when controlling drone's and allowing for use in more real-world applications since they are made to be lightweight wearables [2].

The problem that arises is that the electrical currents coming from the brain are hard to tell apart from each other. When the EEG signals are read noise is also captured, this noise is generated by other unrelated activities originating both in and out of the brain [1], [2]. The noise is what makes reading the signals difficult. BCIs need better signal-acquisition hardware to remove this noise and to allow for the EEG signals read faster [4]. These signals need to be translated in real time into drone commands for the BCI to effectively communicate with the drone. The user would be encoding a certain command into the signal that the BCI reads which the BCI must then derive into a drone command. This requires the user and BCI system to adapt to each other continuously for stable performance [1].

Now the ability to decipher between different brain signals and map those signals to different drone commands is key to having full control of the drone. As I mentioned before, the key problem holding the advancement of full drone control is the fact that brain signals coming through the EEG BCI's are hard to differentiate. To move forward with this research and to have the ability to map various brain signals to different drone commands a few questions would need to be examined. Are there adequate noise removal systems that work in real-world applications? Can the signals be mapped to different drone functions with a high rate of accuracy? Are there other methods to tell the different signals apart? To further this research the plan is to answer this first lingering question focusing on noise removal methods that not only provides the user with a clear brain signal but also processes quick enough to be used in day to day activities.

Methods:

The BCI device used to allow for the drones to be controlled is a device made by Emotiv called EMOTIV Insight. All Emotiv devices come with software packages that allow you to use the BCI devices and analyze the brain signals, that are received from them, in many ways. For this research project, two programs from Emotiv were used, Emotiv Control Panel and XavierEmoKey.

The Emotiv control panel is the program that is used to process the signals that the BCI receives and allows the computer to understand them. The control panel can save a certain state of the brain into a file that the software refers to as a profile. This method of saving profiles is called training, the users need to be trained so the BCI device can accurately read their brain signals. This is done by having the user think of an action, for example pushing a block forward. The user would think this thought for 10 seconds three times. This thought or brain state would then

be saved as the “move” profile. The user would then clear their mind and relax for a period of 10 seconds three times, this would be saved as the “rest” profile.

XavierEmoKey is a software used to link one or both profiles to a key on the keyboard. This is necessary for the BCI device to be used with the drone. The drone used in this research project is the Bebop 2 from Parrot. This drone was chosen because it is a smaller drone that can be flown in doors, and it is also cheap. The Bebop drone also allowed for easy use because its API was readily accessible online on an open source website called GitHub. API stands for “Application Programming Interface," which is a set of commands, functions, protocols, and objects can use to create software or interact with a system [5].

Using this API, a simple Javascript code was created that allowed the drone to connect with the XavierEmoKey software. The takeoff and forward commands on the drone were coded in the JavaScript code to map to the keyboard key “w”. Using the XavierEmoKey software used the “move” profile was also mapped to the key “w”.

Now, when the user thinks about pushing forward the brain state of the user should match the brain state saved in the “move” profile. This would in turn press the “w” key which would cause the drone to first takeoff, and if it is already in the air proceed to move forward. Every time the “move” profile is activated the “w” key is pressed once.

References:

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