Neural Control of Drone Using Steady-State Visually Evoked Potentials

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Introduction

Neurological disorders can often render people with an inability to perform daily tasks using their extremities. This often results in a loss of independence.

The use of brain-computer interfaces (BCIs) provides one solution to retain independence. BCIs are able to interpret brain signals and this can be used both in neuroscience research, as well as in the development of devices that can be controlled using one's thoughts. This allows users to bypass the need for their extremities to perform any of a wide range of tasks.

This project applied a BCI for the use of controlling a drone using a user's neural signals, specifically their steady-state visually evoked potentials (SSVEP).

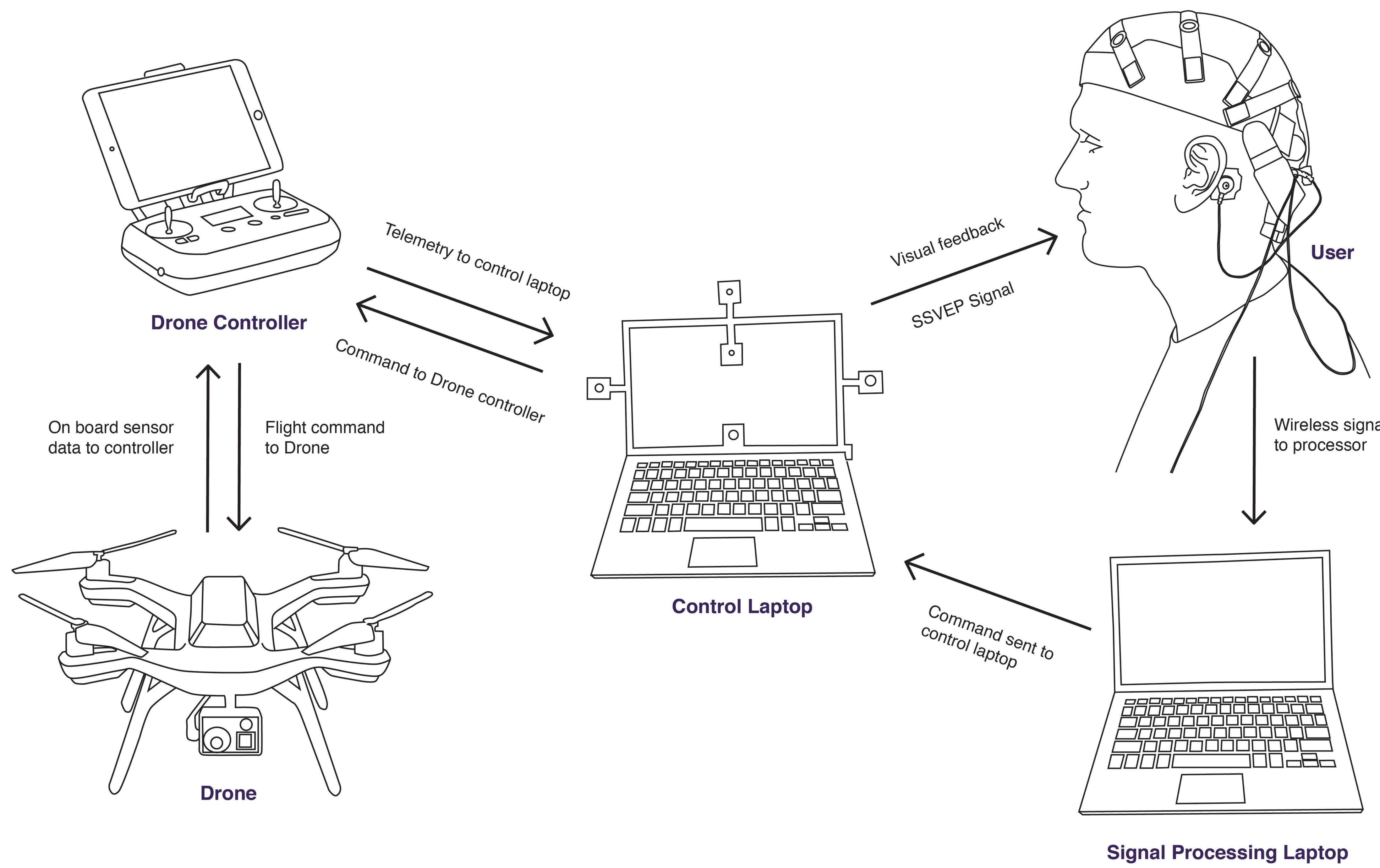


Figure 1. Diagram of closed loop systems

Discussion

This project provided a proof of concept for the implementation of a BCI system that would allow a user to control an external device using signals from their brain. While the commands and drone movement were relatively simple, they can be expanded to an extent to incorporate more commands.

With our current setup, there is about a three second interval between the EEG signal being detected and the classification of a command. The frequency of these commands gives the user rough control over the drone.

There is ongoing research to improve the processing, extraction, and classification of signals to speed up the acquisition of the signals and improve the accuracy of their classification.

Methods

The following components are used in the design of our system to acquire the signals and send them to the drone as seen in Figure 1:

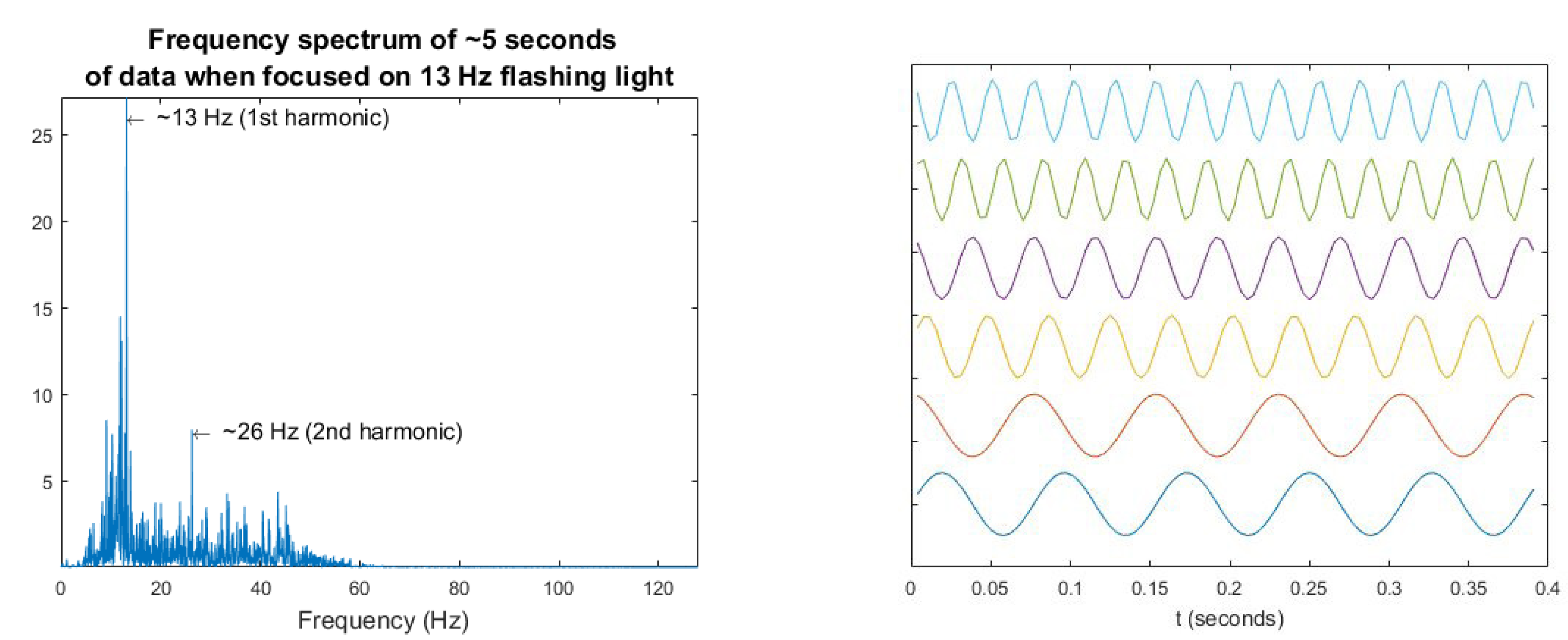
B-Alert X24 EEG System
• 24-channel wireless EEG headset to pick up signals

B-Alert Live
• Real-time recording of signals and upload to MATLAB for processing

3DR Solo Quadcopter Drone
• Programmable drone using open source software

Processing and Classification
• Recursive least-squares adaptive filtering used to filter artifacts
• Canonical correlation analysis used to classify EEG signals, see Figure 2

Python Drone Controller
• Receives and responds to commands from BCI to control drone flight
• Drift control through sensor feedback



Figue 2. Power spectral density of EEG data from 13 Hz flashing LED and the static signals used to correlate for classification

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