Brain-Controlled Drone

THECOOPERUNION

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Problem Statement

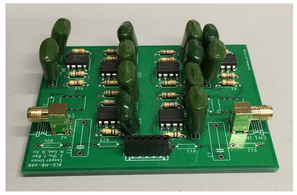
Today, drones are widely used for both recreational and practical applications. However, because many drones read user input through remote control, this can present difficulties for people with hand incapacitations. Whether it's due to disease, or simply because their hands are occupied, they are unable to enjoy the fun and convenience that this technology offers.

Proposed Solution

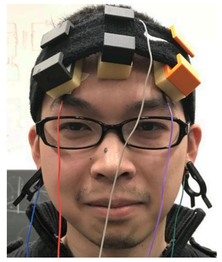
Brain-Controlled Drone is a bio-signal acquisition system designed to record and interpret users' navigational intentions. With BCD, users can move the drone around a 2-D plane via their thoughts, eye movements, and facial expressions.

Signal Acquisition

The front-end electronics, including the LNA and filter, are implemented on a proto-board with the desired specs.



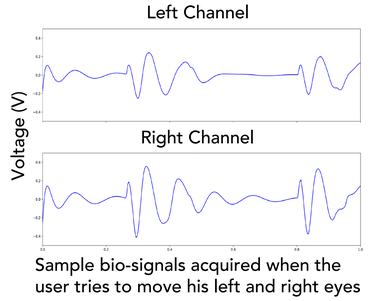
Dual-channel front-end circuit on PCB



Jialun with the headset holding the electrodes at a potential set of locations.

Real-time bio-signals are captured from the user in order to optimize the location of the electrodes for the final design.

Digitized data is stored and used in the PC as a training set for the machine learning (ML) classification algorithm.



Sample bio-signals acquired when the user tries to move his left and right eyes

Drone Control

A Simulink-based development kit is used to calibrate sensors on Parrot AR Drone.

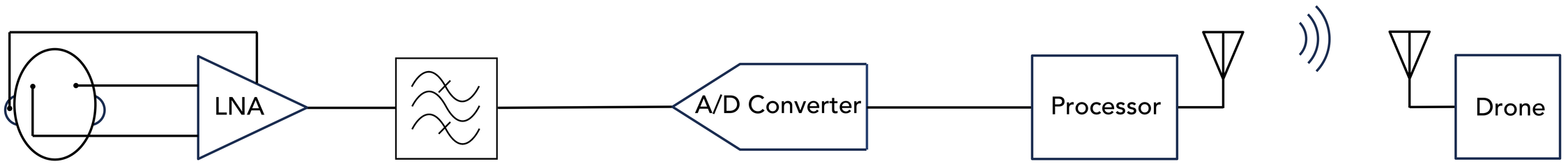
Flying the drone through a hula hoop

The motor control unit of the drone is re-programmed to receive and 2D directional command from the machine learning algorithm and respond with tuned gain values.

Future Work

- Generalize the training and testing of the machine learning classification algorithm
- Design and build a headset that hold the sensors in the optimized position
- Eliminate drone flight drift

System Architecture



Cup electrode sensors are connected to a low-noise instrumentation amplifier with a gain of 60-dB. Signal from the earlobe is used as the driven reference.

The bandpass filter consists of a 1 µF coupling capacitor and an 8^{th}-order Chebyshev low pass filter on one single integrated circuit with cutoff frequency at 35 Hz.

A/D conversion is achieved by an Arduino Zero which has a 12-bit resolution and 300 Hz sampling rate. The digital data is then transmitted to a computer via serial port.

The computer analyzes the digital data using machine learning techniques to classify them into directional commands.

The directional commands are then transmitted via WiFi with a python program. The drone receives the command and responds accordingly.