# Boston University
# Electrical & Computer Engineering
### EC464 Capstone Senior Design Project

# Final Prototype Test Report

*EEG-based Brain-Computer Interface*

Submitted to:

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by

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## Introduction:

This report outlines the results of the prototype testing performed on our hardware and software designed for our senior design project. Our team aimed to achieve two primary goals during the testing: first, to verify the functionality of our hardware and software in receiving data streams from the EEG electrode headset and second, to establish socket connectivity between the different aspects of our project - the headset, neural network, and virtual environment.

## Equipment:

The testing equipment consisted of an EEG electrode headset, 12 electrode probes with housing, a Cyton board case and cover, a Cyton PCB, a USB-A to Micro-USB cable, a PIC32MX250F128B Microcontroller, an ADS1299 Bio-sampling chip, the OpenBCI GUI, the main.py script for 3D virtual environment, the BrainFlow Streaming script, an ML test model, and socket programs for data transfer.

## Setup:

The first goal of the testing was to ensure the functionality of the hardware and software designed for receiving data streams from the device. The setup procedure involved connecting the Cyton board to the OpenBCI GUI to verify the hardware and firmware's proper functioning. After this, we tested the efficiency of the headset-board system by placing the headset on someone's head and viewing the FFT plot of the channels. The aim was to observe distinguishable values in the microvolt range with discrete artifacts.

After the hardware verification, we connected the board to our BrainFlow code, which would detect the board automatically and establish a connection. We then tested the BrainFlow code's functionality by initiating a data stream. The next step was to test the entire system by plugging in the headset, streaming data into the ML model, and sending the ML model output to the virtual environment. In this stage, we aimed to observe the real-time virtual environment updates based on the classification of the ML model.

## Testing Procedure:

Stage 1: We first ensured that the power was being sent to the board, indicated by the blue LED. After connecting the board to the OpenBCI GUI, we observed the FFT plot before and after connecting the headset. We compared the differences and looked for artifacts to ensure proper functioning.

Stage 2: After verifying the system's proper functioning, we disconnected the Cyton, closed the OpenBCI GUI, and opened our streaming software to connect the device. We tested the automatic board detection system and initiated a data stream to ensure proper functioning. Next, we established socket connectivity between the headset, neural network, and virtual environment. This involved testing data transfer from the headset to the neural network and then from the neural network to the virtual environment. We verified that the virtual environment updated in real-time based on the ML model classification.

## Conclusion:

The prototype testing of our hardware and software designed for receiving data streams from the EEG electrode headset and establishing socket connectivity was successful. Our testing procedure verified the proper functioning of the hardware and software, and we were able to transfer data in real-time between the different aspects of the project. Overall, the prototype testing results were positive, and we are confident in the success of our senior design project.