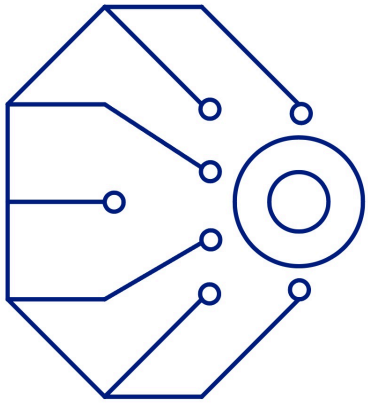
Boston University
Electrical & Computer Engineering
EC463 Senior Design Project

First Prototype Testing Plan



NeuroToys

by

Team 9
NeuroToys

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Required Materials

Hardware:

- ESP-WROOM-32 with Onboard LED, Breakout Board
- L298N Motor Driver
- 18650 3.7V Battery (2)
- 2S 18650 Battery Holder
- NeuroSky Mindwave Mobile 2 Non-invasive EEG
- AAA Batteries
- Personal computer with relevant project files installed
- Assembled RC car

Software:

- Mindwave Mobile 2 ThinkGear Connector
    - Runs a background process on the computer
    - Responsible for directing headset data from the serial port to an open network socket
- Python
    - Bluetooth interface between EEG and ESP32
    - Processes and classifies brainwave data
- C
    - Pre-uploaded to ESP32 to accept commands via Bluetooth

Set Up Summary

There are three primary components to our system: the Neurosky Mindwave Mobile 2 EEG headpiece, a computer which runs the Python interface, and the ESP32. The headpiece transmits raw brain voltage data (μV). The Python interface processes this signal by performing a Fourier Transform to isolate the beta frequency band from the EEG data, which is associated with focus. The beta power is then calculated (expressed in μV^2 or dB), representing the user's focus level. A threshold is established to determine whether a command should be sent to the ESP32, which then controls the movement of the toy car.

Figure 1: Control flow diagram

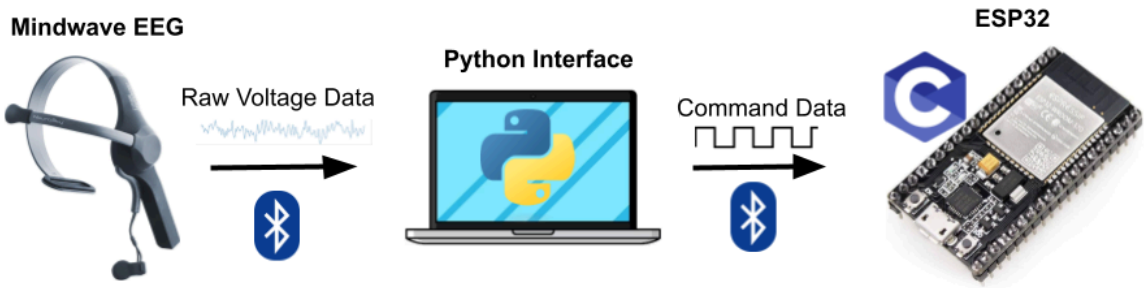
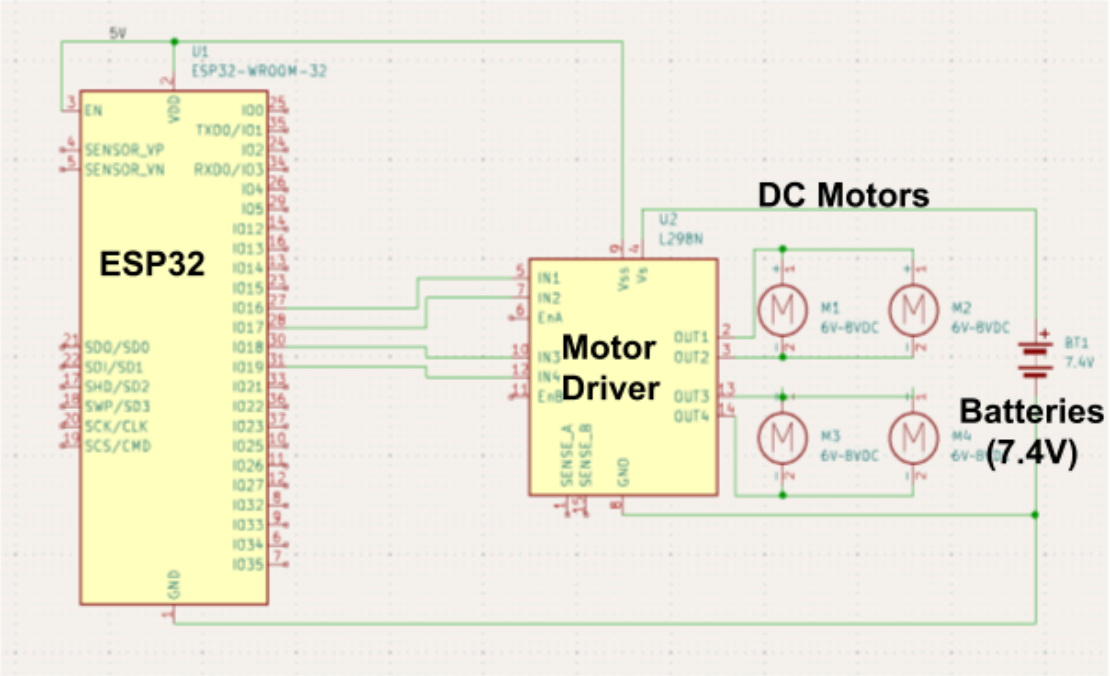


Figure 2: RC car circuit including pinouts



Pre-testing Setup Procedure

1. Insert new AAA battery into headgear
2. Remove Mindwave Mobile 2 headset from computer bluetooth devices (if applicable)
3. Turn on headset
4. Connect headset to device
5. Member 1 wears the headset
6. Supply power to the toy via on/off switch
7. Run the Python script. Wait for connection to be established and then begin testing procedure

Testing Procedure

1. Member 2 starts a 1 minute timer.
2. Member 1 should attempt to focus and unfocus at 10 second intervals. These intervals are announced by Member 2 at the start and each switch.
3. Member 2 marks down errors as they occur at the start of each interval.
4. Movement of the toy is enabled at above the dynamic beta power (focus level) threshold, and disabled when below.

Measurable Criteria

I. Movement of the toy is enabled *at some point* within 5 seconds after a focus period begins and disabled *at some point* within 5 seconds after a focus period ends.

II. Errors are only considered during the 5 second period between focused and unfocused described above. More work is required to stabilize the output outside this range.

III. Maximum error rate of 2 out of 6 total intervals required to pass. Multiple trials are permitted.

Score Sheet

Interval	Error (Y/N)
1. Focus	
2. Unfocus	
3. Focus	
4. Unfocus	
5. Focus	
6. Unfocus	