Development of a Self-Contained Wearable EEG

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Background

Industry Growth

- Portable EEG device market size is estimated to reach 1.83 billion USD by 2028
- Market is growing due to the rising geriatric population worldwide, leading to a rise in studies of age-related neurological disorders

Limitations of Traditional Devices

- Cost of complete portable systems begins at $200, with traditional systems costing upwards of $30,000
- Can only be worn in a controlled laboratory setting

Benefits of Portable Designs

- Reduced device cost allows for an increase in EEG research, and allows for cheap collection of preliminary data
- Allows for recording in extreme environments, or during day-to-day activities

Related Works

- Wearable EEG technology at UPenn
- Underwater EEG for marine life research
- Submerged electrodes with on land recording

Device Considerations

Many devices, cases, analysis programs and electrodes were considered for the project. The table exemplifies the reasoning behind each decision.

Project Applications

Furthering our study of competition anxiety in athletes, as well as offering support to studies wishing to conduct EEG recording in extreme conditions, thus expanding the capacity of EEG studies.

Components	Reason for Use
OpenBCI EEG Recording System	Compact size, open-source software, used in comparable studies
Gold Plated Electrodes	Comfortable for long-term wear, water resistant, produce viable signal
Idun Waterproof Dryodes	Designed for underwater recording, able to be used for EMG recording (a further application of this research)
Pelican 1010 hard case	Small, lightweight, easy to seal, hard plastic offers most protection to EEG device, durable
Joto waterproof phone pouch	Thin, flexible, most potential for a compact system

Purpose

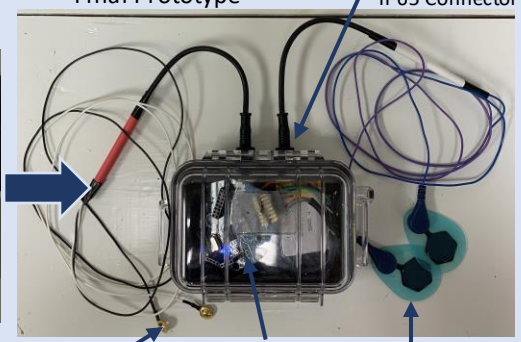
Produce an enclosure that will allow for EEG recording in non-laboratory environments, particularly underwater.

Prototype Construction and Development

Cases Considered

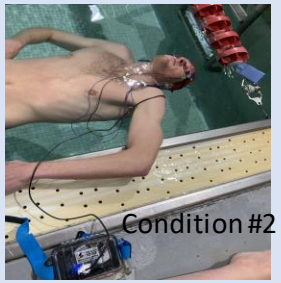
Prototype #1

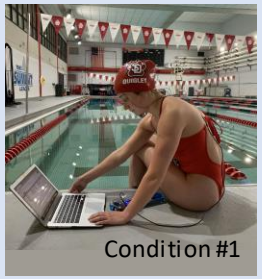
Final Prototype



Testing Protocol

- Lab testing consisted of submerging the prototype in a jar of water (Fig.1)
- Field testing consisted of 4 regimented tests with each prototype;
  1. Recording with the device dry
  2. Recording with the electrodes submerged and the device dry
  3. Recording with the device submerged and the electrodes dry
  4. Recording with the entire system submerged





Wiring and Connectors

- A major constraint of the project was finding waterproof connectors that were small enough to fit our two cases
- The project began with modifying an old USB cable to fit the purposes of the project, keeping expenses low
- The current prototype has 4-pin IP65 connectors

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