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Research-In-Progress

Point of Care Diagnostic Wearable for Traumatic Brain Injury Diagnosis and Characterization

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Introduction: There exists a gap in the point of care testing and long term rehabilitation of traumatic brain injuries (TBIs) for patients who lack access to advanced diagnostic devices or live in rural areas.While EEG has demonstrated sensitivity for TBI diagnosis, it has not displaced imaging as the standard of care. Gait characterization by IMU data has shown efficacy to diagnose TBI. The authors have designed a wearable with EEG and IMU data streams to address this need.

Methods: The TBI wearable consists of EEG and IMU data via non-invasive electrodes and accelerometer. A machine learning algorithm connects both data streams to train and classify abnormal brain activity. EEG electrodes were manufactured using pliable conductive materials and a reference electrode was used to measure electrical potential differences. The use of pliable electrodes improved electrode-skin contact and reduced impedance. An IMU sensor was used to characterize head balance and supplement gait characterization.

Preliminary Results: Goals of benchtop testing were to validate device ability to record brain activity and IMU data. IMU data was validated by a user wearing the device and moving their head in the x, y and z planes demonstrating data acquisition in all planes. To validate brainwave recording, the user was instructed to record equivalent data streams with eyes open and closed. Data was passed through a 4th order butterworth filter then visualized via Power Spectral Density (PSD) converting time to frequency data. There was demonstrably higher power in the Beta frequency range with eyes open confirming recording of brain activity.

Next Steps: Current status of the device is a proof of concept wearable that can record EEG and IMU data. Immediate next steps include improving fidelity to filter and process EEG data. Future study will incorporate a machine learning model from acquired data for diagnosis and characterization.