SynapseSafe: A Device To Detect Mild Traumatic Brain Injury (mTBI) In Athletes Using Brain Waves And Cerebral Blood Flow

Team 1: **Layth Amra, Rashid Kolaghassi, Johnathan Muhvich, Maria Shevchuk**
Advisor: **David Boas, Kenny Kim**

Mild Traumatic Brain Injuries (mTBIs) often go undiagnosed in the general population. The Clinical Journal of Sports Medicine reports that nearly 30.5% (n=486) of athletes in their study reported previously undiagnosed concussions. Individuals with a history of repeated undiagnosed concussions are subject to adverse health effects including neurodegenerative disorders such as Alzheimer's, Chronic Traumatic Encephalopathy (CTE), and reduced life expectancy. Research highlights the promise of quantitative Electroenchaplagrams (qEEG) in detecting mTBIs. These raw EEG signals can be filtered and then transformed into an image using Continuous Wavelet Transformation (CWT) and fed through a Convolutional Neural Network (CNN) to detect concussed subjects. We further seek to improve concussion detection accuracy by incorporating a novel biomarker — cerebral blood flow (CBF). Research reports CBF reduction in gray and white matter in the brain following mTBI in the acute and subacute phases of the injury. Finally, we seek to use this device as more than just a concussion classifier. Research shows that repetitive subconcussive impacts may be the single leading cause of CTE. Subconcussive injuries are inherently hard to detect, and typically are not diagnosed until the damage they cause begins to show symptoms. Our device would give researchers the ability to study both of these biomarkers consistently over a season and see how brain activity changes from baseline from one practice to the next. Furthermore, if proven successful, this device could become a powerful diagnostic tool to assess when repeated subconcussive impacts cause enough damage to warrant intervention with a player.