

Date @November 20, 2023

First half of the day - BCI research - mostly catching up since I feel like I'm missing a lot of background knowledge. There's two main areas to this - the biology of it, and the electronics.

I feel like I understand the biology a little bit - like I know about pyramidal neurons that are perpendicular to the scalp that generate signals (in large groups of neurons) that we can read - but a lot of it is very vague. I also still want to know how, like, the electrodes pick up electricity. This is all very new to me and I feel like I have a very loose understanding of how electricity works - Henry recommended a Veritasium video on how electricity works, which I may watch tomorrow.



lovely diagram sophia created. i understand maybe a quarter of this? lol

There's also the hardware side - basically, in most EEG, signal goes from the scalp to a black box that accounts for ESD (electrostatic discharge, so like static shock), then to a differential amplifier to remove noise and make the signal more readable (differential amplifiers take two inputs and only amplify the difference, to account for noise, from my limited knowledge), then to an analog-digital converter, which converts analog signals to something that can be interpreted by a computer, then to a microcontroller to gather info and forward it to a computer. The ADS1299 is an IC (integrated circuit) which incorporates an amplifier, analog-digital converter, and microcontroller.



shitty signal processing diagram me & henry made. shown is the pipeline from brain \rightarrow ESD protector \rightarrow amplifiers \rightarrow ADC \rightarrow microcontrollers

Second half - working w/ Henry on the first part of our BCI pipeline - from electrodes on the scalp to the amplifier/analog-digital converter chip (ADS1299). Looks like for this we need a device to protect the circuit ESD (electrostatic discharge, so like static shock), along with differential capacitors (?) and resistors. Mostly taking inspiration from the OpenBCI Cyton board, along with HackEEG. We got most of the way there in terms of design and understanding how the below circuit works, and we're halfway to implementing it in KiCAD.



this is what we're trying to replicate - the pipeline from scalp to ADS1299