Design Review 1 Agenda

EEG Alarm Group
Dr. Schafer
Stinson-Remick 205
10:00 AM February 23, 2023

Leader: Josh O'Brien
Scribe: Megan O'Donnell

Agenda

1. Design Review 1
    a. EEG Subsystem
    b. Pulse Oximetry Subsystem
    c. Alarm Subsystem
    d. Internet of Things Subsystem
    e. Powering Requirements
2. Going Forward
3. Comments and Questions

Design Review 1 Minutes

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Notes

1. Design Review 1
    a. *EEG Subsystem*
        i. AD8220 most accurate option for medical uses
            1. Instrumentation amplifiers expensive, due to precision
        ii. Starting with ECG before reading brainwaves
        iii. Plugging leads directly to terminals of instrumentation amp
        iv. Lower frequencies (up to 30Hz) to determine stage of sleep
            1. 1st order low pass, cutoff freq $f_c = 30$ Hz
            2. Gain of 50
        v. Brain signal vs. noise
            1. Fouirer Transform
        vi. Using WiFi, some pins don't work for A/D
            1. Plug voltage divider into A/D input, results should be somewhere in a certain range
        vii. Ground electrode
            1. Buffer, right leg driven circuit
                a. User protection (when plugged into the wall). Using a 9V battery (wireless), there is no user risk, so might be waste of space
            2. If input gets less than -5V, it will pull from somewhere else
    b. Pulse Oximetry Subsystem
        i. Good readings on finger, but want to get it somewhere better for user wear
            1. Ear? Using commercial pulse ox finger clamp
        ii. DC/DC on breakout board for now, eventually need new
            1. PAM2401
        iii. Sensor itself needs 1.8V, MOSFETs take it up to 3.3V for I2C
        iv. Is oxygen saturation levels necessary? Blood oxygen level vs. depth of sleep
    c. Alarm Subsystem
        i. HTML can play audio through audio tag and audio controls tag on local website
        ii. Server can't find downloaded audio file
            1. Platformio
            2. SPIFFs file system, upload data for project rather than embedding it. One-layer file system
                a. Sliders examples using WebSocket

iii. Can't access computer's time through C++ or Aurduino. Has to be through Javascript
    1. Using WiFi, can use network time protocol to get current time

d. IoT Subsystem
    i. Can the alarm be triggered on a phone?
        1. Cannot access alarm app, but can send a notification
        2. Phone app?
        3. Alarm module that runs through Wifi
            a. ESP32 plugs into a USB charger, with display and buzzer?
    ii. Working using SDNet
        1. Connection between local network and ESP32
        2. Occasionally SDNet needs reboot
            a. Very hard to connect to eduroam if you're not running their software
            b. ND-guest less secure, more like what a home router is like

e. Powering Requirements
    i. Can photodetector wavelengths be modified?
        1. Dr. O'Sullivan could help with this
        2. Need common filter. Only using single LED
    ii. 9V alkaline battery, split up 4.5 V each side (virtual ground)
        1. Voltage regulator, ESP32 runs on 3.3V
        2. Less heat dropping from 4.5V to 3.3V than from 9V to 3.3V
            a. Could signals going in be relative to middle voltage? Does it have to be +/-?
            b. Using voltage regulators, which can draw up to 1A
        3. OpAmp before instrumentation for level shift?
            a. Voltage instead of ground on negative terminal of non-inverting
    iii. 3.3V into the board, which has a regulator
        1. LED in photodetector takes 5V, 1.8A
            a. Could choosing a different resistor mean the LED driver needs less voltage?
        2. Boost converter- takes 3.3V, outputs 5V
        3. Logic Converter (I2C)- takes the 4.5V down to 3.3V
    iv. Layout on DC to DC converter (avoid heat and noise)
        1. Currently on detector board. Need something smaller
        2. DC/DC converter
            a. Boosts frequency, which is not a problem since we are working in low frequencies

2. How to demonstrate
    a. Video using prototype to collect data
    b. Show that it can measure change
        i. Relaxing vs. concentrating
    c. Slowing of heart rate/brain waves in deeper sleep. Brain very active in light sleep or REM
3. Notes

a. Getting A/D working
    i. SHould clean signals be a concern before we can do something on the ADC?
b. Spots in ESP32 that are nonlinear. Associated gain 0-1.1V (which can be adjusted). Random Nerds tutorial to hook up A/D, measure signal
c. ESP32, pulse ox powered by computer. Use diode to avoid backfeeding
d. Testing on kit boards
    i. C3 vs. S3 are the same in platformio (just designate board)