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Team TDCS assignment

Project Description Specification

1. Electrical Safety
   1. Current amplitude
      1. The current needs to below a certain limit to prevent skin and neural damage
      2. A display for the current limits should be implemented for better user control and safety
   2. Electrode interactions
      1. Electrodes must use an electrolyte, and the current must not pass through metal or rubber materials as this can cause undesirable chemical interactions (https://www.sciencedirect.com/science/article/pii/S1388245715010883)
      2. Electrode size matters, high current (1mA) requires larger electrodes (larger than 4 cm × 4 cm).
      3. Long term exposure and excessive current can cause itching and redness
   3. Component selection
      1. Components selected should have correct tolerances to be safe within physiological current and voltage limits
      2. Devices should be reliable between each other to be to provide consistent performance
   4. Dosage
      1. Dosage should not exceed 0-2 milliamps for a 20 minute dose (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2754807/>)
      2. Our device should at least be able to have settings that can let the user choose current within safe range
   5. Instructions for users
      1. The device should come with simple and clear instructions on the device itself to prevent misuse.
      2. It should also include a helpful chart regarding electrode size and current settings to help patients prevent skin burns.
   6. Battery safety
      1. A shelf stable alkaline battery should be used to power the device, it doesn't need to be reusable or high capacity.
   7. Contact quality and material: electrodes connected to the sponge. Use fasteners to tight it if needed.
   8. Constant current: users are guaranteed constant current as battery life would not affect the current.
   9. Safety: gradually increasing current for safety. Increases by 0.05mA before reaching actual current.
   10. Voltage protection: the device has a voltage limit and would not exit reasonable voltage (9 V suggested)
2. Low cost and environmental safety
   1. This is a very cheap and easy to make device, as it only should costs around 20 dollars.
   2. The materials that could be used range from resistors, potentiometer, batteries, wires, pcb board, nfc chip. All are low cost.
   3. The circuit could be enclosed with fabric, plastic, or special paper.
      1. Circuit should be protected from moisture of electrodes in package
   4. One important feature is sterilizability, if possible it could make the product stand out
3. Ergonomics:
   1. One person should be able to operate
   2. Device has an option for powering on/off and adjusting voltage
   3. The wires connecting to the electrodes are long enough so that the user can place the device in his/her pocket.
   4. Signal to notify user when the treatment is in progress/finished
   5. Device should be ready to go once opening
   6. User shouldn't have to think so much about pad placement and voltage it should be a relatively hands free operation. And allow easy movement.
   7. Headgear should be unhindered and preferably attached to the device
4. Size and Weight Restrictions:
   1. Weight should not exceed 1 lbs.
   2. Length should not exceed 12 in
   3. Width should not exceed 12 in
   4. Height should not exceed 12 in
   5. Should be able to be packaged in a simple plastic bag with electrode safely
5. User Design
   1. Buttons/controls: Power button, start button, power (current) slide, low battery sign led.
   2. Power (current): 0 mA ~ 2mA.
   3. Duration (min): could be a fixed duration for example 20 min. Sponsor has indicated that the duration and amperage for individual devices may not need to be changeable by user but by manufacturer. Few minutes before the session end the stimulation it will slowly lower the current until it eventually powers down. (One use).
   4. The user should be able to pull the device out of the bag without instructions and be able to use it immediately
   5. The main idea as the sponsor puts it is to make the product cheap and not “fussy” give the user little room to mess up
   6. Electrodes and cheap headgear needs to be designed for this device
   7. It could accommodate different
   8. Device could be for specific application or universal application depending on the complexity.