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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, up to 2 mA (milliamperes) DC.
      2. Current would be specified on the headgear with a label.
   2. Electrode interactions
      1. Electrodes must use an electrolyte, and the cuttent 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 and skin damage, electrical safety mechanism to automatically stop current should be implemented.
   3. Component selection/consistency
      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 provide consistent current output.
   4. Dosage
      1. Dosage should not exceed 30 minutes (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2754807/>)
   5. Safety precautions
      1. The device should come with simple and clear instructions on the device itself to prevent misuse. However, actual use of the device should be intuitive.
   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. Ramp up and down current
      1. gradually increasing current for safety. Increases by 0.05 mA before reaching actual current.
      2. Few minutes before the session end the stimulation, it will slowly lower the current until it eventually powers down. (One use).
   9. 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 15 dollars or less.
   2. The materials that should be used range from resistors, potentiometer, batteries, wires, pcb board, nfc chip. All are low cost.
   3. The circuit should be enclosed with fabric, plastic, or special paper to be safe to handle.
   4. Circuit should be protected from moisture of electrodes in individual package
3. Ergonomics:
   1. One person should be able to operate the device.
   2. Device has an option for powering on/off.
   3. The wires connecting to the electrodes are long enough so that the user can place the device in his/her pocket.
      1. Preferably the headgear is already attached to the circuit with no need to connect wires.
      2. The PCB can be flexible to fit on the head.
   4. Device should be ready to go once opening.
   5. User should not have to think about pad placement and voltage. It should be hands free operation.
   6. Electrodes and cheap headgear needs to be designed for this device
      1. Headgear should accommodate different head sizes.
4. Size and Weight Restrictions:
   1. Weight should not exceed 1 lbs.
   2. Length should not exceed 6 in.
   3. Width should not exceed 6 in.
   4. Height should not exceed 6 in.
   5. Should be able to be packaged in a simple plastic bag with electrode safely.
5. User Interface Design
   1. Buttons/controls: Power/Start button, buttons for each duration/power (current).
      1. Sponsor has indicated that the duration and amperage for individual devices may not need to be changeable by user but by manufacturer.
   2. Packages should be clearly labeled with current rating.
   3. The user should be able to pull the device out of the bag without safety precautions and be able to use it immediately.
   4. Device should be for specific application.
   5. Montage specification
      1. Different montage headgear should be sold with devices rated for specific currents.
      2. Device specifications should be easy to modify at factory.
      3. Packages are designed for individual use cases.
6. “Stretch“ goals
   1. User changeable current
      1. Our device should at least be able to have settings that can let the user choose current within safe range.
      2. Universal application depending on the complexity.
   2. Give user ability to change waveform.
   3. One important feature is sterilizability, if possible it should make the product stand out for uses in sterile environments like operation rooms (mentioned by sponsor).