CREATIVE DESIGN SOLUTIONS

A-TECHTOP
SPRING 2016

Cody Dunn (Project Manager), Rose Leidenfrost (Systems Engineer), Omar Rojas (Systems Engineer), Robin Yancey (Systems Engineer), Stephen Cortez (Electronics Engineer), Marena William (Electronics Engineer), Mimy Ho (Manufacturing Engineer)

OBJECTIVE

- Create a device that records a child's bio-signals and alerts parents and doctors when the child is in danger

OBSTACLES WITH PREVIOUS A-TECHTOP DESIGNS:

- Durability of device and housing

- No EEG measurement for seizure detection, ECG electrode difficulty

- Relatively large size of the device

DESIGN SOLUTIONS TO ECG, DURABILITY, AND HOUSING:

- An example of this type of problem is that one group implemented their device inside a sweatshirt, which cannot be washed or worn everyday
- Forced Relationship Technique:
  - Start with A-TeChToP Housing
  - Want to force a G-Shock watch due to it's durability:
    - Can make housing of components waterproof, dropproof and shockproof
    - Can put the components of A-TeChToP in watch
    - Can put ECG electrodes into a watch
    - Can put sensors into watch and transmit data using accelerometer for rapid movements

http://greenlabel.com/style/casio-g-shock-camo-series-watches/

3

QUESTIONS / EXPERIMENTS TO DETERMINE BEST METHOD:

- What sort of adhesion and conductivity is necessary for ECG electrode placement?

- What types of sealants will best keep out water?

- Does the device still function when dropped from head height?

DESIGN SOLUTIONS TO MEASURING EEG FOR SEIZURES:

- Started with Brainstorming to tackle sub-problems:
  - Wiring and Comfort:
    - Place electrodes at different locations
    - Use less electrodes
    - Wireless transmission of data
    - Helmet
  - Electrode Contact for Data Collection:
    - Contactless electrodes
    - Different methods for adhesion
- Using Different Point of View / Duncker Mindset:
  - How can we <u>not</u> use EEG for seizures (target disease not solution)?:
    - EMG to measure muscle twitches
    - Electrodermal activity (EDA) for skin conductivity
    - Accelerometer for rapid movements

https://www.empatica.com/

5
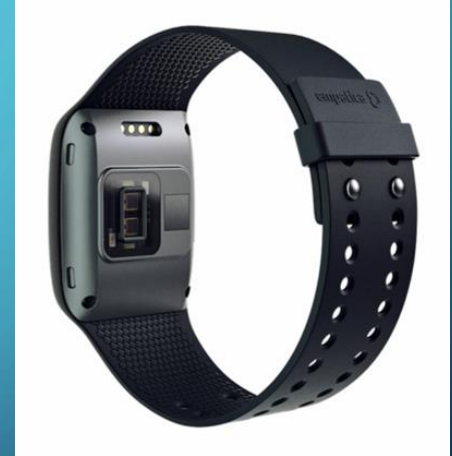
QUESTIONS / EXPERIMENTS TO DETERMINE BEST METHOD:

- Does EMG solve the sub-problems associated with EEG?

- Is an accelerometer a reasonable method for detecting seizure movements?
  - Can these seizure movements be differentiated from standard movement?

- What types of seizures does EDA detect?
  - How is its accuracy when compared to EEG?

DESIGN SOLUTIONS TO THE SIZE AND COMFORT OF THE DEVICE:

- Different Viewpoint Method:
  - View from an ideal future with better technology:
    - Sensors needed for the device are manufactured incredibly small.
    - The device is transparent.
    - Battery pack is compact but capable of powering each part of the device.
    - Child is almost completely uninhibited in terms of movements in play activities.
    - Lily Pad arduino is unnecessary.

SIZE OF THE DEVICE (CONTINUED):

- Continued with a form of Attribute Listing by determining parts of device related to size
  - Microcontroller:
    - Arduino Pro Mini
    - Arduino Nano
    - Arduino Micro
  - PCB design:
    - Multilayer PCB
    - Smaller components
    - Flexible PCB
  - Battery:
    - Solar
    - Rechargeable Batteries
    - Phone's Battery

Flexible sensor array
'Smart Wristband'
Wireless flexible PCB

http://phys.org/news/2016-01-wearable-sensors-reveal-perspiration.html

8

QUESTIONS / EXPERIMENTS TO DETERMINE BEST METHOD:

- What are the differences between the ATmega32U4, ATmega328, and ATmega328P?

- What sort of component limitations are related to the PCB type (also consider cost analysis)?

- We can time how long the battery types last as compared to the specs.