Study Draft

Research Topic:

* Within-subject study analyzing the distraction and urgency level perception among users regarding audio and vibro-tactile parameters

Hypothesis:

* Users will feel the most urgency and emotional distress with higher frequency, longer overall duration, and shorter gap length
* Users will feel the least urgency with lowest frequency and shorter duration
* Users will be most efficient with higher frequency and shorter duration

Background:

* “Ear-cons,” meaning metaphoric sounds recognizable in everyday life, both exist and are designable by altering audio parameters (e.g. single tonal alert for emails or other non-urgent notifications, higher frequency and longer overall duration for sirens or other alarms)
  + Focus on tones rather than speech or music, since speech is slow and dependent on individual language level/syntax and music is easy to recognize but can be complex/dependent on individual musical background
* Vibro-tactile feedback has been found to be more helpful than auditory (Kaul, “HapticHead”), with significantly less accuracy deviation in accuracy (Kerdegari, “Head-Mounted”)
  + Vibro-tactile messages must be self-explaining, and there are higher thresholds on hairy skin; only certain body parts have enough spatial acuity for differentiation (Van Erp, “Guidelines”)

Materials:

* Arduino
* Breadboard
* Wires
* Vibration Motor
* 2x Speakers
* Tobii Eye Tracker + Prototyped Attachments

Independent Variables:

Audio:

* Frequency
* Harmonic Regularity
* Duration
* Rate
* Rhythm
* Location of Speakers

Vibro-tactile:

* Duration
* Gap Length
* Intensity
* Amount of Displays
* Pattern
* Location of Motors

Dependent Variables:

* Urgency Perception
* User Eye Movement
* Time to Complete Task
* Emotional Disturbance

Key Questions:

* How can audio/vibro-tactile parameters be adjusted such that feedback alerts the user but does not cause distress or de-sensitization?
* What is user perception of level of urgency of various audio and vibro-tactile feedback?
* Does changing feedback parameters make a difference in user reaction efficiency?
* Does the location of the feedback display in relation to the head/ears matter?

Experimental Set-Up:

* The user wears the eye tracker prototype, keeping the speakers/buzzer in a set location.
* For reaction time:
  + The user is told to watch a video on a screen in front of them, and to look to a target at a 45-degree angle to the left when they feel feedback
  + User eye movement is measured for accuracy (deviance from most efficient route between video and target), and for amount of movement (distraction), and for amount of time (efficiency)
* For urgency:
  + After each parameter is tested, the user is given a questionnaire on urgency level perceptions
* Audio Test
  + Frequency
    - Single frequency
      * 1A - 50 hz
      * 1B – 200 hz
      * 1C – 500 hz
      * 1D – 1000 hz
    - Beep frequency
      * 1E - 50 hz
      * 1F – 200 hz
      * 1G – 500 hz
      * 1H – 1000 hz
    - Two tone
      * 1I – 50 hz, 1000 hz
      * 1J – 200 hz, 500 hz
      * 1K – 1000 hz, 50 hz
* Vibration Test
  + Intensity
    - A1 – 50%
    - A2 – 25%
    - A3 – 75%
    - A4 – 10%
    - A5 – 5%
* Audio Test
  + Harmonic Regularity
    - Three tone
      * 2A – 200 hz, 50 hz, 500 hz
      * 2B – 1000 hz, 500 hz, 50 hz
      * 2C – 50 hz, 500 hz, 1000 hz
    - Harmonic Up
      * 2D – 50 hz (base), 100 hz (increment), 20 (cycle)
      * 2E – 100 hz, 50 hz, 30 cycles
      * 2F – 800 hz, 20 hz, 10 cycles
    - Harmonic Down
      * 2G – 2000 hz, 50 hz, 30 cycles
      * 2H – 1000 hz, 100 hz, 10 cycles
      * 2I – 500 hz, 20 hz, 20 cycles
* Vibration Test
  + Gap Length
    - B1 – 1000 ms
    - B2 – 500 ms
    - B3 – 250 ms
    - B4 – 100 ms
    - B5 – 1500 ms
* Audio Test
  + Duration
    - Note Duration
      * 3A – 500 ms
      * 3B – 100 ms
      * 3C – 1000 ms
      * 3D – 2000 ms
      * 3E – 50 ms
    - Rate and Duration
      * 3F – 500 ms (duration), 50 ms (gap)
      * 3G – 200 ms, 50 ms
      * 3H – 100 ms, 100 ms
      * 3I – 50 ms, 200 ms
* Vibration Test
  + Duration
    - Total Duration
      * C1 – 1000 ms
      * C2 – 500 ms
      * C3 – 2000 ms
      * C4 – 250 ms
      * C5 – 100 ms
    - Duration and Gap Length
      * C6 – 500 ms
      * C7 – 100 ms
      * C8 – 250 ms
      * C9 – 750 ms
      * C10 – 1000 ms
* Audio Test
  + Rate
    - 4A – 50 ms (gap length)
    - 4B – 200 ms
    - 4C – 500 ms
    - 4D – 1000 ms
    - 4E – 2000 ms
* Vibration Test
  + Rate
    - D1 – 500 ms (gap length), 1000 ms (duration)
    - D2 – 500 ms, 500 ms
    - D3 – 250 ms, 100 ms
    - D4 – 100 ms, 500 ms
* Audio Test
  + Rhythm
    - 5A – 500 ms, 100 ms, 50 ms
    - 5B – 1000 ms, 2000 ms, 200 ms
    - 5C – 200 ms, 100 ms, 800 ms
    - 5D – 1000 ms, 500 ms, 50 ms
    - 5E – 50 ms, 1000 ms, 500 ms
* Vibration Test
  + Pattern
    - E1 – 250 ms (gap length 1), 500 ms (gap length 2), 100 ms (duration 1), 500 ms (duration 2), 50 (intensity 1), 25 (intensity 2)
    - E2 – 100 ms (gap length 1), 750 ms (gap length 2), 500 ms (duration 1), 250 ms (duration 2), 15 (intensity 1), 75 (intensity 2)

Experimental Notes:

* Audio/vibro-tactile feedback occurs at a set time unknown beforehand to the user
* The selected parameter is tested at 5 variations for each testing function written for it
* Target group age range is between 18 and 35 years old (for best hearing abilities)