Wearable Brain Sensing Devices

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Oct 28, 2014
Outline

1. A survey of wearable brain sensing devices that are available on the market

2. Using wearable brain sensing devices to measure cognitive health in seniors and help address medication non adherence
Electroencephalography (EEG)

- EEG uses electrodes on the surface of the scalp to measure the voltage signal arising from large areas of coordinated neural activity.
- Electrophysiological biosignals are already used in the diagnosis and prognosis of a wide range of neurological conditions that afflict older people (e.g., Alzheimer's disease and other forms of dementia, …)
Wearable Brain Sensing Devices
NeuroSky

• EEG chip manufacture that offers a EEG biosensor platform, early mover since 2007
• Single dry electrode (FP1), a variety of form factors, $99~$149
• Focused on consumer market (e.g. partner with Mattel MindFlex, Uncle Milton Star Wars Force Trainer, Puzzlebox Orbit)
• [http://neurosky.com/](http://neurosky.com/)
Emotiv

- **Emotiv EPOC (2009)**
  - 14 dry electrodes (AF3, F7, F3, FC5, T7, P7, O1, O2, P8, T8, FC6, F4, F8, AF4), accelerometer, $399

- **Emotiv Insight (2015)**
  - 5 hydrophilic polymer sensors (AF3, AF4, T7, T8, Pz) + 9-axis inertial sensors, $299

- Focused on research market (e.g. partner with Tobii, the eye tracking company)

- [http://emotiv.com/](http://emotiv.com/)
New Players

• **InteraXon Muse (2014):**
  - 4 (FP1, FP2, TP9, TP10) dry electrodes, accelerometer, $299
  - Recent strong entrant, Indiegogo success followed by $7m funding round
  - [http://www.choosemuse.com](http://www.choosemuse.com)

• **iFocusBand (2014)**
  - 2 (FP1, FP2) soft woven dry sensors, rugged, low key, $310
  - Focused on the sport training markets (e.g., prototype used by 8 US PGA Tour professionals)
Measure Cognitive Wellness in Seniors

• Aging patients are monitored infrequently in the clinic, due to costs in time and money
  • Presented condition may not be representative
  • Progress of degeneration is hard to track
  • Sudden deteriorations may be missed
A Use Case

• A 70 yr old man, healthy, but at risk …
Medication Adherence is an impending problem for healthcare outcomes

Non-adherence to medication costs the US healthcare system USD 100 – 289 Billion per year.

By 2030, the Baby Boomer generation is projected to increase elderly population to 70 Million.
Patient Treatment Journey & Pain Points

Experience Symptoms
Consult with Physician
Obtain Medication
Adherence

Monitor effectiveness
Address adverse effects or cross-reactivity
Positive reinforcement

Resolving Treatment Issues
Competitive Landscape

**Patient Brochure**

**Pill Packaging**

**Email Reminders**

**Physician-Patient**

**Monitoring Devices**

**Mobile app**
MVP: Medication Adherence Network

Wearable Brain Sensing Device

Monitor effectiveness

Positive reinforcement

Internet Cloud

Channel Partners

CVS

Payers

Employers
Looking Forward

- Wearable systems, via smart-phones, tablet computers

- Early-warning systems
  - e.g. for every 1,000 customers, in a single year could expect several incidences of stroke, >50 incidence’s of Alzheimer’s, ~200 individuals with depressive episodes

- Automated alerts to clinicians if danger of acute condition

- Patient-tailored 'gaming' tasks to halt cognitive decline

- Self-management of chronic illness
  - e.g. anti-depressives
Point of Contact

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