Data, personalization, design and inclusive wearable technology

Dr. Sara Diamond,
PI, Visual Analytics Laboratory,
&Inclusive Design Research Centre
President, OCAD University
The Power of Data Analytics

• Data analytics and expression offer opportunities for the empowerment of people with disabilities within the context of wearable technologies.

• Data production, harvesting and analysis provide allow intensive connectivity and the personalization of devices and aesthetics.
Convergence...

Fields as diverse as data analytics and representation; immersive and augmented reality games design; gesture based technology; smart textiles; fashion and technology, neuro-technology, micro-electronics (Arduino, Lilypad); GPS; sensor embedded environments; 3D printing; combined with design savvy and user-centred design can inform next generation devices and experiences.
Winning Tactics

• Appropriate emerging technologies.
• Build with inclusion in mind and PWD as part of design process.
• Sustain control of our data, think through privacy issues and recognize that empowerment and vulnerability are part of the data-rich future.
• Underscore the need for excellent design: multisensory (visual, audio, tactile, texture, usability).
Vibro-tactile data expression

- Flutter
- Time Tremors
- Wristband prototype
- Touch sensitive watches for text entry and device control – Samsung, IBM
Flutter, winner International Symposium on Wearable Computers (ISWC)

- Halley Profita, Nicholas Farrow, and Professor Nikolaus Correll at the University of Colorado – Boulder
- Fuses textiles and robotics
- *Flutter* gives vibrotactile feedback in the direction of a loud sound or alarm to help those with hearing loss respond more intuitively to their external environment.
- *Flutter* was conceived as an alternative form of assistive technology by producing an ethereal and functional garment that calls attention to the beauty of the device, not the disability.
Flutter responding to sound
Flutter Embedded Microphones
Flutter

- Bodice uses cotton and polyester textiles and an inner framework of embedded microphones that network together to determine frequencies and their amplitude of incoming sounds.
- Microphones collectively agree on the direction of sound and, in turn, actuate small vibration motors in the leaflets to simulate fluttering in the direction of the auditory cue.
Time Tremors Game Devices, OCAD University, Zuannon, Xenophile
Vibro-tactile input to make, play and exchange music or a musical pattern and display LEDs
Rubber bracelet: external view | general base

Connection point between bracelets: Combination possibilities

Side higher density rubber Neutral color (silver or graphite gray, or black *)
Intense color (red or blue)

System of closing by snaps

Inner layer EVA: Intense color, fluorescent

System to fit the bracelet on different biotypes

(* considering teenagers)
Rubber bracelet: external view | 7 to 8 years old

- Niches for fitting parts (treasures) around the strap
- System of closing by snaps
- Inner layer EVA: Intense color, fluorescent
- System to fit the bracelet on different biotypes
- Pieces (treasures) in high-density rubber, low or high relief
Rubber bracelet: external view | 7 to 8 years old

- Pieces (treasures) embossed, embedded, Rubber high density
- System of closing by snaps
- Side higher density rubber
- Intense color (red or blue)
- System to fit the bracelet on different biotypes
Rubber bracelet: external view | 9 to 12 years old

- Pieces (treasures) embossed, embedded, in translucent rubber combining the application of LEDs
- System of closing by snaps
- System to fit the bracelet on different biotypes
- Side higher density rubber Intense color (red or blue)
Rubber bracelet: external view | 13 to 15 years old

- Connection point between bracelets
- Side EVA rubber and high density
- OLED screen
TREASURES
Hanlu Ye, Meethu Malu, Uran Oh, Leah Findlater, Wellesley & U. Maryland

• Wristband wirelessly controls iOS VoiceOver screen reading technology – safety and access to information on the go – mostly used for obstacle detection – they are exploring navigation

• Social context – use jewelry (wrist band, bracelet or ring) as integrative design with flexible aesthetics, visually impaired users cited convenience and speed and use on the go, noise, social etiquette better, safety as phone hidden

• Bracelet used to control VoiceOver
Wristband Design

- Ribbon
- Embroidered guide lines
- Capacitive fabric
- Raised divider
- Touch potentiometer
- Capacitive fabric
Visualizing data

• Sensor data can be expressed through LED or other display
• Robert Tu MIU
• Cute Circuit (industrial fashion output)
Robert Tu, the MeU
Growth of DIY and Maker movements
Body controllers and data

- Next generation gesture and micro-gesture based systems
- *Tongue-Drive Enabled System*, Georgia Institute of Technology, J. Kim, X. Huo, M. Ghovanloo
- Non-invasive, wireless and wearable assistive technology that helps people with severe disabilities control their environments using their tongue motion. TDS translates specific tongue gestures to commands by detecting a small permanent magnetic tracer on the users' tongue.
- Linked TDS to a smartphone (iPhone/iPod Touch) with a customized wireless module, added to the iPhone.
Tongue-Drive Enabled System
Di Mainstone/Sara Diamond, Company Keeper, 2004-5
*Ping* – monitors gestures and communicates activities on fb
Display

- Chrome dioxide surfaces
- Coats fabric and allows storage of data through magnetic modulation
- Information written and read through touching surface with glove device
- Reading head – electromagnetic sense coil reads fluctuations in chrome dioxide material
Soft Circuits
Challenges

• Connectivity

• Power: Thermal harvesting, Piezo electronics + electro static + electro-magnetic (muscle generated + gravity), solar cells.
Personalization of Assistive Devices

- Exoskeletons, limb extensions – emphasizing personalization, 3D printing and design opportunities.
- Personalized data is critical in the development of these products.
Stylized medical aides

• Francesca Lanzavecchia, Time to Design New Talent Award, Denmark.
• ProAesthetics Supports – orthoses, braces and canes
Wrist Brace
Cane/Side of Body Prosthetic
This project involves the use of 3D printing technology to allow for the prosthetic hand and its attachments to be quickly and cheaply printed at home with a desktop 3D printer, such as the Makerbot, or through a local 3D printing service.

The components of my project are the following:

- The prosthetic hand supporting multiple task-specific attachments
- An online community that actively participates in innovating the product by designing new attachments
- Makers, designers, and inventors that are interested in creating solutions to various problems
- Amputees, individuals with limb deficiencies, and their peers
Brain Wave Controllers

- brainwave technology – games, productivity, self-help
Toyota Brainwave controlled Wheelchair, 2009
Emotiv Insight

• Emotiv Insight is an aesthetically attractive, miniaturized, 5 channel, wireless headset that reads brainwaves and a mobile app that translates those signals into meaningful data that is easily understood.

• Emotiv Insight allows users to optimize your brain fitness & performance, measure and monitor your own or other’s who provide permission cognitive data.
Emotiv-Insight – Red Dot Dot Winners
Emotiv Insight – Red Dot Award Winners

• Brainwear can understand and decipher basic mental commands such as push, pull, levitate, rotate and even commands that are harder to visualize such as disappear. It also detects facial expressions such as blinks, winks, frown, surprise, clench and smile.

• Data is produced, personalized and available to port to mobile and other applications.

• Mobile applications that can translate brainwaves into controllers.
Mobile applications
Emotiv Insight – use for learning, browsing, web access
Computer assisted vision devices

• Google Glass (e.g. Andy Lin, Los Amigos National Rehabilitation Centre) and note opportunities presented by other visual emerging technology such as the Occulus Rift – an immersive real-time virtual reality gaming headset that uses spatial and optical data for navigation.
How do these different approaches reflect data?

• Data is produced and used to facilitate functionality and interaction with wearable

• Data is harvested and stored – creating a history

• The user personalizes the device through the use of data

• Data privacy and control hence are fundamental
Wearable devices that support data monitoring

• Goal: enhanced self-care and community support.

• Wearable technology should both support autonomy and strengthen bonds and interactions between people.
Network for Innovative Personalization: Supporting Inclusive and Sustainable Prosperity

1. Research methods, metrics and measures that encompass diversity and capture the complexity of requirements. These measures provide the evidence for policy, the data for smart systems, and the feedback for refinement, and self-correction.

2. We need to develop inclusive means of analyzing, synthesizing and visualizing the data and metrics gathered. This means that the data or metrics must be made understandable to a range of end users including users with cognitive access issues and users without sight.

3. Lastly we need to develop products, environments, systems and policies that are designed for diversity; as well as design and development tools that encourage inclusive design. This is best achieved through personalization and one-size-fits-one responsive design.