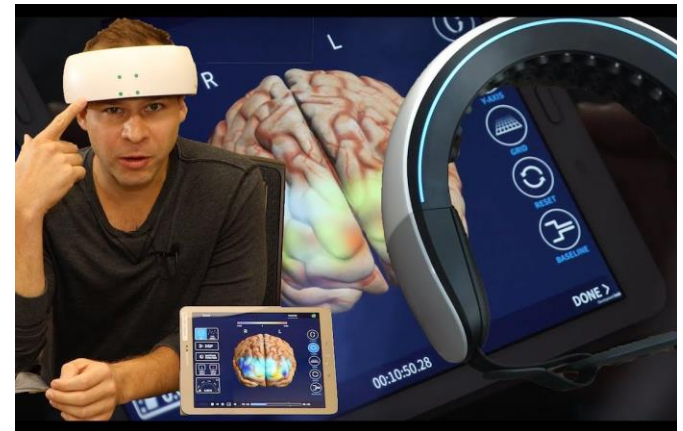# Wearables, the Quantified Self, and Longitudinal Research

Nadine Aburumman

slides are based on materials created by Prof. Jasna Kuljis

What are Wearables?

K. Lee *et al.*, "Pedestrian Detection with Wearable Cameras for the Blind: A Two-way Perspective", In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA, 1–12

X. Jiang *et al.*, "WeDA: Designing and Evaluating A Scale-driven Wearable Diagnostic Assessment System for Children with ADHD", In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA, 1–12

the jammer's noise is **inaudible** to humans

audible limit

frequency 25kHz

voice assistant (jammed)

smartphone (jammed)

smartwatch (jammed)

wearable jammer

Y. Chen *et al.*, "Wearable Microphone Jamming", In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA, 1–12

Wearables are small computing devices that are worn under, with, or on top of clothing

Generation-0 (Smart) Wearables

Pedometer

Glass

Pocket Watch
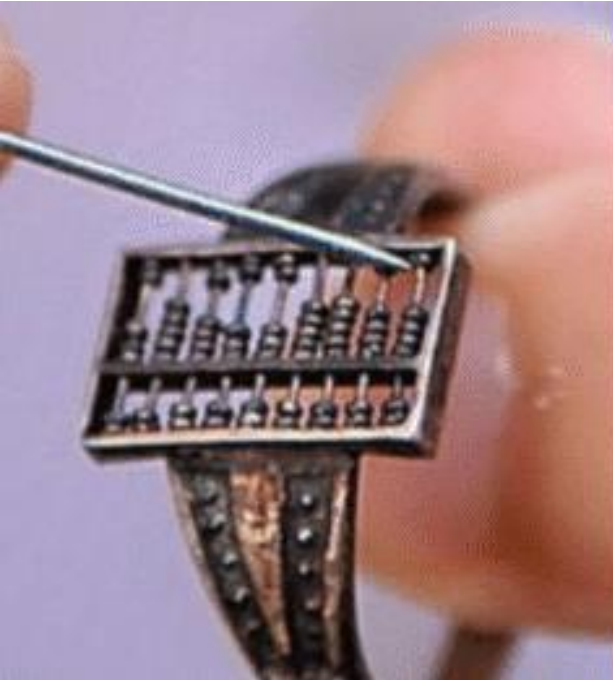
Portable Music Players

Watch

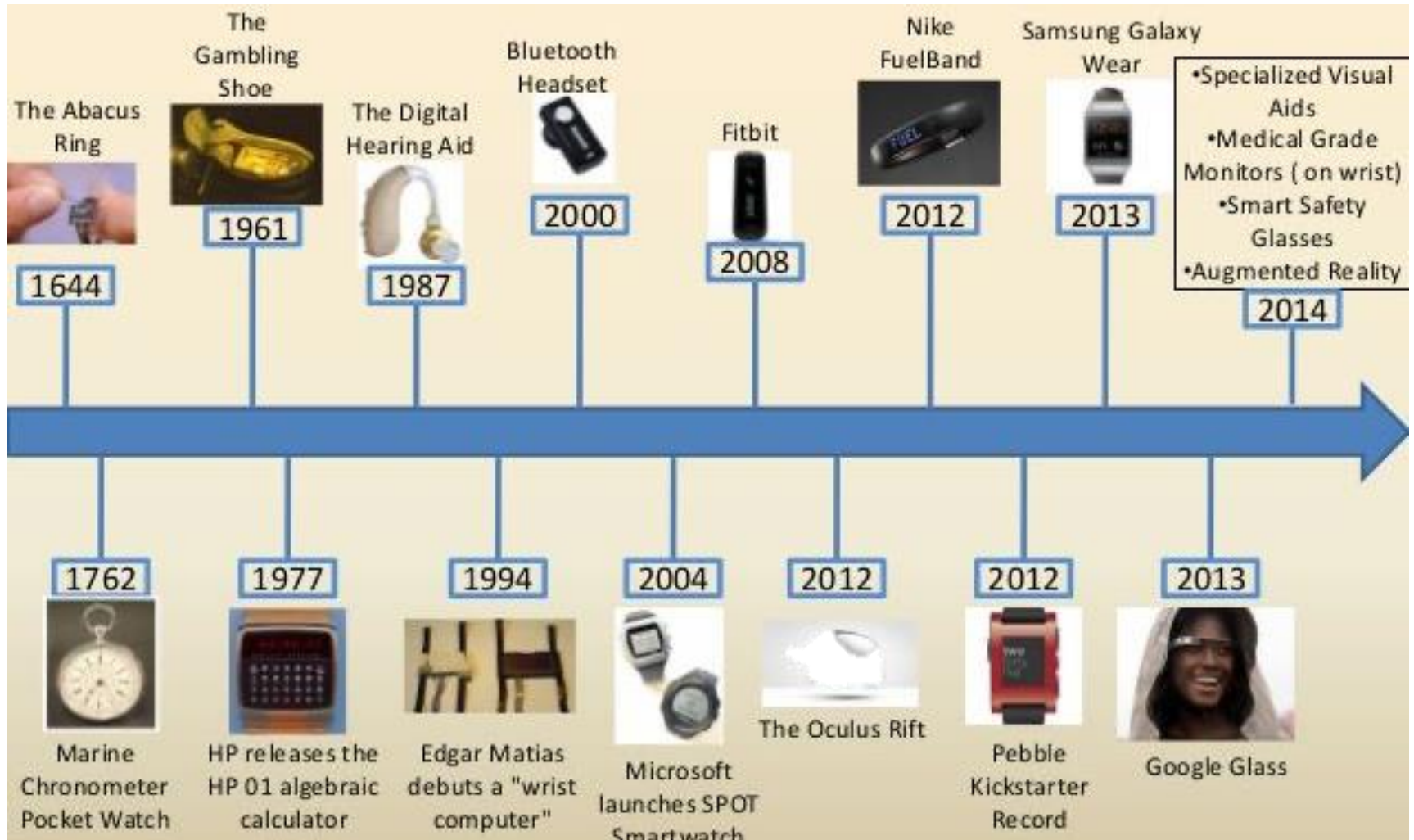# History of Wearable Technology

1699 Abacus Ring   1974 Casio Watch   2015 Smart Watch

History of Wearable Technology

The Abacus Ring — 1644

The Gambling Shoe — 1961

The Digital Hearing Aid — 1987

Bluetooth Headset — 2000

Fitbit — 2008

Nike FuelBand — 2012

Samsung Galaxy Wear — 2013

- Specialized Visual Aids
- Medical Grade Monitors (on wrist)
- Smart Safety Glasses
- Augmented Reality

2014

1762 — Marine Chronometer Pocket Watch

1977 — HP releases the HP 01 algebraic calculator

1994 — Edgar Matias debuts a "wrist computer"

2004 — Microsoft launches SPOT Smartwatch

2012 — The Oculus Rift

2012 — Pebble Kickstarter Record

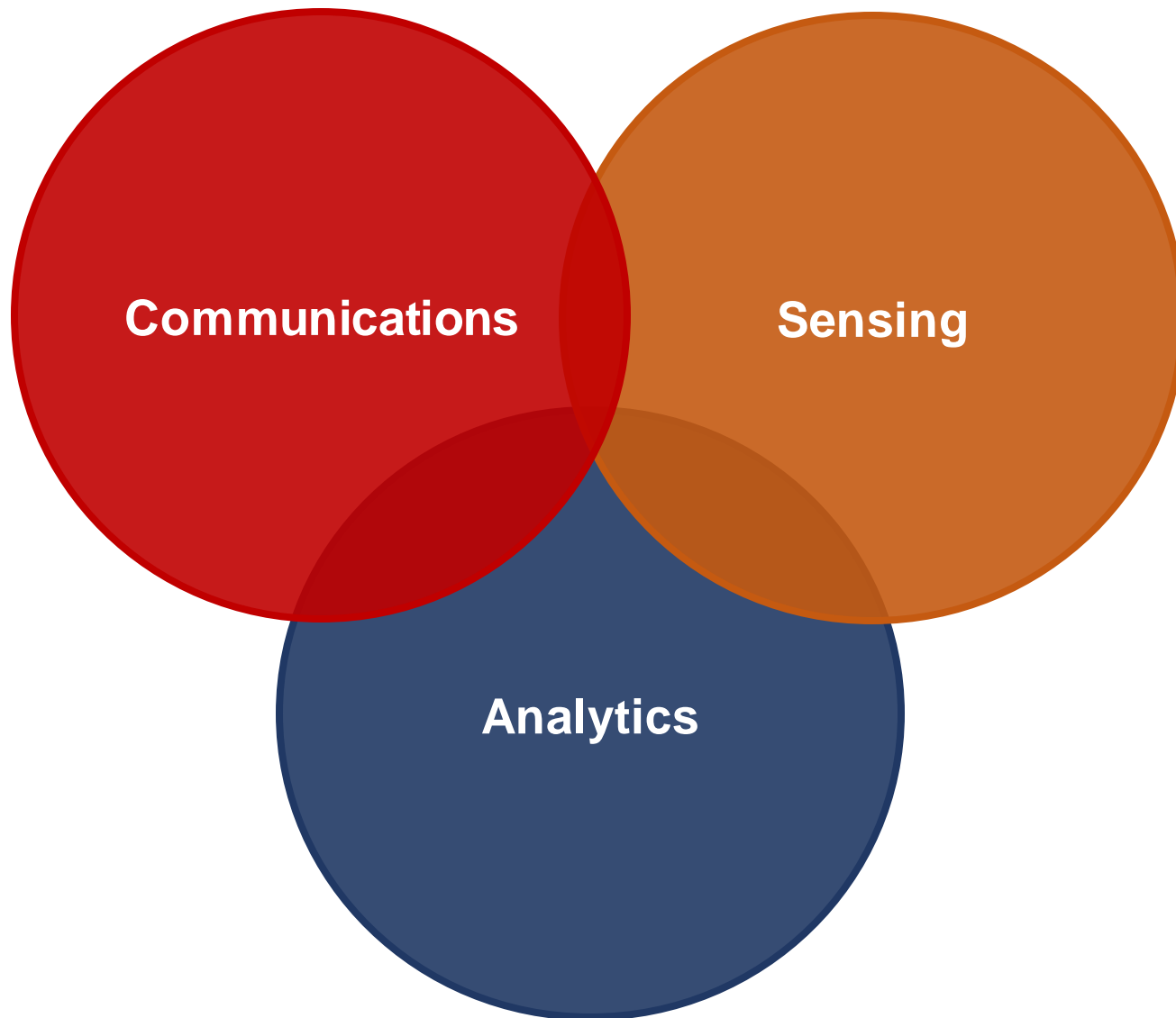2013 — Google Glass

Wearable Technology

- ## Space suits
Can you list key components of such an integrated wearable 'computer' system?

- ## Emergency services suits
Firefighters may have in their protective clothing built in audio, GPS, head-up display, etc.

Converting Trends

Major Changes in Computing Platforms

Desktop

Laptop

Smartphone

Glasses

What is a Wearable Computer?

- Portable while operational

- Enables hand-free/hand-limited use

- Able to get the user's attention

- Always on, acting on behalf of the user

- Able to sense the user's current context

Rhodes, B.J., 1997. The wearable remembrance agent: A system for augmented memory. Personal Technologies, 1(4), pp.218-224.

Wearable Computing

A computer on the body that is

- Always on

- Always accessible

- Always connected

other attributes

- Augmented user action

- Aware of user and surroundings
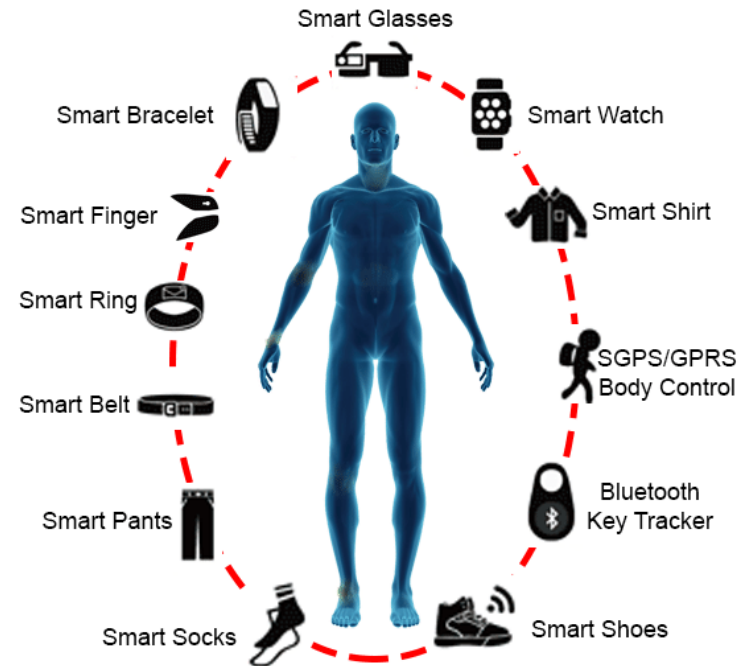

Wearables and Digital Biomarkers

The Ideal Wearable

- **Persists and provides constant access:**

  Designed for everyday and continuous user over a lifetime

- **Senses and models context:**

  Models the users environment, mental state

Thad Starner and Alex Pentland. 1999. Wearable computing and contextual awareness. Ph.D. Dissertation. Massachusetts Institute of Technology, USA. Order Number: AAI0801159.
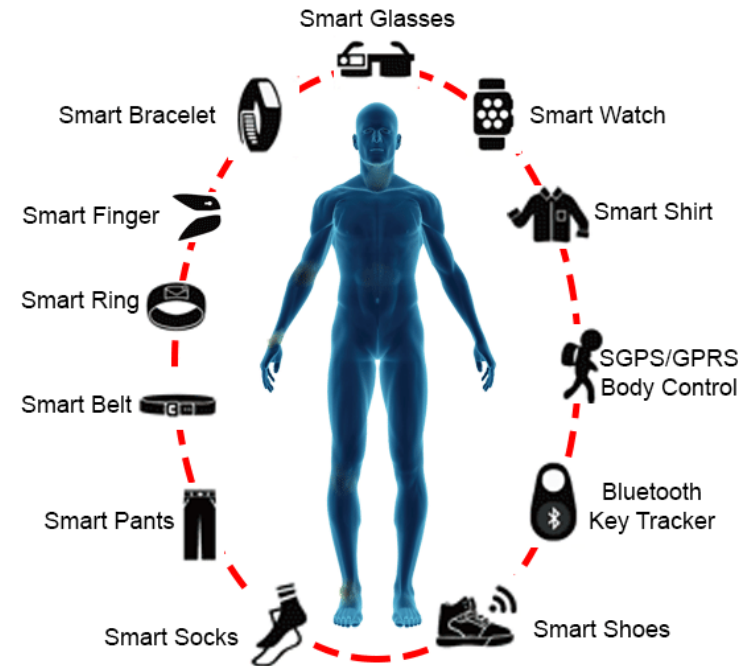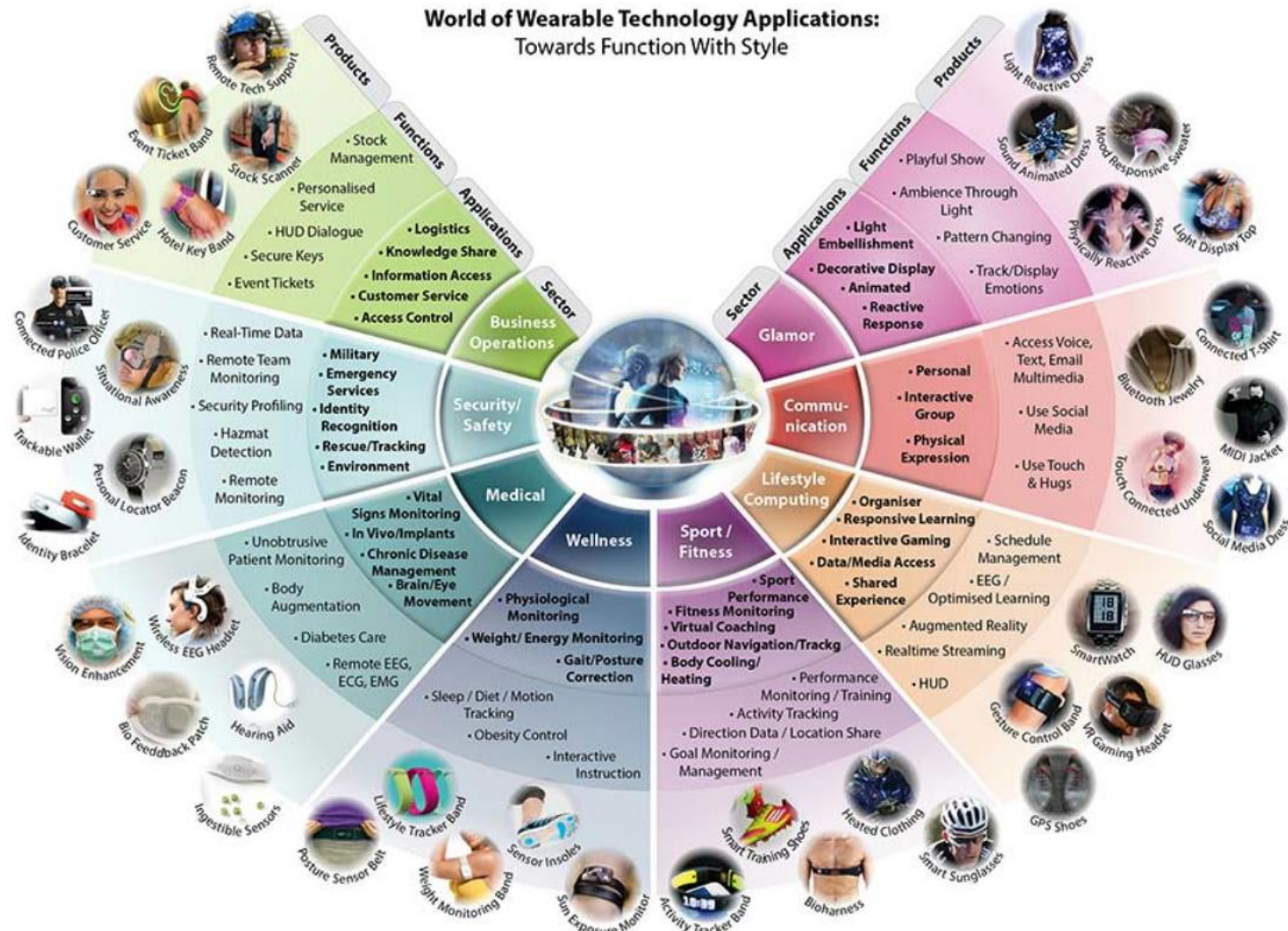
The Ideal Wearable

- **Augments and mediates:**

Information support for the user in both the physical and virtual realities

- **Interacts seamlessly:**

Adopts its input and output modalities to those most appropriate at the time

Smart Glasses
Smart Bracelet
Smart Watch
Smart Finger
Smart Shirt
Smart Ring
SGPS/GPRS Body Control
Smart Belt
Bluetooth Key Tracker
Smart Pants
Smart Socks
Smart Shoes

Thad Starner and Alex Pentland. 1999. Wearable computing and contextual awareness. Ph.D. Dissertation. Massachusetts Institute of Technology, USA. Order Number: AAI0801159.

The World of Wearable Technology

World of Wearable Technology Applications:
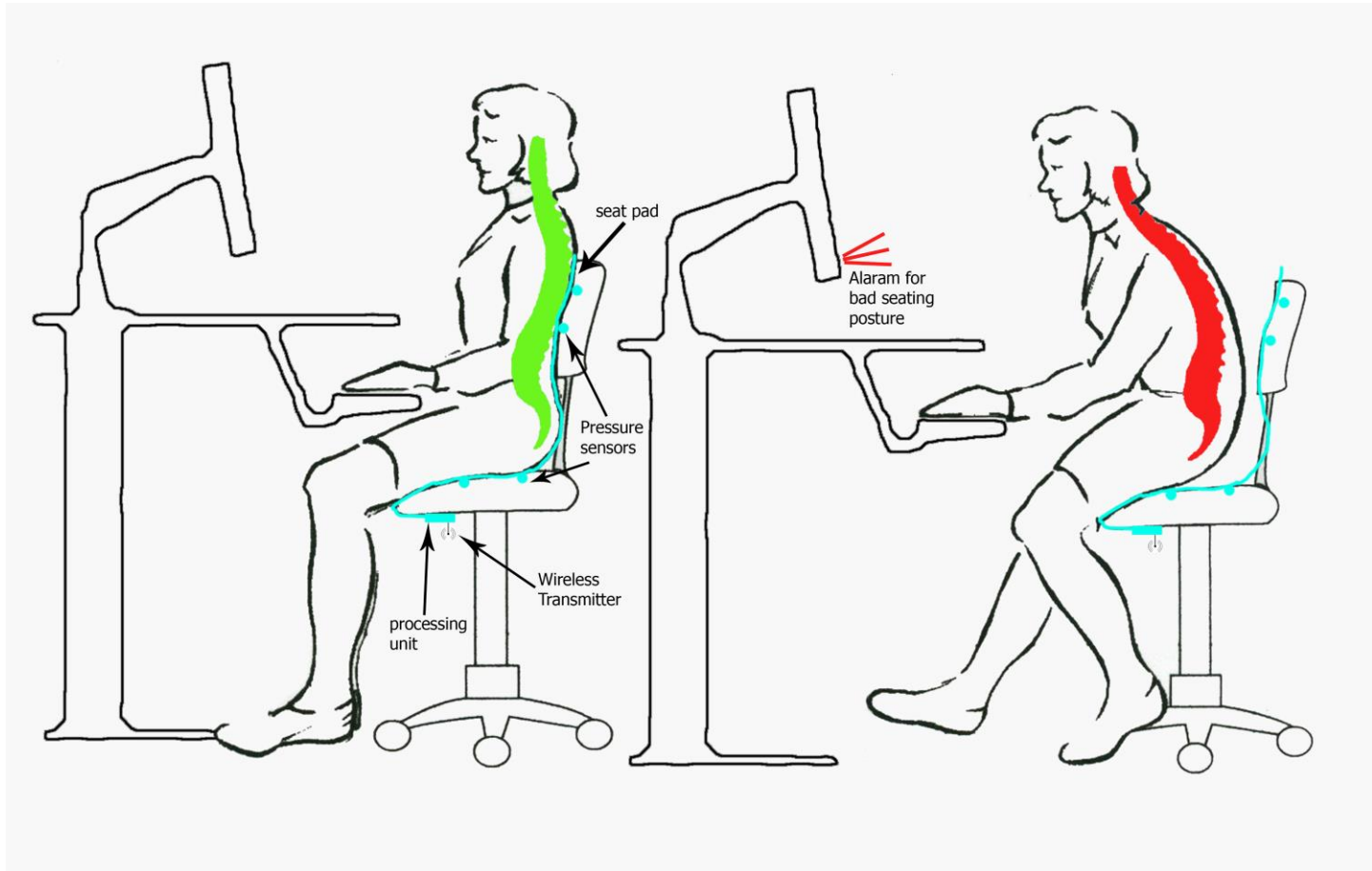Towards Function With Style

http://www.beechamresearch.com/article.aspx?id=20

Wearables: The Future of Everything

Dr Joanna Berzowska "[Wearables: The Future of Everything](#)" talk at TEDxYouth

Design a wearable posture monitor

Wearables for the Quantified Self

- **Quantified self** is a movement that incorporates technology such as sensors

- **Wearables** to acquire data on various aspects of an individual's life

improve **self**-sensing, **self**-awareness and human performance within the digital health industry.
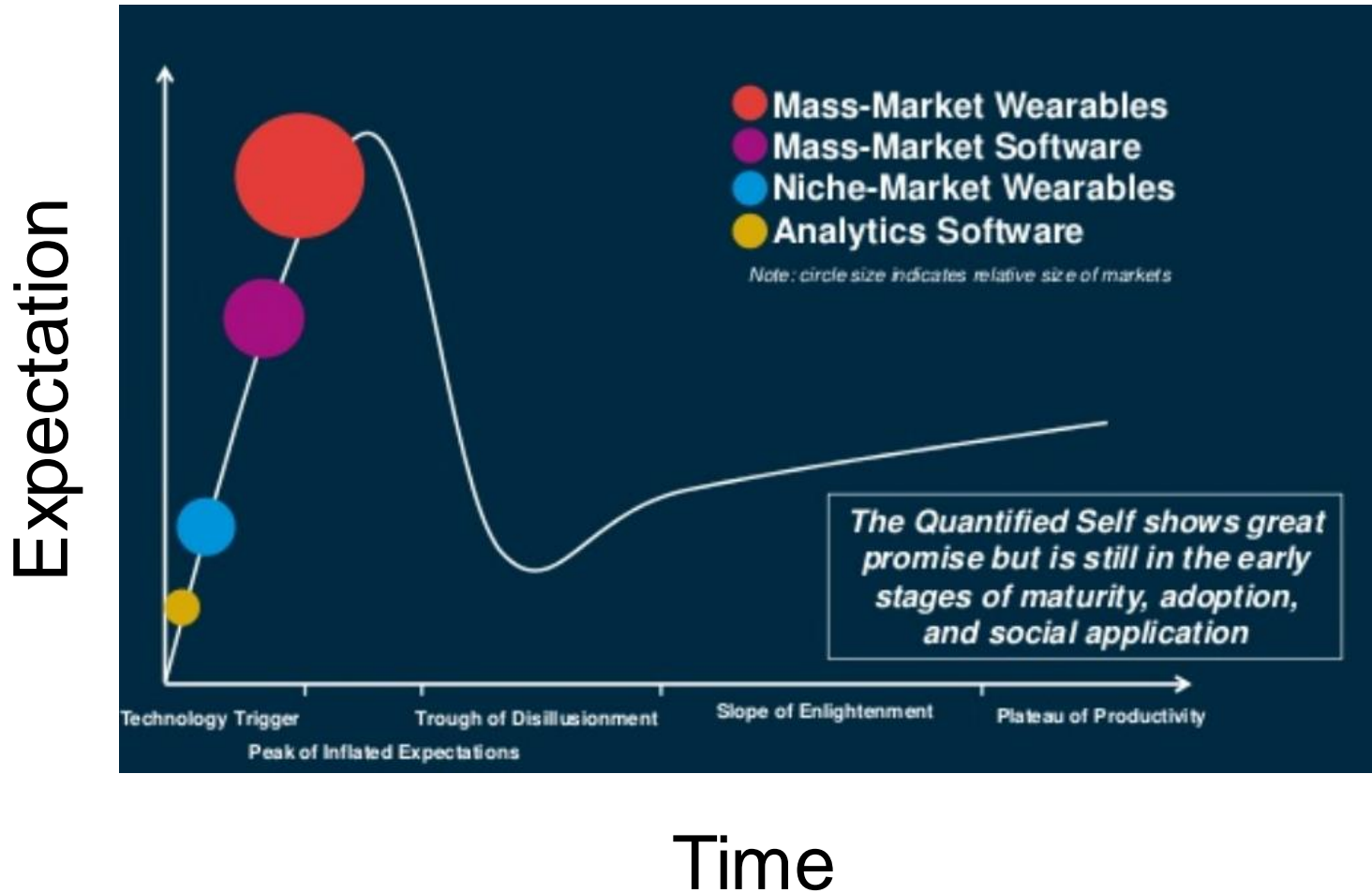
Quantified Self (aka Self-Tracking)

Data is collected on

- **Inputs**: e.g. food consumed and quality of surroundings

- **States**: e.g. mood, blood oxygen level

- **Performance**: e.g. mental and physical

Personal analytics enabled by the availability of various bio-sensors in mobile and wearable devices
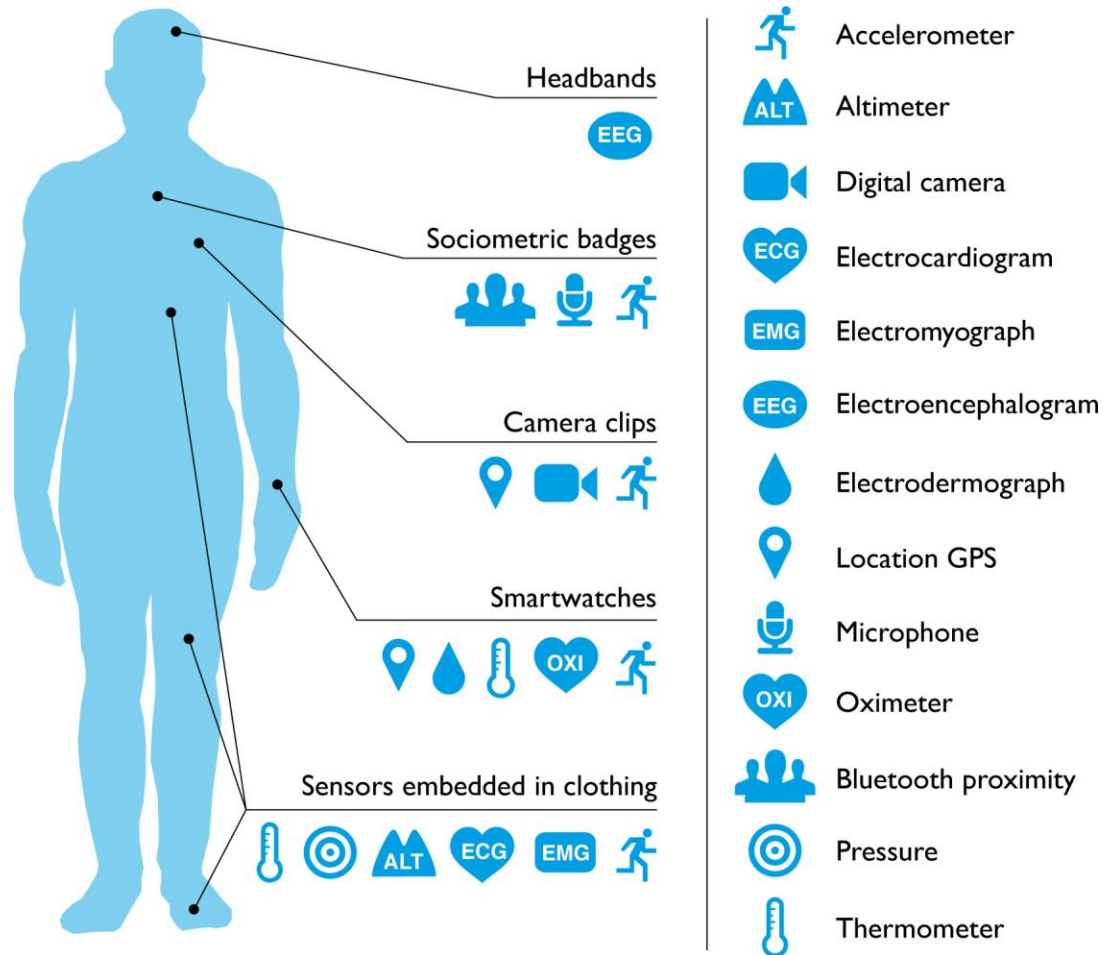
Quantified Self: Hype Curve

Common uses of Computers in Health

Medical and patient data	Notes about the patient and treatment
Patient monitoring	Computers control lab equipment, blood pressure monitors, heart rate monitors, and other equipment
Medical imaging and equipment	Computers are used to control medical devices and perform CT scans, ultrasound, MRIs, or blood test.
Medical procedures and operations	Cardiac procedures surgeries, laser surgeries, keyhole surgeries, etc. are performed with an aid of computers
Devices for self monitoring	Monitors that measure blood pressure, heart rate, blood oxygen, skin temperature, glucose levels, etc.

What Can Wearables Measure?

PiwekL, Ellis DA, Andrews S, Joinson A (2016) The Rise of Consumer Health Wearables: Promises and Barriers.
PLoSMed13(2): e1001953.

Applications of Wearable Computing

- Sensors for checking vital bodily functions (heart rate, blood pressure, etc.)

- Medical implants

  - Non interactive (muscle stimulators, artificial heart, etc.)

  - Interactive (brain-computer interface, hearing aids, etc.)

Devices in Healthcare: Main Concerns

- Developing safer devices

  - About 10% of preventable deaths in hospitals are due to computational errors
  - Error rates can be reliably reduced dramatically by software and HCI Improvements

- Improving user interface in order to make computer systems and equipment easier to use

https://www.swansea.ac.uk/compsci/research-and-impact/safer-human-computer-interaction-for-healthcare/
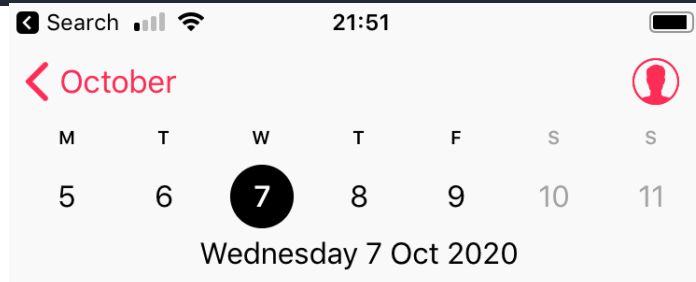
Wearable Tech Expands Human Potential

**Lauren Constantini "[Wearable Tech Expands Human Potential](#)"
talk at TEDxMileHigh**

In-Class Activity (Health Data)

How many steps did you walk yesterday?

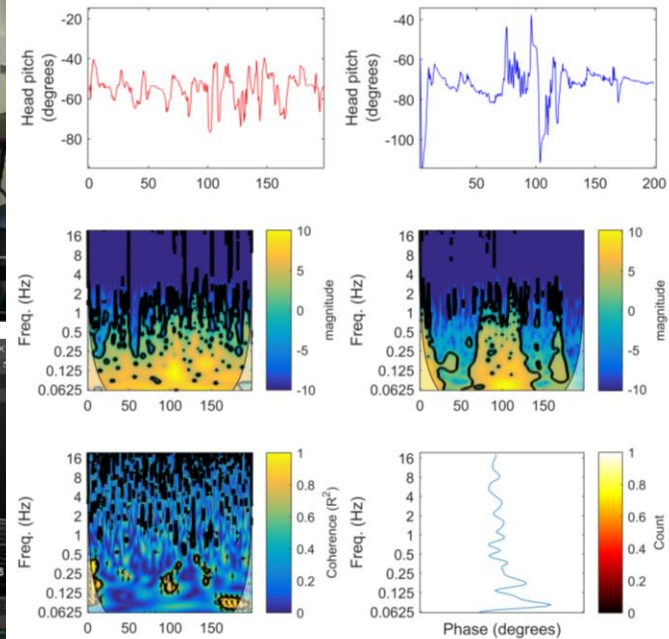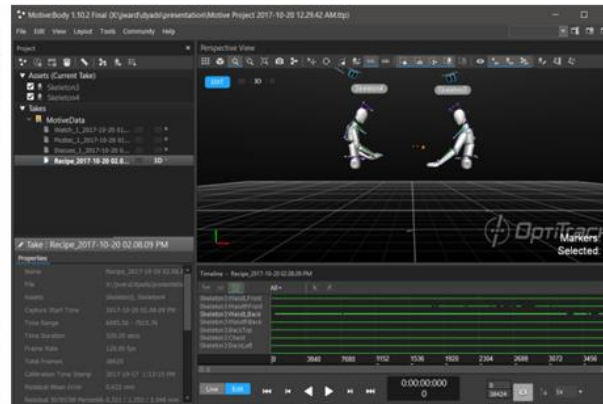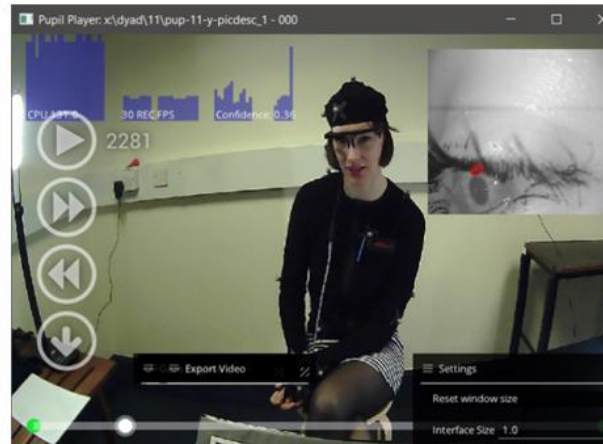# Wearable Devices for Research

Wearables for Exploring Social Signals

Wearable Devices for Research
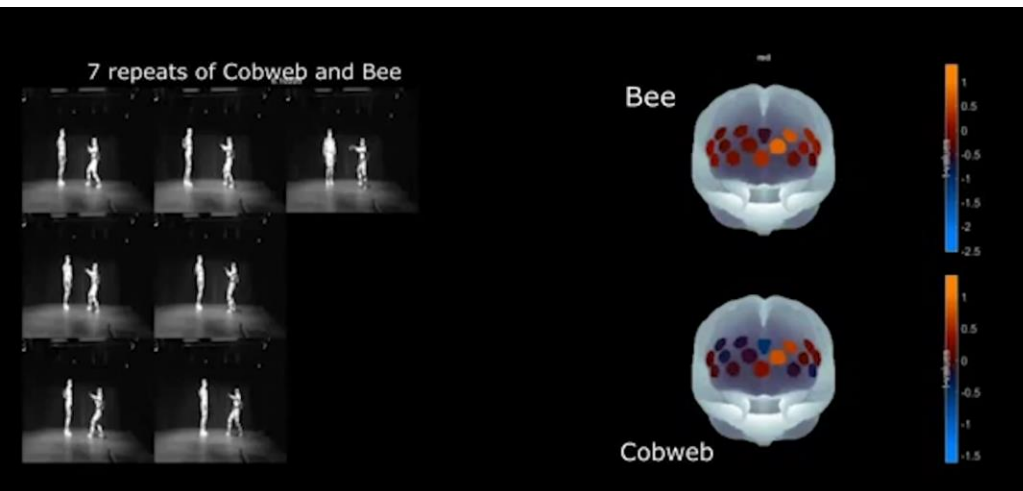
Wearables in the Theatre

Wearable Devices for Longitudinal Research

Wearable Devices Make it Possible to Capture Data for Extended Periods

- Example: The [Millenium Cohort Study](#)

- Conducted by the [Centre for Longitudal Studies](#)at UCL

- Following the lives of a sample of about 18,818 babies born in the UK in the year 2000–2001aim is to create a multi-purpose data-set that describes the diversity of backgrounds into which children are born in the beginning of the 21st century.

- Study measures e.g. health child development, social stratification and family life.

Wearable Devices for Longitudinal Research

- How were wearable devices used in the Millenium Cohort Study?

  - At ages 7 and 14, MCS participants were asked to wear wrist-worn accelerometers.

  - Resulted in data on daily physical activity of around 10000 participants

Seminar Exercise (30 minutes)

X. Jiang et al., "WeDA: Designing and Evaluating A Scale-driven Wearable Diagnostic Assessment System for Children with ADHD", In Proceedings of the CHI 2020.

Discuss in your group:

- The main research question/s
- What research methods were used
- Who are the potential beneficiaries of this research?
- What are the potential benefits of this research to the identified beneficiaries?

Access the collaborative whiteboard link according to your assigned group and use it to write down or illustrate your discussion (**to be able to access, you need to sign in as a guest)**.

Ask Week (Coursework)

Paper selection is now live and a link has been added to the Assignments area on BBL

Week 8

Social Computing and Fun will be given by Prof Kate Hone

Questions

Office hours: Monday 2:30 p.m. - 3:30 p.m.

Email: Nadine.Aburumman@brunel.ac.uk

Book an appointment:
https://nadineaburumman.youcanbook.me/