Introduction to Intelligent User Interfaces

Users' Context in Smart Environments

Objects and Artifacts in our Life

How many things do you own? 72?

- Green tshirt
- Dark blue v-neck tshirt
- Green/grey long sleeve tshirt
- Tan tshirt
- White v-neck tshirt (with Google Homepage drawn on it…ah, Halloween)
- Light blue polo
- Yellow polo
- Grey polo
- Light blue military-style shirt
- Light blue shirt
- Torn up jeans
- Rock star jeans
- Fashiony jeans
- Green casual jacket
- Dark blue fancier jacket
- 5 pairs of boxer briefs
- 6 pairs of socks (solid colors and argyle)
- Brown leather belt
- Brown leather watch
- Slim Slimmy Wallet, Passport, ID, Debit cards, Credit card, Pesos, Business card with notes scribbled all over it
- Cheap sunglasses
- Newsie-style hat
- Brown leather flip flops
- Brown leather sexy shoes
- Vibram Five Finger workout shoes
- Umbrella
- Nike+ workout watch and sensor
- Workout shorts
- 2 sleeveless workout shirts
- Travel journal
- Medium and small Moleskine notebooks
- Array of pens, pencils and markers
- iPod Touch and armband
- iPhone headphones
- Unlocked RAZR
- Brown leather satchel
- EEE PC 1005HA netbook with sleeve
- 15″ Macbook Pro
- 15″ Mabook Pro sleeve
- Wireless Mighty Mouse
- USB-splitter
- 3 USB-powered hard drives
- Mini DisplayPort to DVi adapter
- Mac Software install discs
- Lumix LX3 digital camera with case
- HF100 Digital HD camcorder with remote
- Gorillapod tripod
- Spare 512 MB SD card and microfiber screen-cleaning cloth
- Rechargeable batteries
- Toothbrush, toothpaste, floss
- Nose and facial hair trimmers
- Hair product
- Prescription glasses and case
- Spare contact lenses, case and solution
- Carry-on bag
- Wine aerator

http://exilelifestyle.com/all-72-things-own/

How many things do you own? 288?

- **Life Tools & Accessories**. 33 items, including my car, guitar, books, hairbrush, toothbrush, etc.
- **Consumables**. 5 groups of items, including food, cleaning supplies, hygiene supplies, office supplies, and paper goods.
- **Kitchen Items**. 19 items, including pots, pans, utensils, coffeemaker, toaster, oven mitt, etc.
- **Bathroom Items**. 6 items, including my bathroom scale, rugs, trash can, shower caddy, etc.
- **Electronics**. 10 items, including my BlackBerry, MacBook, Printer, iPod, etc.
- **Furniture**. 18 items, including my bed, couch, coffee table, desk, chairs, etc.
- **Decorations**. 14 items, including decorative plants, artwork, digital picture frames, wall clock, etc.
- **Casual Clothes**. 79 items, including jeans, hoodies, T-shirts, button-down shirts, etc.
- **Dress Clothes**. 50 items, including suits, ties, dress shirts, etc.
- **Clothes (Miscellaneous)**. 58 items, including shoes, socks, underwear, belts, gym shorts, coats, etc.

http://www.theminimalists.com/288/

Breakout Sessions

- How many things do you own?
- How many things do you own that cost more than 50€?

- List things you own that are electrically powered?

3 min

How many things do you touch?

Alberto Frigo

Figure 1: All objects touched by Alberto Frigo in January 2004, 2009 and 2014. Every line shows the images of the touched objects for one day. Please use the magnifying functionality of your PDF reader to take a closer look at the photos.

You Can Touch This: Eleven Years and 258218 Images of Objects

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CHI 16 Extended Abstracts, May 07–12, 2016, San Jose, CA, USA.

ACM 978-1-4503-4082-3/16/05 ...$15.00
DOI: http://dx.doi.org/10.1145/2851581.2892575

Abstract
Touch has become a central input modality for a wide variety of interactive devices, most of our mobile devices are operated using touch. In addition to interacting with digital artifacts, people touch and interact with many other objects in their daily lives. We provide a unique photo dataset containing all touched objects over the last 11 years. All photos were contributed by Alberto Frigo, who was involved early on in the "Quantified Self" movement. He takes photos of every object he touches with his dominant hand. We analyzed the 258,218 images with respect to the types objects, their distribution, and related activities.

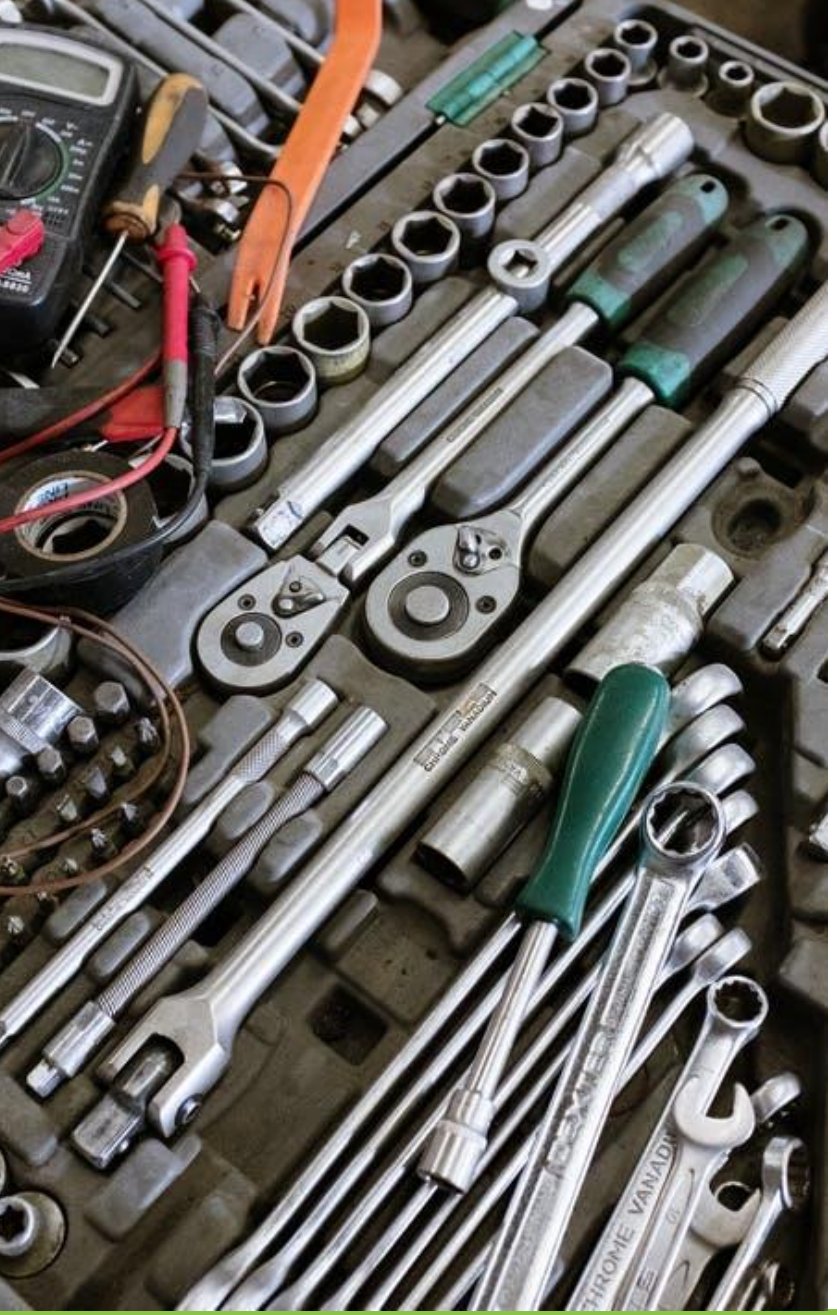
Author Keywords
Touch Interaction; Tangible Interaction; Life Logging; Quantified Self

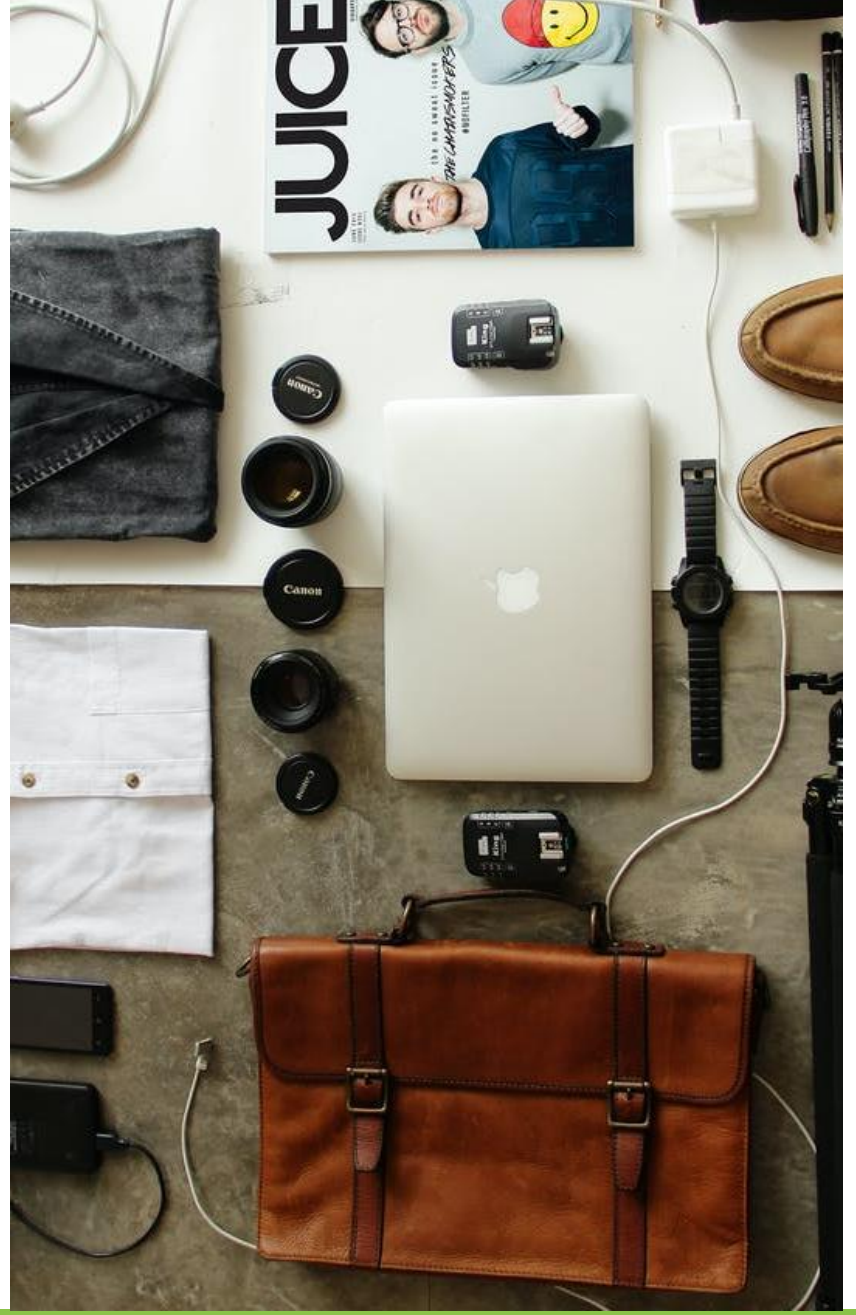
ACM Classi cation Keywords
H.5.2. [User Interfaces]: Haptic I/O

Introduction & Context
Touch interaction is heavily studied in the area of human-computer interaction (HCI). From research in the area of tangible computing [8, 10] to research enriching touch as an input modality [3, 20], the topic has gained growing importance in the field. In addition to using touch to interact with the digital world, like a computer mouse or a smartphone,

https://en.wikipedia.org/wiki/Alberto_Frigo

Nina Runge, Johannes Schöning, Rainer Malaka, and Alberto Frigo. 2016. You Can Touch This: Eleven Years and 258218 Images of Objects. In Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '16). Association for Computing Machinery, New York, NY, USA, 541–552. DOI: https://doi.org/10.1145/2851581.2892575




JUICE
Canon


10x

Ubiquitous Computing

Ubiquitous Computing

Mark Weiser, 1991

"The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it"

"…Hundreds of computers in a room could seem intimidating at first, […] these hundreds of computers will come to be invisible to common awareness. People will simply use them unconsciously to accomplish everyday tasks."

Mark Weiser. 1991. The Computer for the 21 st Century. Scientific american, 265(3). https://www.jstor.org/stable/24938718

Ubiquitous Computing

Surfaces of different sizes and scales are used in information processing: Prototypes of Tabs, Pads, and Boards (inch-, foot-, yard-sized computers).

Mark Weiser. 1991. The Computer for the 21 st Century. Scientific american, 265(3). https://www.jstor.org/stable/24938718

Ubiquitous Computing

“Most of the computers that participate in **embodied virtuality** will be **invisible in fact as well as in metaphor**. Already computers in light switches, thermostats, stereos and ovens help to activate the world. These machines and more will be interconnected in a ubiquitous network.”

“In our experimental embodied virtuality, **doors open only to the right badge wearer**, rooms greet people by name, telephone calls can be automatically forwarded to wherever the recipient may be, receptionists actually know where people are, computer terminals retrieve the preferences of whoever is sitting at them, and appointment diaries write themselves. **No revolution in artificial intelligence is needed--just the proper imbedding of computers into the everyday world.**”

Mark Weiser. 1991. The Computer for the 21 st Century. Scientific american, 265(3). https://www.jstor.org/stable/24938718

Ubiquitous Computing

Mark Weiser, 1993

"**The computer today is isolated from the overall situation**, however, and fails to get out of the way of the work. In other words, rather than being a tool through which we work, and thus disappearing from our awareness, **the computer too often remains the focus of attention.**"

"The challenge is to create a new kind of relationship of people to computers, one in which the **computer would have to take the lead in** becoming vastly better at **getting out of the way, allowing people to just go about their live.**"

Mark Weiser. 1993. Some computer science issues in ubiquitous computing. Commun. ACM (July 1993). DOI: http://dx.doi.org/10.1145/159544.159617

Breakout Sessions

- List as many **electrical/digital tools/appliances** as you can and use, which are ubiquitous in your environment?

2 min

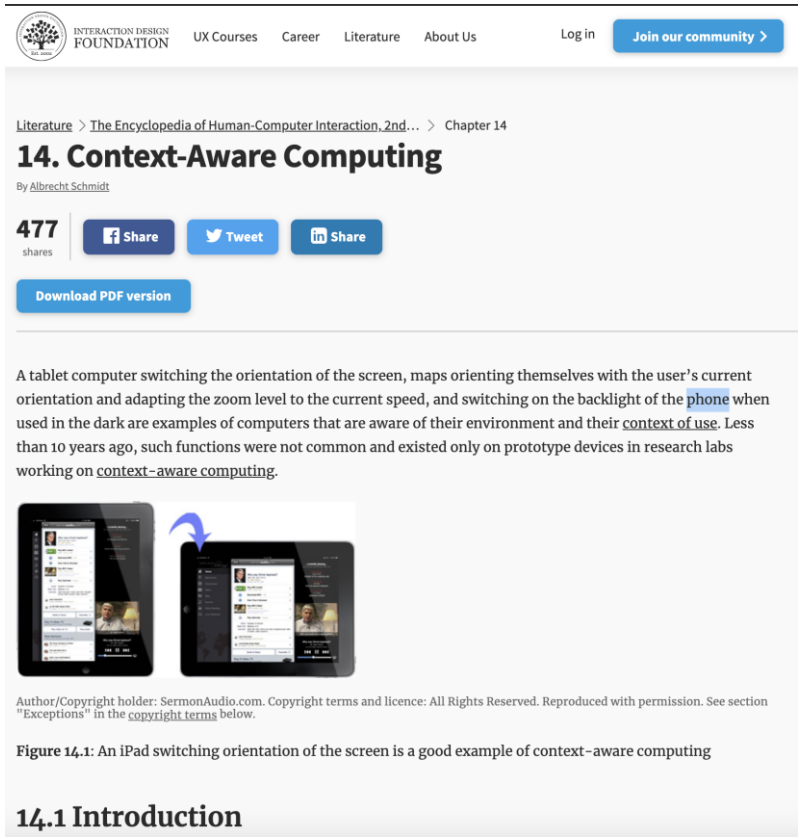
Voice Assistants

- Powerful tool
- Cumbersome to use as they leg contextual information

"Apple HomePod - June 2018 (1923)" by varnent is licensed with CC BY-SA 4.0.

"Google Home with Home Hub and Home Mini on table" by Y2kcrazyjoker4 is licensed with CC BY-SA 4.0.

Sensing and Context-Aware Objects



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Literature > The Encyclopedia of Human-Computer Interaction, 2nd... > Chapter 14

14. Context-Aware Computing

By Albrecht Schmidt

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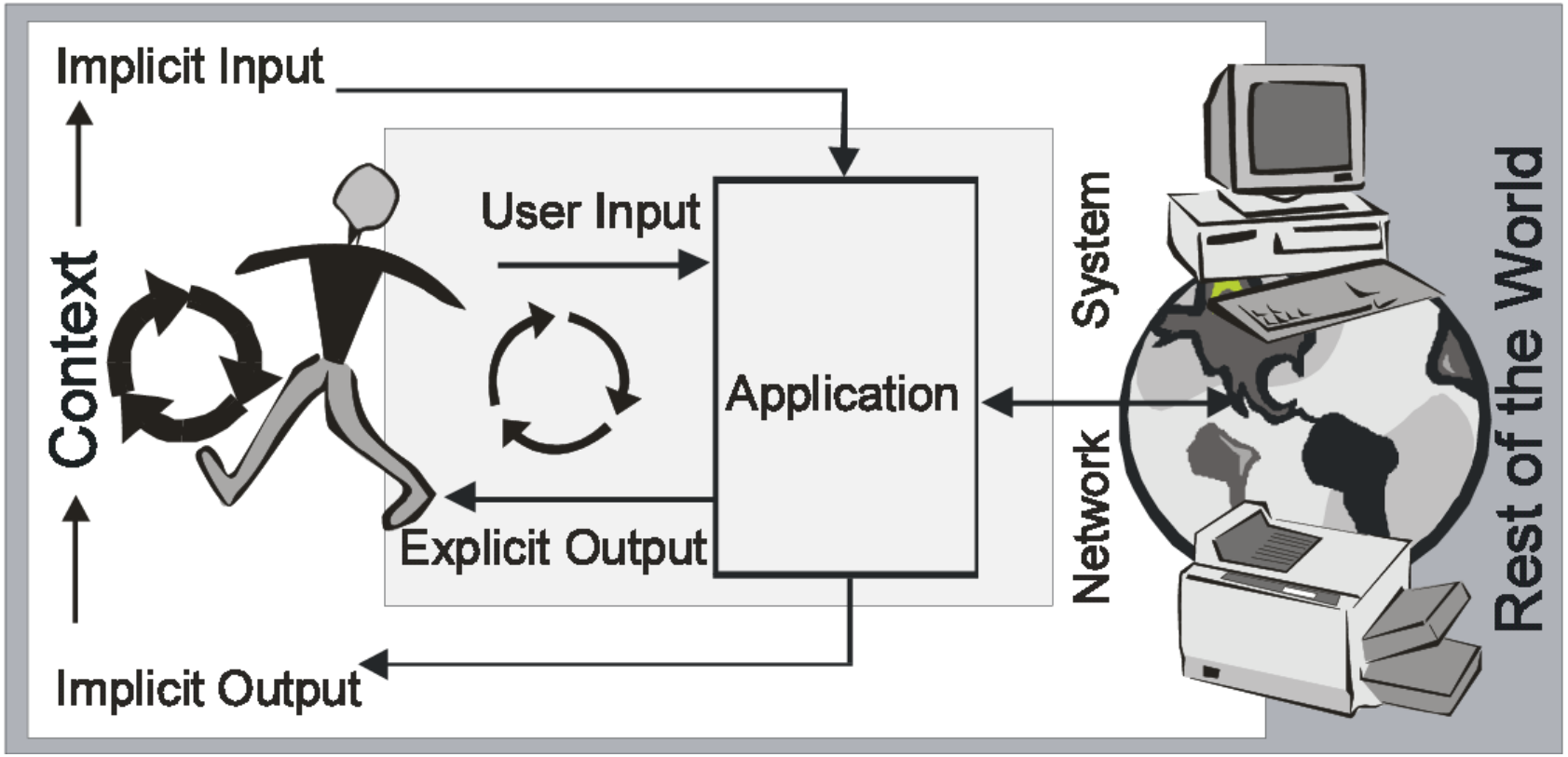
A tablet computer switching the orientation of the screen, maps orienting themselves with the user's current orientation and adapting the zoom level to the current speed, and switching on the backlight of the phone when used in the dark are examples of computers that are aware of their environment and their context of use. Less than 10 years ago, such functions were not common and existed only on prototype devices in research labs working on context-aware computing.

Figure 14.1: An iPad switching orientation of the screen is a good example of context-aware computing

14.1 Introduction

https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/context-aware-computing-context-awareness-context-aware-user-interfaces-and-implicit-interaction

Design for explicit and implicit Interaction



Albrecht Schmidt. "Implicit human computer interaction through context." Personal technologies 4, no. 2 (2000): 191-199.
Albrecht Schmidt. Ubiquitous computing-computing in context (Doctoral dissertation) (2003).

Embedding Information and Interaction

"Potentially everyone has access to enormous amounts of information nowadays. […] We suggest a different approach for **contextual information delivery**. Instead of detecting the context we place the information **– by the choice of the information display** - in context. **The assumption is that in future we can afford environments where there is a massive over-provision of displays.** […] Our first step is to provide additional information at decision points (e.g. what should I wear, do I go by bike or by car, should I take the umbrella or not) that help to make a more informed decision."

Schmidt, Albrecht, Matthias Kranz, and Paul Holleis. "Embedded information." In *Proc. Workshop Ubiquitous Display Environments in conjunction with UbiComp*. 2004.

Kranz, Matthias, Paul Holleis, and Albrecht Schmidt. "Embedded interaction: Interacting with the internet of things." IEEE internet computing 14, no. 2 (2010): 46-53.

Design Criteria for Embedding Information

- Basic principle: **over-provision of information displays**
- Embedding information **where and when it is useful**
  It is central to provide the information so that the user can benefit from it. Information is embedded at points where decisions are made. The information provided should increase the user's ability to make an informed choice.
- Embedding information **in a most unobtrusive way**
  The information provided should not be forced onto the user. It should be embedded in such a way giving the user the right clue but in a way not to become an annoyance.
- Providing information in a way that there **is no interaction required**
  It is essential that there is no action required from the user when information is provided. This requires dedicated information displays that are only used for providing a specific type of information.

Schmidt, Albrecht, Matthias Kranz, and Paul Holleis. "Embedded information." In *Proc. Workshop Ubiquitous Display Environments in conjunction with UbiComp*. 2004.

Kranz, Matthias, Paul Holleis, and Albrecht Schmidt. "Embedded interaction: Interacting with the internet of things." IEEE internet computing 14, no. 2 (2010): 46-53.

Breakout Sessions

2 min

- What information would you embed into the following objects?

Context in Interactive Systems

- Use context for **adaptation** of
  - Application
  - Content
  - Presentation
  - Interaction modality
  - Time of interruption
- Context as **content**
  - Tagging of media (e.g. location and time in photos)
  - Creating meta information
  - Context as the content (e.g. recording a walking track)
  - Real-time sharing of context (e.g. presence)
- Rethink user interface options
  - Output
  - Input
  - Communication

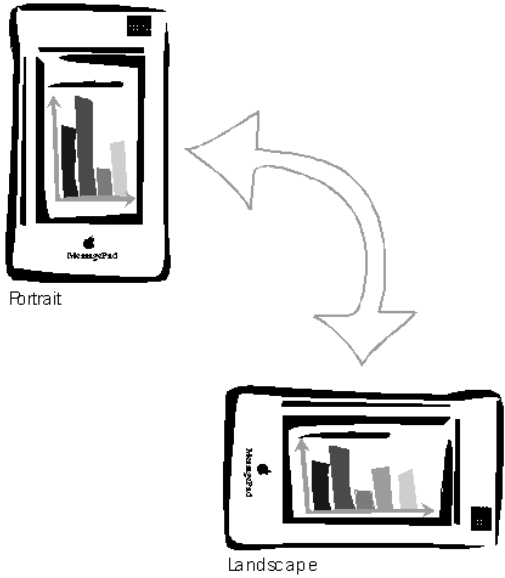
Rethink Output

- Make use of context
- Adjusting media quality
- Adapt media usages
- Choose the modality
- Adapt content and visual representation
- Timing of output / notification
  - Interrupt at “appropriate” times

Rethink Input

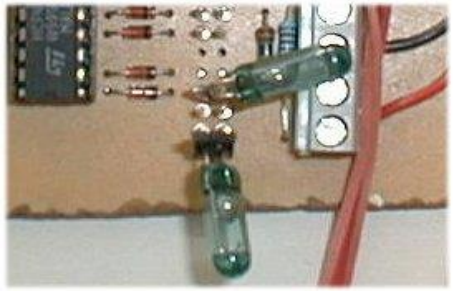
- Easing input by using context knowledge
- Automate input
  - current time
  - who is in a meeting
  - tracking documents used
  - places visited…
- Provide context-dependent defaults
- Optimize input space to fit to current context
  - recognizer for handwriting/speech,
  - context-sensitive menus

Getting Physical (1) Initial Experience (1998)



Extremely simple, but still it creates a new experience

- 2-Bit Input
- Not an input device
- Very specific function



A. Schmidt, M. Beigl, H. Gellersen. There is more to context than location. Computers and Graphics, 23(6):893--901, 1999.
http://www.comp.lancs.ac.uk/~albrecht/pubs/pdf/schmidt_cug_elsevier_12-1999-context-is-more-than-location.pdf

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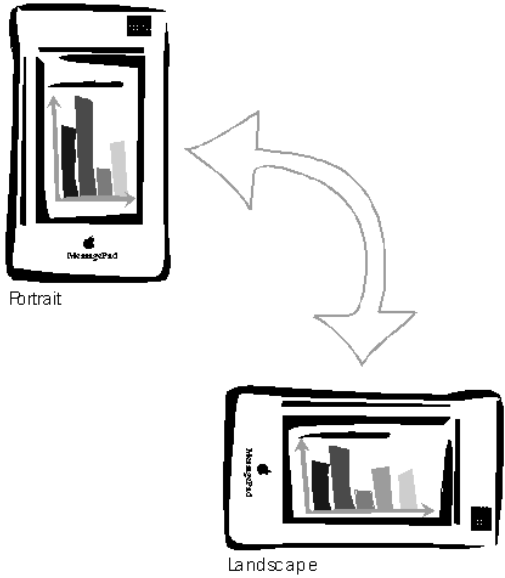

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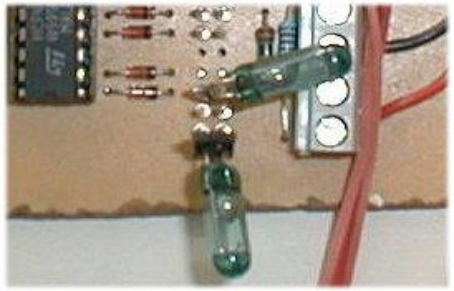
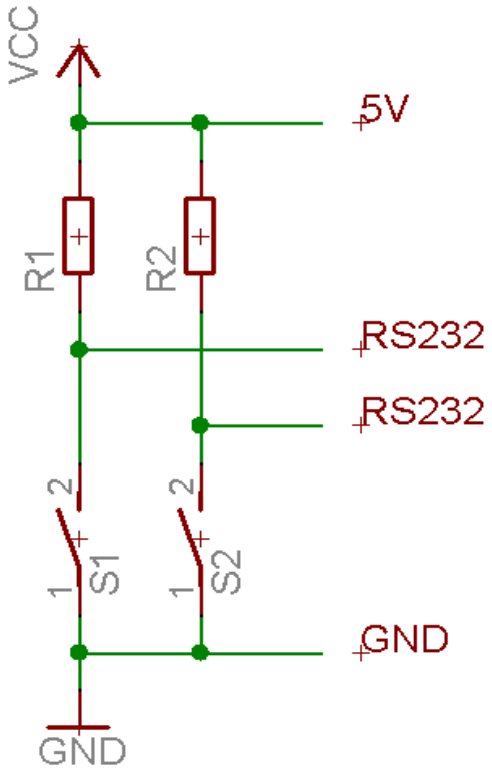
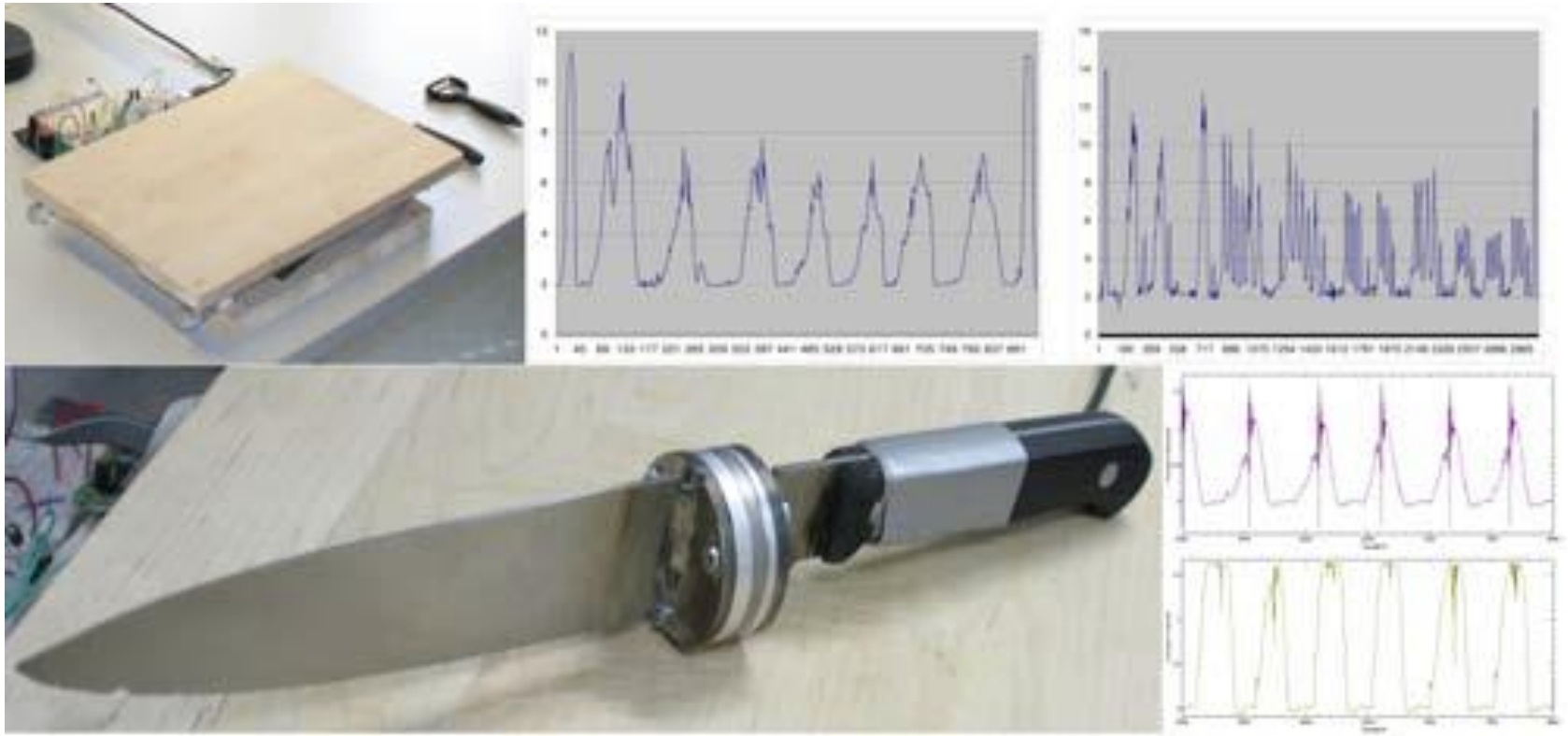




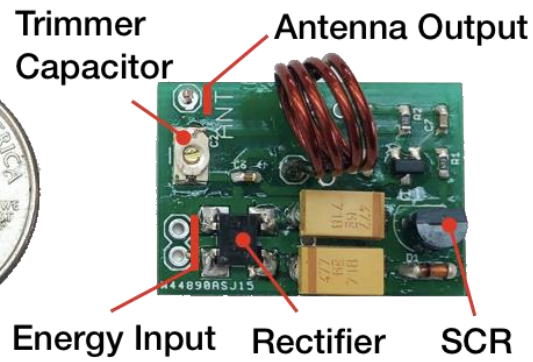
A. Schmidt, M. Beigl, H. Gellersen. There is more to context than location. Computers and Graphics, 23(6):893--901, 1999.
http://www.comp.lancs.ac.uk/~albrecht/pubs/pdf/schmidt_cug_elsevier_12-1999-context-is-more-than-location.pdf

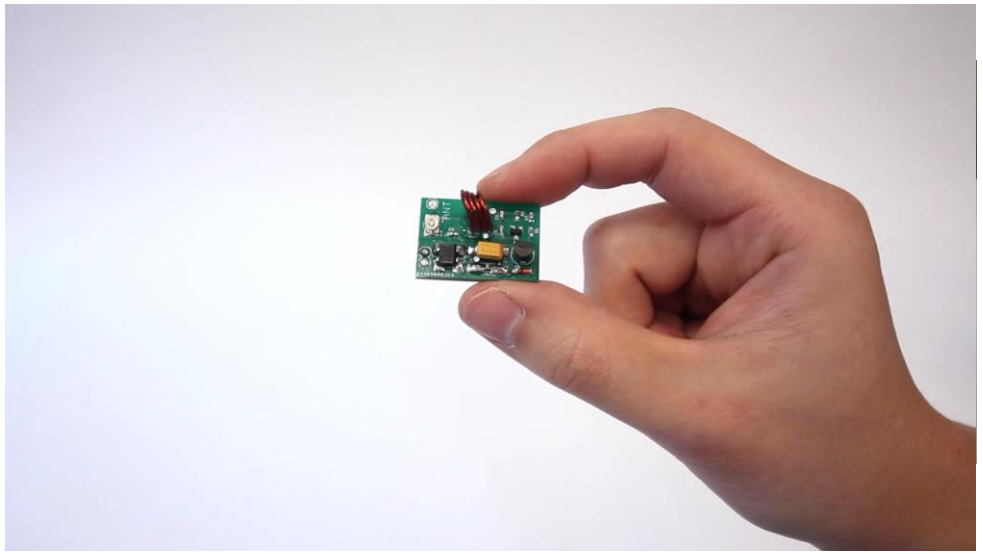
Knife that “knows” what its cuts



Matthias Kranz, Albrecht Schmidt, Alexis Maldonado, Radu Bogdan Rusu, Michael Beetz, Benedikt Hörnler, and Gerhard Rigoll. 2007. Context-aware kitchen utilities. In Proceedings of the 1st international conference on Tangible and embedded interaction (TEI '07). Association for Computing Machinery, New York, NY, USA, 213–214. DOI: https://doi.org/10.1145/1226969.1227013

Radio Tags for Activity Sensing

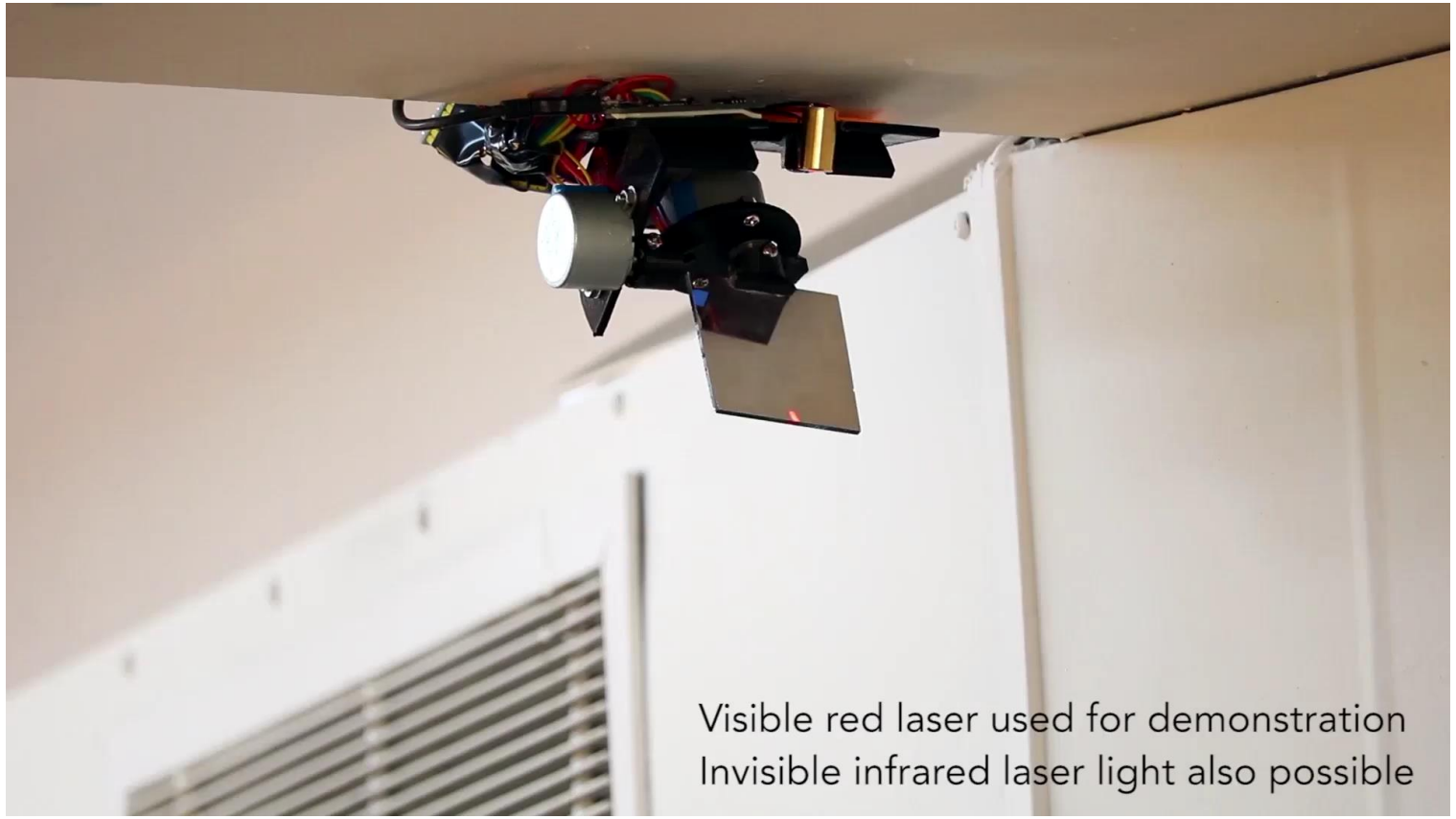




Yang Zhang, Yasha Iravantchi, Haojian Jin, Swarun Kumar, and Chris Harrison. 2019. Sozu: Self-Powered Radio Tags for Building-Scale Activity Sensing. In Proceedings of the 32nd Annual ACM Symposium on User Interface Software and Technology (UIST '19). ACM, New York, NY, USA, 973–985. DOI: https://doi.org/10.1145/3332165.3347952

Video: https://youtu.be/wbq-eOOIPyw

Vibrometry for Environment Sensing



https://youtu.be/51XaZDki6yg

Yang Zhang, Gierad Laput, and Chris Harrison. 2018. Vibrosight: Long-Range Vibrometry for Smart Environment Sensing. In Proceedings of the 31st Annual ACM Symposium on User Interface Software and Technology (UIST '18). ACM, New York, NY, USA, 225–236. DOI: https://doi.org/10.1145/3242587.3242608

Visions and Terms (Embodiment)

- What does make an object into a smart object?
- How is the physical shape and the way an object is constructed impacting how „intelligent“ an object is?
- Where is embodiment required for intelligent behavior in the real world?

2 min

Passive Dynamic Walker

https://youtu.be/uU0baFifDKE

Steven H. Collins, Martijn Wisse, and Andy Ruina. A three-dimensional passive-dynamic walking robot with two legs and knees. *The International Journal of Robotics Research* 20.7 (2001). DOI: https://doi.org/10.1177/02783640122067561

Elephants Don't Play Chess

Rodney A. Brooks
MIT Artificial Intelligence Laboratory, Cambridge, MA 02139, USA

Robotics and Autonomous Systems 6 (1990) 3-15

Keywords: Situated activity; Mobile robots; Planning; Subsumption architecture; Artificial Intelligence.

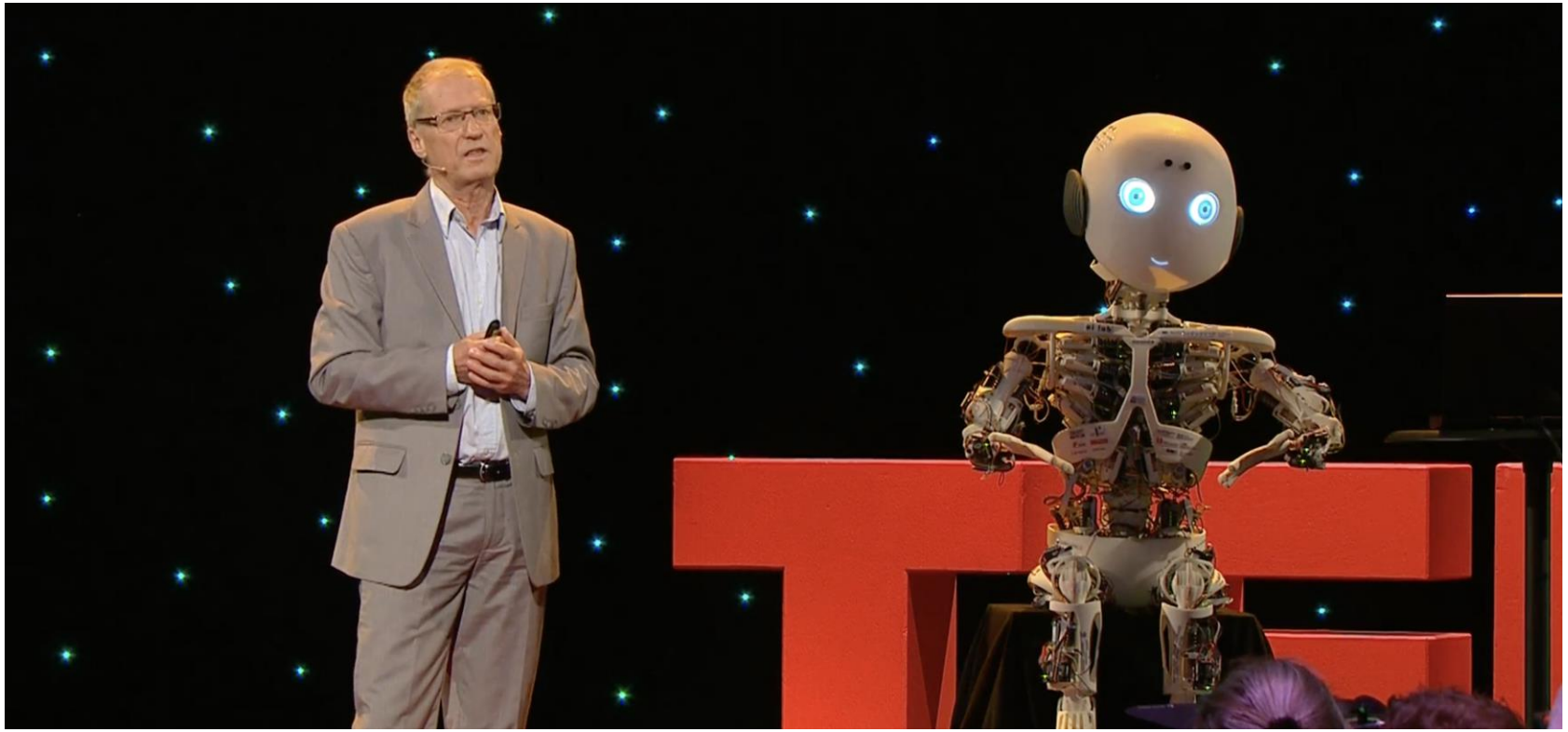
Rodney A. Brooks was born in Adelaide, Australia. He studied Mathematics at the Flinders University of South Australia and received a Ph.D. from Stanford in Computer Science in 1981. Since then he has held research associate positions at Carnegie Mellon University and the Massachusetts Institute of Technology and faculty positions at Stanford and M.I.T. He is currently an Associate Professor of Electrical Engineering and Computer Science at M.I.T. and a member of the Artificial Intelligence Laboratory where he leads the mobile robot group. He has authored two books, numerous scientific papers, and is the editor of the *International Journal of Computer Vision.*

There is an alternative route to Artificial Intelligence that diverges from the directions pursued under that banner for the last thirty some years. The traditional approach has emphasized the abstract manipulation of symbols, whose grounding, in physical reality has . rarely been achieved. We explore a research methodology which emphasizes ongoing physical interaction with the environment as the primary source of constraint on the design of intelligent systems. We show how this methodology has recently had significant successes on a par with the most successful classical efforts. We outline plausible future work along these lines which can lead to vastly more ambitious systems.

Rodney A. Brooks. Elephants don't play chess. Robotics and autonomous systems 6, no. 1-2 (1990): 3-15.

“How the body shapes the way we think”

https://youtu.be/mhWwoaoxlyc



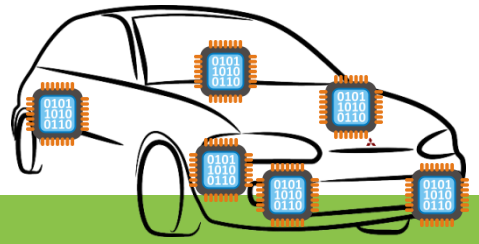
Rolf Pfeifer at TEDxZurich 2013. He professor of computer science at the Department of Informatics University of Zurich.

How to create the IoT and Cyber-Physical-Systems?

- Revolution or Evolution – two views
  - adding computing as required and extending the traditional systems with computing
  - adding physicality (through sensors, actuators) to software

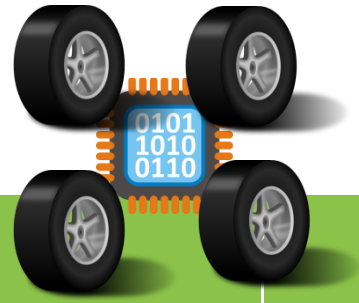
> Evolution

- Cyber-physical system as an electro-mechanical system with computers added



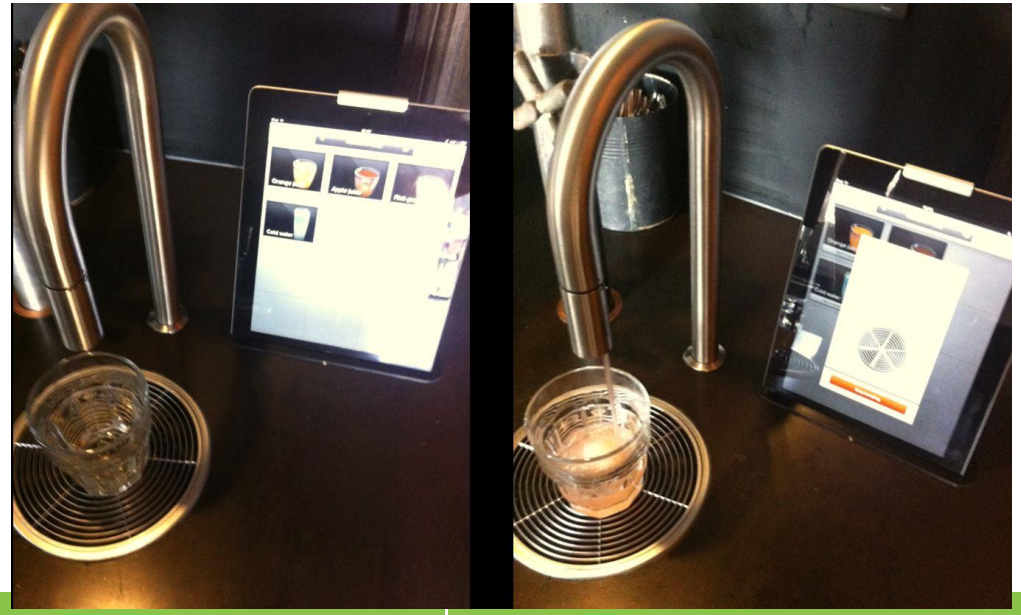
> Revolution

- As a computer with the electro-mechanical system attached to



Revolution or Evolution – two approaches

- Established (engineering) companies and industries are usually on the “evolution path”
- Newcomers and it-driven enterprises are on the “revolution path”



How to use a door…

How to use a door…


A USER INTERFACE
IS LIKE A JOKE.
IF YOU HAVE
TO EXPLAIN IT,
IT'S NOT
THAT GOOD.
Martin LeBlanc


9:54

Digital vs. Mechanical