LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

Amplification of the Human Mind and Intervention User Interfaces

New Interaction Paradigms in the Age of Artificial Intelligence

Albrecht Schmidt, LMU Munich
Professor for Human-Centered Ubiquitous Media

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How many things do you own?

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/

Paula Zuccotti
How many things do you touch?

https://www.theguardian.com/society/2015/nov/06/its-the-little-things-everything-i-touched-today

Photograph: Paula Zuccotti

How many things do you touch?

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

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.

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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,

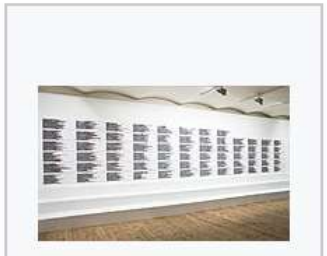
https://en.wikipedia.org/wiki/Alberto_Frigo

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). ACM, New York, NY, USA, 541-552. DOI: https://doi.org/10.1145/2851581.2892575

Alberto Frigo

"Alberto Frigo is regarded as an early proponent of lifelogging. He is known for having photographed every object his right hand has used since the 24th September 2003. Continuously documenting 18 aspects of his life, Frigo intends to create a Rosetta Stone of time to be concluded at 60 years of age, in 2040, after 36 years. The most extreme example of self-tracking, Frigo is the only known person to have digitally documented his life manually and for over thirteen years."

2006: OK Centrum, Linz



2009: Art Museum, Uppsala

2015: Science Gallery, Dublin

2015: MAK, Frankfurt

2016: Hasselblad Foundation, Gothenburg

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

How many things do you own?

There are 300,000 items in the average American home (**LA Times**).

While 25% of people with two-car garages don't have room to park cars inside them and 32% only have room for one vehicle. (**U.S. Department of Energy**).

British research found that the average 10-year-old owns 238 toys but plays with just 12 daily (**The Telegraph**).

The average American woman owns 30 outfits—one for every day of the month. In 1930, that figure was nine (**Forbes**).

https://www.becomingminimalist.com/clutter-stats/

Internet of Things by 2020

JAN 29, 2017 @ 12:30 PM 25,057

Internet Of Things Market To Reach $267B

Louis Columbus, CONTRIBUTOR

I cover CRM, Cloud Computing, ERP and Enterprise Software FULL BIO

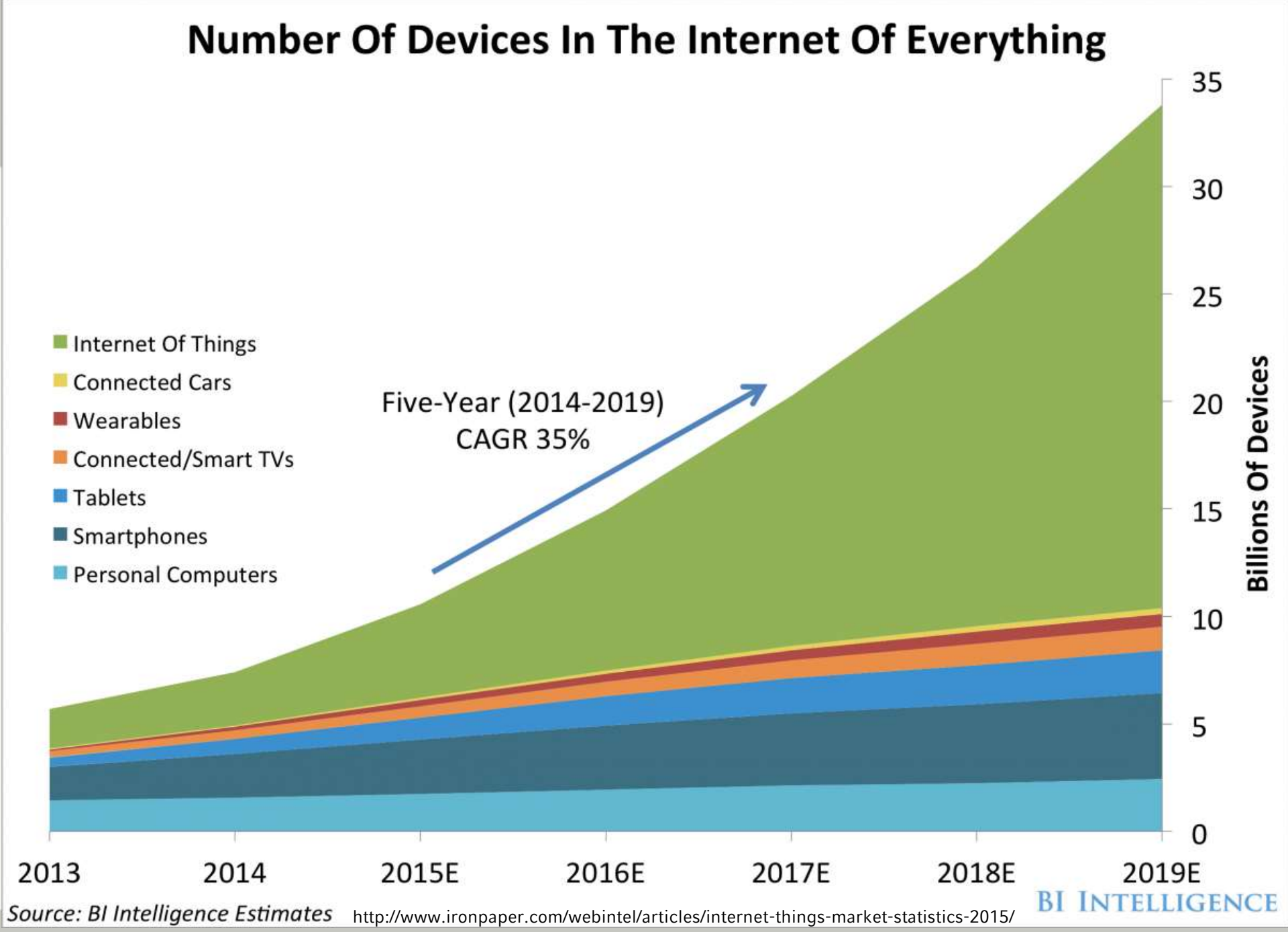
Opinions expressed by Forbes Contributors are their own.

TWEET THIS

B2B spending on IoT technologies, apps and solutions will reach €250B ($267B) by 2020.

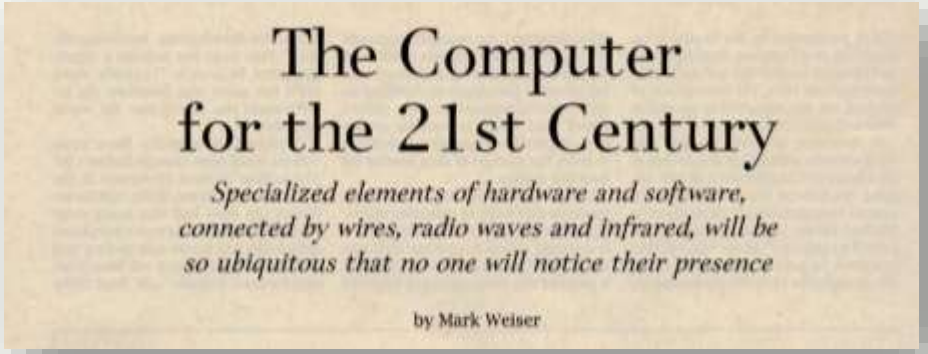
By 2020, 50% of IoT spending will be driven by discrete manufacturing, transportation and logistics, and utilities

https://www.forbes.com/sites/louiscolumbus/2017/01/29/internet-of-things-market-to-reach-267b-by-2020/#347d9465609b


Number Of Devices In The Internet Of Everything
Internet Of Things
Connected Cars
Wearables
Connected/Smart TVs
Tablets
Smartphones
Personal Computers
Five-Year (2014-2019)
CAGR 35%
35
30
25
20
15
10
5
0
Billions Of Devices
2013
2014
2015E
2016E
2017E
2018E
2019E
Source: BI Intelligence Estimates
http://www.ironpaper.com/webintel/articles/internet-things-market-statistics-2015/
BI INTELLIGENCE

How to use a door...

Current interface concepts will not scale!


The Computer for the 21st Century

Specialized elements of hardware and software, connected by wires, radio waves and infrared, will be so ubiquitous that no one will notice their presence

by Mark Weiser

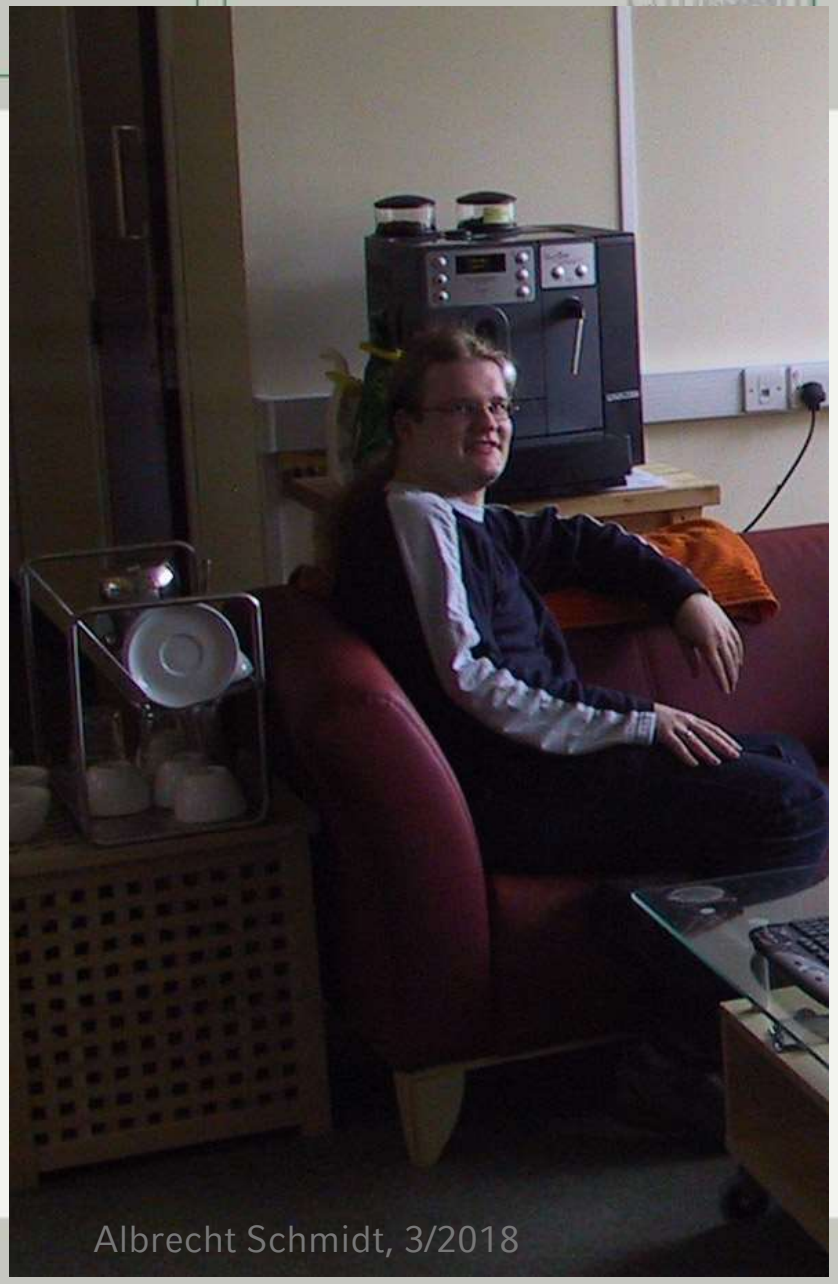
"The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it."

"...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."

Weiser, M., 1991. The computer for the 21st century. *Scientific American* 265.3, pp94-104, 1991.

EU-Project Smart-Its (2001)

EU-Project Smart-Its (2001)




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

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Digital vs. Mechanical

Digital vs. Mechanical

Revolution or Evolution – two views

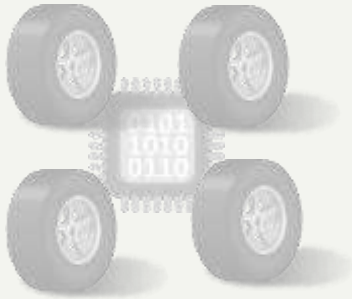
- adding computing as required and extending the traditional systems with computing
- adding physicality (through sensors, actuators) to software

> 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"

Engineering Changes - Systems

Examples

- Buildings
- Cities

Source: http://newsroom.scania.com/

Requires to fundamentally re-think how to engineer systems

- Temporal aspect – one cannot start with software when building is ready
- Developing mechanical, electrical, and software in parallel
- Need for simulation

Envisioning and Design

Implementation and manufacturing

Deployment

Maintenance, update, upgrade

Envisioning and Design

- Gained degrees of freedom need to be understood
- Constraints will disappear, fundamentally re-thinking of design

Changing Roles: Customer Manufacturer Relationship

- Direct (public) feedback channels from (un)satisfied users
- Understanding demand and change of demand and expectations in real time
- Users as (implicit) co-inventors

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Chess:
Are computers smarter than humans?

- 1996/97: Controversial victory of deep blue over then world chess champion Garry Kasparov
- 2006: Chess programs can defeat even the strongest chess players
- 2018: Who is the best chess player in the world?
  What is the most interesting chess to watch?

https://www.flickr.com/photos/tenspeedphotography/3536942268
by Richard Heaven [CC BY 2.0]

What can humans do, that machines cannot?

Stephen Hawking says artificial intelligence could DESTROY society by taking over humans

The world-famous cosmologist believes there is no deep difference between what can be achieved by a biological brain and what can be achieved by a computer

73 SHARES COMMENTS

BY CECILE BORKHATARIA, ADAM CARE, FLO SNEAD
12:19, 20 OCT 2016 UPDATED 13:31, 20 OCT 2016

NEWS

http://www.mirror.co.uk/news/uk-news/stephen-hawking-says-artificial-intelligence-9086652

Social intelligence

Emotional intelligence

Human-machine systems outperform humans as well as machines

- Human-computer interaction is the key discipline for creating intelligent systems
- Intuitive cooperation between humans and computers is the key challenge
- Machine learning and automation are only components in a solution

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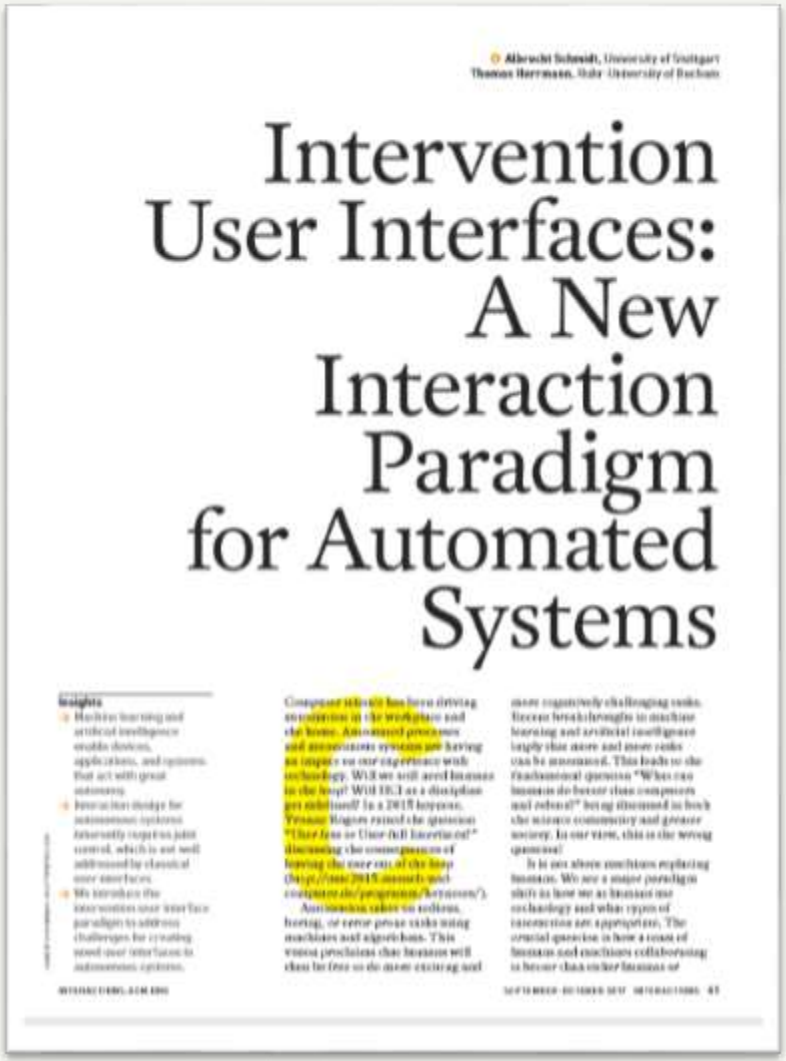
How can humans stay in control?

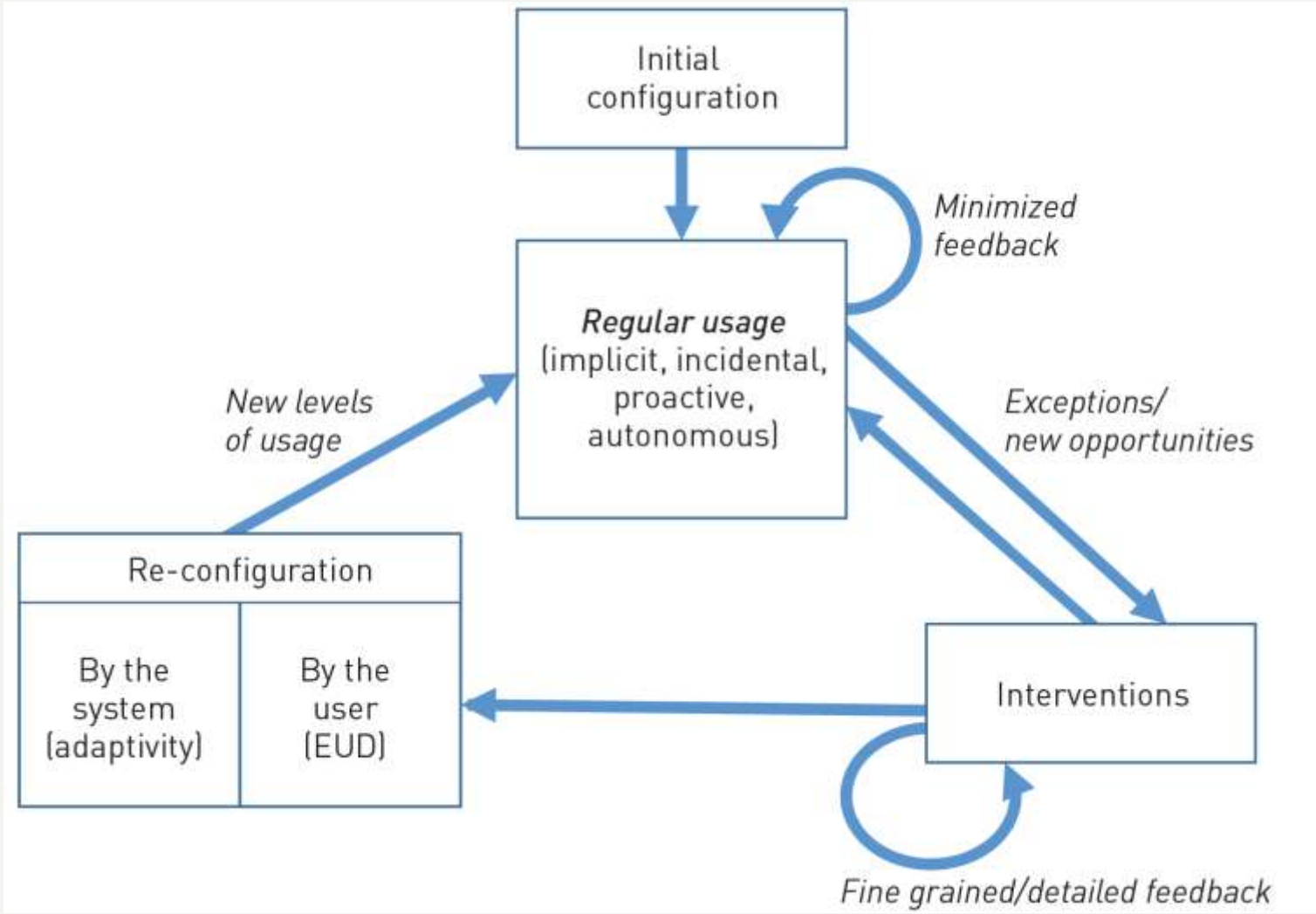


Albrecht Schmidt, University of Stuttgart
Thomas Herrmann, Ruhr University of Bochum

Intervention User Interfaces: A New Interaction Paradigm for Automated Systems

We believe that a large class of automated and autonomous systems allow for joint control, where the majority of decisions are automated but where users can intervene.

Regular usage, intervention, and configuration



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Rethink the granularity of interaction

Examples:

- Parking a car
- Trading stocks
- Unloading a ship

The **granularity** of decision making as well as the **timing** changes, the notion of "being in control" should not.

Designing for (perceived) **agency rather than for direct control**

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Shneiderman's Golden Rules

1 Strive for consistency.

Consistent sequences of actions should be required in similar situations; identical terminology should be used in prompts, menus, and help screens; and consistent commands should be employed throughout.

2 Enable frequent users to use shortcuts.

As the frequency of use increases, so do the user's desires to reduce the number of interactions and to increase the pace of interaction. Abbreviations, function keys, hidden commands, and macro facilities are very helpful to an expert user.

3 Offer informative feedback.

For every operator action, there should be some system feedback. For frequent and minor actions, the response can be modest, while for infrequent and major actions, the response should be more substantial.

4 Design dialog to yield closure.

Sequences of actions should be organized into groups with a beginning, middle, and end. The informative feedback at the completion of a group of actions gives the operators the satisfaction of accomplishment, a sense of relief, the signal to drop contingency plans and options from their minds, and an indication that the way is clear to prepare for the next group of actions.

5 Offer simple error handling.

As much as possible, design the system so the user cannot make a serious error. If an error is made, the system should be able to detect the error and offer simple, comprehensible mechanisms for handling the error.

6 Permit easy reversal of actions.

This feature relieves anxiety, since the user knows that errors can be undone; it thus encourages exploration of unfamiliar options. The units of reversibility may be a single action, a data entry, or a complete group of actions.

7 Support internal locus of control.

Experienced operators strongly desire the sense that they are in charge of the system and that the system responds to their actions. Design the system to make users the initiators of actions rather than the responders.

8 Reduce short-term memory load.

The limitation of human information processing in short-term memory requires that displays be kept simple, multiple page displays be consolidated, window-motion frequency be reduced, and sufficient training time be allotted for codes, mnemonics, and sequences of actions.

Strive for consistency

*Strive for **dynamic and contextual consistency** and ensure expectability and predictability.*

Deviations from expected behavior (e.g., an autonomous car always takes the same route) *should be understandable and explainable. If inconsistency is perceived, intervention must be offered.*

Enable frequent users to use shortcuts

Shortcuts make frequent and repetitive actions more efficient. Automation already removes needs for frequent actions and explicit interaction becomes an exception. Thus we propose: ***Replace the need for frequent explicit actions and interventions*** *by automation. Create shortcuts for interventions that combine a sequence of interactions.*

Offer informative feedback

Designing the balance of automation and intervention has to address the feedback dilemma: Calm environments and minimizing the attention required are key aspects; feedback directs attention to unexpected behavior. *Feedback about the impacts of automated behavior and the temporary* ***potentials for intervention*** *must be offered.* This is complemented by: *Provide feedback on whether or not intervention is occurring* and: *Offer feedback (implicit/explicit) on the impact of intervention.*

Design dialogue to yield closure

Therefore, we propose: *Design the start and control of intervention in conjunction with clear and simple options for completing and terminating it.*
Interventions should be designed to have a limited temporal impact.

Offer simple error handling

With automated systems, the challenge is about whether the user lets the system go on when errors happen or may be expected. Thus the context of automation requires: ***Allow for immediate intervention to avoid*** *the occurrence or repetition of* ***unsolicited automated behavior****.*

Permit easy reversal of actions

This feature encourages users to try efficient ways and unfamiliar features. This remains an important rule, but literal reversal of human action may not be feasible; reversing its *impact*, however, may be. Thus we state: *Combine the means for reversing the impact of automated actions with intervention interfaces* and: ***Allow for simple means for reversing the impact of interventions.*** This kind of reversibility is crucial to encourage users to explore the system.

Support internal locus of control

The **user should feel like they are the one who controls the system**. It has clearly to be communicated:

- *How the impacts of interventions are related to the goals being pursued by the automated processes*
- *How control is distributed between the automated system and the user.*

Reduce short-term memory load

The amount of information to be kept in mind to efficiently interact with a system has to be reduced.

We propose: ***Do not require the user to remember a previous system status***. And between the interventions: *Minimize required attention and* ***design for default behavior***. The system should be designed in such a way that the user could intervene and go back to automated behavior without remembering and noting the current status for future use.

Mini exercise

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Design Principles for Intervention user interfaces

- *Ensure expectability and predictability.*
- *Communicate options for interventions.*
- *Allow easy exploration of interventions.*
- *Easy reversal of automated and intervention actions.*
- *Minimize required attention.*
- *Communicate how control is shared.*

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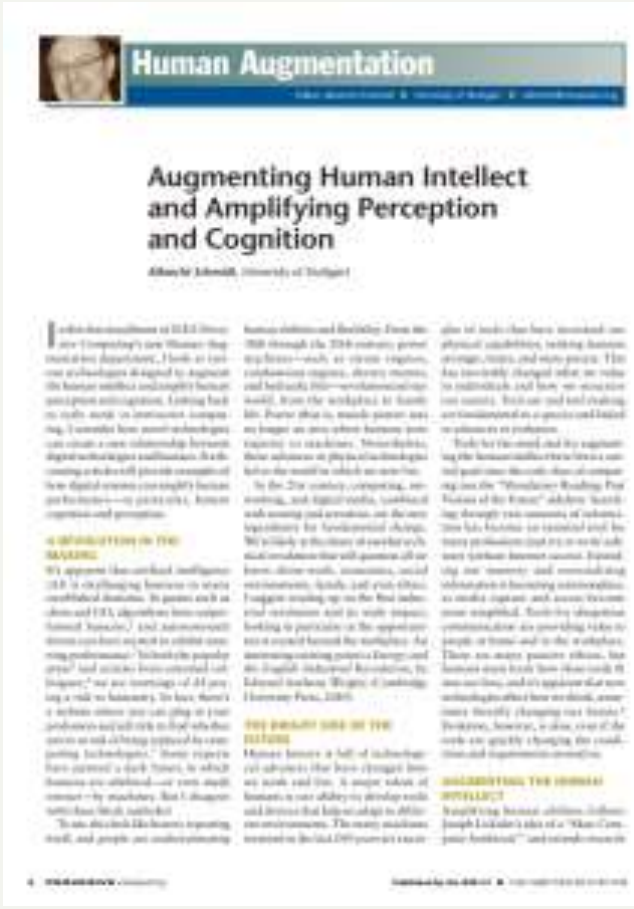
Amplification of the mind

INDISTINGUISHABLE FROM MAGIC

Technologies to Amplify the Mind

By providing access to computing and offering intuitive control via users' physiological signals, new technologies can seamlessly amplify humans' cognitive abilities.



Human Augmentation

Augmenting Human Intellect and Amplifying Perception and Cognition

How can we amplify the mind?

- How can we use tools to improve perception and cognition?
- How can we use media to extend or memory and improve our thinking?
- What tasks can we support with an amplified mind?
- Can we quantify the amplification of perception and cognition and can we measure it?

Camera: Sensors vs. senses?

- Higher framerate than the human eye (e.g. 1000fps vs 20fps)
- More flexible lenses and higher magnification
- High resolution imaging (e.g. 50 Mega Pixel and more)
- Amplification in low light condition
- Perception of a broad spectrum – beyond the visible light

https://www.flickr.com/photos/robmoody/3549353497
by Rob Moody [CC BY-NC-ND 2.0]

Are sensor technologies better than human senses?
What about "Sensor-Hardware" and what about processing?

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  - Cyber physical systems
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- Intervention user interfaces
  - Control: granularity, timing, agency
  - Golden rules revisited
  - Design Principles
- Amplification of the human mind
  - How to amplify perceptual and cognitive abilities
  - **Background and drivers**
  - Binoculars vs. glasses?
  - ERC Amplify concepts & Prototypes
- Inevitably embedding values
  - Can technology make us happy and healthy?
- Don’t ask the user! Understand their desires…

Augmentation not automation… or towards amplification?

- As We May Think by Vannevar Bush (Bush, 1945)
- Joseph Lickider's idea of a "Man-Computer Symbiosis" (Licklieder, 1960)
- Douglas Engelbart's research on "Augmenting [the] Human Intellect" (Engelbart, 1962)
- Ubiquitous Computing as described by Mark Weiser (Weiser, 1992)
- Augmented Cognition (DARPA)

Bush, V.,1945. As we may think. *The Atlantic*, July 1945, pp.101-108.
Licklider, J. C. R., 1960. Man-Computer Symbiosis. *IRE Transactions on Human Factors in Electronics*, HFE-1, March 1960, pp 4-11
Engelbart, D. C. 1962. Augmenting Human Intellect: A Conceptual Framework. *SRI Summary Report AFOSR-3223*. October 1962.
Weiser, M., 1991. The computer for the 21st century. *Scientific American* 265.3, pp94-104, 1991.

Enhancing and amplifying perception and cognition

Theoretical motivation

- Extended mind and active externalization
- Distributed cognition
- Collaborative knowledge and group cognition
- Use of space and external representations

Technology push

- Superior sensing and capture systems
- Advances in AI, processing, and communication
- Devices for embedded presentation and augmented reality

Hollan, J., Hutchins, E. and Kirsh, D., 2000. Distributed cognition: toward a new foundation for human-computer interaction research. *ACM Transactions on Computer-Human Interaction (TOCHI)*, *7*(2), pp.174-196.
Clark, A. and Chalmers, D., 1998. The extended mind. analysis, 58(1), pp.7-19.
Kirsh, D., 2010. Thinking with external representations. *Ai & Society*, *25*(4), pp.441-454.
Stahl, G., 2006. Group Cognition: Computer Support for Building Collaborative Knowledge (Acting with Technology).

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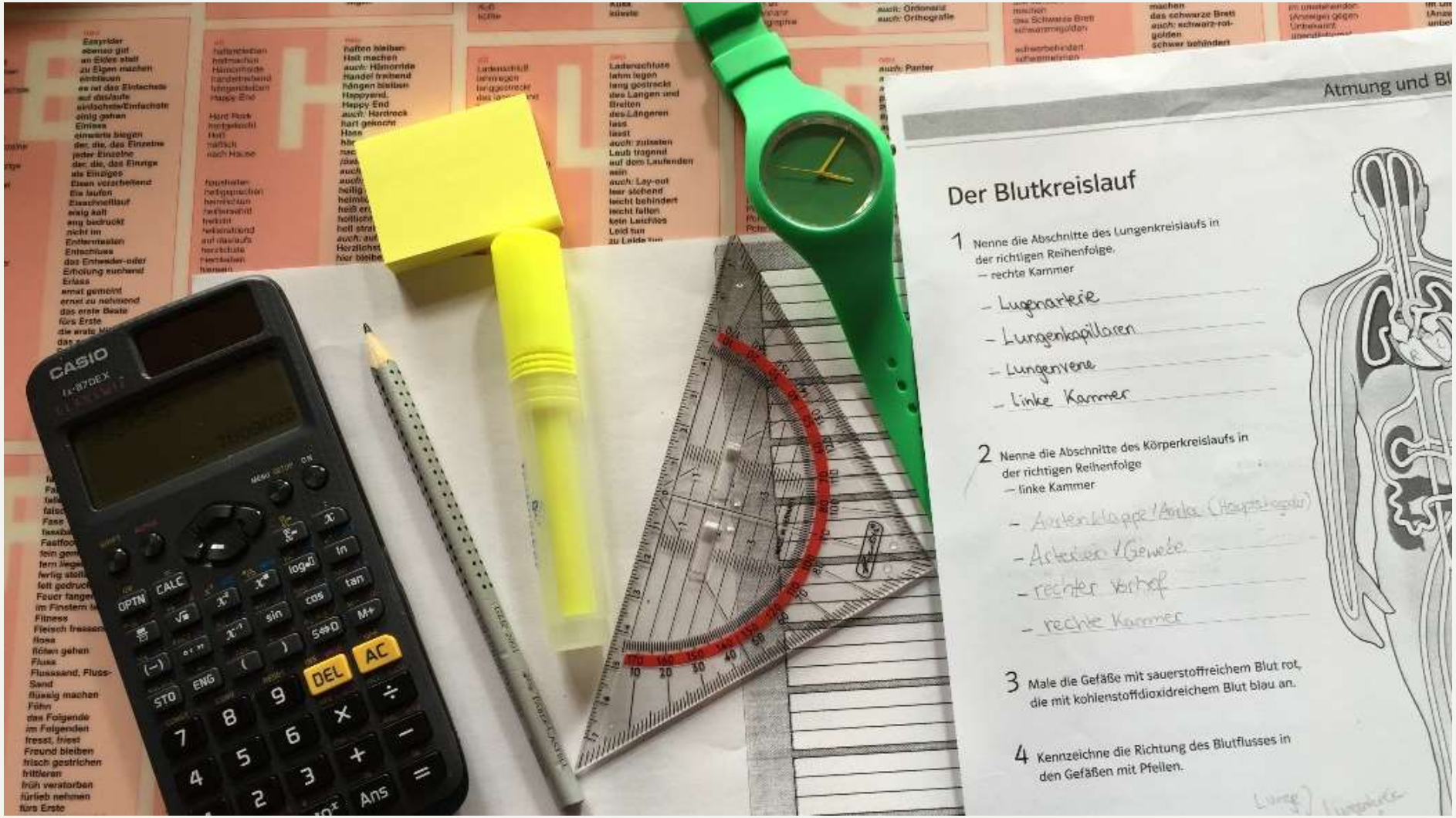
Cognitive tools in everyday use



Traditional tool to aid perception

https://en.wikipedia.org/wiki/Hearing_aid
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Metaphor: Glasses vs. Binoculars

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  - Background and drivers
  - Binoculars vs. glasses?
  - **ERC Amplify concepts & Prototypes**
- Inevitably embedding values
  - Can technology make us happy and healthy?
- Don’t ask the user! Understand their desires…

Project
AMPLIFY: Amplifying Human Perception Through Interactive Digital Technologies

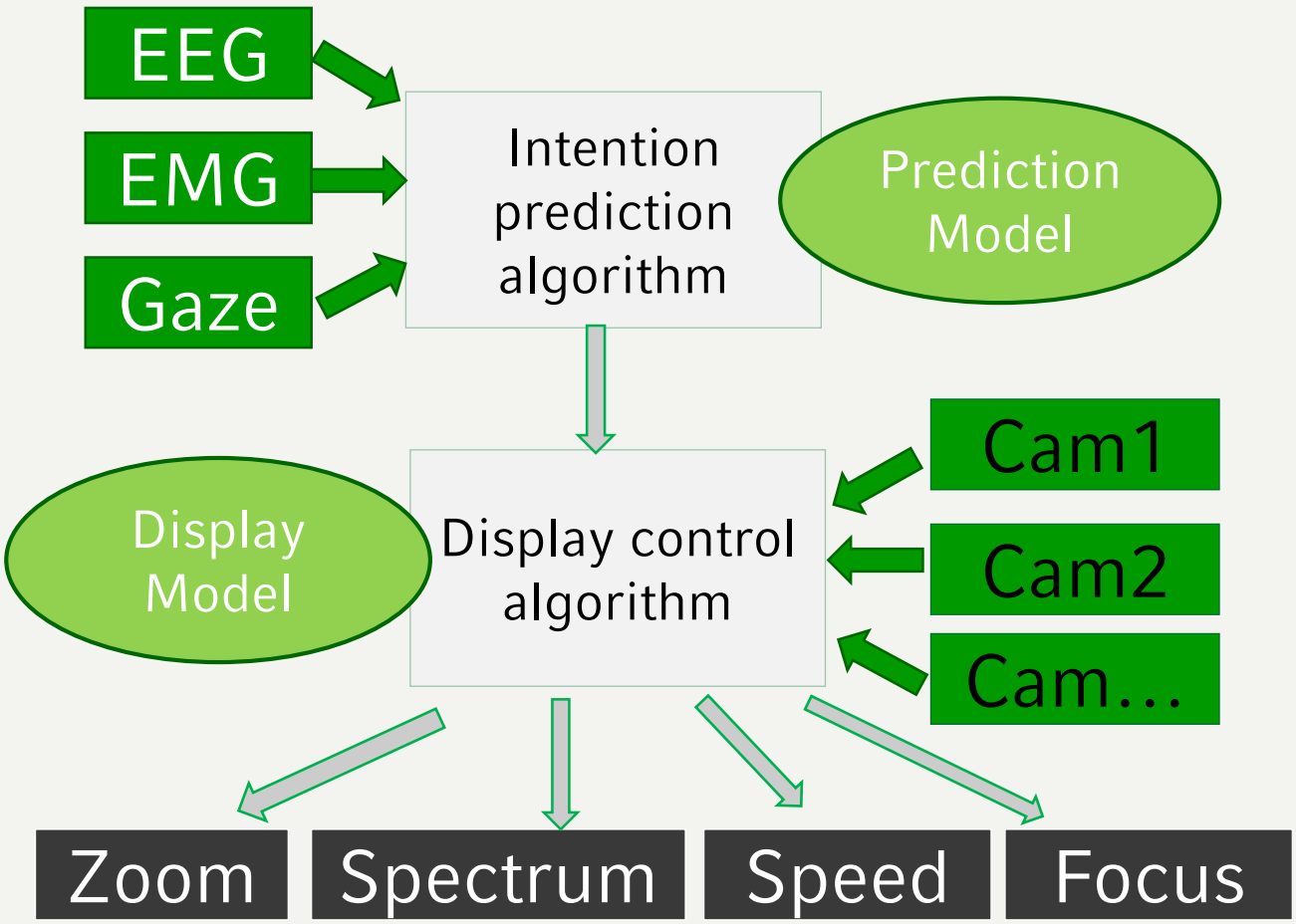
Conceptual foundation for a technical amplification of **human perception** and **artificial reflexes**.

Concepts, models, algorithms, and platforms to enable the creation of interactive systems that **measurably increase human perceptual capabilities.**

erc European Research Council

European Commission

Example of an Envisioned Device: Amplified Visual Perception



Artificial Sense

Artificial Reflex

Refinement of the Prototype:

Miniature Thermal Sensors

Information overload?

Information overload? No!
We will see the world more clearly!

Artificial Sense

Artificial Reflex

More protoypes...

Exercise

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- **Inevitably embedding values**
  - Can technology make us happy and healthy?
- Don’t ask the user! Understand their desires…

It is inevitable that with many design decisions we encode value!

Human centered vs. User Centered vs Customer Centered

Is it better that the user stays on my page or the she sleeps enough? (social media interface)

Is it better that the user walks more or should the design go for convenience? (parking assistance)

Human computer interaction is shaping the interaction humans have in a future world!

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  - Can technology make us happy and healthy?
- **Don’t ask the user! Understand their desires…**

If you create disruptive technologies, asking the user is not helpful!

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Contact

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Projekt Amplify: http://amp.ubicomp.net/

http://thingos.io/

European Commission | Horizon 2020 European Union funding for Research & Innovation | erc

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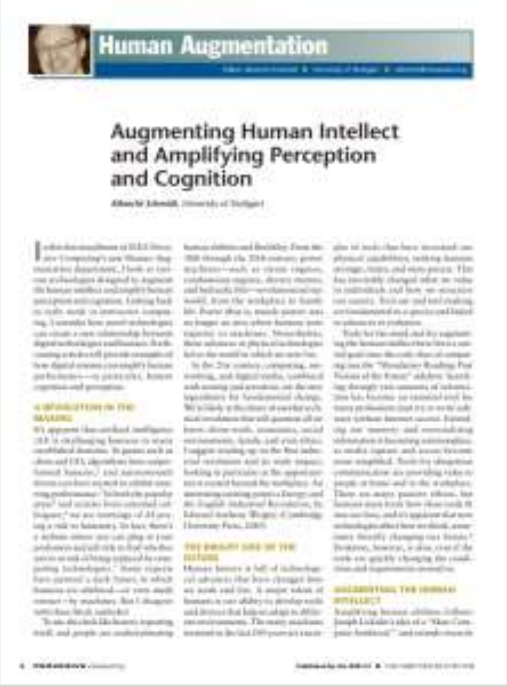
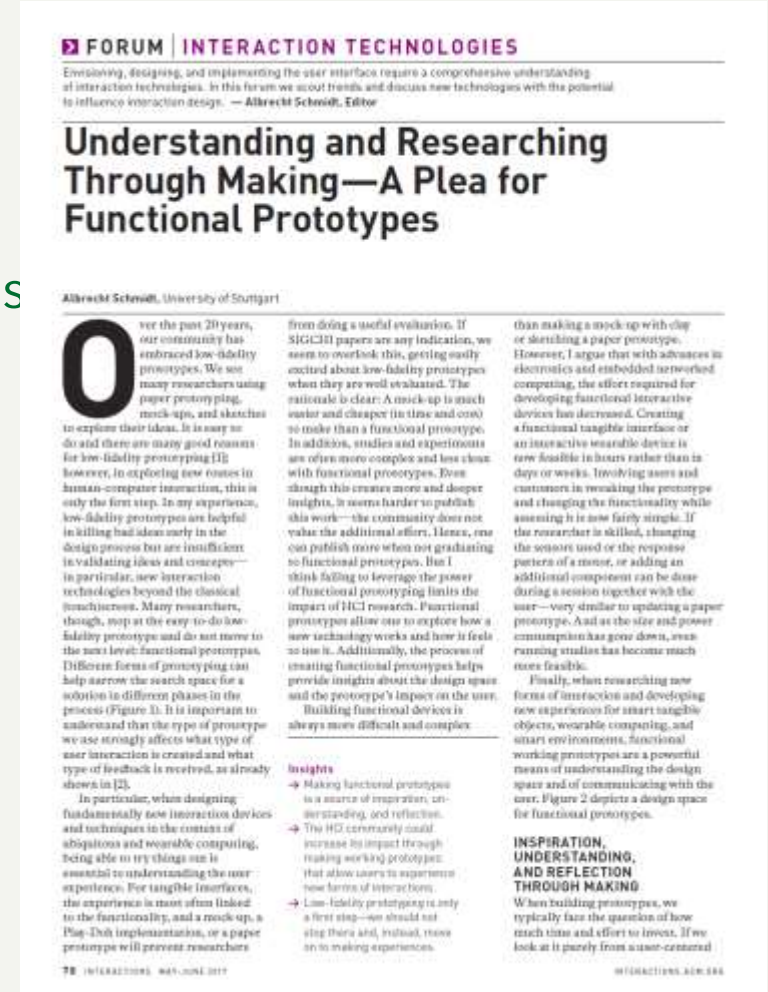
[3] Albrecht Schmidt and Thomas Herrmann. Intervention user interfaces: a new interaction paradigm for automated systems. ACM interactions 24, 5, 2017. https://doi.org/10.1145/3121357



Further Reading on Prototyping

[4] A. Schmidt "Understanding and researching through making: a plea for functional prototypes." ACM Interactions Magazine, no. 3, 2017, pp. 78–81. DOI:



FORUM | INTERACTION TECHNOLOGIES

Envisioning, designing, and implementing the user interface require a comprehensive understanding of interaction technologies. In this forum we scout trends and discuss new technologies with the potential to influence interaction design. — **Albrecht Schmidt, Editor**

Understanding and Researching Through Making—A Plea for Functional Prototypes

Albrecht Schmidt, University of Stuttgart

Over the past 20 years, our community has embraced low-fidelity prototypes. We see many researchers using paper prototyping, mock-ups, and sketches to explore their ideas. It is easy to do and there are many good reasons for low-fidelity prototyping [1]; however, in exploring new routes in human-computer interaction, this is only the first step. In my experience, low-fidelity prototypes are helpful in killing bad ideas early in the design process but are insufficient in validating ideas and concepts—in particular, new interaction technologies beyond the classical (touch)screen. Many researchers, though, stop at the easy-to-do low-fidelity prototype and do not move to the next level: functional prototypes. Different forms of prototyping can help narrow the search space for a solution in different phases in the process (Figure 1). It is important to understand that the type of prototype we use strongly affects what type of user interaction is created and what type of feedback is received, as already shown in [2].

In particular, when designing fundamentally new interaction devices and techniques in the context of ubiquitous and wearable computing, being able to try things out is essential to understanding the user experience. For tangible interfaces, the experience is most often linked to the functionality, and a mock-up, a Play-Doh implementation, or a paper prototype will prevent researchers from doing a useful evaluation. If SIGCHI papers are any indication, we seem to overlook this, getting easily excited about low-fidelity prototypes when they are well evaluated. The rationale is clear: A mock-up is much easier and cheaper (in time and cost) to make than a functional prototype. In addition, studies and experiments are often more complex and less clean with functional prototypes. Even though this creates more and deeper insights, it seems harder to publish this work—the community does not value the additional effort. Hence, one can publish more when not graduating to functional prototypes. But I think failing to leverage the power of functional prototyping limits the impact of HCI research. Functional prototypes allow one to explore how a new technology works and how it feels to use it. Additionally, the process of creating functional prototypes helps provide insights about the design space and the prototype's impact on the user.

Building functional devices is always more difficult and complex than making a mock-up with clay or sketching a paper prototype. However, I argue that with advances in electronics and embedded networked computing, the effort required for developing functional interactive devices has decreased. Creating a functional tangible interface or an interactive wearable device is now feasible in hours rather than in days or weeks. Involving users and customers in tweaking the prototype and changing the functionality while assessing it is now fairly simple. If the researcher is skilled, changing the sensors used or the response pattern of a motor, or adding an additional component can be done during a session together with the user—very similar to updating a paper prototype. And as the size and power consumption has gone down, even-running studies has become much more feasible.

Finally, when researching new forms of interaction and developing new experiences for smart tangible objects, wearable computing, and smart environments, functional working prototypes are a powerful means of understanding the design space and of communicating with the user. Figure 2 depicts a design space for functional prototypes.

Insights

- Making functional prototypes is a source of inspiration, understanding, and reflection.
- The HCI community could increase its impact through making working prototypes that allow users to experience new forms of interactions.
- Low-fidelity prototyping is only a first step—we should not stop there and, instead, move on to making experiences.

INSPIRATION, UNDERSTANDING, AND REFLECTION THROUGH MAKING

When building prototypes, we typically face the question of how much time and effort to invest. If we look at it purely from a user-centered

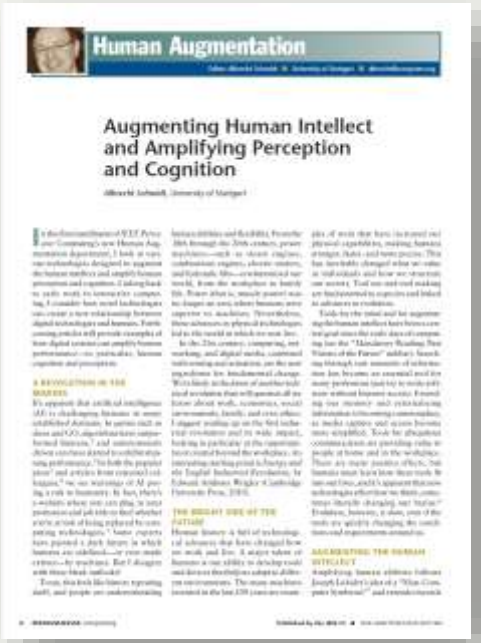
Further Reading on Conceptual Issues

Challenges in Engineering Cyber-Physical Systems

Manfred Broy, Albrecht Schmidt. Challenges in Engineering Cyber-Physical Systems. IEEE Computer. Feb. 2014 (vol. 47 no. 2). pp. 70-72. http://doi.ieeecomputersociety.org/10.1109/MC.2014.30

Perception beyond the Here and Now

Albrecht Schmidt, Marc Langheinrich, Kristian Kersting, "Perception beyond the Here and Now," Computer, vol. 44, no. 2, pp. 86-88, Feb. 2011, doi:10.1109/MC.2011.54



Human Augmentation

Augmenting Human Intellect and Amplifying Perception and Cognition

Albrecht Schmidt: Augmenting Human Intellect and Amplifying Perception and Cognition. IEEE Pervasive Computing 16(1): 6-10 (2017), doi:10.1109/MPRV.2017.8

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Amplification of the Human Mind and Intervention User Interfaces: New Interaction Paradigms in the Age of Artificial Intelligence

Albrecht Schmidt, Ludwig-Maximilians-Universität München

Abstract. The use and development of tools is strongly linked to human evolution and intelligence. Physical tools, from the wheel to the plane and from knifes to production machines, have transformed what people can do and how people live. Currently, we are at the beginning of an even more fundamental transformation fueled by artificial intelligence and autonomous systems: digital tools, with build-in intelligence to amplify human abilities. Such digital technologies will provide us with entirely new opportunities to (1) enhance the perceptual and cognitive abilities of humans and (2) to delegate intermediate decisions and to interact on a different level of granularity. In our research we create novel digital technologies that systematically and empirically explore how to enhance human abilities. We aim at creating an efficient and pleasant cooperation between intelligent systems driven by artificial intelligence and human actors. If such a cooperation is successful, the resulting human-technology-system will outperform the technical system without a human user. Our experimental approach is to: first, understand the users in their context as well as the potential for enhancement. Second, we create innovative interventions that provide functionality that rethinks the granularity of interaction and provides humans with new powers. And third, we empirically evaluate and quantify the enhancement that is gained by these developments. It is exciting to see how ultimately these new ubiquitous computing technologies have the potential for making human actor measurably. With these technologies we could make humans more powerful, could overcoming fundamental limitations in human perception and cognition and eventually create abilities, currently considers super powers.

Short Bio. Albrecht Schmidt is professor for Human-Centered Ubiquitous Media in the computer science department of the Ludwig-Maximilians-Universität München in Germany. He studied computer science in Ulm and Manchester and received a PhD from Lancaster University, UK, in 2003. He held several prior academic positions at different universities, including Stuttgart, Cambridge, Duisburg-Essen, and Bonn and also worked as a researcher at the Fraunhofer Institute for Intelligent Analysis and Information Systems (IAIS) and at Microsoft Research in Cambridge. In his research, he investigates the inherent complexity of human-computer interaction in ubiquitous computing environments, particularly in view of increasing computer intelligence and system autonomy. Albrecht has actively contributed to the scientific discourse in human-computer interaction through the development, deployment, and study of functional prototypes of interactive systems and interface technologies in different real world domains. His early experimental work addressed the use of diverse sensors to recognize situations and interactions, influencing our understanding of context-awareness and situated computing. He proposed the concept of implicit human-computer interaction. Over the years, he worked on automotive user interfaces, tangible interaction, interactive public display systems, interaction with large high-resolution screens, and physiological interfaces. Most recently, he focuses on how information technology can provide cognitive and perceptual support to amplify the human mind. To investigate this further, he received in 2016 a ERC grant. Albrecht has co-chaired several SIGCHI conferences; he is in the editorial board of ACM TOCHI, edits a forum in ACM interactions, a column of human augmentation in IEEE Pervasive, and formerly edited a column on interaction technologies in IEEE Computer. The ACM conferences on tangible and embedded interaction in 2007 and on automotive user interfaces in 2010 were co-founded by him.