Simple Design Guidelines and UI Considerations for different Devices

Four Design Guidelines

These help with design and layout of UI (multiple types)

1. Simplicity
2. Structure
3. Consistency
4. Tolerance

1. Simplicity

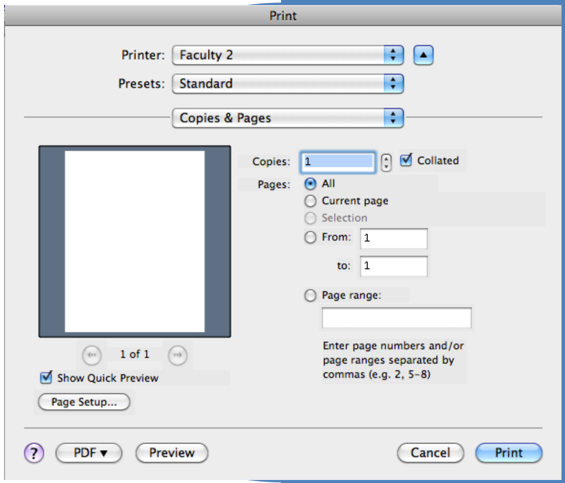
- Emphasizes importance of keeping UI’s as simple as possible
- Should communicate clearly and simply in users' own language
- Should use actions, icons, words, and UI controls that are natural to users
- Complex tasks should be broken into sub-tasks
- Simplicity is a hard to do well

2. Structure

- Emphasizes importance of organizing the UI in a meaningful and useful way
- Related features should appear together on the user interface (and separate unrelated features)
- Should reflect users understanding of the domain and their expectations about how the UI should be structured

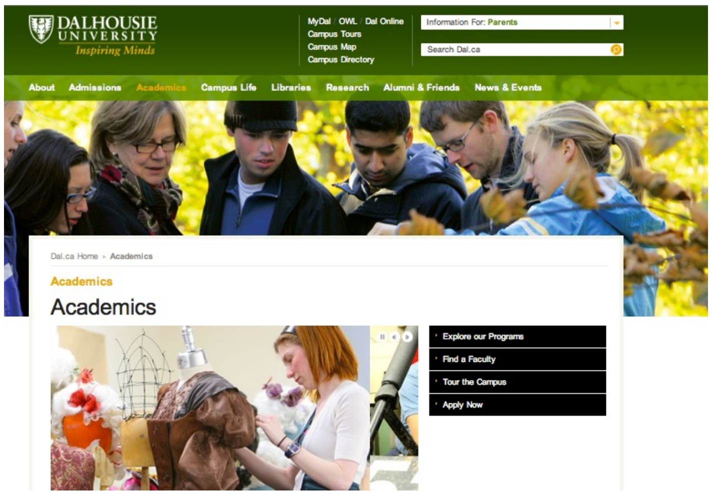
2. Structure

- Structure should align, group and position the user controls in a way to help the user use them efficiently and effectively
- Metaphors can help structure the interface in a way that is familiar
- E.g., tourism kiosk → uses maps



3. Consistency

- Emphasizes importance of uniformity in appearance, placement, and behaviour in a UI to make a system easy to learn and remember
- If you do something on one level of the UI, users expect it to be the same throughout the UI because they develop a mental model of the UI (this UI helps them predict how the subsequent screens, levels, layers, etc will behave)



3. Consistency

- Greatly affects usability – is users think the system will act one way and it acts another – frustration
- Consider consistency for single systems, across systems within an organization or familiar domain (e.g., websites, MS office Suite)
- To ensure consistency: REUSE
  - GUI controls and design strategies within and between systems (e.g., logos, menus, etc.)
  - It is advantageous to users because they will need to learn fewer things and transfer knowledge

4. Tolerance

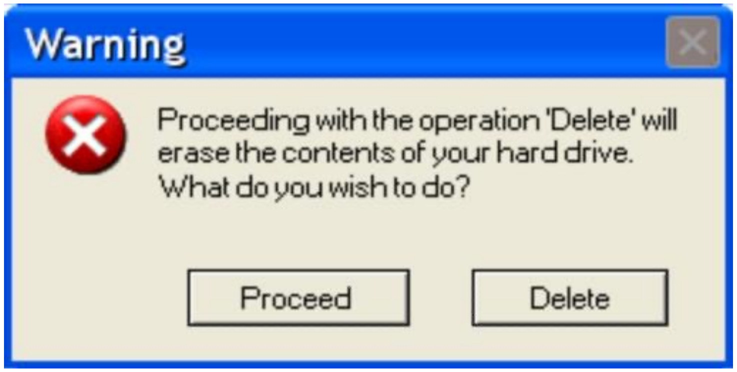
- Emphasizes importance of designing the user interface to prevent user from making errors
  - Errors can be due to bad UI designs but also from poor task knowledge or domain knowledge, stress, etc.
  - Reduce errors by:
    - Help users avoid mistakenly by making wrong choice unavailable (e.g., grey out choices)
    - Show how info should be entered or accept all formats (e.g., dates on a form)
    - Help users recover if they make errors

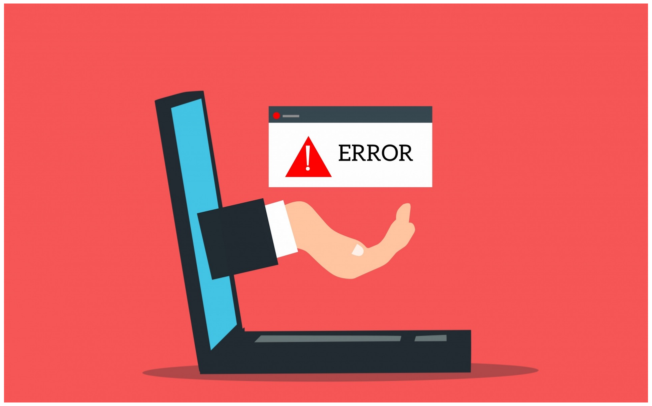
4. Tolerance

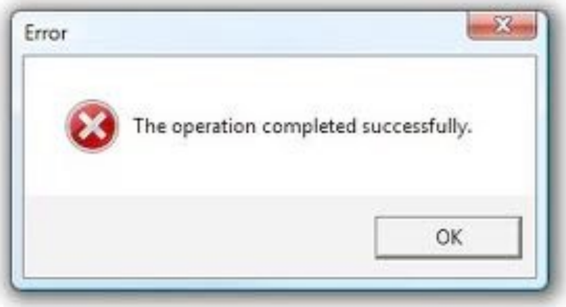
- Two types of recovery:
  - Forward error recovery
    - System accepts the error then helps the user accomplish their goal
    - The user may not be able to undo the action but provides an alternative route to enable them to recover
    - Example: Word recovers a document
  - Backward error recovery
    - Undo the efforts of the previous interaction to return to the prior state (e.g., Undo, Stop, Cancel)

4. Tolerance

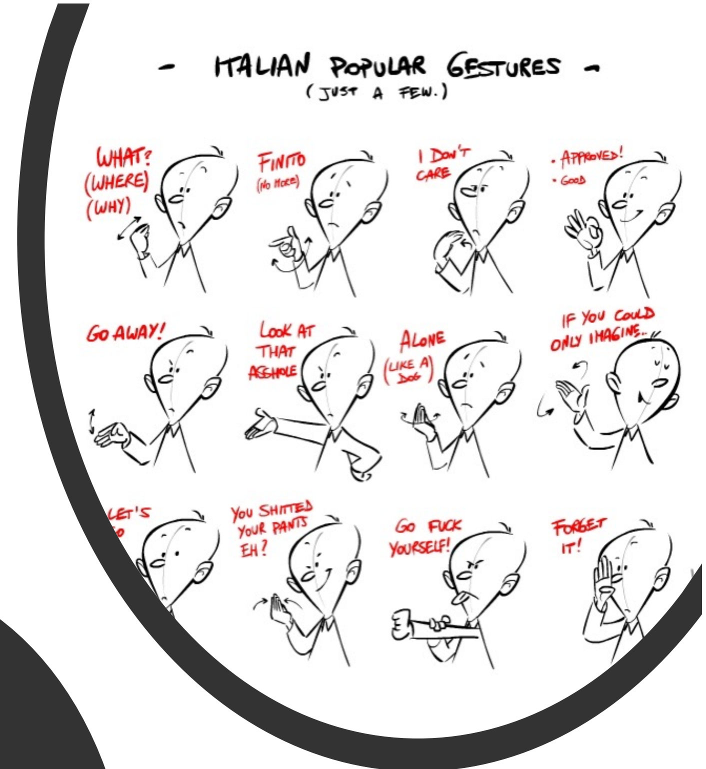
- Help users recover from errors by showing proper error messages
  - Explain errors and help the user correct them
  - Be clear and concise (don't confuse the user with mismatched messages)
  - If the user requests, provide more information
  - Use language that the user will understand
  - Use positive language (non-threatening)
  - Use specific, constructive terms
  - Let the system take the blame for the error







Inputs



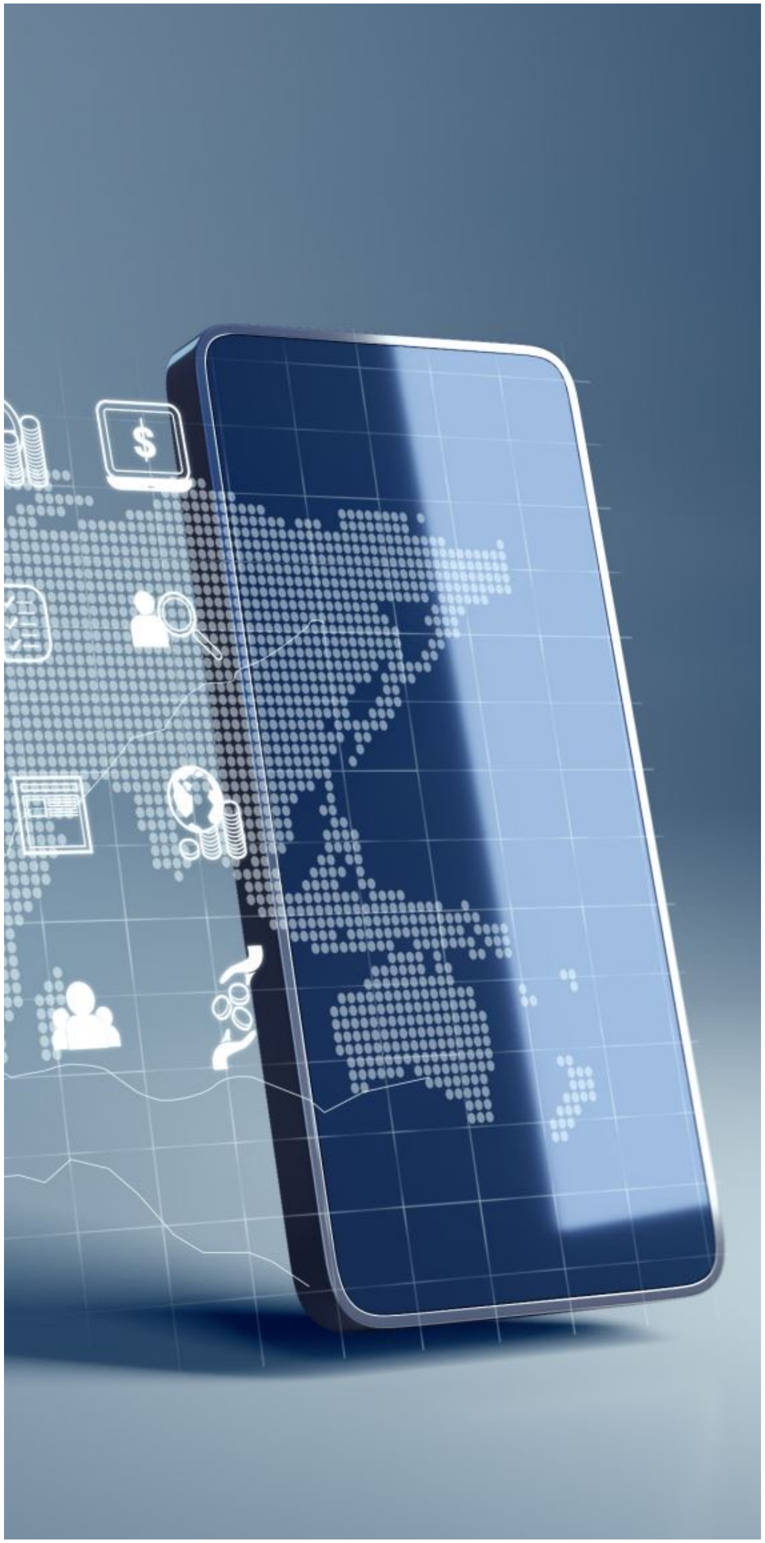
- Inputs (communicating with the system)
- This includes different ways that we can interact with different systems:
- For example:
  - keyboard
  - mouse
  - microphone (speech input)
  - scanner
  - digital camera
  - gestures

Outputs

Outputs (communicating with the user)

This includes different ways that the system communicates with us (the users), for example:

- Screens / visual
- Printers / physical
- Speakers
- Haptic feedback (e.g., phone vibrates when on mute)
- A/R and V/R

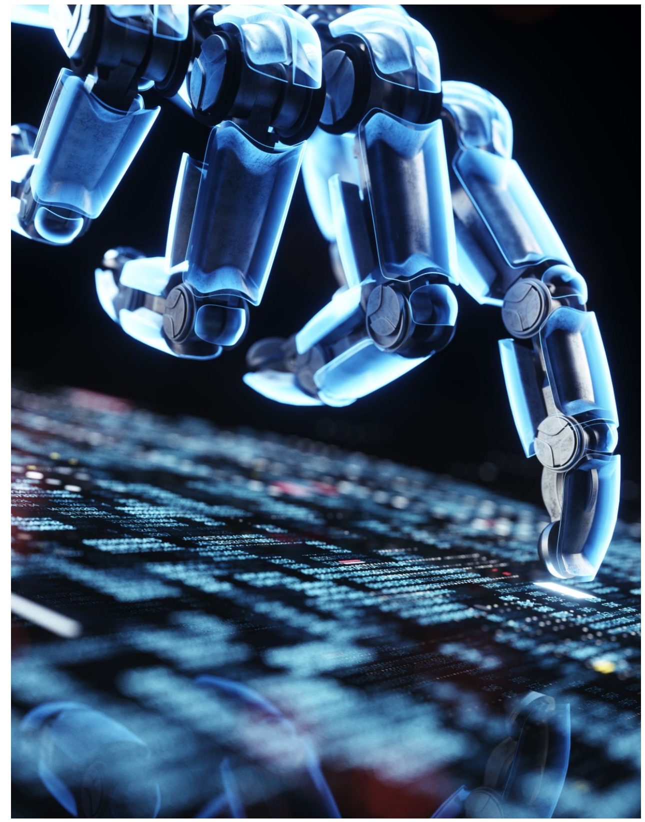


What impacts interactions?

- Users
- Tasks
- Size of device (e.g., screen size)
- Ways of inputting
- Others?

Diverse Devices

- Diverse systems require different UI and interaction considerations: (just a few examples)
  - Mobile
  - Wearable
  - Robots
  - Speech
  - Augmented Reality
  - Big Display (wall, table, collaboration)

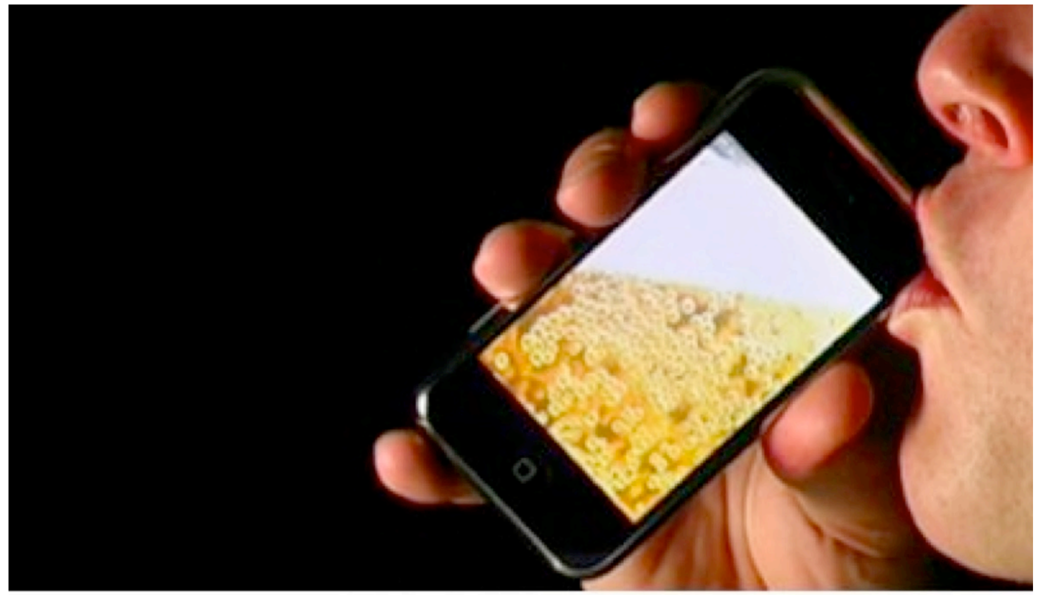


Mobile Devices /Small Screen

- Handheld devices intended to be used while on the move
- Have become pervasive, increasingly used in all aspects of everyday and working life
- light weight, easy to carry, mobile, convenient
- Applications running on handhelds have greatly expanded, e.g.
  - used in restaurants to take orders
  - car rentals to check in car returns
  - supermarkets for checking stock
  - in the streets for multi-user gaming
  - in education to support life-long learning

The advent of the iPhone app

- A whole new user experience that was designed primarily for people to enjoy
  - many apps not designed for any need, want or use but purely for idle moments to have some fun
  - e.g. iBeer developed by magician Steve Sheraton
  - ingenious use of the accelerometer that is inside the phone



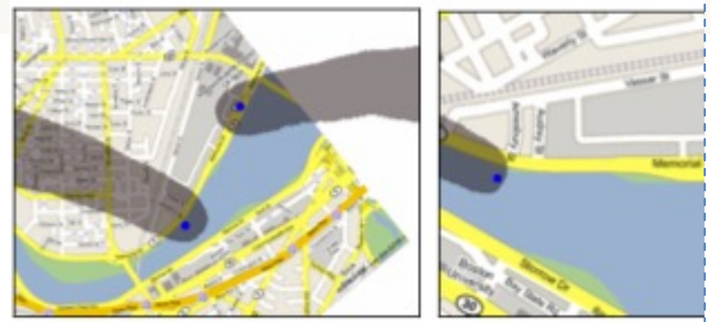
hottrixdownload.com

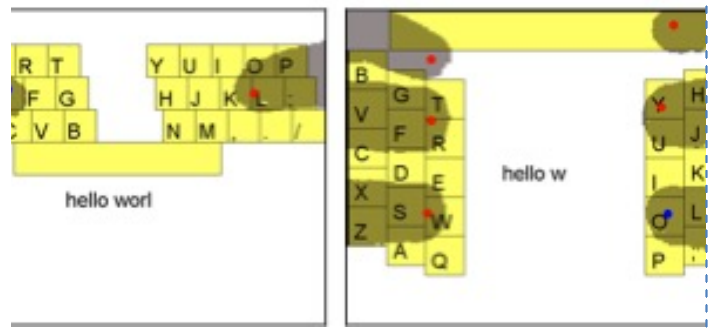
Mobile/Small Screen Challenges

- Small screen size/limited space to present information
- Lighting and angles can affect visibility of device
- Battery life (better now)
- Access to Internet (data – becoming less $$ and more places offering free internet but give up your info)
- Dexterity issues/ vision issues with users
- Can be hard to input data, selection

Size, Input, and Occlusion

- Issues/Considerations for design
- Only one hand available
- Can’t see a lot on the screen at one time (fall-off)
- Occlusion issues while selecting/interacting
- Using in potential small spaces, lighting, weather? etc.
- Selection accuracy (e.g., overshooting, large fingers)
- Holding and inputting with other hand
- Some Approaches
  - Touch screen inputting, gesture, tilt
  - Semi-transparent approach?
  - Larger device for input tablets), expandable keyboard
  - Projectors

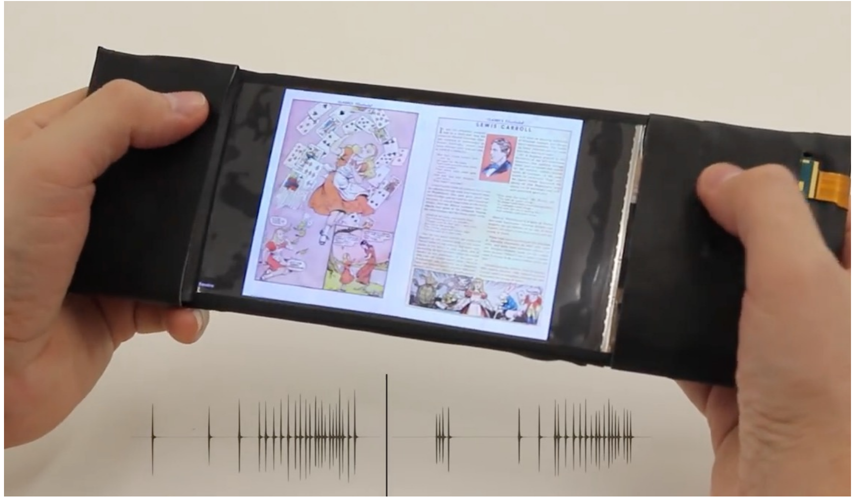




Daniel Wigdor et al. 2007. Lucid touch: a see-through mobile device

Newish Mobile Devices Approaches

Bendable with tactile response



https://www.youtube.com/watch?v=Sfc_Peev660

Paul Strohmeier et al. 2016. ReFlex: A Flexible Smartphone with Active Haptic Feedback for Bend Input

Projection

https://www.youtube.com/watch?v=9J7GpVQCfms

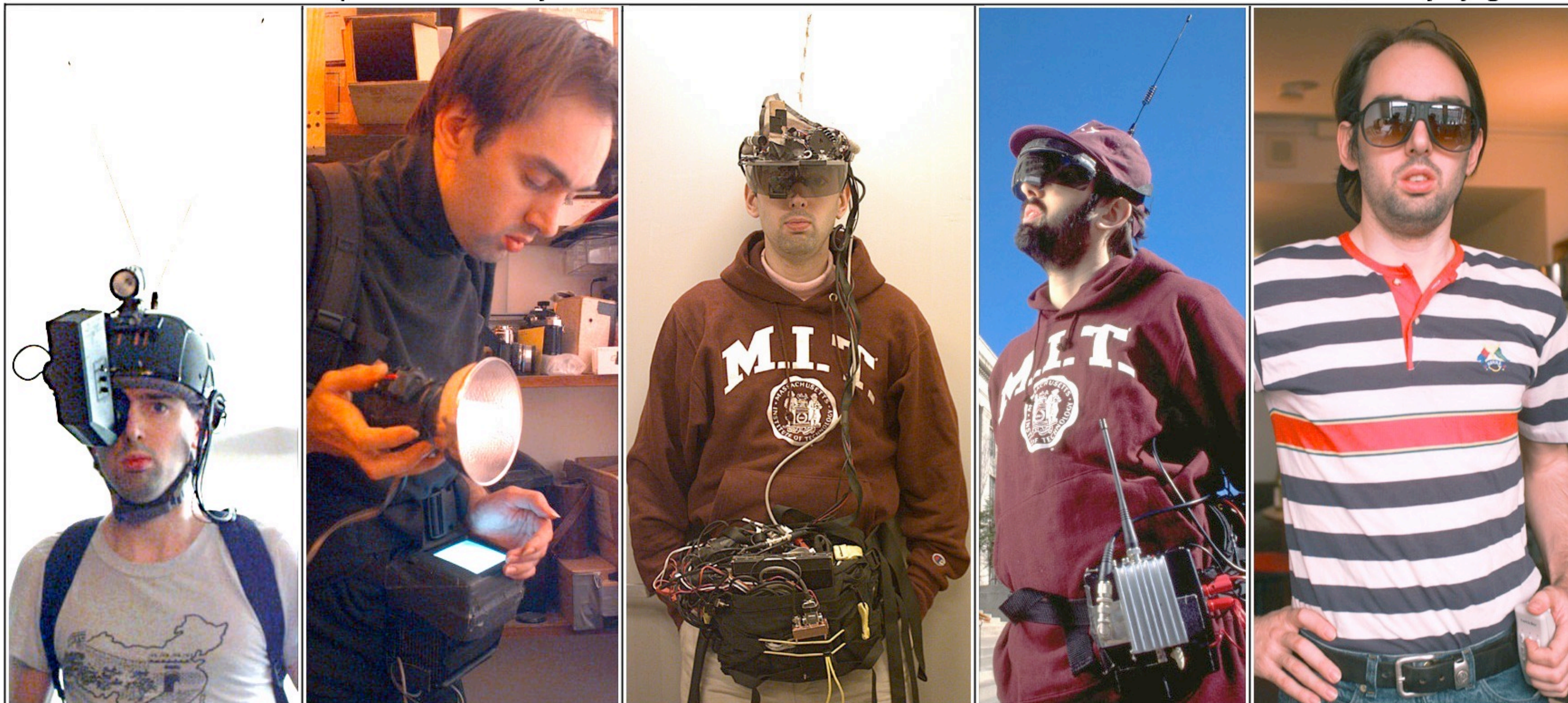
www.cicret.com

Wearable Devices

- First developments were head- and eyewear-mounted cameras that enabled user to record what was seen and to access digital information
- Since, jewellery, head-mounted caps, smart fabrics, glasses, shoes, and jackets have all been used
  - provide the user with a means of interacting with digital information while on the move
- Applications include automatic diaries, tour guides, cycle indicators and fashion clothing

Steve Mann - pioneer of wearables

Steve Mann's "wearable computer" and "reality mediator" inventions of the 1970s have evolved into what looks like ordinary eyeglasses.



(a)	(b)	(c)	(d)	(e)
1980	Mid 1980s	Early 1990s	Mid 1990s	Late 1990s

https://en.wikipedia.org/wiki/Lifelog#cite_note-1
http://wearcam.org/steve5.htm

Steve Mann

- Has been using these devices for 35+ years

Photo: Richard Howard/Time Life Pictures/Getty Images

Grand Day Out: While a graduate student at MIT, the author experimented with wearable computing systems, including this rather ungainly 1996 arrangement.

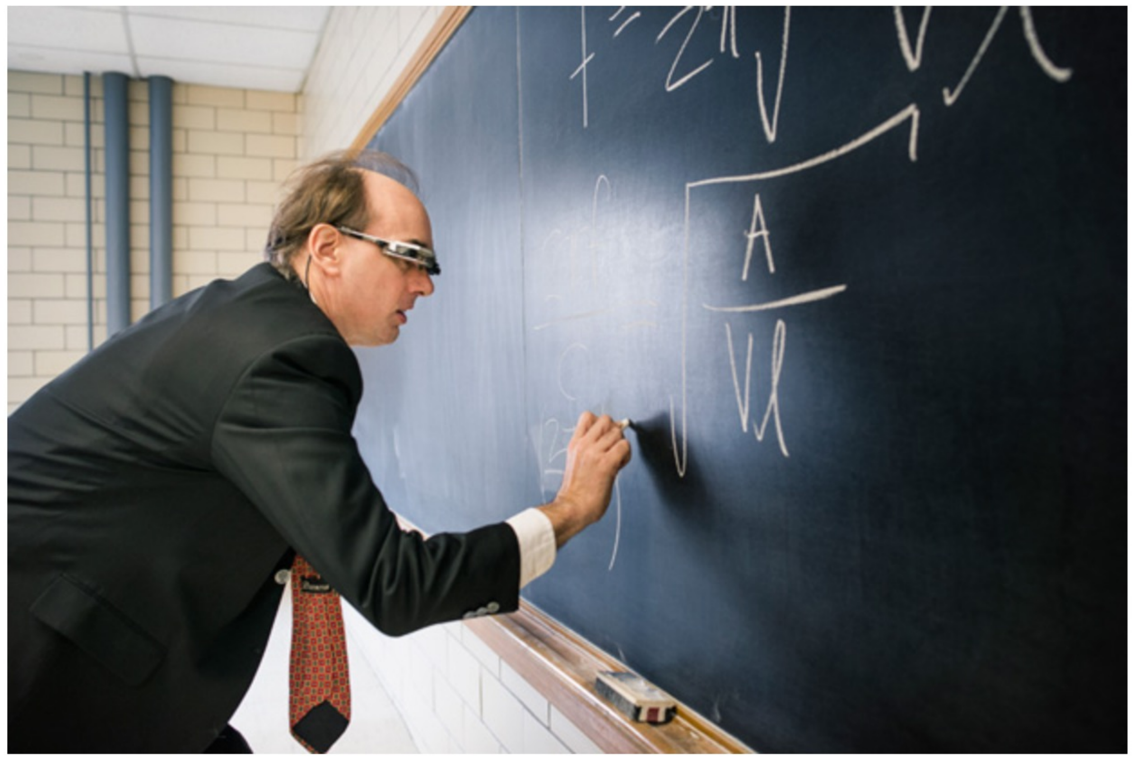


Photo: Ryan Enn Hughes

Seeing the Solution: The author wears his Generation 4 glass during one of his lectures at the University of Toronto.

http://wearcam.org/ieeecomputer/r2025.htm

Steve Mann

"I have been designing, building, and wearing some form of this gear for more than 35 years. I have found these systems to be enormously empowering. For example, when a car's headlights shine directly into my eyes at night, I can still make out the driver's face clearly. That's because the computerized system combines multiple images taken with different exposures before displaying the results to me."

Has done research over the years – to see how far can push the boundaries:

- One version can use a camera with long-wavelength infrared to detect subtle heat signatures e.g.., can tell if anyone has left their seat in class
- Other version uses enhanced text to read signs that would otherwise be too far away to figure out or written in a different language.

https://spectrum.ieee.org/geek-life/profiles/steve-mann-my-augmediated-life

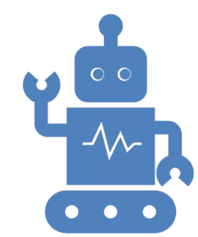
Issues and Challenges

- Comfort
  - needs to be light, small, not get in the way, fashionable, and preferably hidden in the clothing
- Hygiene
  - is it possible to wash or clean the clothing once worn?
- Ease of wear
  - how easy is it to remove the electronic gadgetry and replace it?
- Usability
  - how does the user control the devices that are embedded in the clothing?
  - Where to put camera, how to interact with the device, where do you project information?

Robots

Four main types

1. remote robots used in hazardous settings or in hard to get to places (e.g., underwater)
2. domestic robots helping around the house
3. pet robots as human companions
4. sociable robots that work collaboratively with humans, and communicate and socialize with them – as if they were our peers



Advantages

- Pet robots are assumed to have therapeutic qualities, being able to reduce stress and loneliness
- Remote robots can be controlled to investigate bombs and other dangerous materials

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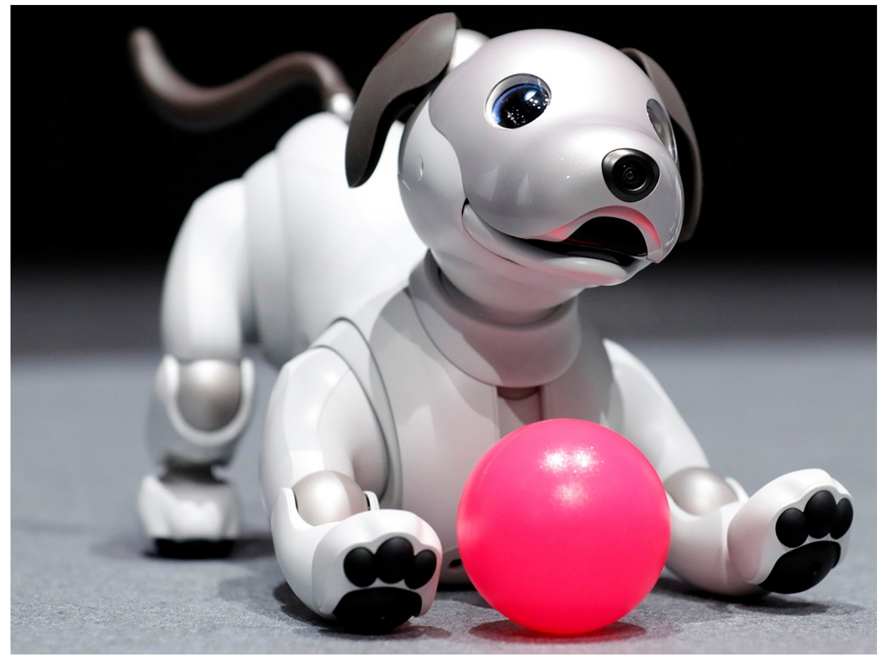
Issues and Challenges

- How do humans react to physical robots designed to exhibit behaviors (e.g. making facial expressions) compared with virtual ones?
- Should robots be designed to be human-like or look like and behave like robots that serve a clearly defined purpose?
- Should the interaction be designed to enable people to interact with the robot as if it was another human being or more human-computer-like (e.g. pressing buttons to issue commands)?

Sony Aibo

Sony Aibo 2000

Sony Aibo Today



https://spectrum.ieee.org/automaton/robotics/home-robots/sony-advanced-aibo-robot-dog-unleashed
http://www.sony-aibo.com/aibo-models/sony-aibo-ers110/

Speech Interfaces

- Where a person talks with a system that has a spoken language application, e.g., timetable, travel planner
- Used most for inquiring about very specific information, e.g. flight times or to perform a transaction, e.g. buy a ticket
- Also used by people with disabilities
  - e.g. speech recognition word processors, page scanners, web readers, home control systems

Have speech interfaces come of age?

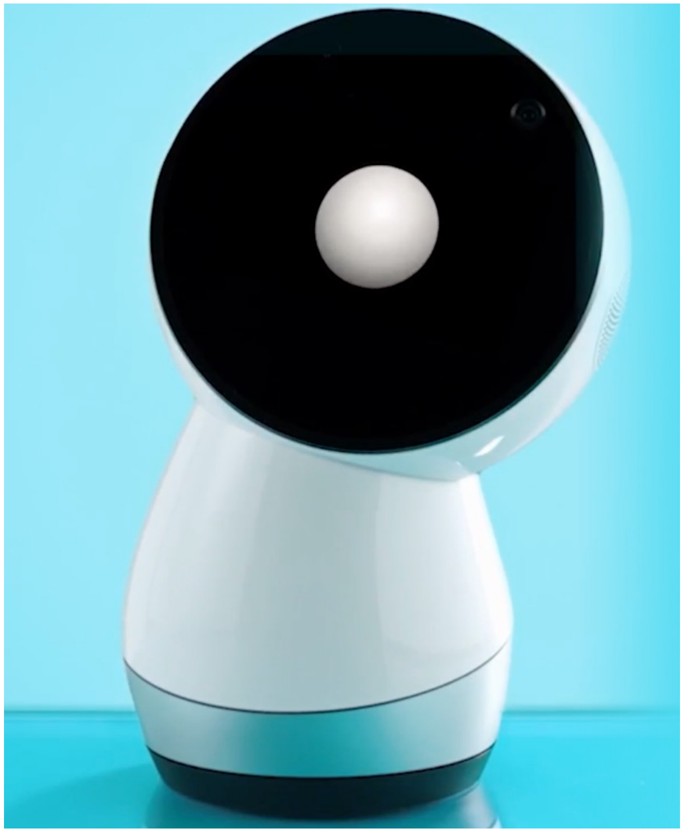
Get me a human operator!

- Most popular use of speech interfaces currently is for call routing
- Caller-led speech where users state their needs in their own words
  - e.g. “I’m having problems with my voice mail”
- Idea is they are automatically forwarded to the appropriate service
- What is your experience of speech systems?

Issues and Challenges

- How to design systems that can keep conversation on track and keep it natural
  - help people navigate efficiently through a menu system
  - enable them to easily recover from errors
  - guide those who are vague or ambiguous in their requests for information or services
  - Infer conversation
- Type of voice actor (e.g. male, female, neutral, or dialect)
  - do people prefer to listen to and are more patient with a female or male voice, a northern or southern accent?
- Technology is still evolving – but getting much better and much more dependable!

http://www.youtube.com/watch?v=kX8oYoYy2Gc



https://www.youtube.com/watch?v=vaCAiJ6NP3k
Jibo
https://www.youtube.com/watch?v=nwPtcqcqz00
Voice input – not always reliable

Augmented Reality

- Virtual representations are super-imposed on physical devices and objects
- Views of real world are combined with virtual environment

Augmented Reality

Example:

- AR is used in mobile apps to show wifi spaces, nearby restaurants, directions, for games,
- AR is also being used to help workers (maintenance, planning and survey)
- Currently use paper geographic information systems (GIS) on paper and notepads – usually 2D
- Hard to apply **mental model** from flat maps to reality (in terms of scale and knowing how to apply)
- 3D would help users do some tasks, such as locate structures for maintenance or to know where to dig
- E.g., use GIS and GPS with AR

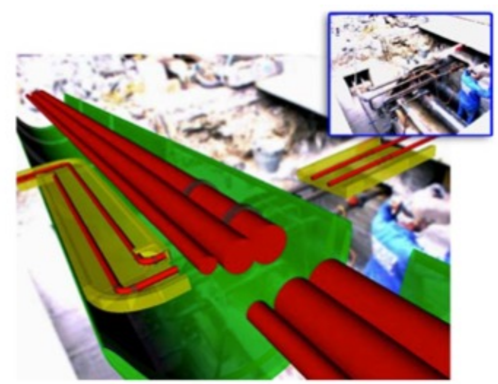


Fig. 1 The geospatial 3D model of the underground infrastructure is superimposed on a construction site

Considerations and images: Schall, G., Mendez, E., Kruijff, E. *et al.* (2009). Handheld Augmented Reality for underground infrastructure visualization

AR Issues to Consider

- Suitable Interface
  - E.g., to extract GIS info and translate to 3D or overlay directions on a map
  - Filter display to avoid clutter
  - Need to indicate depth cues
  - How to interact/manipulate/annotate?

- Geospatial Model
  - Structural complexity
  - Scale (e.g., to add details to a building – how large?
  - Incorporate different sources of information

AR Issues to Consider

3. Hardware
   - Display – wearable, mobile device, flexible?
   - Sensor for location to register graphics
   - See through facility to see interface and real world simultaneously
   - Often use headset –hands free hard for collaboration/ sharing of the display, bulky
   - Input, RFID

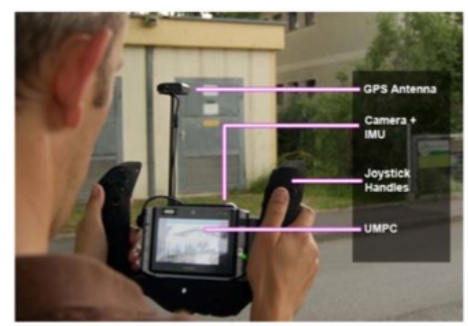
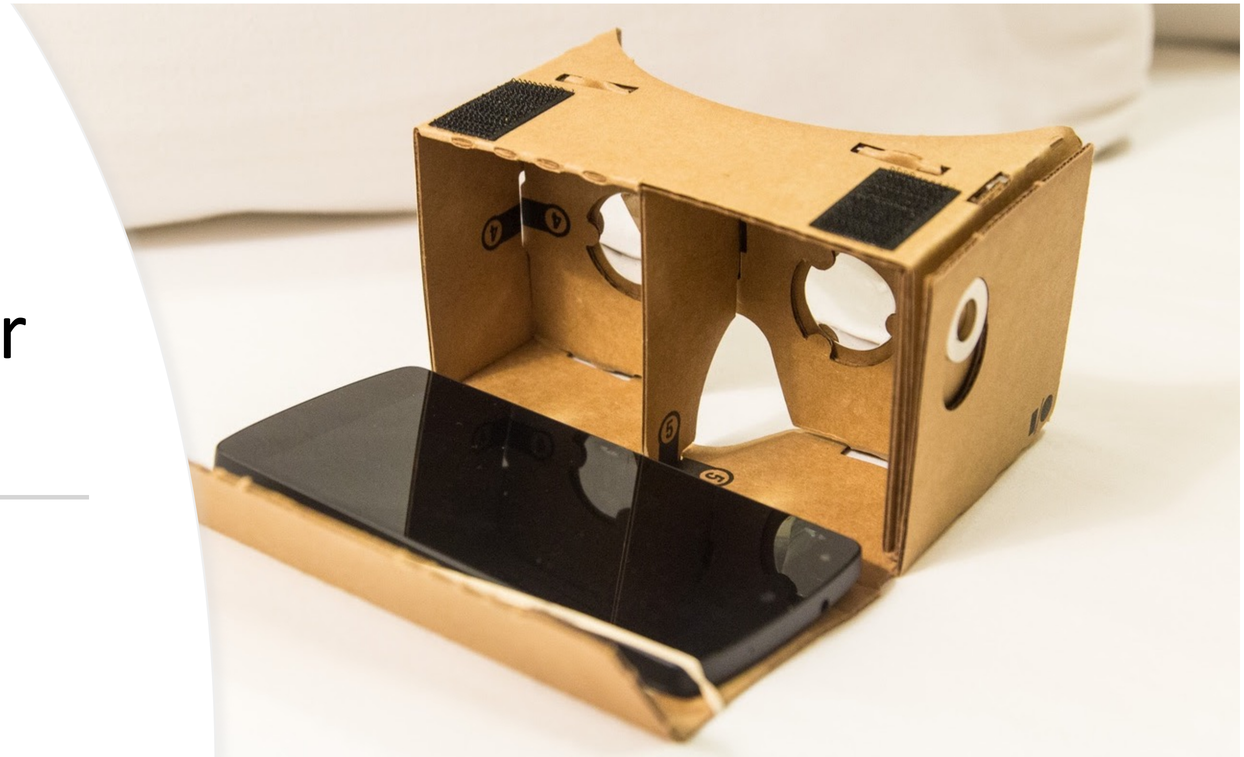


Fig. 6 Vesp'R is a design for an ergonomic handheld Augmented Reality device designed around an ultra-mobile PC

AR Issues to Consider

- Calibration for aligning real and virtual worlds when the user is fixed
  - Tracking (e.g., local and fixed global tracking sensors, visual using cameras and positions, marker based, and hybrid)
  - e.g., Use point-and-shoot approach of handheld video cameras with a video-see-through using GPS and GIS (for AR)



AR Issues to Consider

5. Others
   - Tracking 3D still hard to do:
     - complexity of scene
     - occlusion or image noise
     - object can change due to different illuminations
   - When mobile – consider:
     - battery time
     - processing power
     - weight and mobility of device
     - task (e.g., need hands)

Collaboration (Shared/col-located, tabletop and wall display)

- The main advantage of tabletop and wall displays is that they provide a large interactional space that can support flexible group working – allows groups to create content together at same time
- Can support more equitable participation compared with groups using single PC
- BUT when sharing a device issue of multiple inputs and feedback
  - usually provide multiple inputs and can sometimes even allow simultaneous input by col-located groups (or need to know who is ‘in charge’ and be able to hand off)
  - If multiple inputs allowed need way to show who is who…

Tabletop Displays

- Better for more collaborative activities
- Offers support for formal and informal collaborative activities, such as planning, designing, and organizing
- People can stand around a table and interact alone and together
- Issues of showing people ideas (e.g., upside down views), interactions, and sharing information (e.g., passing files/images, etc.) or selection (e.g., hard to reach)

Large Screens e.g., Table tops

Potential Issues??

Personal vs. group/shared space
Sharing of documents
Reach

Potential Solutions??

Create Bubbles
Gestures on the screen
Gestures on the screen

Unsuitable Tasks??

Entering personal information
Others

https://www.computer.org/csdl/mags/pc/2015/02/mpc2015020032.html
Liu, Y. et al., "A Tabletop-Centric Smart Space for Emergency Response" in IEEE Pervasive Computing

Large Wall Displays

- Better for presentations and for sharing views with large groups of people
- Still issues of interaction and deciding who has control over input, selection, and interactions
- Problem similar to small screen devices – how to navigate large spaces (SIGCHI Conference 2016– two research approaches)

Glowworms and Fireflies: Ambient Light on Large Interactive Surfaces
F. Perteneder, E-M. Grossauer, J. Leong, W. Stuerzlinger and M. Haller. In Proc. CHI16

https://www.youtube.com/watch?v=RLYrSP_Qz38

Off-Limits: Interacting Beyond the Boundaries of Large Displays Anders Markussen, Sebastian Boring, Mikkel R. Jakobsen, Kasper Hornbæk

https://www.youtube.com/watch?v=Lygko4rlnNo

Visualization

- How do represent large amounts of data on a finite sized screen? What needs to be shown, how can the data be adapted?
- The process of transforming data, information and knowledge into graphical presentations to support tasks, such as data analysis, information exploration, information explanations, trend predications, pattern detection
- Offers a method for seeing unseen, enriches process of scientific discovery, fosters unexpected insights

Visualization

- Requires algorithms to transform raw data into meaningful, interpretable, and displayable form to visually convey info to people
- It helps create a mental model to help process large amounts of information
- Issues of figuring out how to display the information in a meaningful way
- How to learn the domain [for visualization] to properly visualize the info (different mental models)

Interesting Visualization Approaches

Rethinking Map Legends with Visualization

- Presents new guidance for creating map legends in a dynamic environment
- Enhanced legend design with visualization by considering: selection, layout, symbols, position, dynamism and design and process.

Dykes, J.; Wood, J.; Slingsby, A.; , "Rethinking Map Legends with Visualization," Visualization and Computer Graphics, IEEE Transactions on , vol.16, no.6, pp.890-899, Nov.-Dec. 2010
doi: 10.1109/TVCG.2010.191

Map Legends

ıy. Three legend / map pairs show bec
r era (*left*, *center*) and lithology (*right*).
:e orders at and for each level of the attri
f *the British Geological Survey.*

What they learned about legends:

- Show relevant information but relevance changes over time according to task and user
  - Therefore, visual methods may be useful to highlight updates and make dynamic legends using input from the user and system
- Reflect meaningful geospatial or attribute structure by arranging legend symbols in a relational manner.
- Symbols in the legend must relate directly to those used on the map
- In dynamic environments consider: layout, symbols and position to suit situation, task and user

Map Legends

- To explore data, software should support typical queries discussed
  - Are there more A or B-roads on this map?
  - Where are the museums?
  - What type of land cover do windmills occur on?
  - Does this vary in different places?
- Can also consider the legend to be the map at times

Fig. 5. *The Legend as Statistical Graphic – Hierarchy*. Three legend / map pairs show bedrock geology for the United Kingdom in *Prototype 4*. Areas on the legend relate to areas on the map for era (*left, center*) and lithology (*right*). The legend can be interactively reordered to show chronological (*left*), geospatial (*center, right*) or attribute orders at and for each level of the attribute hierarchy.
Based upon 1:625K DiGMapGB with the permission of the British Geological Survey.

First, need to identify the problems

- For example:

IDEAS ???

http://www.redmondpie.com/decision-to-include-google-maps-on-the-original-2007-iphone-was-made-weeks-before-launch-report/
http://environmentalgeography.blogspot.ca/2010/05/right-down-street.html

Try different solutions

Halo

Halo: a technique for visualizing off-screen objects
Patrick Baudisch and Ruth Rosenholtz

http://nhenze.net/?paged=2

Wedge

Wedge: clutter-free visualization of off-screen locations
Sean Gustafson, Patrick Baudisch, Carl Gutwin, and Pourang Irani

Tangible Devices

- Interacting with digital information using the physical environment

Reactable, an electronic musical instrument example of tangible user interface.

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

https://www.youtube.com/watch?v=Mgy1S8qymx0

https://www.youtube.com/watch?v=lHtN7Iz0t0A

Mobile:
https://www.youtube.com/watch?v=jbq7Ji25Ieo

Another example of Tangible

MIT Media Lab, the Tangible Media Group: "inFORM like a table of living clay, the inFORM is a surface that three-dimensionally changes shape, allowing users to not only interact with digital content, but even hold hands with a person hundreds of miles away. " https://tangible.media.mit.edu/project/inform

https://www.youtube.com/watch?v=lvtfD_rJ2hE

Emotional Design

- Understand the connection that people have with the elements around them in the world – make thing aesthetically pleasing or make things that cause an emotional response may motive users to use it

Stairs or escalator… make the stairs fun

https://www.youtube.com/watch?v=97Q8qj2HEgU

- Don Norman
- Design of Everyday things
- Also, focuses on Emotional Design – things that makes you happy – TED Talk

https://www.youtube.com/watch?v=RIQEoJaLQRA

- http://www.questioningsoftware.com/2007/08/failure-usability.html
- http://www.userkind.com/blog/really-bad-yet-comical-error-messages/
- http://www.instructionaldesign.org/bad_error_messages.html
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