



Class 7 CS545

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Welcome to class 7.



Roadmap

- Log
- Multimedia and Ubiquitous Interfaces
- Training/Documentation
- Errors
- More Design
- Readings this class: Stone et.al. Chapters 18, 20-23;
- Readings next class: Stone et.al. Chapters 24-27;

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This week we look at multimedia, ubiquitous interfaces (first pass) and training and documentation with a bit on errors and design.



Log - Yo

Yo is an almost absurd exercise in minimalism; the app allows you to send and receive "Yo" with your contacts—and that's it. There's no content, no options, no customization... just "Yo."

WHAT GOOD IS THIS APP?

<http://www.dailydot.com/technology/yo-app-israel-missile-strike/>

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The app yo is a great example of social media being cleverly repurposed by users. Yo when activate sends “yo” to every member on your contact list. Sounds pretty silly, eh? Yet it has some popularity. But then something amazing happened, see url above. During Palestinian missile attacks, folks would use yo to alert all their friends that a missile had been fired, as indicated by an air raid alarm, giving them a few more vital seconds to seek safety. Quite a repurposing of the app – users are creative!



Interface being a physical environment rather than a command based, conversational metaphor

A network of things

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There is an increasing tendency to make the world our interface to computation and the internet. I tweeted a really bizarre take on this <http://datenform.de/blog/dead-drops-preview/> The usb drops really take it to the extreme. But first multimedia to set the stage.



Multimedia Interfaces

(Moogridge)

- Often about affordances
 - Objects that are self evident, when you see an object it reminds you of what it does
 - How interfaces convey information about what you can do with them
 - Surfaces for walking, tools for manipulating
 - “perceivable possibilities for action.”
 - Blurring the line between real and simulated
 - Tangible user interface
 - “sound conveys mostly information about the source”

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Many times what we are striving for in multi-media interfaces are more natural interfaces which afford a behavior. And then there are always these design tidbits, such as the last bullet. Sound truly does orient you to the source. If not overused it is an excellent way to capture attention momentarily.



Multimedia Interfaces

- Actually Ubiquitous Interfaces!
 - Recoverable paper
 - Context aware computing
 - Ubiquitous computing
 - Cyborg, Me++, Thad Starner
 - When things begin to think
- Psychology - learning enhanced, multiple traces, active learning, availability accessibility distinction
- Back to basics - aspects of multimedia
- Augmented Reality, Virtual Reality, Diminished Reality
- Now, of course, Google Glass and Oculus Rift



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And if we take it to the extreme we get to Thad Starner, who in his graduate days at MIT was continuously connected. Interesting that with smart phones we are now continuously connected without the hardware. With this connectivity comes many new “realities.” More on those new realities later. But less progress through the multi-media technique/device space. The black and white picture shows Steve Mann in an earlier instance, ~1997



Pointing Devices

- (Keyboard types, chording may have renewed life- cell phones & size)
- Pointing tasks: select, position, orient, path, quantify and text (move)
- Direct control (touch screen or stylus) versus indirect control-- away from screen (mouse and the rest)
- Novel: foot controls, eye/hand tracking (Minority Report), data gloves, digital paper, both hands

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So keyboards and touch sensitive screens with keyboards (for minimal typing). Pointing devices can get very sophisticated and there are an expanding number of them: wii controller, move controller, body movements with Kinect. One very popular mechanism for a bit was the data glove, but motion capture has become more sophisticated and we can dispense with the glove.



Pointing Device Success Criteria

- Speed and accuracy
- Efficacy for task (size of “target”)
- Learning time
- Cost and reliability
- Size and weight
- (environmental issues)

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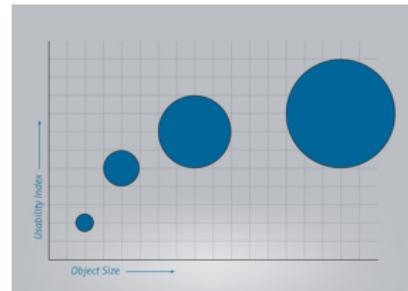
8

Pointing devices have to be selected for tasks – you do not want to use full range body movements for detailed pointing. It also has to be appropriate to the environment – you cannot use full range hand movements in a fighter jet cockpit obviously.



Pointing Devices - Heuristics

- Touch screens and trackball are durable and easy - kiosks
- Mouse rules - was controversial in early days
- Pens for drawing/handwriting
- Joysticks - games/navigation
- Indirect requires more learning
- Fitts Law, model of human hand movement
 - time for hand movement dependent on distance moved, D, and target size, W. Doubling distance is longer, but not twice as long and increasing the size of target makes pointing easier
 - $MT = a + b \log_2(D/W+1)$, MT = movement time, a = start/stop time of device, b = device speed. There are variants



multimedia

<http://blog.sebastianwaters.com/post/6382361390/improving-usability-with-fitts-law>

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Touch screens are the device of choice for many public devices from Disney world kiosks to your local atm. Interestingly in the early days of computing there was a debate about the utility of the computer mouse – folks did not like that it took you away from the keyboard! Fitts Law is one of the few equations in HCI but it is an interesting one. Note the relationship between size of target and speed – big targets can be tracked quickly but smaller targets make that difficult. Cool stuff and it matches our intuitions. For very low latency tasks it is a great idea to model using Fitts Law. It also provides clues on how to make computer games using pointing devices more difficult to play!



Displays



- Portability, privacy, saliency(attract attention), ubiquity, simultaneity (# of users)
- Size, resolution, palette, luminance/contrast/glare, POWER, refresh rates (animation video), cost & reliability



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Of course displays rule as multimedia devices and there are lots of variants these days and they include touch and cameras and all manner of great possibilities for creating multi-media applications. The key is to understand how the user interacts with the device and your application depending on the control surface, touch or extensive buttons for Sony PSP for instance. Size of display matters too. For various reading tasks the iPad is the preferred choice – at least for this user. It will be a real kick to see how these pages change over the years. Scientists who study pervasive systems have an inch, foot and yard take on displays, the metric referring to how distant the display is. AN inch display is a smart phone or smart watch. A foot display is a laptop or desktop. A yard display is a large screen lcd, large tvs, store displays.



Other Reproduction

- Electronic ink
- 3D printers



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<http://www.scienceprog.com/wp-content/uploads/2010/06/3d-printer.jpg>

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So electronic ink with the preponderance of book readers is making a difference and 3D printers are great for prototyping materials. This has become increasingly popular with the “maker” movement. Check out burning man, <http://www.burningman.com/>, to understand the culture. There is even a 3D printer on the spacestation

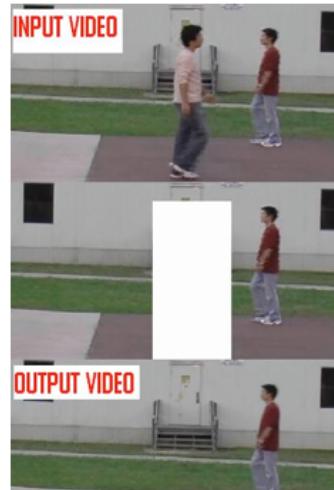


Some New “Realities”

- Virtual Reality
- Augmented Reality
- Diminished Reality



<http://peaks.augmented-outdoors.com/>



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<http://cil.cs.ucf.edu/img/diminishedreality/diminished1.jpg>

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Many of us have experienced virtual reality either through MMORPG games, e.g., EverQuest or social sites, Second Life. Augmented reality provides additional information such as the names of mountains on a camera display using the peaks application. Diminished Reality reduces the number of objects on a screen. This provides an interface that focuses the user on the critical elements, eliminating distractions. In multimedia, PAR is a big deal!



RFIDs

- IFF
- EZPass
- WalMart (pharmaceuticals)
- Department of Defense
- Use foil, honest
- Subdermal RFIDs
- Express credit cards
- Intelligent car keys
- No easy way to activate/deactivate
- More in your future!



Picture credit: <http://people.csail.mit.edu/rahimi/helmet/>

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One other source to augment multimedia interfaces are things. For example, RFIDs are being used throughout industry because they can hold a fair amount of information and are inexpensive. Passive RFIDs have to be activated and you must be very close to them to read them, making them suitable mostly for retail applications. There also is a controversial ability to apply sub-dermal RFIDs in human. Needless to say there are so many privacy issues with RFIDs that part of the work of the user experience team should be to determine whether privacy is an issue for users (and insist on education). Tin foil does block the signal – nonetheless you are likely to see more of them. Check out <http://www.rpi-polymath.com/ducttape/RFIDWallet.php> for a discussion of some of the issues and how to build your own foil wallet to protect your RFID cards. Upon further reflection the person in the picture is not that crazy although I do not think we have RFID devices implanted in our head ... yet. But they are implanted in our pets and in some humans – check out the wikipedia article on RFIDs if you are interested.



RFID Gen2

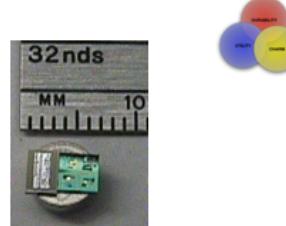
- 96 bits of memory
- 2-3 times smaller
- Reader “kill” capability
- Cheaper
- Less interference
- Read rate 10x faster

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Just some specifications for the newest generation of RFIDs. One can place a lot of info in 96 bits! The kill capacity is crucial but there are issue with verify that the chip is indeed dead/unreadable.

Smart Dust



- (lots of other devices in the book)
- Computer atop a battery (limits: power and range, related)
- Commercialized - www.dustnetworks.com
- Software support - TinyOS



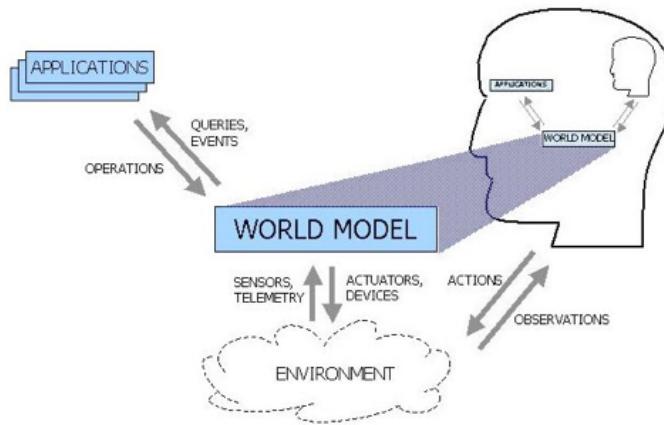
Initial source:<http://robotics.eecs.brown.edu/~gregg/6900dust/>

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Smart Dust makes things that think even more interesting. I am involved in several projects using TinyOS and smart dust. We are using them for temperature, humidity and power consumption. The key for these devices are power consumption. Radios sap power. Of course the smart dust will become even more dust like and the more there are – the closer they are, the less power necessary for the radios making applications even more powerful. Of course the key is access to the internet at some point in their communication stream so that they can report to us. There are lots of SoC chips out there (System on a Chip) – I work with them on a daily basis for pervasive computing research.



Ubiquitous/Pervasive Computing



<http://www.cl.cam.ac.uk/research/dtg/attarchive/spirit/>
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This is one early vision of ubiquitous computing – termed sentient computing by our British counter parts at the time, the video is here <http://www.cl.cam.ac.uk/research/dtg/attarchive/labvid.html>. A bit dated but still really spot on in terms of potential. Okay now from the multimedia world to documentation!



User Documentation

Boeing 737 Max

- "Clean documentation cannot improve messy systems"
- Many users learn from other users who know the interface - **keystone species**
 - But this unfortunately is changing ☹
- Good documentation is intention/task oriented
- Documenter is your first user!
- Traditional paper forms: installation manual, getting started notes, introductory tutorial, thorough tutorial, detailed reference manual, quick reference card, conversion manual, roadmap

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Just like testing cannot insure quality, documentation cannot make a bad system good. The term keystone species comes from information ecologies which we will discuss in a later lecture. The best bet is learning from other users BUT given the current work environment there are not always experienced users around. The key to great documentation is to focus on the goal, tasks and actions of the user.



User Documentation - 2

- Online help: manual, help, context sensitive help, tutorial animated demonstration, guides (animated or real)
- FAQs
- Online communities and variants
 - PHOAKS, collaborative filtering

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These are fairly straight forward. Online communities help through group problem solving – sometimes known as crowd sourcing. PHOAKS was a community established at AT&T. PHOAKS stood for People Helping One Another Know Stuff, you have to have a great acronym! Basically getting the user community to shoulder a substantial part of the burden.



Criteria for Effective Documentation

- In order of priority:
 - Availability - does it exist?
 - Suitability - is it focused on the intentions and tasks of the users?
 - Accessibility - can you find what you need?
 - Readability - is it easy to understand?

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Some criteria – the key is to prototype and test the documentation – it too is a user interface! Note the first and key attribute – does it exist!



User Documentation - 3

User's Goal	Paper	Online
buy	Sales brochure, fact sheet	Animated demonstration, *
learn	Tutorial	Manual, tutorial, guide, animated demo
use	User manual	Manual, help, context-sensitive help
solve	FAQ	Help, FAQ, online community

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LBGUPS = Learn + Buy + Get + Use + Pay + Service

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This table provides some generic user goals and what type of documentation may be necessary. At the bottom is an acronym common with in some industries that adds acquisition (get) and maintenance (service) as roles. Service in particular may best be supplemented with an on line user's group since many of the issues may be unanticipated.



User Documentation Issues

- Reading on screen is slower than text -- proofreading task 15 to 30% slower
 - Generational, check out your local community printer
 - Displays versus photos of displays were equal - but be careful.
 - Key may be resolution and LCDs
- Plasticity of documents - device independence and dynamic documentation are requirements
- **Active User Paradox** - too busy to learn, skills remain mediocre
- "people are incredibly creative in generating errors and misconceptions" Schneideman

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This addresses the question of whether documentation should be paperless. With the advent of ereaders, there may be a greater percentage of folks converting to paperless documentation. On Hyundai high end models, instead of a car manual an iPad is included. It is still generational with a heavier reliance on paper by older individuals. This suggests that if older folks are part of your target population, then you should include paper documentation. I would like to highlight the active user paradox – folks are too busy to learn so they remain as a mediocre user.



User Manual Guidelines

- Choose an action oriented approach: get to doing, numerous examples, verbs, ...
- User's tasks guide the organization of the documentation
- Support error recognition and recovery
- Support reading to do, study and locate
 - Brief, don't be exhaustive
 - Easy access - table of contents, index, glossary, job aids
 - **Clean, simple writing style: Elements of Style**
 - Closure of each chapter -- a complete lesson
 - Examples
 - Replace prose with structured text: step action table, decision tree, decision table
- **Test it for usability!**

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The first sentence is key - :reading to do. Use a clear writing style, there is no better primer than Strunk and White, Elements of Style. An electronic copy of an older edition can be found here:
<http://www.crockford.com/wrrld/style.html> . If you like it buy it, it is support of art. Another key is to test the documentation for utility and usability too.



Online Manual and Help Guidelines

- Easy accessibility and return
- Specific and procedural help -- How to do's
- Collect data -- [prototype help and manuals](#)
- User control of help system (and customizability)
- Avoid as much as possible being on the web, there is enough disk these days
- Tune help to user type
- **Not a panacea for poor user interface design**
- Test it for usability!

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The web can be a delivery vehicle for later versions of the documentation. Of course if you need the web to run the tool then most of the documentation can be on the web. Getting the hint on testing documentation for usability?



Document Development Process

- Start early
- Manager involved (first user)
- Seek professional writers and creatives interplay with engineer
 - Increasingly refined information from engineer until document emerges
- Review drafts thoroughly
- Field test
- Feedback mechanism
- Maintain currency and readability
- Roadmaps - documents for the documents!

Onto errors!

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The manager also can be the first writer too, but for products, please have a professional writer involved. They could use the help! Search is related to documentation so I thought we would discuss it next.



Slips

- Intend to do one action and discover you are doing another
- Psychology of everyday errors
 - Some slips may have darker meanings (Freud)
 - Most slips can be accounted for by simple things
- Slips result from lack of attention - folks can only concentrate on one thing at a time
- Examples of slips ...

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One nasty user slip is intending to delete files in a directory and either deleting files in the incorrect directory or deleting the directory! Note that inattention is not remedied easily, so the “are you sure?” questions usually do not prevent the error.



Capture Errors

- A frequent activity takes charge instead of the one intended
- Two different action sequences have their initial stages in common, with one being unfamiliar (or more recent) and the other being well practiced
- Driving to work on Sunday
- Your examples?

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One of the real issues with systems is that we overlearn how we use them, in a sense it is a habit. Because it is a habit if we try to use the system in a different way there must be clear indicators that we are using it in a different way to jar us from automatic behavior to more conscious behavior. For example when I do pass my normal work path on a weekend, I consciously have to rehearse, “do not turn.” Similarly when I am on one of my class email systems I have to prevent deleting emails that are not familiar and explore them. It would help to have some additional cues, different font, background color, ... to indicate this is not a typical use of the system.



Description Errors

- The intended action has much in common with others that are possible
- Internal description of intention was not sufficiently precise
- Correct action on wrong object
- User experienced and well practiced but not paying attention
- Orange juice into a coffee cup
- Yours?

Note that most of these errors are due to lack of attention or encountering a unique occurrence in a highly traveled User experience path. A common instance of this for me is to do a computationally intensive task on my notebook. Since I often remotely connect I sometimes do not notice I am local or remote and that lack of attention burns me since most things seem to be right. In all these instances you should think of personal instances of these errors. A remedy for my wrong system error is simply for the terminal screen and my shell prompt to indicate the name of the system – that often helps and is a simple remedy.



Data-Driven Errors

- Automatic actions are data-driven triggered by arrival of sensory data
- Dialing 9 first on my home phone for a conference call (also could be frequency)
- Yours?

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Much like taking the wrong turn to work on the weekend. Interesting that even with a totally different phone, I will still dial the 9 since my fingers take off. It is even worse know that I am at Stevens – I keep on dialing a 9 first instead of a 7 to get an outside line. A cruel thing to do is to reconfigure the key pad so that your fingers do not take off on their automatic behavior chain, but it would get your attention! Another would be pre-emptive prompting, programming the system to ask are you sure you wanted to dial a nine as the first number?



Associative Activation Errors

- Internal thoughts and associations can trigger actions
- Freudian slips -- you think something that ought not to be said but you say it
- Yours?

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You see a tmp file or a subject heading on an email and you automatically delete – when it could have been a mislabeled file or an important email. These are very difficult to resolve and often, the solution may lie earlier in the behavior chain – You have placed these files in the /tmp directory – are you sure? They will be subject to automatic deletion.



Loss-of-Activation Errors

- Forgetting to do something or forgetting part of the act
- Activation of the goals has decayed
- Too numerous to state just one -- common walking from my office to the lab (50 yds)
 - Increases with age
- Yours?

This generally occurs in user experiences when the task has a deep chain of actions – you have to do so many actions to get to a page in a web site or do a task that you forget some important information. Possible remedies, including reducing the depth of the tree through macros or scripts (automate some actions) or hyperlinks that take you to important pages that have been deeply embedded in your site (this may require analyzing site logs to determine some common errors or pages).



Mode Errors

- Devices have more than one mode and actions appropriate for one are not for the other
- Especially when controls must do double duty and device does not make mode visible
- Digital watch (gulp! Automatic pilots)
- Yours?

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Mode errors are quite common. If you use vi or vim, ever typed a command when you were in insert mode? This does not happen in emacs, but emacs has its own set of issues ☺. Digital watch manufacturers are getting better.



Yet Another View of Errors

Thimbleby

We want to reduce
an error's persistence
once it is made!

- User may slip and randomly fall off path
- User does things in wrong order
- User misses steps but does sort of right things (on the wrong path)
- Miss some initial steps – preparation, but then proceed on right path
- They may quit before end of path, acting as if finished – completion errors (writing to file)
- They may follow a correct path for a different task – everything looks smooth, could be transfer error
- If two paths start same way they may go down the preferred, more frequent path – they start out doing what they meant, but ... capture error
- Users may not stop when they have otherwise completed task – overrun errors

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Some more observations from Thimbleby, that are worth keeping even though I no longer use the book. An interesting one, is indicating when a task is completed!



Detecting/Preventing Slips

- Discrepancy between goal and result - requires feedback
- Issue actions can be specified at many levels and you have to provide feedback at appropriate level
 - Makes error correction difficult - wrong car syndrome
- **Error correction mechanism usually starts at lowest level possible and works its way up the chain**

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The last bullet is the most powerful advice – for error correction you must start at the error, it is bottom up, if you mistype a command you must correct it at the input not redo the whole task. However for prevention one often thinks top down, providing perhaps layered menus rather than type or automating common tasks in scripts. The middle bullet specifies a dilemma that is part of Norman's Gulf's chart. If you select the wrong car in the parking lot you may think the problem is with the key but really the problem is with your car choice.



Slip Prevention

- Mode errors are minimized by minimizing modes - Doh!
 - Or at least making them visible
- Confirmation before a command is executed is cool but ill-timed, user still usually content with choice, confirming action not, for example, the file name or pattern to be deleted
- Gaining attention or reducing attention demands!

The first bullet is profound but true – we often go mode crazy when all that is needed is a simple command or two. The last bullet suggests that you have to either grapple with obtaining attention or reduce the attention load necessary for the task.



Mistake Heuristics

- Seldom does a major accident occur without numerous errors
[pedestrian bridge in Florida](#)
- Social pressure is a factor in many accidents
- Try forcing functions - Atari game example
 - A form of physical constraint
 - In safety engineering known as interlocks, lockins, lockouts
- Warning signals are usually not the answer --they can go off in error and are often subverted



<https://www.sun-sentinel.com/local/miami-dade/fl-ne-fiu-bridge-design-flaws-ntsb-20181116-story.html>

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Many catastrophic transportation accidents occurred due to a chain of errors that overrode the safety mechanisms and processes. Social pressure is sometimes a factor especially in certain demographic groups, e.g., teens. Sequence control: interlock forces a sequence, for example a microwave chain of commands, lockins prevent states from ending prematurely – removing a bowl before the mixer stops and lockout prevents one from entering a dangerous place, when the laser is operational the door is locked. Warning signals in dangerous situations are not reliable.

FIU

Interlock forces sequence -- microwave

Lockin soft switch -- keeps action going preventing premature stoppage

Lockout - prevent entering dangerous place



Designing for Error

- Understand the causes of error and design to minimize those causes
- Make it possible to reverse actions or make it harder to do what cannot be reversed
- Make it easier to discover the errors that do occur, and make it easier to correct them
- Change the attitude toward errors, folks are getting there by imperfect approximations
- When someone makes an error there is usually a good reason - record it

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The last two are key – errors create design challenges!



Error taxonomy

ERROR TYPE	SITUATION	REMEDY
mode	Editors, watches	Decrease number of modes or highlight current mode
state	Fatigue, pressure, repetition	Address the situation, e.g., get rest
knowledge - previous knowledge - none	Conflicts Naïve,	Education, prompts Automation, education

This table is my attempt to provide a way of addressing the errors. For instance if you have multiple modes that result in errors, reduce the number of modes or make the current mode salient. If you are tired, get rest or slow the required planning and response time or automate! If previous knowledge causes conflicts with the new knowledge then more education and training is required including prompts. If there is no knowledge – provide training, multiple help modes and automation.



Design

- Time is the devil -- the force that works against evolutionary design
- The curse of individuality -- marking behavior
- Phone & typewriter
- Do not permit focus on cost, durability aesthetics get in the way of usability and understanding (right!)

Okay I cannot resist adding to your design list advice! With all that is good about iterations and User centered design the fact is that time is always our enemy and therefore we must be selective about our evolutionary improvements. There also are other factors, that we must constrain: we all want to leave our mark on the design, we continue to design typewriters when computers are needed, costs, durability and aesthetics cannot be avoided and we must balance with usability.



Why Designers Go Astray

- Aesthetics first – room numbers at Babbio Center
- Designers are not typical users
- Designers clients (aka stakeholders) may not be users
- There is no such thing as the average person
 - Make everything adjustable
 - Designing with our future selves in mind -BBS
- The problem of focus, selective attention, squeaky wheel- problem case

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What is wrong with the numbers that mark rooms in the Babbio center (hint it is even worse when you are short like me). All of these are forces that nudge you from user centered design.



Designer's Daily Temptations

- Creeping featurism
- Worshipping false images
 - Both designer and user are tempted to worship complexity, Maeda on white space (and sometimes inappropriate metaphors)
 - Component interaction (see Parnas again)

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As designers, techies and engineers we love complexity – we need to appreciate simplicity too

Oh and the answer to the question on slide 28 is that the room numbers are on the door frames at the top of the door!



How to Design HCI Wrong

- Make things invisible (different from the invisibility of the tool)
 - Widen gulf of execution - no hints to the operations expected
 - Establish the gulf of evaluation: no feedback, the tyranny of the blank screen
- Be inconsistent, change the rules
- Make operations unintelligible use idiosyncratic language or abbreviations, uninformative error messages
- Be impolite - treat errors rudely
- Make operations dangerous rm *.* at / and unrecoverable

Some things not to do!



References

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- Shneiderman and Plaisant, Designing the User Interface 4th Edition, Addison-Wesley, 2005, ISBN: 0-321-19786-0

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