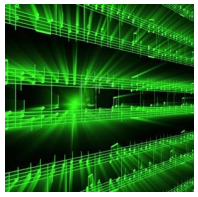
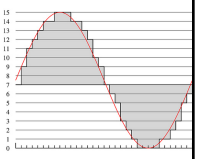
Penn Engineering

ESE





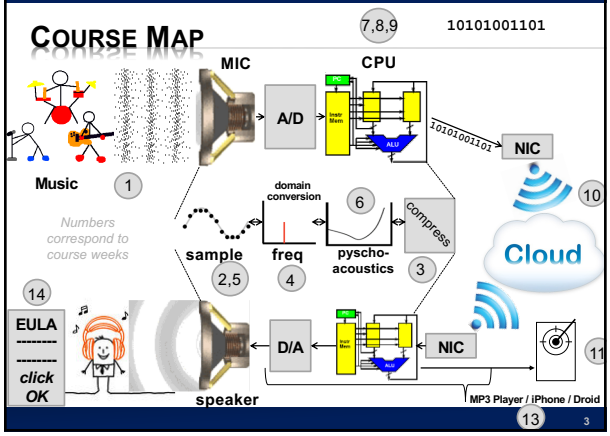
Lecture #23 – User Interface 2

ESE 150 – Digital Audio Basics

Lecture Topics

- **Where are we on course map?**
- **User Interface**
  - Motivation
  - Issues and Principals
  - Developer vs. User
  - Design Choices
  - Approaches and Prototyping
  - Advancing/Enabling Technology

Course Map



Review

User Interface

- **When a user sees a product**
  - See the interface
  - Not the underlying design
    - ….and that's the way it should be
- **Interface determines if the user can get job done**
  - …or will walk away frustrated
- **Successful interface**
  - Make it easy, pleasant to use
  - Hide all the complexity that makes it work

Who's to Blame for Usability Failures?

- **Most Returned Products Work Fine:** Study Says Only 5 percent of returned products are genuinely defective: Yardena Arar, *PC World*, June 2, 2008 4:00 pm
- **Only 5 percent of consumer electronics products returned to retailers are malfunctioning --**yet many people who return working products think they are broken, a new study indicates.
- The report by technology consulting and outsourcing firm Accenture pegs the costs of consumer electronics returns in 2007 at **$13.8 billion** in the United States alone, *with return rates ranging from 11 percent to 20 percent*, depending on the type of product.

http://www.pcworld.com/article/146576/most_returned_products_work_fine_study_says.html

User vs. Implementer

- **Thesis:** Engineer who implements something is seldom the right person to judge the goodness of the user interface
  - Knows how should work
  - Has a mental model of inner workings
  - Motivated to reduce implementation complexity
- Contrast user
  - Doesn't know how works – shouldn't have to!
  - Benefit from reduced use complexity
    - Reduced cognitive load

7

Approach

8

Donald Norman: UI Guru

Referring to Norman's book: *Design of Everyday Things*

- **Visibility –** visible functions aid user awareness; invisible functions are more difficult to find and know how to use.
- **Feedback –** return information about what action has been done and what has been accomplished.
- **Constraints –** restricting the kind of user interaction that can take place at a given moment.
- **Mapping –** the (functional, geometric, appearance) relationship between controls and their effects in the world.
- **Consistency –** use similar operations and use similar elements for achieving similar tasks.
- **Affordance –** an attribute of an object that allows people to know how to use it.

Add: **Tolerance** – reducing cost of mistakes, allowing recovery.

http://twobenches.wordpress.com/2008/06/05/don-normans-design-principles/

9

How use Principles and Goals?

Principles are generally:

- **Descriptive, comparative and analytical (i.e., how alternatives compare; test and refine paradigm)**
  - Give us some idea how to evaluate a UI
- **Not constructive (i.e., do not define the process of developing user interface design)**
  - No automated (good) interface design tools exist (e.g., that could have predicted the iPod user interface design)

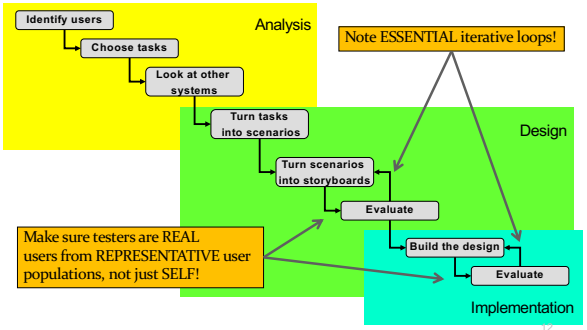
10

Principles Must Be Considered in the Context of User Population

- **Principles define an optimization problem where the (target) user population is not uniform in skill, cognitive ability, needs, experience, learning style, or motivation.**

11

Task-Centered Design



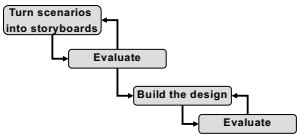
http://www.comp.rgu.ac.uk/staff/sw/materials/cm2006/Interface%20design.L4.ppt

12

Analysis Techniques

- **Task analysis**
  - Models the steps involved in completing a task.
- **Interviewing and questionnaires**
  - Asks the users about the work they do.
- **Ethnography**
  - Observes the user at work.

Prototyping



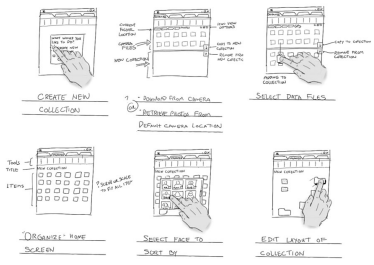
User Interface Prototyping

- **Aim:** allow users to experience the interface.
- **Without direct experience,**
  - it is impossible to judge the usability of an interface.
- **Prototyping often a two-stage process:**
  - Early: paper prototypes
    - Don't wait until have completely implemented to start getting feedback!
  - Refine to increasingly sophisticated automated prototypes

Paper Prototyping

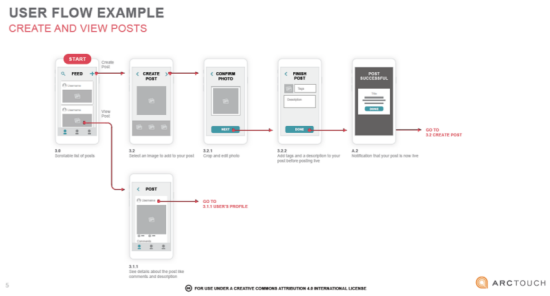
- **Work through scenarios using sketches of the interface.**
- **Use a *storyboard* to present a series of interactions with the system.**
- **Paper prototyping to get user reactions to a design proposal.**

Storyboard



From Microsoft Hilo Chapter 4:
https://msdn.microsoft.com/en-us/library/windows/desktop/ff800706.aspx

Storyboard



- Arctouch arctouch.com

Prototyping Techniques

- **Use PowerPoint as a substitute for an editable script.**
  - Can include links to different slides/displays
- **Script-driven prototyping**
  - Develop a set of scripts and screens using a UI design tool. When the user interacts with these, the screen changes to the next display.
- **Internet-based prototyping**
  - Use a web browser and associated scripts.
- **Visual programming**
  - Language designed for rapid development such as Visual Basic.
  - Python+GTK ← will use in lab

User Interface Evaluation

- **Some evaluation of a user interface design should be carried out to assess its suitability.**
- **Full scale evaluation is very expensive and impractical for most systems.**
- **Ideally, an interface should be evaluated against a usability specification.**
  - However, it is rare for such specifications to be produced.
- **Can evaluate against a "design principles" list.**

User Testing

Sample Usability Attributes

Attribute	Description
Learnability	How long does it take a new user to become productive with the system?
Speed of Operation (use)	How well does the system response match the user's work practice and task requirements?
Robustness	How tolerant is the system of user error?
Recoverability	How good is the system at recovering from user errors?
Adaptability	How closely is the system tied to a single model of work?

Part 2

Technology Change

Preclass 1

- **How many instructions should we be willing to execute to save a second of human time?**
  - Cost of second of human time?
    - Assume $300K/yr., 250 days/yr, 8 hours/day
  - Given Energy cost:
    - 10^{-15} cents per instruction
  - Number of instructions cost same as human-second?

Impact

- **Can afford to spend computation to bridge between natural user view (interaction) and underlying implementation view**
- **Energy/op has reduced over time**
  - Increasing this ratio
- Can afford to spend **more** computation now than in past

32

Evolution

- Dedicated Buttons and Knobs
- Keyboard
  - With character display
- Mouse, graphics
- Touch Screens
- Accelerometers
- Audio, video, …
- Augmented Reality

Platforms shrinking

- Rooms and Racks
- Desktops
- Laptops
- Tablets/phones
  - No physical keyboard
- Watch
- Glasses?

33

Demand and Opportunity

- Demand
  - Shrinking platforms demand move beyond full-sized keyboard
  - Portability also demands less bulky inputs
- Opportunity
  - New sensors
  - …with cheap processing to "understand" complex/noisy signals
  - Direct computer with movement, voice, direct interaction with world

34

Rise of Voice Control

- **Siri**
- **Ok Google**
- **Alexa**
- **Voice Remote**

- **Locally recognize "wake words"**
  - Ship off to server farm for bulk speech recognition

35

Preclass 2

- **How GPS data ease data lookup for bus stop, schedule?**
- **Compared to what must do without GPS data?**
  - (what does Google Maps do?)

36

Context Awareness

- **Sense context**
  - Can reduce information need to explicitly gather from user
  - Prioritize/reorder data presented
    - Know more about likely common case
- **Other context examples?**

37

Natural(?) Input

- Audio and Voice processing
- Vision, Radar
- Location
- Motion (e.g. fitbit, iWatch)
- Biometrics
- Coupled with signal processing, cheap computation
- Opportunity to take input from natural interactions

38

Augmented Reality with Portable Devices (Smartphone)

https://mashable.com/2016/07/10/john-hanke-pokemon-go/#edHFGDBS1kqI

- Use the embedded camera and overlap synthesized images and animation.
- Pokemon Go
- Need real-time feature tracking for registration.

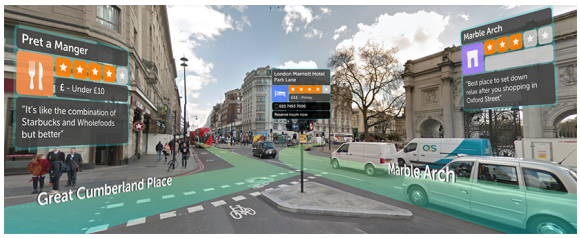
"Invisible Train": Schmalstieg and Reitmayr, 2004

Overlaid Directions

http://www.youtube.com/watch?v=zOS5Mbk_luc

39

Augmented Reality



(Doctor Who fans: search for augmented reality tardis)

https://blippar.com/en/resources/blog/2017/11/06/welcome-ar-city-future-maps-and-navigation/ 40

Big Ideas

- **User Interface essential**
  - And worth designing carefully and deliberately
- **View should match user goals, not internal design**
  - Spend computing cycles to bridge
  - Make simple, safe, intuitive
- **Implementer seldom a good judge of interface goodness**
  - Knows too much about how should work
  - Conflict of goals
- **Important to test and get *representative* user feedback**

41

Next Labs

- Lab 11
  - Actuators and WiFi
  - Prelab to get setup; including on AirPennNet-Device for those on campus
- Lab 12
  - Develop and analyze User Interface(s) for internet-connected devices
    - Networking to control
    - Develop GUI
  - More user-friendly interface than the engineer-friendly one we will use for Lab 11

42

Reading

- *The Design of Everyday Things*, Donald Norman -- a classic book on design for usability (broader than just hardware and software)
- *The Inmates are Running the Asylum*, Alan Cooper -- a manifesto calling out computer/software industry for poor design
- *Set Phasers on Stun: And Other True Tales of Design, Technology, and Human Error*, Steven M. Casey -- a series of anecdotes (case-studies) on how bad design and interfaces can go wrong, perhaps even killing people.

43

Learn More @ Penn

- **Courses**
  - ESE543 – Human Factors Engineering

44

Remember

- **Feedback**

45