Nontraditional Interfaces

An Introduction into Nontraditional Interfaces

SWEN-444
What are Nontraditional Interfaces?

• So far we have focused on conventional or traditional GUI’s
• Nontraditional interfaces involve our senses
• Still an area of much research although some technologies have been moving into mainstream products
• Some examples…
  • Motion detection
  • Gestures
  • Voice recognition and synthesis
  • Augmented and virtual reality, …
Traditional Interfaces Evolving
Skeuomorphic vs. Flat Design

• Skeuomorphic design – metaphor based design using graphical representation of real world objects
  • Familiar and understandable affordances
  • Aesthetically pleasing but can become dated
  • (Vs “realism” - a design style that mimics physical items for aesthetic reasons

• Flat design – minimalist, emphasize simple usability
  • More abstract – object meaning and relationships expressed via color, shape, proximity
  • 3D illusion (drop shadows, gradients or textures)
  • Need associated typography to understand
  • More responsive

• Do users care or only designers?

https://www.nngroup.com/articles/flat-design/
Flat Design

- Initially, too “flat”, less obvious affordances
- “Fatting flat design” - more depth, shadows and highlights
Anthropomorphic Design

- Designing the HCI to possess human like qualities
  - E.g., error messages written as human to human dialog (“We’re sorry, but that page cannot be found.”), human forms on icons, or human voice based feedback
- Social theories of why there is value…
  - Familiarity
  - Comfort – things like us
  - Elicit human responses when interacting with inanimate objects; e.g., emotion
- Controversial – anthropomorphic interfaces need to be believable and predictable; otherwise they become annoying and reduce usability; e.g., Microsoft’s “Clippy”

Should computers say they are sorry?

What are Nontraditional Interfaces?

• Haptic interfaces – sense of touch and body movement
• Gesture interfaces – hand and face movement
• Speech and hearing
• Olfactory interfaces – sense of smell
• Taste – research topic
• Other research areas – brain wave interpretation, holographic interfaces (air as the medium), …
General Observations

- The UX life cycle still applies
- Affordances and design guidelines still apply
- Still need to achieve learnability, memorability, understandability, effectiveness, satisfaction
- Greater need to account for user’s physical skills and capabilities
- Localization still necessary
- Different interface techniques collaborate to support UX just as our natural senses do
Haptic Interfaces

• Based on two integrated human touch related senses …
• Tactile (cutaneous) feedback based on the sense of touch
  • Skin based to feel heat, pain, and texture
    ▪ Texture most important for haptic interfaces
      o Sensation of pressure, vibration, motion, shape
• Movement (kinesthetic) – sensing the location, direction and speed of 3D movement of the body and its appendages
• Bidirectional – sense environment, exert force on the environment

TED Talk- Haptography: Digitizing our sense of touch - Katherine Kuchenbecker
How Do We Perceive Our Environment?

• We move our bodies and appendages for physical space perception
• Space perception does not always correspond accurately with physical space
• Haptic feedback should augment visual feedback
• Tactile and kinetic perceptions should be integrated
Some Examples of Haptic Interfaces

• **“Teleoperation” of robotic devices** particularly in hazardous or hard to reach environments (e.g., radioactive material, minimally invasive surgery)
  • Operation at a distance
• **Disability assistance**
  • Environmental sensors detect objects that re-route a blind person via tactile feedback
  • Lechal – sneaker that vibrates to indicate turns
  • Enactive Torch – infrared sensors detect narrow passages and vibrate wrist bands for visually impaired
  • Tactile Braille readers (e.g., Anagraphs)
  • Exoskeleton devices for motor disabilities
• **Scientific visualization** that integrates **tactile feedback** with the visual information
• **Gaming**
  • Controller devices, environment immersion effects based on tactile feedback (Immersion Studio® SDK)
• **ZeroUI – Ziro** – hand controlled robotic kit; [http://ziro.io/](http://ziro.io/)
Technology

- Various sensors and actuators, and manipulation devices such as gloves and arms

Issues:
- Perceptual threshold
- Size/weight
- User fatigue
- Pain
- Annoyance
- Cost
- Portability
- External environment
- Backdriveability – move without interference
- Latency
- Stability
Speech and Hearing

• Hearing – the sense by which we perceive sound (note, not necessarily listening)
  • We respond more quickly to audio input than visual stimuli
  • Fundamental connection to our environment
• Speech - significant part of our interaction with the world
  • Advantages – natural form of communication, easier to speak than write
  • Disadvantages – requires knowledge of a language, more efficient to read than listen
Using Sound in Interactive Design

• Redundant Coding
  • Use sound to augment and reinforce basic interaction
  • E.g., selection, alerts, actions
  • Aids memory and efficiency

• Psychology of sound - positive/negative feedback
  • Success confirmation is welcome and effective
  • Alarms and error notification may be necessary but unwelcome

• Speech and non-speech applications
• Significant internationalization implications
Speech Applications

• Speech to text conversion
  • Document composition, annotation, editing
  • Conversation transcription
• Speech recognition to initiate commands
  • Virtual assistants - Siri, Cortana, Google Now, Alexa
  • FYI – Google claims 90% accuracy for search
• And of course direct person-to-person communications
Non-Speech Sound

• Second nature, monitor the environment unconsciously
• Advantages – direct feedback, faster processing than speech, no language
• Disadvantages when used in interfaces:
  • It can be ambiguous
  • It must be learned
  • It must be familiar
  • It may not have high discrimination
  • It is transitory
  • It can become annoying
Nonspeech Applications

• Nonspeech sounds are either …
  • Concrete – those that exist in nature OR …
  • Abstract – those created by humans (e.g., music)
• Auditory icons – concrete, “ecological listening”
  • Everyday sounds designed to convey information about events by analogy to everyday sound-producing events
  • E.g., delete a file with sound of paper being crunched into waste basket
  • Examples:
Auditory Icon Design Guidelines

• Cohesion – each auditory icon should be identifiably unique
• Conceptual mapping – sound must map to the user interface context
• Balance physical sound parameters – length, quality, frequency range for good usability
• User experience response; e.g., not too harsh, too cute

Example: Plug in or remove USB device on Windows
Earcons

• Short recognizable musical snippets that represent system objects or processes
• E.g., Windows startup and shutdown
• Distinguish musical properties such as pitch and timbre for usability differentiation
• Design challenge is to ensure memorability and discrimination (avoid mute due to user annoyance)
• Examples: http://sonification.de/handbook/index.php/chapters/chapter14/
References

- Steven Heim, *The Resonant Interface*, Pearson, 2008, Chapter 13 and 14
- Philip Kortum, *HCI Beyond the GUI: Design for Haptic, Speech, Olfactory and Other Nontraditional Interfaces*, Morgan Kaufmann Publishers, 2008
Gesture Interface Design

Hand Gestures
Intro to Gestures

“A gesture is any physical movement that a digital system can sense and respond to without the aid of a traditional pointing device such as a mouse. A wave, a head nod, a touch, a toe tap, a facial expression can be a gesture.”

• **Touchscreen** – the user touches the screen to directly manipulate objects
• **Free-form** – the user’s motion is sensed remotely
• Examples of everyday products?
  • Clapper – auditory sensor
  • Lights in this classroom
  • Water faucet
  • Touch screen kiosks, smartphones, tablets, …
More Sophisticated Examples

• Word gesture touch screen keyboard
  • Trace from starting to end letter
  • Pattern is analyzed to find the most likely word

• Microsoft Kinect - motion sensing input device
  • Users interact using gestures and spoken commands
  • Software technology enables gesture, facial, and voice recognition

• “Air Writing”
  • Sensors attached to a glove capture hand movements
  • User writes letters in the air
  • System recognizes characters (<5% error rate)

Karlsruhe Institute of Technology (KIT) research project
Gesture Design Guidelines and Techniques

• Match gesture complexity to task complexity
  • Sequence gestures based on task analysis
• Design gestures appropriate to the available sensors and input devices
• Avoid putting essential information like a label below a touchable target – the hand may hide it
• Target size – apply Fitt’s Law, target size $\geq 1$ cm (finger pad size)
  • Iceberg targets – touch target is larger than the visible icon representing it
  • Adaptive targets – algorithmically predict the user’s next target and increase its size
Gesture Design Guidelines and Techniques (cont.)

- Natural behavior – match the gesture to intuitive real world user actions; e.g., push a button
- Consider the ergonomic impact of gesture motion as constrained by the physiology of the human body
  - Avoid hyperextension or extreme stretches
  - Avoid repetition
  - Utilize relaxed, neutral positions
  - Avoid staying in a static position
  - Avoid internal or external force on joints
Human Anatomy Considerations

• Physical dimensions and range of motion

- 8-10mm
- 10-14mm
- 16-20mm
Human Anatomy Considerations (cont.)

- Fingernails (fake fingernails are an issue)
- Finger oil
- Fingerprints
- (Left) Handedness
- Accessibility issues
- Wrist support
- Gloves
- Inaccurate (when compared to a cursor)
- Screen Coverage
Gesture Design Guidelines and Techniques (cont.)

• Distinguish the beginning and end of a discrete gesture
• Account for cultural differences
• Provide appropriate feedback
  • Integrate with other interface modalities
• Learnable gesture vocabularies
Learnability

• The more complicated the gesture, the fewer people capable of doing it
• New users have a learning curve with a gesture interface
  • No visual clues in a simple interface
  • Non-intuitive vocabularies
  • Particularly true for new application specific gestures
• Document
  • Written instructions
  • Graphical illustrations
  • Video demonstration
  • Iconic symbols
Gesture “Vocabulary” Design

• Gesture taxonomies – a kind of vocabulary
  • Semantic – the gesture meaning (non-verbal)
    ▪ E.g., a ring formed by the thumb and index finger; in Western culture this means "Okay," in Japan it means "Money."
  • Functional - intended usage in an application
    ▪ E.g., pointing, propositional ("this big")
  • Descriptive - refer to the manner in which the gestures are performed in space and time
    ▪ E.g., sign language
Gesture “Vocabulary” Design (cont.)

• Limit the vocabulary

• Context dependent vocabulary
  • E.g., edit commands - select, copy, cut, paste, release

• What about usability? Intuitive?
Gestures vs. Traditional Interface Conventions

• Many traditional conventions still work well with gestures; selecting, drag and drop, scrolling, …

• Others are not as useful or necessary
  • Cursors – you know where your finger is
  • Hovers and mouse-over events are awkward
  • Double click timing
  • Right click

• Typically gesture based interfaces are stateless
  • There is only one task goal for the system to accomplish at any one time
  • KISS principle
Gesture Patterns

• Gesture patterns have emerged as best practice
  • *E.g.*, “Touch Gesture REFERENCE GUIDE”
  • Defacto “standards”

• A sampling of “core gestures”
  • Tap to open/activate/select an object
  • Drag to move an object
  • Slide to scroll or pan
  • Two fingers to scroll
  • Spin to scroll – rapid scroll with limited screen space
  • Flick to nudge
  • Fling to scroll rapidly
  • Pinch to shrink, spread to enlarge

Personal Experience?
References

- Saffer, Dan, *Designing Gestural Interfaces*, O Reilly Media Inc., 2009