HCI – Lesson 3

Gesture based interaction

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Interface Evolution

Command Line Interface

Graphical User Interface

NUI
Natural User Interface

- Computer Vision
  - Facial Recognition
  - Spatial Recognition
  - Augmented Reality
  - Gesture Sensing

- Touch
  - Single Touch
  - Multi-Touch
  - Pen Input

- Audio Recognition
  - Voice Command
  - Natural Speech
  - Ambient Noise

- Sensors
  - Geospatial Sensing
  - Accelerometers
  - Biometrics
  - Ambient Light

- Brain Waves
  - Mind Control
  - Mood Recognition
Multi-Touch interface

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make a withdrawal...
Airplane check-in...
Shopping...
What’s happened?
“When you see an object you want to touch it, it’s the most immediate and spontaneous reaction that a human can have. Interact with a computer without keyboard or other, but only with hands, I believe that is the best way to break the technological barrier.”
What is changing?

BEFORE

- More devices
- Individual experience
- 1 click

AFTER

- Single device
- Collaborative experiences
- More points
Sensible to touch surface (touch screen)

- RESISTIVE
- CAPACITIVE
Camera-based technology:

- Laser Line Plan
- Frustrated Total Internal Reflection
- Diffused illumination
- Pixel Sense

http://sethsandler.com/multitouch/
Multitouch Devices

SmartPhone

iphone – iPod Touch
Multitouch Devices (2)

Tangible Table/ Wall

Microsoft Surface 2

Perceptive Pixel Multi-touch wall
Multitouch Devices (3)

Monitor and tablet

Dell Multi-Touch Monitor

Apple iPad
Click
Press down anywhere on the Multi-Touch surface to physically click or double-click. Or, with “Tap to Click” enabled in System Preferences, simply tap or double-tap the surface.

Swipe
Using three fingers, brush left and right along the Multi-Touch surface to page forward and back.

Scroll
Brush two fingers along the Multi-Touch surface to scroll in any direction — vertically, horizontally, or diagonally.

Rotate
With your thumb and index finger on the Multi-Touch surface, twist clockwise or counterclockwise to rotate an image.
All new versions of the principal OS support multitouch, but in different ways:

- Pen input
- Multi-Touch screen
- Multi-Touch trackpad
Microsoft "Surface SDK" and "Windows Presentation Foundation" include API, documentation and tool to develop multitouch App on Windows 7 and Surface

"Cocoa Touch" is a library to develop software for iPhone, iPod Touch, e iPad. "Cocoa Touch" is included in iPhone SDK.

Android SDK include tool, emulator, debugger and library to develop App for Android OS

Gestureworks (by Ideum) is an interesting Flash multitouch. The Gestureworks software allows to develop multiuser and multitouch-enabled applications with Adobe Flash.
Common Gestures

- **Tap**: Briefly touch surface with fingertip.
- **Double tap**: Rapidly touch surface twice with fingertip.
- **Drag**: Move fingertip over surface without losing contact.
- **Flick**: Quickly brush surface with fingertip.
- **Pinch**: Touch surface with two fingers and bring them closer together.
- **Spread**: Touch surface with two fingers and move them apart.
- **Press**: Touch surface for extended period of time.
- **Press and tap**: Press surface with one finger and briefly touch surface with second finger.
- **Press and drag**: Press surface with one finger and move second finger over surface without losing contact.
- **Rotate**: Touch surface with two fingers and move them in a clockwise or counterclockwise direction.

Problems: Input

- Nails
- Gloves
- Dirty fingers
- Gestures (are they so easy?)
- Accuracy
Problems: Accessibility

Gorilla arm problem
Touch-based applications introduce new important constraints in design of interface and interaction:

- Target’s dimensions must be fit to fingers’ dimension (min 10mm)
• Labels’ position: hands and fingers can hide information
Problems: Usability (3)

• Gesture’s design: some actions can hide part of information too.
• Iceberg Tips: create a wider invisible area

• Adaptive Targets: device tries to guess next button pressed by user and zooms it
• Don’t assume that people will know that they can touch a screen.

• Create an “attract state” that demonstrates interactivity while nobody is using the device

• Make touchable things look touchable

• Design for fingers

• Make sure hands don’t cover up information necessary for interaction

• Don’t rely on traditional mouse-based interactions, such as hover & double click

• Use consistent and familiar gestures
Some Links

• TED : Jeff Han (2006) Ideas Worth Sharing
  http://www.youtube.com/watch?v=5JcSu7h-I40

• Multi Touch (new touchscreen technology)
  http://www.youtube.com/watch?v=1ftJhDBZqss

• Google Earth on PQWindow Multi-Touch Screen
  http://www.youtube.com/watch?v=tLgbPZuWeFU

• DIY Multi-touch table http://nuigroup.com/go and
  http://www.tuio.org/ and http://sparkon.net/
What is Microsoft Surface?

- Project began in 2001
- Introduced in 2008
- A surface computing platform from Microsoft.

“Microsoft Surface represents a fundamental change in the way we interact with digital content. With Surface, we can actually grab data with our hands, and move information between objects with natural gestures and touch. Surface features a 30-inch tabletop display whose unique abilities allow for several people to work independently or simultaneously. All without using a mouse or a keyboard.”

Microsoft.com
What is surface computing?

A form of computing that offers “a natural way of interacting with information,” rather than the “traditional user interface.”

- **Direct Interaction**: The ability to "grab" digital information with hands - interacting with touch/gesture, not with a mouse or keyboard.

- **Multi–Touch**: The ability to recognize multiple points of contact at the same time, not just one (Ex. One finger, like with most touch screens), but dozens.
What is surface computing?

- **Multi–User:** The Surface’s screen is horizontal, allowing many people to come together around it and experience a “collaborative, face–to–face computing experience”.

- **Object Recognition:** Physical objects can be placed on the Surface’s screen to “trigger different types of digital responses” (Ex. cell phones, cameras, & glasses of wine).
Some common uses

• Wireless transfer pictures from camera to Surface and cell phone. “Drag and drop virtual content to physical objects.”

• Digital interactive painting

• At a phone store? Place cell phone on the Surface and get information, compare different phones, select service plan, accessories, and pay at table!
Some common uses (2)

- At a restaurant? View menu, order drinks and meal at your table! It’s a durable surface you can eat off of (withstands spills, etc.). Need separate checks? Split bill at and pay at table.

- Play games and use the Internet.
- Watch television
- Jukebox! Browse music, make play lists.
- Billboard for advertising
- Maps
2008 - Surface 1.0

- 15,000 $
- ≈ 70 kg
- 30"
- 1024 x 768
- Vista OS
2011 - Surface 2.0

- 7,600 $
- ≈ 30 kg
- 1920x1080, Full HD
- 50 simultaneous touches
- 40" (102 cm) LCD panel with Gorilla Glass
- Windows 7 OS
- Pixelsense
Mounting

Vertical

Horizontal
Similar DEVICES

- DiamondTouch
- reacTable
- Gesture Table
- Lemur Input Device
- Philips Entertaible
Video

• Promo Microsoft
  http://www.youtube.com/watch?v=6VfpVYYQzHs&feature=related

• Case Studies

• Microsoft Surface wine-tasting demo
  http://www.youtube.com/watch?v=Y3KzprGxpZU&feature=related

• Garibaldi Project on Microsoft Surface
  http://www.youtube.com/watch?v=c1SKr8dQKwo

• Patient Consultation Interface Surface Application
  http://www.youtube.com/watch?v=Qf0WxOo3O4g&feature=related

• Banking App
  http://www.youtube.com/watch?v=TU6Ghp0L8bM&feature=related

• Playing with Microsoft Surface
  http://www.youtube.com/watch?v=SUFfRSZppUYs&feature=related
Video (2)

- Touch2Much - Microsoft Surface Museum/Gallery Application
  [http://www.youtube.com/watch?v=DDrCq9632YY](http://www.youtube.com/watch?v=DDrCq9632YY)

- AR.Drone Quadrotor Flight via Microsoft Surface
  [http://www.youtube.com/watch?v=x1bbT8M6uRs](http://www.youtube.com/watch?v=x1bbT8M6uRs)
Resources

- Microsoft® Surface® 2 Development Whitepaper
- Microsoft® Surface® 2 Design and Interaction Guide
- Microsoft® Surface® 2 SDK
- Multitouch Book (free PDF)
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Some examples
QuiQui’s Giant Bouce

Game for children (4 - 9 years)
Game’s paradigm: story telling whit characters animated

- Camera
- Monitor
- Microphone

The actions of child active specific behaviors of avatar
When the child runs the avatar runs

When the child cries the avatar breathes fire
The EyeToy is a color digital camera device, similar to a webcam, for the PlayStation 2.

The technology uses computer vision and Gesture recognition to process images taken by the camera.

This allows players to interact with games using motion, color detection and also sound, through its built-in microphone.

Limited success due to the low precision.
The console was released on November 19, 2006. About eight days after, 600,000 Wii’s were reported to be sold.

It has revolutionized game play and has impacted society: anyone can play
The Wii remote, or “Wiimote”, interacts with a sensor bar by using accelerometers, infrared LED’s, and triangulation.

In general, a player’s Wiimote movements would determine their character’s actions. A gamer would have to move in order to play.
Wii and wiimote communicate by bluetooth

**TED 2008**: Johnny Lee show how is possible connect wiimote with a normal pc and use them in innovative application:

- interactive whiteboard
- 3D head tracking
- finger tracking

Many others researcher start to use wiimote in academia projects: [http://hackaday.com](http://hackaday.com)
Kinect

- It is a motion sensing input device by Microsoft for the Xbox 360 video game console.
- Based on a webcam-style add-on peripheral for the Xbox 360 console, it enables users to control and interact with the Xbox without the need to touch a game controller, through a natural user interface using gestures and spoken commands.
- Kinect was launched in November 2010.
- 8 million units in its first 60 days.
In November 2010, is released the first Linux driver that allows the use of both the RGB camera and depth sensitivity functions of the device.

In December 2010, PrimeSense, that produces the camera, released their open source drivers with motion tracking middleware called NITE.

Microsoft released a non-commercial Kinect SDK for Windows on June 16, 2011, with a commercial version following at next year.
What does it do?
Kinect’s magic

Immersive user experience
Interaction metaphors

- Depend by the tasks
- Important aspect in design of UI

Cursors (hands tracking):
Target an object

Avatars (body tracking):
Interaction with virtual space
The shadow/mirror effect

Shadow Effect:
• I see the back of my avatar
• Problems with Z movements

Mirror Effect:
• I see the front of my avatar
• Problem with mapping left/right movements
How to design a gesture?
User Interaction

Game mindset ≠ UI mindset

Challenging = fun

Challenging = easy and effective
Gesture semantically fits user task

Abstract

Meaningful
System’s UI feedback relates to the user’s physical movement
System’s UI feedback relates to the user’s physical movement.
Each gesture feels related and cohesive with entire gesture set.
Will users want/need to perform the proposed gesture repeatedly?
Will users want/need to perform the proposed gesture repeatedly?
Different gesture depending on hand: only left hand can do gesture A
One-handed gestures are preferred
Two hand gesture should be symmetrical
Interactions requiring more work and effort should have a higher payoff.
Fatigue is the start of downward that kills gesture

Fatigue increase messiness $\rightarrow$ poor performance $\rightarrow$ frustration $\rightarrow$ bad UX
Fatigue kills gesture (2)

Gorilla arm problem: try to put the hand up for 10 minutes...
User Posture

User posture may affect design of a gesture
The challenges

- Physical variable
The challenges

• Physical variable
• Environment
The challenges

• Physical variable
• Environment
• Input variability
• Recognizing intent
The challenges

- Physical variable
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The challenges

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- Environment
- Input variability
- Recognizing intent

Test gestures with users!!
Takeaways
• Gestures should have a clear cognitive association with the semantic functions they perform and the effects they achieve. Intuitiveness can be enforced by appropriate interface and feedbacks.

• The semantics of gestural patterns that belong to everyday life or common task should be as consistent as possible to their “conventional” meaning, but also take into account that intuitiveness is strongly associated with users’ cultural background, general knowledge, and experience.
• Gestural communication involves more muscles than keyboard interaction or speech. Gestural commands must therefore be concise and quick, and minimize user’s effort and physical stress.

• Two types of muscular stress are known: static, the effort required maintaining a posture for a fixed amount of time; dynamic, related to the effort required to move a portion of the body through a trajectory.
• It must be easy for the user to learn how to perform and remember gestures, minimizing the mental load of recalling movement trajectories and associated actions.

• The learning rate depends on tasks, user experience, skills, as well as the size of the gesture language (more gestures decrease the learnability rate).
• The gestures that are most natural, easy to learn and are immediately assimilated by the user are those that belong to everyday life, or involve the least physical effort. These gestures should be associated to the most frequent interactions.

• Complex gestures can be more expressive and give more control, but have a higher learnability burden.

• Hence there is clearly a tension between design requirements, among which a compromise must be made: naturalness of gestures, minimum size of the gesture language, expressiveness and completeness of the gesture language.
• Users can perform unintended gestures, i.e., movements that are not meant to communicate with the system they are interacting with.

• The “immersion syndrome” occurs if every movement is interpreted by the system, whether or not it was intended, and may determine interaction effects against the user’s will.
• The designer must identify well-defined means to detect the intention of the gestures, as distinguishing useful movements from unintentional ones is not easy.

• Body tension and non-relaxed posture of users can be used to make explicit the user intention to start interaction, issue a command, or confirm a choice.

• The tense period should be short to not generate fatigue.
Not-self-revealing

- Appropriate feedback indicating the effects and correctness of the gesture performed is necessary for successful interaction, and to improve the user's confidence in the system.
• [http://www.youtube.com/watch?v=id7OZAbFaVI&feature=related](http://www.youtube.com/watch?v=id7OZAbFaVI&feature=related) (Medical suse)
• [http://www.youtube.com/watch?v=9xMSGmjOZlg&feature=related](http://www.youtube.com/watch?v=9xMSGmjOZlg&feature=related) (Holographic projection)
• [http://www.youtube.com/watch?v=s0Fn6Pylfj0I&feature=related](http://www.youtube.com/watch?v=s0Fn6Pylfj0I&feature=related) (Kinect Virtual Fashion, the Future of Shopping at Home)
- [Multidevice computing](http://www.youtube.com/watch?v=oALluVb0NJ4)
- [Kinect Touch wall](http://www.youtube.com/watch?v=-yxRTn3fj1g&feature=related)
- [Kinect window Bank of Moscow](http://www.youtube.com/watch?v=KBHgRcMPaYI&feature=related)
- [Kinect Banking App Video](http://kinecthacks.net/motion-control-banking-is-so-easy-even-your-pet-can-do-it/)
- [Art](http://www.youtube.com/watch?v=FMCIO0KNjrs)
- [Interactive LED Floor](http://www.youtube.com/watch?v=g6N9Qid8Tqs&feature=related)
- [Kinect in Education](http://www.youtube.com/watch?v=c6jZjpvlio4)
- [explore universe](http://www.youtube.com/watch?v=_qvMHAvu-yc&feature=related)
Resources and tools

- [http://kinecthacks.net/](http://kinecthacks.net/) (Others projects)
- [http://www.modmykinect.com](http://www.modmykinect.com) (Others projects)
- [http://kinectforwindows.org/resources/](http://kinectforwindows.org/resources/) (Microsoft SDK)
- [http://projects.ict.usc.edu/mxr/faast/](http://projects.ict.usc.edu/mxr/faast/) (gesture recognition library)
- [http://leenissen.dk/fann/wp/](http://leenissen.dk/fann/wp/) (gesture recognition library)
See you next time