Gesture-Based Interaction Design

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Overview

1. What is gesture?
2. What is it good for?
3. HCI, NUI, and Motion Sensing Technologies
4. Some of my research projects related to gesture
5. Usability and user-centered research
6. Free Applications and Advice for building TUI and Touch Tables
7. Demonstration a DIY TUI Using Flash, FLOSC & Reactivition
8. Some in-depth literature where you can learn more
What is Gesture?

- Manifest deliberate expressiveness
- Treated by those co-present as communicative
- Has a sharp boundary of onset and offset
- Does not result in sustained change in position
- Moves from mimesis toward codified language

Quotes from Adam Kendon

- A) GIVE [uninflected]
- B) GIVE [durational]
  'give to each, that action recurring over time'
- C) GIVE [exhaustive]
  'give to each'
- D) GIVE [exhaustive] [durational]
- E) GIVE [durational] [exhaustive]
  'give continuously to each in turn'
- F) GIVE [ex] [dur] [ex]
  'give continuously to each in turn, that action recurring over time'
So what are they good for?

- Our hands help us think
- externalize temporal – spatial – kinetic experiences
- Watching = Enacting in the brain (Mirror Neurons)
- Language Development - Preverbal Skills
- Describing temporal–spatial transformations
- Describing shifts in point of view
- To establish spatial pattern or temporal beat
- To communicate through pantomime
Gesture-Based Interaction Design

Overview

What is gesture?

Gesture & HCI

Motion Sensing

Usability

Open Source

Demo

Great Literature

Gesture Classifications

Diectic & Spatial Movement Gestures

depict spatial position and relationships between objects & people (real or imaged)

Path & Location

Pictographic Gestures

depict the shape of objects, people, boundaries or regions.

Shape

Kinetographic Gestures

depict bodily action that may be performed with or without reference to an object at hand

Motion

Beat Gestures

used to beat time and create rhythm in speech

Pace

denote divisions in timing and pace emphasis on speech

Great Literature
"We have the gestural vocabulary of a fruit fly" - Bill Buxton

“A computer’s image of human beings is reflected by its input and output devices. In the case of most desktop computers, this means a mouse, a keyboard, a monitor, and speakers. To such a computer we might look like a hand with one finger, one eye, and two ears. To change how the computer reacts to use, we have to change how it sees us."

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Toward 'Natural' Interaction

Microsoft Surface design team (August de los Reyes, 2009):
Rear Projected Multi-touch

Scientific American
How it Works:
Multi-touch Surfaces
Explained
June 18, 2008

Hands-On Computing:
How Multi-Touch
Screens Could Change
the Way We Interact
with Computers and
Each Other:
The iPhone and even
wilder interfaces could
improve collaboration
without a mouse or
keyboard

By Stuart F. Brown
FTIR (Frustrate Total Internal Reflection)

Scientific American
How it Works:
Multi-touch Surfaces
Explained
June 18, 2008

Hands-On Computing:
How Multi-Touch
Screens Could Change
the Way We Interact
with Computers and
Each Other:
The iPhone and even
wilder interfaces could
improve collaboration
without a mouse or
keyboard

By Stuart F. Brown
Diffused Illumination

How it Works:
Multi-touch Surfaces Explained
June 18, 2008

Hands-On Computing:
How Multi-Touch Screens Could Change the Way We Interact with Computers and Each Other:
The iPhone and even wilder interfaces could improve collaboration without a mouse or keyboard

By Stuart F. Brown
Capacitive Touch Screens
Touch Surfaces - Video Based

Microsoft Surface

- Runs on Vista OS
- Develop using .Net
- Bluetooth Capabilities
- $15,000 for table
- $15,000 for development kit
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Touch Surfaces - Video Based

Perceptive Pixel

- FTIR - Internal Reflection
- Jeff Han - perceptivepixel.com
- Pressure sensing
- Patents Pending
- Not disclosing price

![Perceptive Pixel Diagram](image.png)
Touch Surfaces - Video Based?

Multitouch, Finland - Cellular

- Expandable
- Not disclosing price
- 60 FPS
- Differentiates Multiple Fingers & Hands
**Touch Surfaces - Capacitive**

**I-Phone**

- Use the capacitance of skin - won't work with gloves
- An accelerometer enables flipping from portrait to landscape view
- An ambient light sensor adjusts screen brightness automatically
- Infrared sensor disables touch screen when near the head
IR Camera & Accelerometers

Wii

• Low Cost Accelerometer
• Less expensive processor than competitors
• Small Infrared Camera
• Encouraging new groups to start gaming
• Uses pantomime gestures with baton for things like sword fighting, archery, and other gestures

Place the Form Baton in your palm, tip forward and buttons facing up.
See yourself serving a group of socialites. Such grace, they cry!
Such style! Such hors d'oeuvres!

The Waiter
High Res. Mocap

Polhemus FaskTrack

- Electromagnetic
- 6 Degrees of Freedom
- Small sensors provide high resolution tracking
- No Occlusion

Vicon Motion Systems - Cameras

- Can expand to include tons of cameras
- High Resolution
- Occlusion can occur, but is less likely with more cameras
Data Gloves

4D Dataglove

Gestural Character Control

• direct a character using programmed gesture signals, some of which are loosely based on modified American Sign Language

• Using hand gestures you can tell Eva, a 3-D Virtual Character, when to walk, run, sit, stand, jump and open doors

• use the glove to navigate through the joint hierarchy of a virtual mannequin and manipulate its posture by selecting and reorienting its joints.

displayed on Good Day Columbus May '07
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RFID Technology
Digital Seeds
TUI Table

Geometry Drawing Table
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**Gesture-Based Interaction Design**

## Mutli-User Usability Research Findings

1. People who learn with multi-user interfaces are likely to learn more information at a faster rate than individual interacting alone.

2. People are more aware of issues, problems and questions and when these matters arise there is more opportunity to debate and share information.

3. Members of a group are more confident in the information they learn and are likely to take action with the knowledge they have more quickly.

The interface was created by: Alan Price et al  
http://accad.osu.edu/~aprice  
temporarily on display at COSI
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User Center Gesture Research

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Gesture Library

TITLE: Aligning Books, 1
CUP LENGTH: 00:20 secs / 00:22 secs

While saying "a hand comes in"
Open Source

nuigroup.com

eyesweb.org

opensoundcontrol.org

processing.org

whitenoiseaudio.com/touchlib/

reactivision.org

reactivision.sourceforge.net

opencv.willowgarage.com/wiki/

johnnylee.net/projects/wii/

interactivegestures.com
Open Source - Finger Tracking

**Touchlib**

- Touchlib is a library for creating multi-touch interaction surfaces.

- Track IR Blobs and has built recognition of events like 'finger down', 'finger moved', and 'finger released'

- Sends messages to several programs that recieve OSC protocol (sent via the UDP port)

**Note:** You can use Touchlib only on Windows and it requires you to download an application called FLOSC before you can use it with FLASH

Visit Ben Chun's website for a free download:
http://www.benchun.net/flosc/
http://www.transmote.com/flosc/

**FLOSC** - "a standalone application written in Java that sends and receives OSC packets via UDP, translates bidirectionally between binary OSC packets and an XML encoding of OSC packets, and sends and receives XML entities via TCP in a way that's compatible with Flash's XMLSocket feature."
Open Source - Symbol Tracking

Reactivison

• A computer vision engine that tracks the position and rotation of specialized markers on a table top surface

• Software, markers, and a calibration template are free to download. Calibration is simple and built into the software

• Now also includes finger tracking

• Calibration is simple and built into the software

NOTE: This also requires you to download FLOSC

Visit http://mtg.upf.edu/reactable/?software
Open Source - Symbol Tracking

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multitouch control

TUI Application

reactTIVision

diffuse infrared illumination

(video feedback)

video

 TUION

camera

projector

(video)

tangibles tagged with fiducials

Open Source - Symbol Tracking
Computer Vision
Open CV, Jitter, EyesWeb

- Symbol Tracking
- Blob Tracking
- Frame Differencing
- Background Subtraction
- Edge Detection
- Area of Motion
- Center of Motion
- Quantity of Motion
- Direction of Motion
- Trajectory of Motion
Open Source - Computer Vision

Processing

• Includes Code Libraries for computer vision techniques such as shape tracking, blob tracking, & face detection

• Includes libraries for Reactivision and the JMyron (formerly known as WebcamXtra in Director)

Visit http://processing.org/reference/libraries/
scroll down to the computer vision section
DIY TUI

Step 1 - Download & Install

- Visit: http://mtg.upf.edu/reactable/?software
- print Fiducial Markers and calibration grid

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**reactTVision vision engine**

- reactTVision-1.4pre2-w32.zip (Win32)
- reactTVision-1.4pre2-mac.zip (MacOS X)
- reactTVision-1.4pre2-src.zip (source, all platforms)
- TUIO_Simulator.zip (platform independent)

**release history**

- 05-AUG-2008: reactTVision 1.4pre2
- 17-JUN-2008: reactTVision 1.4pre1
- 22-NOV-2006: reactTVision 1.3
- 19-AUG-2006: reactTVision 1.2d
- 23-JAN-2006: reactTVision 1.1
- 29-NOV-2005: reactTVision 1.0

**reactTVision client examples**

- C++: TUIO_CPP.zip (source, all platforms)
- Java: TUIO_JAVA.zip (platform independent)
- C#: TUIO_CSHARP.zip (platform independent)
- Processing: TUIO_Processing.zip (platform independent)
- Pure Data: TUIO_PureData.zip (all platforms)
- Max/MSP: TUIO_MaxMSP.zip (all platforms)
- Quartz Composer: TUIO_Quartz.zip (Mac OS X 10.5)
- Flash: TUIO_Flash.zip (platform independent)

**unsupported third party clients**

- SuperCollider: TUIO Server (by Till Bovermann)
- Squeak (Smalltalk): TUIO Smalltalk demo (by Simon Holland)
- Python: pyTUIO python library (by Jannis Leidel)
DIY TUI

Step 1 - Download & Install

- Visit: http://www.benchun.net/flosc/
- Also look at this tutorial: http://www.transmote.com/flosc/
- Reactivision sends UDP formatted messages, but flash only reads TCP
- This converts OSC Packets into a format that flash can read
- Use the XMLSocket() Object to receive message packets

Download

Current Version

This archive contains the .java and .class files for the flosc server, as well as an example Flash client. The code might be useful if you want to see how to write a recursive OSC packet parser in Java, or how to parse or create XML in Flash, or how to create a 4-byte boundary aligned array of bytes from objects in Java. Why reinvent the wheel? You can do anything you want with flosc and the source code. Just don't start selling it or blaming me for anything.

flosc-0.3.1.tar.gz
(All platforms – 56 KB)

Previous versions are available, but are probably only useful for historical purposes.

Please visit www.lanekuhlman.com for a links and sample AS3 Code
DIY TUI

Step 2 - Get a camera

- Camera needs to have a firewire connection
- Helps to have wide angle
- Some cameras have detachable lenses:
  http://www.unibrain.com

- 2-3 pieces of exposed film filters visible light
- It is better to have a black and white camera
- Once you camera is positioned, you can calibrate it using a printable grid
DIY TUI

Step 3 - Prototype

• Test out several scenarios until you get the best lighting and vision from your camera.

• Consider the lighting scenario of the location where the table will eventually live.

• For projection underneath the table try using a mirror tilted at a 45 degree angle to increase the throw. Note that tilting projectors can cause the bulbs to burn out much faster.

NOTE: Some nice projectors exist that allow you to throw from short distances, but these can be expensive.
DIY TUI

Step 4 - Lighting

WARNING: Lighting is the most difficult element of creating a table.

Projected images in visible spectrum do not interfere with IR spectrum

This means working with light you cannot see with the naked eye

NOTE: For diffused lighting use wide angle LEDs
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+ Great Literature

Great Gesture Books

Saffer, Dan
Designing Gestural Interfaces.
COMING SOON!
First Chapter and Introduction available at:
http://www.designinggesturalinterfaces.com/

Buxton, Bill.
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Great Gesture Books


Gesture-Based Communication in Human-Computer Interaction. 5th International Gesture Workshop, GW 2003, Genova, Italy, April 15-17, 2003
Thanks You!
Please Visit the ACCAD Open House
Friday, May 8th, 4:00-7:00 PM
accad.osu.edu
Email me at: Lane@LaneKuhlman.com