User Interaction: Intro to Multi-Touch

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Multi-Touch Approach #1

- Design specific multi-touch/gesture events that you can register for:
  - Pinching movements (in or out)
    - meaning zoom out or zoom in
  - Rotate: Two fingers moving in opposite semicircles is a gesture meaning rotate.
  - Swipe: Three fingers brushing across the trackpad surface in a common direction.
  - Scroll: Two fingers moving vertically or horizontally is a scroll gesture.
Multi-Touch Approach #1

- Advantages:
  - Simple to code
  - Library/OS does all the work

- Disadvantages
  - No flexibility
  - Limited to supported events
Multi-Touch Approach #1

- Examples (demo):
  - Document browsing in Preview
    - Zoom
    - Scale
    - Swipe
Multi-Touch Approach #2

- Blob tracking by program
- A program receives information about the location/“pressure”/orientation of multiple touches
- Each touch gets an id to uniquely identify it
- This is a stream of data
  - continuously updating locations and ids
Multi-Touch Approach #2

- Advantages
  - Supports unlimited numbers of touches
  - two hands / multiple people
  - Programs can have gestures that make unique sense for them
  - OS does a lot of work to find and report blobs
Multi-Touch Approach #2

- Disadvantages
  - Each program has to figure out all events itself
    - Was that a pinch?
    - Was that a rotate?
    - Where is the thumb?
Multi-Touch Approach #2

- **Examples**
  - MacMultitouch Demo
  - FingerMgmt
Multi-Touch Approach #3

- Create your own event layer for everyone b/c
  - Everyone wants to detect triangle touches
  - Everyone wants to interpret for multiple people
  - Everyone needs a “tiptap” interaction
Multi-Touch Approach #3

• Advantages:
  • Scalable (Other people can use it)
  • Allows completely new interface design
    • “3-finger pinch”
  • Lots of potential for innovation

• Disadvantages
  • Lots to code
  • Limited application support
Multi-Touch Approach #3: Better Touch Tool (http://boastra.net/)
Multi-Touch Approach #4

- Grayscale input
  - A program receives a stream of images
  - Darker (or lighter) colors indicates pressure or proximity
Multi-Touch Approach #4

- Advantages
  - Maximum flexibility
  - Not restricted to “finger touch” paradigm
  - Can recognize a “cup down” event for example
Multi-Touch Approach #4

- Disadvantages
  - This is full-fledged computer vision
  - Different technologies generate different quality images
  - Robustly and consistently recognizing events is hard.
Multi-Touch Approach #4

- **Examples**
  - iShred
    - [http://www.youtube.com/watch?v=eZpnzzKbY2l&feature=player_embedded](http://www.youtube.com/watch?v=eZpnzzKbY2l&feature=player_embedded)
  - Microsoft Surface (old school)
    - [http://youtu.be/C36rm5yS4c4](http://youtu.be/C36rm5yS4c4)

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How do you choose?

- How fast do you need to get your application done?
  - #1 is fastest, #4 is slowest
- Who are your users?
  - #1 is the most familiar to users, #4 requires users to adapt
- What is your application?
  - #1 is basically point and click extensions
  - #4 supports crazy gaming/applications
- Are you showcasing multi-touch? or supporting a task?
Our assignment

- Build a multi-touch Java paint application
- No OS support
Our assignment

- Where are we going to get a grayscale input?
- You can build your own
- You can use prerecorded video
Our assignment

- How will we interface to the computer?
- Use standard camera inputs
Our assignment

- How will we process it without OS support?
- We will use Community Core Vision to process the grayscale images
Our assignment

- How will our application get information about multi-touch events?
- Using the TUIO standard and a TUIO library for java
Our assignment

- How will I write a multi-touch application?
- Register for multi-touch events and then respond when you receive them.
Getting Multi-Touch up and Running

- Your program
- MT4J
- TUIO
- Community Core Vision
- web cam
Community Core Vision (http://ccv.nuigroup.com/) is an open source/cross-platform solution for computer vision and machine sensing. It takes a video input stream and outputs tracking data (e.g. coordinates and blob size) and events (e.g. finger down, moved and released) that are used in building multi-touch applications.
Getting Multi-Touch up and Running

• MT4J

• MT4j - Multitouch for Java™ - is an open source Java™ development platform, created for rapid development of graphically rich applications. MT4j is designed to support different kinds of input devices with a special focus on multitouch support.

• http://www.mt4j.org
Getting Multi-Touch up and Running

• TUIO

• TUIO is an open framework that defines a common protocol and API for tangible multitouch surfaces. The TUIO protocol allows the transmission of an abstract description of interactive surfaces, including touch events and tangible object states.

• http://www.tuio.org/
Getting Multi-Touch up and Running

How to Make an Inexpensive Multitouch Pad

in Just a Few Minutes
Getting Multi-Touch up and Running: Demo #1

- To a flash application that is multi-touch aware
- Through a TUIO server
- Going through CCV
- Video from recorded gray scale
Getting Multi-Touch up and Running: Demo #2

- To a flash application that is multi-touch aware
- Through a TUIO server
- Going through CCV
- Live video

User's Program

System Library

Operating System

Hardware Interface

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Getting Multi-Touch up and Running: Demo #3

- To a MT4J application that is multi-touch aware
- Going through a MT4J TUIO server
- Multitouch from a TUIO simulator
Getting Multi-Touch up and Running: Demo #4

- To a MT4J application that is multi-touch aware
- Going through a MT4J TUIO server
- Live multitouch from iPhone
Getting Multi-Touch up and Running: Demo #4

- To a MT4J application that is multi-touch aware
- Going through a MT4J TUIO server
- Going through CCV
- Live video
Getting Multi-Touch up and Running: Demo #4

- To a MT4J application that is multi-touch aware
- Going through a MT4J TUIO server
- Going through CCV
- Live video from lights
Getting Multi-Touch up and Running

1) EVENT-DRIVEN ARCHITECTURE
2) BLOB-TRACKING
3) 3RD PARTY BLOB TRACKING LIBRARY
4) GRAY SCALE INTERPRETATION
Getting Multi-Touch up and Running
Getting Multi-Touch up and Running

1. Flash App
   - Run it "Fire"
2. TUIO Server
   - Launch
3. CCV
   - Calibration
4. Pick Video
5. Recorded Video
6. Live Video
7. LED
Getting Multi-Touch up and Running

Diagram:
- APPLICATION #1
- APPLICATION #N
- TUIO SERVER
- Hardware
- Issues
  - CCV Version
  - 1.5 Windows
  - 1.3/1.2 Mac/Linux