Multi-Touch Gestures for Controlling Synchronized Map Views

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Outline

• Multi-user vs multi-touch
• Multi-touch gestures for synchronized map views
• Enhancing and using ESRI applications in a multi-user multi-touch environment.
  – Integration with ArcGIS
Multi-User or Multi-Touch?
Multi-User VS Multi-Touch

Multi-touch, but not multi-user

Multi-user, but not multi-touch
Multi-Touch: Good for Rich Gestural Interactions

- Can simulate all mouse functionality
  - including mouse-overs (vs mouse-drag), right/middle-drag, scroll-wheel, precision-input, etc
- Can build new functionality on top of mouse
  - fist-swipe or fist-drag => take a screenshot and launch a multi-user paint program
- Interact with multiple objects at once (piano)
- Change the size, location and/or rotation of a region simultaneously
- Example:
  - Use 1-finger to select, flick or do mouse-operations; 2-fingers to resize/move/rotate object; 5 fingers to pan entire map; fist to scroll or tilt
Some Commercial Multi-Touch Tabletops

Microsoft Surface.com

TouchTable.com

PerceptivePixel.com

DiamondTouch CircleTwelve.com
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Synchronized Map Views

- **Problem**: Different views/layers of the same geographic area may look very different (population density vs streetmap)
- At some point creating multiple layers on the same map becomes cumbersome and some information may become obscured or too hard to understand.
- **Solution**: Separate views into different, but synchronized, windows.
  - When used with a multi-touch surface, add a “Synchronize Views” mode to ArcDesktop to draw a line between two touch points. This centerpoint, rotation, and separation of the points controls the secondary views.
  - The primary map view, shown on the multi-touch surface, does not change as the user interacts with it.
  - Note: ArcDesktop allows multiple Views (Window > Viewer). But our goal was to synchronize 2D and 3D views, and to synchronize different applications (typically a 2D view in ArcDesktop driving 3D views in Google Earth and/or Virtual Earth).
Multi-surface GIS

- Synchronized content
- Synchronized displays

✓ WebService-based synchronization of different applications (shown here on the same surface)
Implementation

- This technique was developed using a multi-user multi-touch DiamondTouch system, which is based on capacitive coupling.
- The technique will work with any technology capable of reliably tracking two points of contact. Systems are typically based on cameras, resistance, pressure, interrupting a IR light path, etc.
- Information about the latitude, longitude, rotation and zoom amount indicated by the two touches (along with other information helpful for cross application integration) is passed to a web service.
  - Basing the system on a standard web service insured that a wide variety of clients (even cross platform) could be synchronized.
Synchronized Views Across Applications
ArcMap Driving GoogleEarth
Multi-Touch Gestures To Control Secondary Views

Secondary view is determined by:
- Location: Mid-point of 2 touch points
- Rotation: Angle between 2 touch points
- Zoom: How far apart you move the two touch points
Control Local or Remote Secondary View(s)
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DiamondTouch ArcMap Extension

- An extension for ArcDesktop which provides support for simultaneous symbol-drawing by up to four users of a multi-user multi-touch DiamondTouch table.
- Used in conjunction with the DiamondTouch Mouse Emulation tool (DTMouse) that ships with DiamondTouch.
- Lets people interact at the same time, and keeps track of who did what.
- Users can use multi-finger gestures to zoom and pan without changing the selected tool.
- Targets Emergency Operations Centers, disaster response, and any collaborative situations that can benefit from the more effective communications that are realized with face-to-face discussions.
DiamondTouch ArcMap Extension
DiamondTouch ArcMap Extension

• GUI Controls

Buttons:
- Simultaneous Element Sketching
- Extension Properties
- Toucher timeline
- Toucher toolbars (4)

Per-user Toucher Toolbars:
- Pen Tool
- Marker Tool
- Line Tool
- Area Tool
- Delete Tool

Toucher Timeline (replays element additions)
DiamondTouch ArcMap Extension

- Toucher Geodatabase
  - All elements added by touchers are saved with ToucherID and timestamp in a separate Toucher geodatabase

- Toucher Layers
  - Organized by Toucher (1 through 4)
  - Within toucher, organized by element type (markers, lines, areas)
  - Can turn on or off layers added by each toucher (by toucher or by element type)

- Toucher Timeline
  - Can “go back” to an earlier time in the discussion (and maybe turn off some toucher layers while reviewing)
DiamondTouch ArcMap Extension

• Built-in Multi-Touch Gestures
  – 2-Finger PanZoom
    • Touch the map with 2 fingers at the same time to initiate 2 finger-zooming
    • “Draggable” lines of longitude will appear under your fingers
    • Drag them (independently) relative to each other to zoom in or out
    • Drag them (together) up/down/left/right to pan
  – 5-Finger Pan
    • Put 3 or more fingers down at the same time and drag them to pan the map
Gestures for Mouse Events

- **DiamondTouch Mouse Emulator Utility**
  - Allows you to run any (mouse-based) software on the table as is
  - Converts touch inputs to mouse inputs
  - Provides functionality of a 3-button mouse including mousewheel
  - Allows precision input
  - Coordinates multiple touchers
    - First to touch assumes mouse control
      - others are ignored
  - One user at a time, but no need to explicitly hand off control – no physical device (i.e., mouse, keyboard) to pass back and forth
Mouse Emulation Challenges

- Specifying a particular pixel, finger obscuring content, moving the mouse without dragging:
  - “Precision-Hover” mode
- Timing and spacing (for double-tapping, etc)
  - Touch Properties settings independent of mouse settings
- Right and middle mouse buttons
  - Tap with second finger to toggle right mouse button
  - Tap twice with second finger to toggle middle mouse button
- Desktop Incorporation
  - System tray icon with context menu; special gesture for muting; audio feedback
Disaster Response Application

- Modeling & Simulation, Information Systems Dept, Mitsubishi Elec Corp, Kamakura, Japan
- In Development: “Decision Support System for Disaster Response”

- Used ArcGIS with maps and satellite images of December 2004 flooding in Indonesia
- Collaboratively analyzed on a DiamondTouch table
Suitability of Shared Tabletops for Emergency Response and Situational Awareness

• Shared situational awareness:
  – All participants *perceive* elements and *comprehend* meaning/implications
  – can only be achieved with **effective communications**.
• A shared tabletop environment allows for important face-to-face interactions without which subtleties of communication (gestures, expressions) could be lost.
• Direct Input
  – clearly communicates to other participants *who* is doing *what*. Facilitates building **shared mental model**.
• Simultaneous users
  – In an emergency, you don’t want to take turns.
    • With customizations, everyone can do things at the same time.
    • If using the mouse, turn-taking is required, but a first-to-touch-wins policy avoids chaotic mouse cursor movement.
• Multi-finger input
  – Key to rich gestures for advanced functionality
Other GIS Touch Applications
Questions?

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