



MITSUBISHI ELECTRIC RESEARCH LABORATORIES
Cambridge, Massachusetts, USA

Multi-Touch Gestures for Controlling Synchronized Map Views



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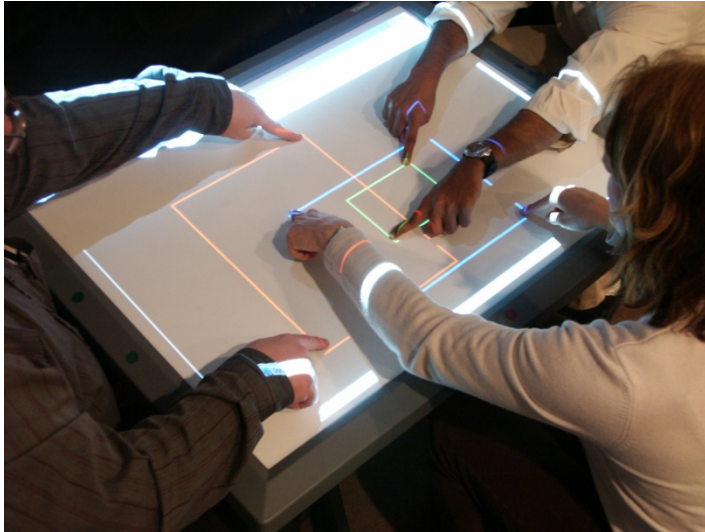
2008 ESRI International User Conference



Outline

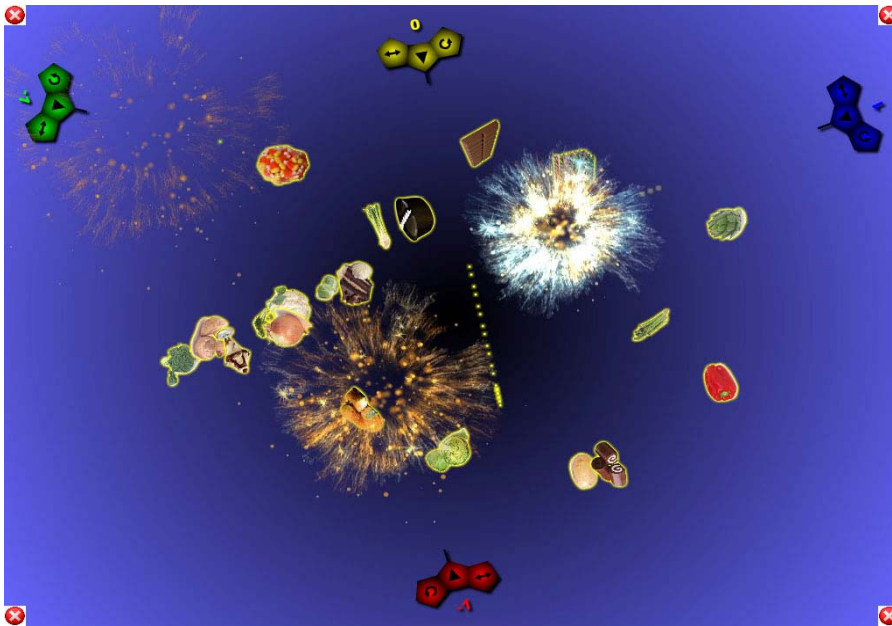
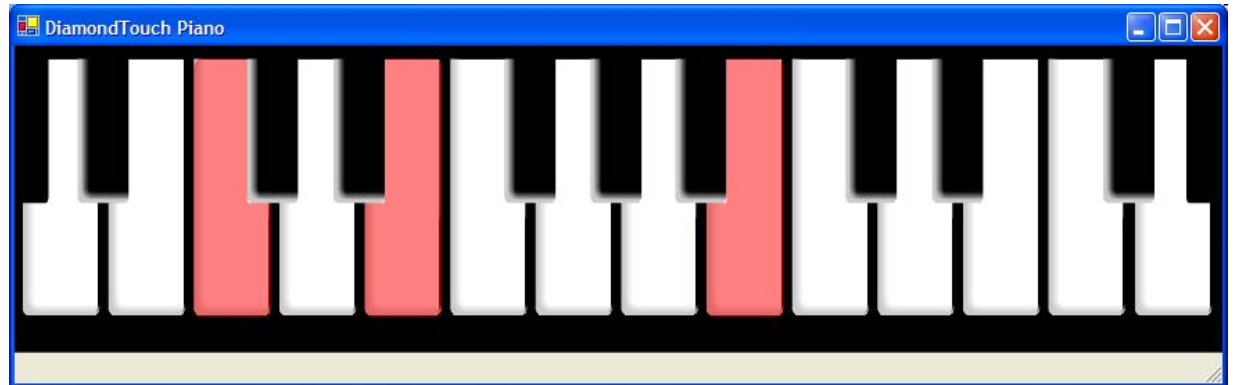
- Multi-user vs multi-touch
- Multi-touch gestures for synchronized map views
- Enhancing and using ESRI applications in a multi-user multi-touch environment.
 - Integration with ArcGIS

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

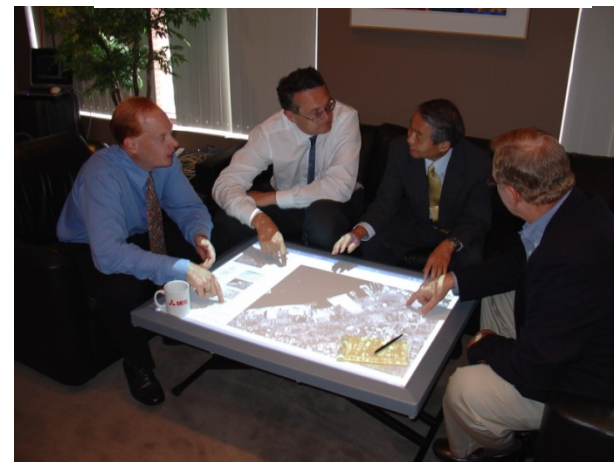
Microsoft
Surface
.com



TouchTable.com



PerceptivePixel.com



DiamondTouch
CircleTwelve.com



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Synchronized Map Views

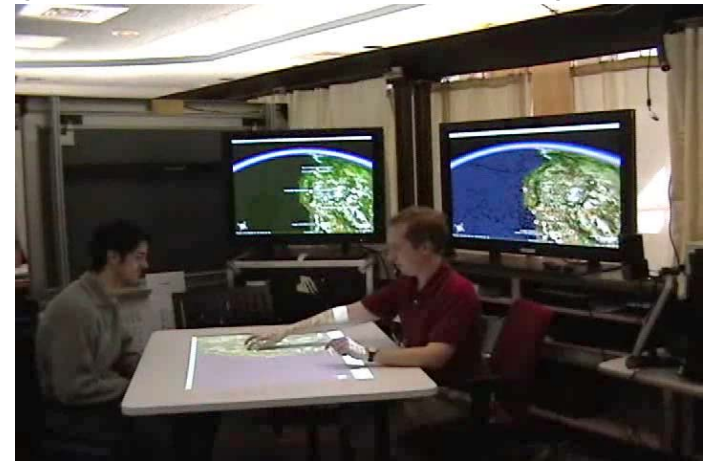
- **Problem:** Different views/layers of the same geographic area may look very different (population density vs streetmap)
- At some point creating multiple layers on the same map becomes cumbersome and some information may become obscured or too hard to understand.
- **Solution:** Separate views into 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



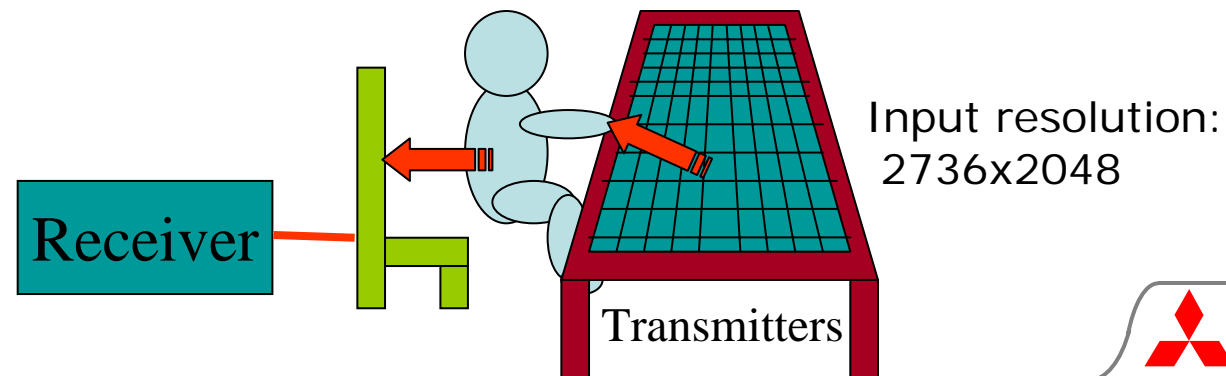
- Synchronized displays



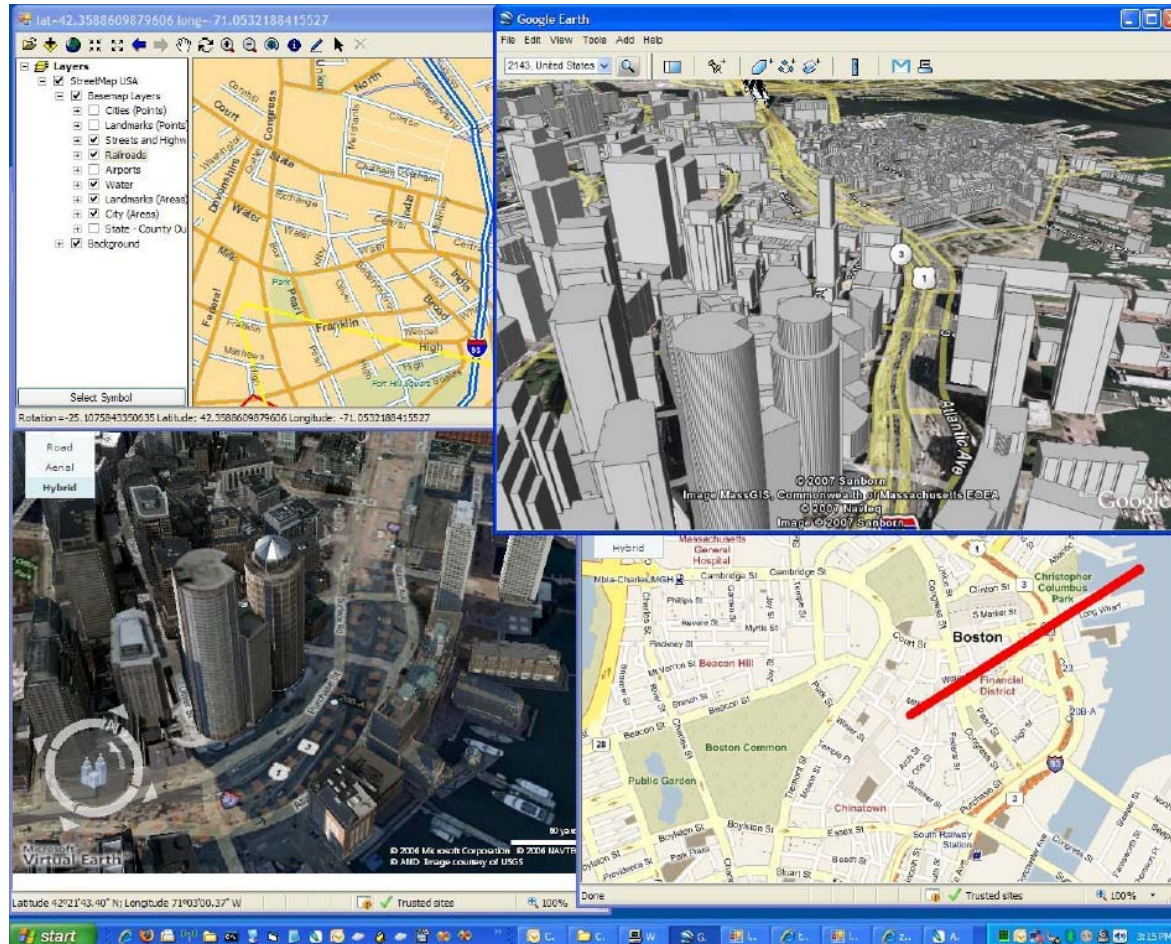
- ✓ WebService-based synchronization of different applications (shown here on the same surface)

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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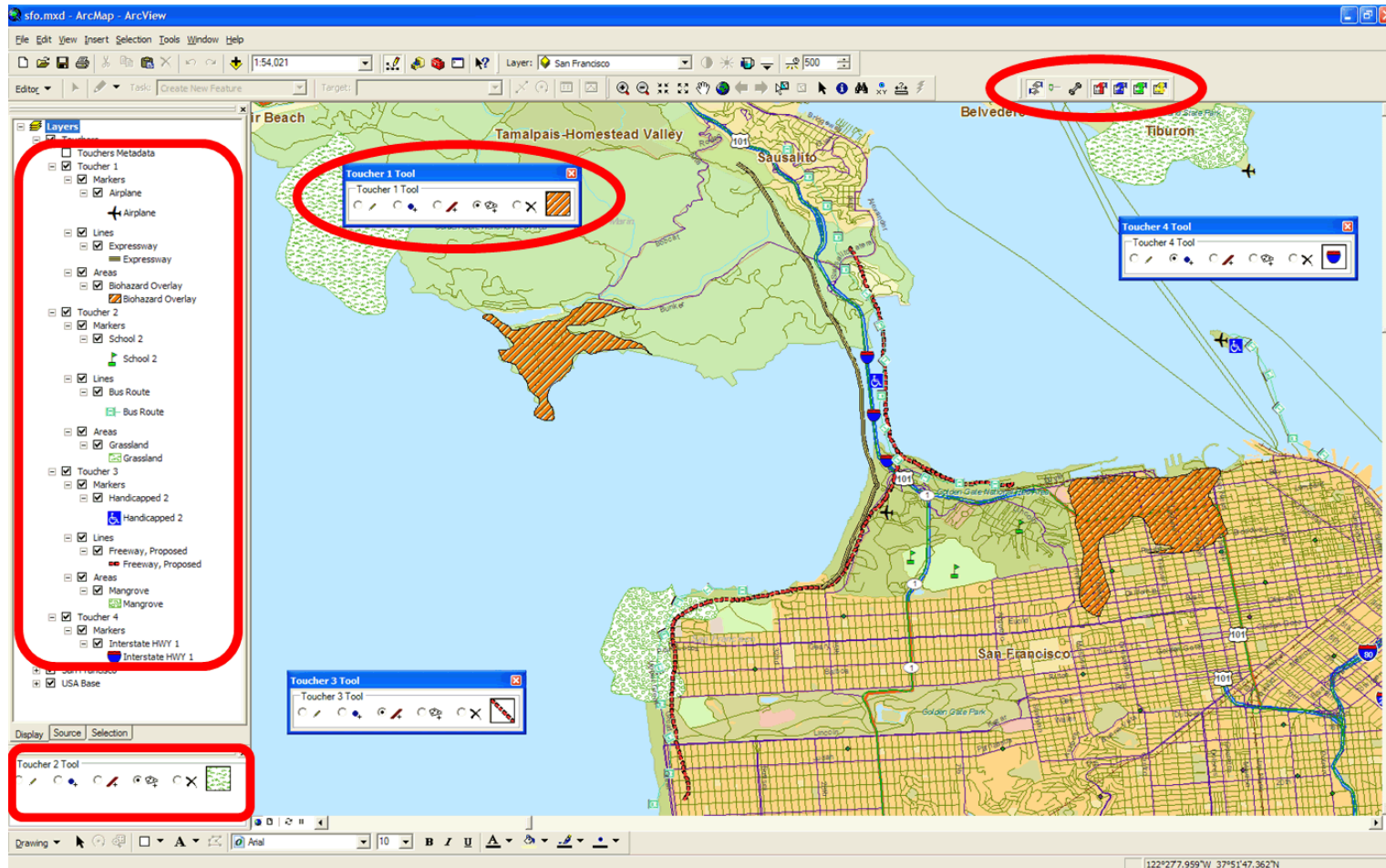


DiamondTouch ArcMap Extension

- 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



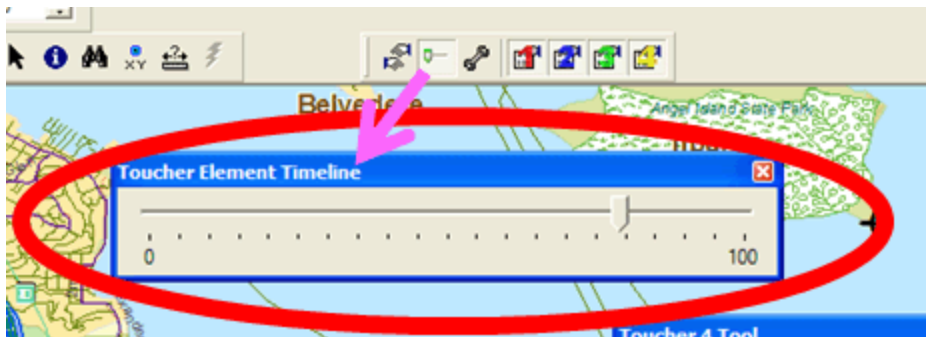
DiamondTouch ArcMap Extension

- GUI Controls

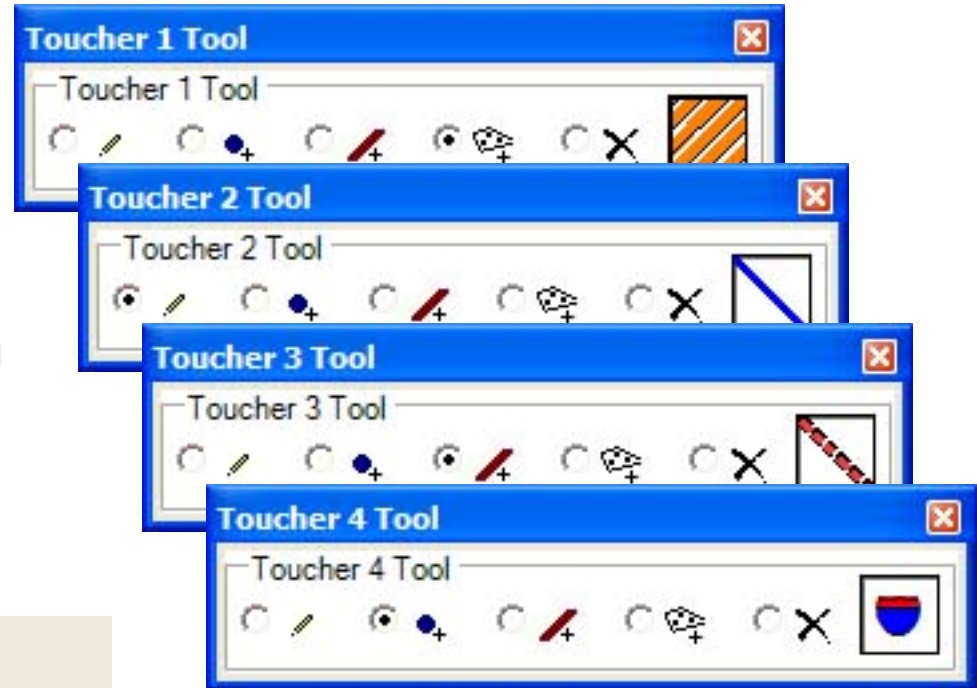


Buttons:

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



Toucher Timeline (replays element additions)



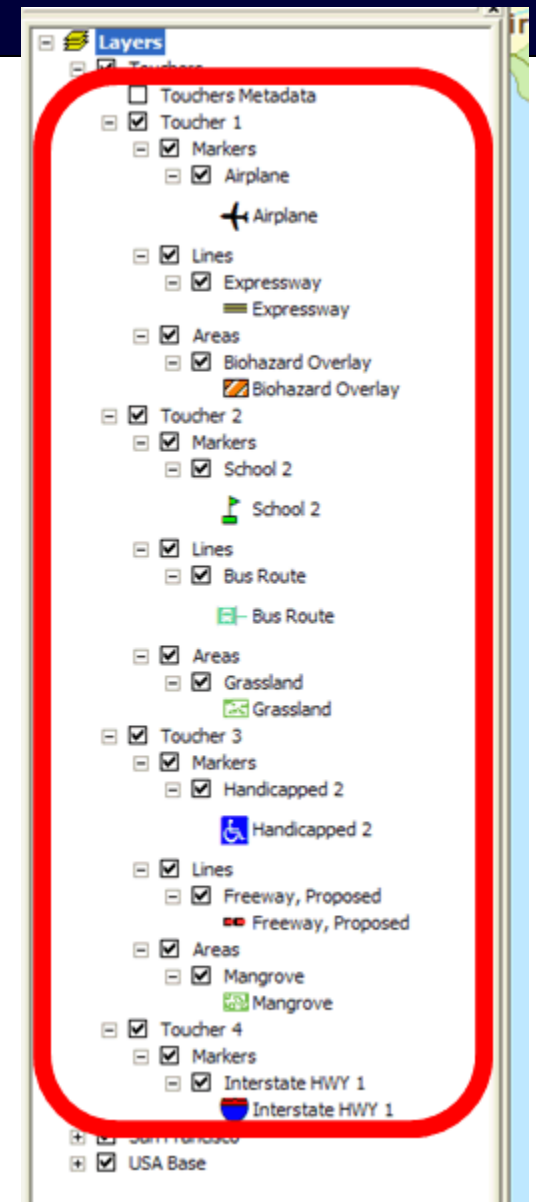
Per-user Toucher Toolbars:

- Pen Tool
- Marker Tool
- Line Tool
- Area Tool
- Delete Tool



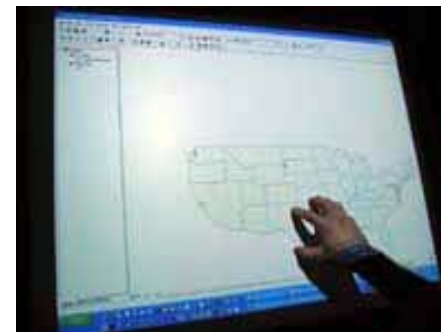
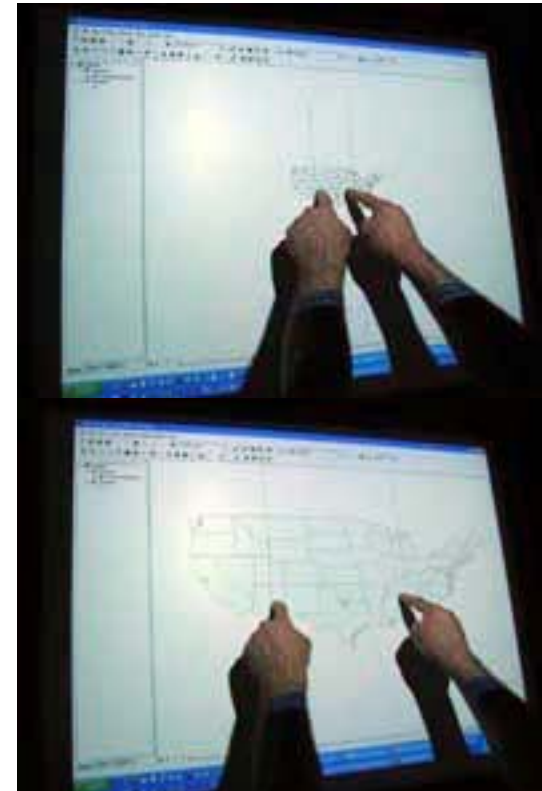
DiamondTouch ArcMap Extension

- 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)



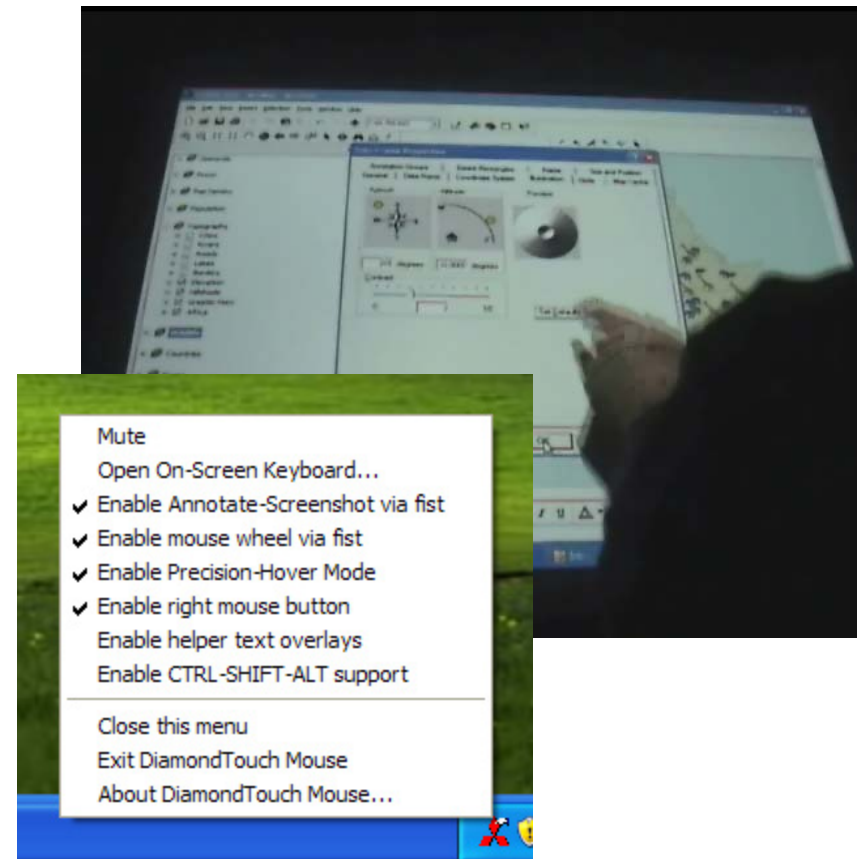
DiamondTouch ArcMap Extension

- 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

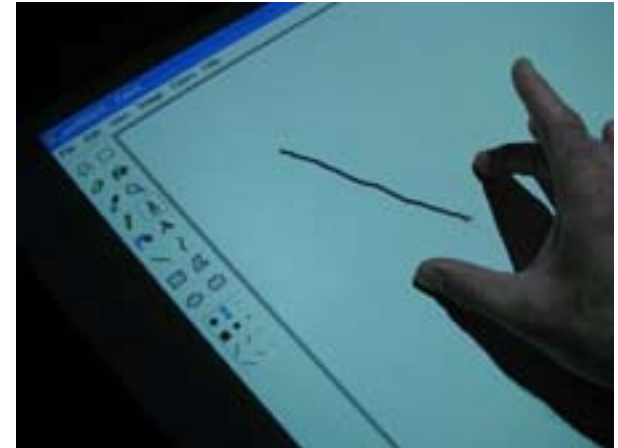
- DiamondTouch Mouse Emulator Utility
 - Allows you to run any (mouse-based) software on the table as is
 - Converts touch inputs to mouse inputs
 - Provides functionality of a 3-button mouse including mousewheel
 - Allows precision input
 - Coordinates multiple touchers
 - First to touch assumes mouse 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

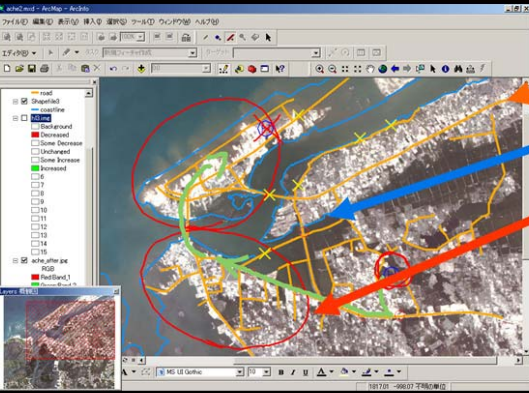

- Specifying a particular pixel, finger obscuring content, moving the mouse without dragging:
 - “Precision-Hover” mode
- Timing and spacing (for double-tapping ,etc)
 - Touch Properties settings independent of mouse settings
- Right and middle mouse buttons
 - Tap with second finger to toggle right 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”*

災害時意思決定支援システムへの応用

災害発生時、DiamondTouchとArcGISを用いる協調作業によって速やかに被害状況を把握し、複数の指揮官による複数組織に対する的確な意思決定を支援することが可能となる。



Before: July 26, 2004 After: Dec 28, 2004 Analysis
Tsunami images (c) 2005 DigitalGlobe Inc.



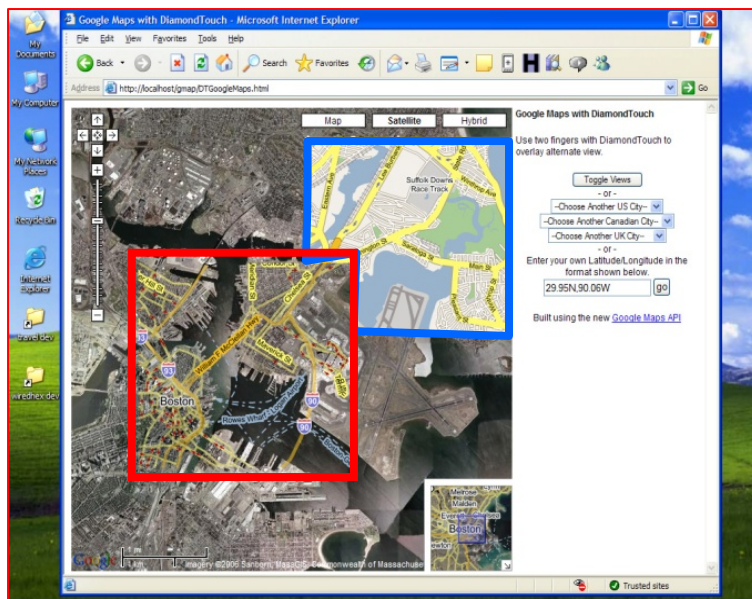
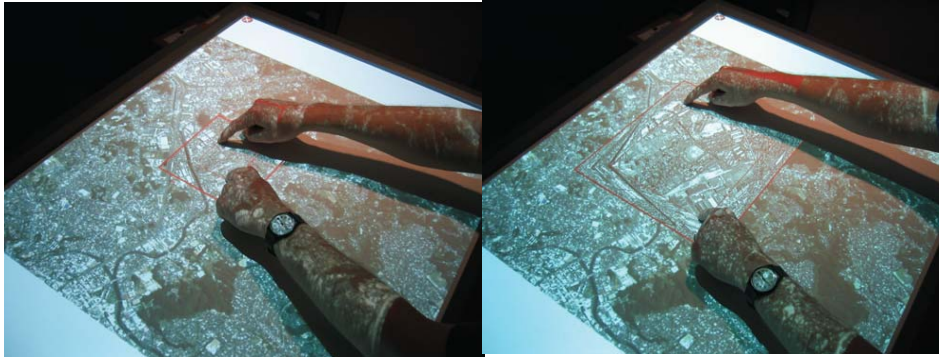
- Used ArcGIS with maps and satellite images of December 2004 flooding in Indonesia
- Collaboratively analyzed on a DiamondTouch table



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





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Questions?

<http://www.merl.com/projects/DiamondTouch/>

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