Implementations of Multi-Touch Interaction for Non-Visual Map Exploration and Manipulation

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To enable computer based geographic learning for blind and visually impaired users, a refined presentation platform is needed to convey visual information via alternative sensory modalities. However, synoptic perception of content is not possible for users exploring geographic information rendered in a non-visual format, as it is for sighted users viewing content on display screens. Information must be mentally inferred from sensory feedback provided in response to user input activities. As such, if richer and more meaningful non-visual sensory feedback can be obtained from a system that enables intrinsically spatial tactile user interactions, then better mental inferences can be made regarding the content of an unseen map.

Multi-touch technology is one such mechanism for intuitive human computer interactions that allows users to manipulate and explore information on personal computers in a highly interactive and acutely kinesthetic manner. Additionally, there is a strong consensus among researchers that multi-touch technology is well suited for use with geospatial information and GIS software. This poster will present an overview of six implementations of multi-touch interaction that demonstrate the potential viability of this technology for use with non-visual geographic information systems.

The basic function of Multi-Touch interaction technology involves tracking the movements of a user's fingers upon a sensor laden surface. Data from these sensors is received by a computer that registers the detected points of contact within a virtual scene, such as a Cartesian plane, and initiates any functions that may be prompted by discrete gestures. Consequent actions may include the point and select functions typically available using a mouse controlled cursor, or they may be more complex functions that are moderated by the arrangement, sequence, size, pressure, movement, direction or speed of any or all of the detected points of contact. It is the immersiveness of the later class of multi-touch interactions that are most useful to non-visual users.
The interaction cases provided on this poster will be categorically divided into examples of multi-touch gestures used for the discovery and exploration of geographic information and examples of manipulation of map scenes. Photo depictions will be provided to illustrate the gesture and effect suggested in each case.

When exploring virtual map content without vision, a user must attempt to correlate sensory feedback, such as spoken text or sound clips, with kinesthetic perceptions of hand or fingertip position and then infer the location of a feature within the extent of the unseen map. In order to learn about the composition of a certain portion of a map, a user could invoke an inventory function by creating a rectangular region with the thumb and first finger of the left and right hand, or by tracing a circle with one or two fingers. After the region is established with these gestures, a verbal list of the features contained within the region would be provided using speech synthesis. Alternatively, in order to determine the size of an object on the map or the distance between two points, a measurement function can be invoked using a two finger tapping gesture. The straight line distance between the first and second finger would then be provided via speech synthesis. As a final example in this category, a user that has found and selected a particular map feature with the finger of one hand could investigate attribute information about that feature by using a sweeping motion with a second finger in order to progress through an audible dictation of attributes.

When manipulating map content in a non-visual manner, a user interacts with a virtual scene by prompting transformations that are moderated by the type of multi-touch gesture used. In order to select or apply focus to a map feature for which the precise position within a general area is unknown, a user could perform a four fingered plucking gesture, as if picking up stone from on top of a table. This allows the user to quickly and easily target the intended feature for selection by capturing it within the boundaries of a shrinking polygon shape, instead of having to tap directly on its precise location. Alternatively, in order to enlarge or shrink map content being explored, a zooming function could be carried out by performing a stretching or compacting gesture wherein a user’s hands move away from or towards each other. The degree of zooming applied would thus be a function of the displacement of the user’s hand and would be indicated with graduated pitches of sound to denote map scale attained. As a final example in the second category, a user who wishes to pan or scroll across a map, in order to explore content adjacent to what is presented, could invoke a dragging function by sweeping a whole hand across the multi-touch surface as if moving a piece of paper across a table.