7 things you should know about...

Multi-Touch Interfaces

Scenario

Dr. Fuller, a professor in the College of Environmental Design, team-teaches a graduate course in landscape architecture with Dr. Petersen, a professor of architecture. The course objective is for students to understand how best to integrate building and landscape design to create efficient and sustainable structures. The 20 students in the course are grouped in pairs, one student from each specialty. For the final project, each pair of students will submit an integrated architectural and landscape design plan for a remodel of an off-campus building constructed in the 1920s.

Sonja and Craig are partners for the project. The university recently implemented a sophisticated design system with a multi-touch interface, which the students use for their project. The system features a large-format display where students can manipulate their designs by simply touching the area they want to change and moving their fingers on the screen. For example, by placing two fingers on the screen that shows the building and sliding her fingers in opposite directions, Sonja zooms in on a doorway, similar to the movement inside a virtual world but controlled through touch. Once "inside," Sonja can use touch gestures to move or eliminate walls, create windows, and make other changes to the architectural design. Similarly, Craig can edit his landscape design by adding trees and plants, moving a tree or changing its size, altering the slope of grassy areas, or incorporating pedestrian pathways.

Sonja and Craig's plan includes a photovoltaic array on the building's roof, and they work to maximize the amount of sunlight that will hit the array. The design system includes data about the position of the sun throughout the year, and the students can create visualizations of the building at any time of the day, on any day of the year, showing exactly where the sun shines on the building. They reposition trees and the solar array for the best results. Using touch gestures, they rotate the view, zoom in and out, and position deciduous trees where they will provide shade in the summer and evergreen trees where they won't block the winter sun. They use the interface to add windows and simply drag a window to reposition it or touch two corners of the window to resize it. Bridging their individual areas of expertise around simultaneous input, Craig and Sonja see the results of collaborative decision making in the cross-disciplinary design process—a reflection of authentic professional practice.

1 What is it?

Multi-touch interfaces are input devices that recognize two or more simultaneous touches, allowing one or more users to interact with computer applications through various gestures created by fingers on a surface. Some devices also recognize differences in pressure and temperature. Unlike a keyboard or a single-point input device such as a mouse or a traditional touchpad, multi-touch technology introduces users to swipes, pinches, rotations, and other actions that allow for richer, more immediate interaction with digital content. Multi-touch technology can be found not only in touchpads but also in displays, in which the user manipulates icons and other content directly on a screen. For example, with a photo application that uses multi-touch technology, users can touch and drag photos, creating a digital approximation of manipulating a collection of printed photos. The interface also lets users "grab" the corner of a photo and rotate it or touch opposing corners of the picture and resize it by spreading their fingers apart or pinching them together. Multi-touch interfaces recognize these and other gestures from multiple places on the device simultaneously, allowing several users to interact with an application at the same time.

2 Who's doing it?

Research on multi-touch interfaces dates back to the early 1980s at IBM, Bell Labs, the University of Toronto, and other research centers. These efforts produced a variety of devices that demonstrated the potential for input technologies that rely on hand and finger gestures. In June 2007, Apple introduced a multi-touch interface on the iPhone and later that year on the iPod touch. For these devices, the technology allows users to choose from various types of inputs on the small screen, such as text (through a digital keypad) or scrolling through a series of photos or album covers by sweeping a finger across the display. Apple has since incorporated a multi-touch touchpad on many of its laptop computers. Jeff Han, a recent developer of multi-touch technology, founded a company called Perceptive Pixel that markets large-scale multi-touch devices. CNN has incorporated one of the displays in its election coverage, using the interface to manipulate data to give viewers a quick, visual representation of state-by-state primary results, as well as how delegates would be apportioned in various scenarios. In a somewhat different vein, Microsoft is developing a technology it calls Surface, which combines a multi-touch interface with a table-like display. With Surface, users can interact with data and applications through similar gestures, and the technology also recognizes physical

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objects placed on the surface through Wi-Fi communication and also through markers (similar in concept to a barcode) that cameras in the system can read. Microsoft also recently demonstrated a technology called TouchWall, which uses infrared lasers, an infrared camera, and a projector to turn nearly any flat surface into a multi-touch interface, though the company said it currently has no plans to market the technology.

How does it work?

The idea behind multi-touch technology is to create a more direct interaction with data and applications by making the interface "invisible," resulting in what some describe as a blurring of the line between the physical and virtual worlds. Users can manipulate photos or documents on a screen, for instance, by sliding them and rotating them (or even turning them over) as if they were physical objects, but with the added functionality of digital tools to search, zoom in and out, change colors or text, or copy and paste. Multi-touch interfaces are designed to recognize intuitive gestures and respond in ways that users will see as appropriate or "natural." Swiping a finger across the display will move a page or image off the screen as the next one slides in to take its place. A digital keyboard or number pad can be called up to let users type on the interface. Microsoft Surface also includes the ability to recognize physical objects. When a Wi-Fi cell phone is placed on the surface, for example, the technology can access the photos or ringtones on that phone, display or play them, and let users share them by dragging them to create copies on other portable devices.

Why is it significant?

Multi-touch technology has the potential to replace traditional input devices, such as the keyboard, the mouse, and even the stylus, with an "invisible" interface that enables new ways of interacting with information. Being able to "thumb through" a stack of digital papers provides a compelling experience that resembles interaction with physical objects, while at the same time providing users with the functionality of digital tools, such as searching or changing text. As applications become more sophisticated and processing capabilities increase, the means of interacting with and manipulating data need also to be refined, if not reconceived, to allow users to take full advantage of new possibilities. Maps, for example, are now able to incorporate vast amounts of satellite imagery, GIS data, weather information, real-time traffic conditions, and other elements. Allowing users of advanced mapping tools to manipulate the applications with their hands results in a more immediate, richer experience and greater understanding. In addition, large-format interfaces allow multiple users to interact with the same device simultaneously.

What are the downsides?

Despite their limitations, not to mention the risk they pose for repetitive motion injuries, the keyboard and mouse are familiar tools, and to the extent that multi-touch interfaces completely do away with these devices, some users will be uncomfortable adopting an entirely new method of using computers. Moreover, multi-touch interfaces may present a barrier to users with visual impairments or disabilities that limit physical dexterity. Despite the popularity of the iPhone, Apple offers relatively few applications for the interface, though the user community has indicated its eagerness to contribute multi-touch applications. Similarly, few applications have been developed for Microsoft Surface, which so far has only been piloted in a small number of AT&T stores, or for the Perceptive Pixel devices. These latter two systems are also relatively expensive.

Where is it going?

Today's multi-touch interfaces support a narrow range of gestures, corresponding to a limited set of functions. Apple, for one, is working on systems that will recognize many additional discrete motions, such as moving different combinations of fingers in arcs, both clockwise and counterclockwise, to perform a much wider range of common computer functions, such as opening and closing a file, copying and pasting, saving, opening a new file, and others. If this and similar efforts succeed on the technical front and in persuading users to adopt new ways of interacting with computers, consumer electronics devices could start to look very different. Apple is also said to be working on a full multi-touch MacBook, one that doesn't include traditional input devices at all. Data visualization tools work to present information in visual, often dynamic or animated, form, and multi-touch interfaces would seem to offer new opportunities for creative manipulation of such tools. Digital games, simulations, and their entertainment counterparts will also be good candidates for multi-touch interfaces as they mature.

What are the implications for teaching and learning?

Multi-touch interfaces have the potential to alter the way we work with data and applications, resulting in more dynamic interactions around content. These devices and supporting applications offer diverse ways of visualizing information to improve understanding. They also facilitate new ways to foster collaborative creation, permitting several users to work simultaneously on a single screen. Given their simplicity and the broad range of possibilities, multi-touch interfaces might persuade more faculty to experiment with the technology, taking a creative approach to the question of how information and concepts can be presented to students to maximize their understanding.

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May 2008