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SEMINAR OF
MULTI TOUCH SCREEN TECHNOLOGY

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ABSTRACT

Multi touch screen is a new technology that is supposed to be the beginning of new generation in a field of the human interaction with devices. Multi touch screen is an interactive technique that makes use of points of contact rather than movement. It enables people to use computer in more easier way by touching the screen with their all fingers. In addition to the interesting made by it, we can make a single computer works by many users at the same time. Multi touch screen can feel finger's touch and tell this is from whom. Multi touch screen is a simple built screen that can be done by individuals. It can be seen now in the hotel, conference, restaurants and any other public places.
1: INTRODUCTION:

1-1: What is the multi touch screen?

Multi-touch screen interface is a set of interaction techniques which allow computer users to control graphical applications with several fingers.

Multi-touch screen interface consists of a touch screen (screen, table, wall, etc.) as well as software that recognizes multiple simultaneous touch points, as opposed to the standard touch screen (e.g. computer touchpad, ATM), which recognizes only one touch point. This effect is achieved through a variety of means, including but not limited to: heat, finger pressure, high capture rate cameras, infrared light, optic capture, tuned electromagnetic induction, ultrasonic receivers, transducer microphones, laser rangefinders, and shadow capture.

Many applications for multi-touch interfaces exist and are being proposed. Some uses are individualistic (e.g. iPhone, iPod touch, MacBook Pro, MacBook Air, HTC Diamond) and some are for collaboration (e.g. diamond touch, Microsoft surface). However, multi-touch technology is mainly used to incorporate collaboration into the computing experience.

1-2 Multi touch screen – general view:

Multi touch screen is an input device that recognizes 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 swipe, pinch, rotation, and other actions that allow for richer, more immediate interaction with digital content.

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. The traditional way of interacting with a computer is by using a mouse and/or a keyboard.

We provide the computer with inputs more or less by the use of buttons. Regardless of the input type, the computer can more or less only handle one input at the time which makes the input handling and sorting very easy. However, multi-touch is as far from single input handling as one can come. The amount of concurrent events in this interface is limited only by the data type holding the number of finger inputs.

The amount of simultaneous users is pretty much unlimited in the same way, which of course comes in handy for larger scale display systems. That amount of potential synchronous inputs requires new ways to detect the inputs. Since they aren’t the kind of ”on/off” inputs we are used to in the traditional sense, there are needs for new ways to interpret and analyze the input type and the gesture(s) they make out.

The multi-touch screen interface makes the user handling very intuitive. It is in some ways comparable to paper sheets laid upon a table, in the sense that there isn’t really any need for a manual in how to interact with a piece of paper or move it around – the simplicity of it makes it all very natural for us. Software interaction through a multi-touch interface has the potential of becoming as intuitive and natural for us as moving papers around on a table.
2. HISTORY OF Touching - Multi Touch Screen:

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. But the researches were so slowly and not efficient because of the high cost of building large one.

In 2006, Jeff Han, a recent developer of multi-touch technology, founded a company called Perceptive Pixel that markets large-scale multi-touch devices with low cost.

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.

CNN has incorporated one of the large multi touch 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 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 markets the technology.
3. OVERALL VIEW IN THE STRUCTURE AND THE WORK MECHANISM OF THE MULTI TOUCH SCREEN:

First of all there is a need to discuss a little information about how the regular touch screen works.

3.1 The structure of single touch screen:
There is a 3 kinds of touch screen:
1. Resistive.
2. Capacitive

The resistive system consists of a normal glass panel that is covered with a conductive and a resistive metallic layer. These two layers are held apart by spacers, and a scratch-resistant layer is placed on top of the whole setup. An electrical current runs through the two layers while the monitor is operational. When a user touches the screen, the two layers make contact in that exact spot. The change in the electrical field is noted and the coordinates of the point of contact are calculated by the computer. Once the coordinates are known, a special driver translates the touch into something that the operating system can understand, much as a computer mouse driver translates a mouse’s movements into a click or a drag.

In the capacitive system, a layer that stores electrical charge is placed on the glass panel of the monitor. When a user touches the monitor with his or her finger, some of the charge is transferred to the user, so the charge on the capacitive layer decreases. This decrease is measured in circuits located at each corner of the monitor. The computer calculates, from the relative differences in charge at each corner, exactly where the touch event took place and then relays that information to the touch-screen driver software. One advantage that the capacitive system has over the resistive system is that it
transmits almost 90 percent of the light from the monitor, whereas the resistive system only transmits about 75 percent. This gives the capacitive system a much clearer picture than the resistive system.

On the monitor of a surface acoustic wave system, two transducers (one receiving and one sending) are placed along the x and y axes of the monitor's glass plate. Also placed on the glass are reflectors -- they reflect an electrical signal sent from one transducer to the other. The receiving transducer is able to tell if the wave has been disturbed by a touch event at any instant, and can locate it accordingly. The wave setup has no metallic layers on the screen, allowing for 100-percent light throughput and perfect image clarity. This makes the surface acoustic wave system best for displaying detailed graphics.

3.2 The structure of multi touch screen:

The structure of the multi touch screen built in cell phone is differ from the one built in the large multi touch screen. This difference occurs because of the high cost of the components of which the screen made from. So the structure can be described in to different categories:

3.2.1 the structure of cell phone’s multi touch screen:

The multi touch screen in cell phone is similar to the regular touch screen. The multi touch screen in the iphone made from capacitive system where there is a glass panel contained a layer that stores electrical charges. When any touch is made in the glass panel, some of the charge is transferred to the user's body. So the charge in the capacitive layer decreases. The decrease is measured by the circuit that exist in each corner of the monitor. Computer responds to the touch by calculating the difference made from decrease and determine where the touch is done by considering the screen.
as X-Y panel. This allows the phone to determine the location and movement of simultaneous touches in multiple locations.

A mutual capacitance touch-screen contains a grid of sensing lines and driving lines to determine where the user is touching.

A self capacitance screen contains sensing circuits and electrodes to determine where a user is touching.

The iphone's screen detects touch through one of two methods: Mutual capacitance or self capacitance. In mutual capacitance, the capacitive circuitry requires two distinct layers of material. One houses driving lines, which carry current, and other houses sensing lines, which detect the current at nodes. Self capacitance uses one layer of individual electrodes connected with capacitance-sensing circuitry.

Both of these possible setups send touch data as electrical impulses.
3.2.2- the structure of the large of multi touch screen:

The earlier version of the multi touch screen was using the same techniques of the one in the cell phone. But it seems that it needs high cost to build it and it is not available for the public. So Jeff Han, a consulting research scientist, has developed a low-cost form of the multi touch screen that consists of projector, web camera (some type used reflection sensor instead of camera), LED (Light Emitting Diode), acrylic surface, and of course CPU. FTIR stands for Frustrated Total Internal Reflection and is the most widely spread representation of the multi-touch technology today. There are occurrences of other methods as well, but FTIR seems to be the method most frequently referred to. It is also considered among the cheapest setups.

The principles of the technology are quite simple:

Infra Red light is shined into the side of a pane of a somewhat transparent higher-index Medium (acrylic, glass, plastic) and is trapped inside this medium by the refraction Index of the material. The light sources in the FTIR-case are a number of infra-red diodes attached to the side of the pane, while touch light uses one infra-red Illuminant shining on to the surface. Total Internal Reflection occurs when the light ray is traveling inside a higher-index medium and strikes a surface boundary into a lower-Index medium. When a finger touches the surface of the pane, the light is frustrated, causing the light to scatter downwards where it is picked up by an IR camera. It is Really an example of the laws of geometric optics.
On the side opposite from the user is a camera with visible light filter that registers the Scattered light. There is also a projector which projects the image on to the projection Screen.

On the side opposite from the User was a back projection material, which provided the user with a clear image from The projector. To register the frustrated light, we used a web-camera with a filter to Block out the visible light. In some cases the filter was made out of a couple of Fluorescent-light exposed photo negatives, which were attached to the camera lens.

It can send it to the remote CPU by using Wi-Fi or Bluetooth camera that transfer touches to it.
4. HOW MULTI TOUCH SCREEN WORKS?

When the camera is used to capture the touches in the screen, the size of image must be equal to the size of the touch surface and predefined already in the application. The image is captured by the camera and transferred to the processor that converts it to 8-bit grayscale for simplified processing. Then processor identified where bright spots are in the image. To do that, image must be mono-chrome. Each pixel is white or black. Processor sums pixels in each rows & columns (white = 1, black = 0) (figure 7). Rows or columns with high values indicate touch point. Then it generates a set of x, y co-ordinates for all touch points (figure 6). Generated points can be reversed when the processor tests possible locations to get accurate result. So we now have a set of touch point co-ordinates. Simple events are somewhat like mouse events that is used to change of position, new touch point or touch point disappeared.

![X, Y for point 1](image)

**Figure 6: X-Y plane to determine touch point**

Touch point code is more complex than mouse because it must track points and figure out when a new one appears or an existing one disappears. Gesture recognition is even more complex because it must swipe movement, expand/shrink/rotate using two points and require time-based analysis.
Figure 7: How Multi touch works
5. THE SYSTEM OF MULTI-TOUCH SCREEN TECHNOLOGY:

The multi-touch screen technology can be used with current systems like Windows, Vista, Mac OS, and Linux but with mouse emulation that build with javaFx. Under windows the multi-touch SDK (Software Development Kit) can generate 'augmented mouse events' that contain the user ID info in an extra field.

Mouse emulator works with traditional software. A computer implemented method for emulating a mouse with a multi-touch sensitive display surface. Sensing a touching, movement or tapping by one or several fingers or fist emulates mechanical mouse functionality.

Sensing a first touching by a first finger at a first location on a multi-touch sensitive display surface and sensing concurrently a second touching by a second finger at a second location on the multi-touch sensitive display surface displays a graphic object on the multi-touch display surface at a position dependent on the first location and the second location to emulate moving a mouse.

JavaFx is created for image manipulation. It belongs to java 2D and Java Advanced Imaging API. JavaFx is easy and simple to design and implement the user interface. JavaFx technology is easy to integrate with new type event and make building multi-touch user interface simple.

At the’ All Things Digital conference’, Microsoft demonstrated some Windows 7 features. Supposedly the main feature of Windows 7 will be multi-touch capabilities, as already seen in the Microsoft Surface demos.
6. APPLICATIONS SUPPORTING THE MULTI TOUCH TECHNOLOGY:

The use of multi touch screen and touch system is growing at a tremendous rate. Touch applications appear in an increasing variety of applications—from the medical field, to industrial machine control, to subway ticketing machines—all fueled by a steady decrease in hardware costs. At the same time, the number of companies meeting these growing market demands has expanded, each offering a variety of technologies and solutions.

The multi touch enables designers to create new usage models for product such as mobile handsets, portable media players (PMPs), GPS system and other product.

The multi touch screen can be also used in photo. In 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.

Maps the most widely use multi touch technology. Maps 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 this application the display, which is projected onto a ‘Diamond touch’ surface, contains a satellite map image. Different views can be overlaid onto the map. The following figure (figure 8) shows two users interacting with
the application. Each user selects his or her own view, which may be the same as or different from other users' views. As each user touches the diamond touch display his or her lens appears, revealing the appropriate customized information.

Multi touch screen can support the attribute of user recognition by supposing users who set around the multi touch table as collaboration so that every one of them do his own movement in the multi touch table and also his own space of touching. the multi touch interface enables a group of people to interact with a surface without interfering with each other. Furthermore, objects placed on the surface do not interfere with multi touch operation.

Some type of multi touch uses an array of antennas embedded into a surface, with each antenna transmitting a unique signal. Each user has their own receiver, generally attached to their chair. When a person touches the surface, energy from nearby antennas is coupled through the user to their receiver. Using this mechanism, the system determines who is touching where. (figure 9)
Multi touch technology also used in robot field and 3D games as remote control e.g. the UML USAR interface (shown in figure 10) with a participant using the multi touch configuration. This interface allows the user to operate the iRobot ATRV (figure 11) through the NIST USAR course using the gesture that activate interface features and autonomy modes.
Figure 12: These are some uses of multi touch screen application
7. HOW MULTI-TOUCH SCREEN COULD CHANGE THE WAY WE INTERACT WITH COMPUTERS AND EACH OTHER?

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 screen allows multiple users to work together to solve difficult problems. However, simply scaling the techniques that work well for a single user creates awkward systems. In a collaborative environment, sharing a single mouse is very awkward. Providing multiple mice only makes matters worse. It is extremely difficult to keep track of what each user in the group is doing. Touch screen technologies appeared promising since a glance reveals each users activities. However, touch technologies are usually restricted to detecting a single touch point. They also tend to be somewhat fragile. Multi-touch screen unique hardware that provide multi touch input; it is a touch technology specifically designed for a multi user environment. Enabling input from multiple participants is important for computer-supported collaboration and access to this hardware will facilitate exploration in these areas.

- So, Rather than responding to the presence of a single finger, multi-touch computer screens can follow the instructions of many fingers simultaneously.
- A wall-size screen can respond to as many as 10 fingers or multiple hands. Also there are smaller, specialized systems for hotels, stores, and engineering and design firms.
Multi-touch computing could one day free us from the mouse as our primary computer interface, the way the mouse freed us from keyboards.

7.1 what are the implications for teaching and learning?

Multi touch interface 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.
8. THE ADVANTAGES OF MULTI-TOUCH SCREEN TECHNOLOGY:

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.

The multi touch screen also enables users to manipulate new functions easily. Advantages include optical clarity, durability and cost-effective implementation of multi touch features.

The use of touch screen and touch systems is growing at a tremendous rate. The software in multi touch screen can alter the screen while it is running making it more flexible than a printed overlay keyboard and no extra peripherals are needed apart from the touch screen monitor itself. Multi-touch interfaces have the potential to alter the way we work with data and applications, resulting in more dynamic interactions around content.

In addition, the multi touch technology intuitive user interactions. In it there is multiple point of interactions. Multi touch technology allows multiple users interaction with software. So, the multi touch screen is cool and interesting technology.

The multi-touch screen technology enables the users to interact with what is displayed directly on the screen, where it is displayed, rather than indirectly with mouse or touchpad.

The multi-touch screen technology lets one do so without requiring any intermediate device, again, such as stylus that need to be held in the hand. Such display can be attached to computers or, as terminals, to networks. They also play a prominent role in the design of digital appliances such as personal digital assistant (PDA), satellite navigation devices and mobile phones.
9. DOWNSIDE OF THE MULTI TOUCH SCREEN:

Despite mouse and keyboard limitations, not to mention the risk they pose for repetitive motion injuries, they 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. Similarly, few applications have been developed for Microsoft Surface, which so far has only been piloted in a small number of AT&T stores. These later two systems are also relatively expensive.

The multi touch screen not suitable for inputting large amounts of data and Selecting detailed objects can be difficult with fingers. Also, it Difficult to select small items. It is still approximately expensive to use by regular users.
10: CONCLUSION: THE FUTURE OF MULTI TOUCH SCREEN TECHNOLOGY:

Even multi touch screen, the interaction technology, is not very necessary to use the computer but it will change the whole way of interaction as the mouse generation was changing the keyboard century. The use of multi-touch technology is expected to rapidly become common place. For example, touch screen telephones are expected to increase from 200,000 shipped in 2006, to 21 million in 2012. Data visualization tools work to present information in visual, often dynamic or animated, form, and multi touch screen 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. Developers of the technology have suggested a variety of ways that multi-touch can be used including:

- Enhanced dining experience.
  - order food, ask for refills, split check, pay bill, entertainment while dining.
- Concierge service.
  - locate landmarks, plan day, uplink info to cellular phone
- Gaming.
- Governmental use.
- Concept mapping.
- An enhanced multimedia experience.
- Collaboration and instruction on Interactive Whiteboards.
REFERENCES:

HOW CELL PHONE'S MULTI TOUCH SCREEN WORK
(howstaffworks.com)

AMERICAN SCIENTISTS -HANDS-ON COMPUTING: HOW MULTI-TOUCH SCREENS COULD CHANGE THE WAY WE INTERACT WITH COMPUTERS AND EACH OTHER
(http://www.sciam.com/article.cfm?id=hands-on-computing)

SUN JAVA (java.sun.com/javaone)

EDUCAUSE LEARNING INTIATIVE (www.educause.edu/eli)

MITSUBISHI ELECTRIC RESEARCH LABORATORIES
(http://www.merl.com)

MULTI-TOUCH SYSTEMS THAT I HAVE KNOWN AND LOVED
(http://www.billbuxton.com/multitouchoverview.html)

GESTURE ANALYZING FOR MULTI-TOUCH SCREEN INTERFACES
(luleå university of technology).

MULTI TOUCH INTERFACE RESEARCHES
(http://cs.nyu.edu/~jhan/ftirtouch/)

MULTI TOUCH (http://en.wikipedia.org/wiki/multi-touch)