UNIVERSITÉ BISHOP'S UNIVERSITY

CS 469 / CS 569: Special Topics in Computer Science: Human-Computer Interaction

Devices

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Devices

Topics

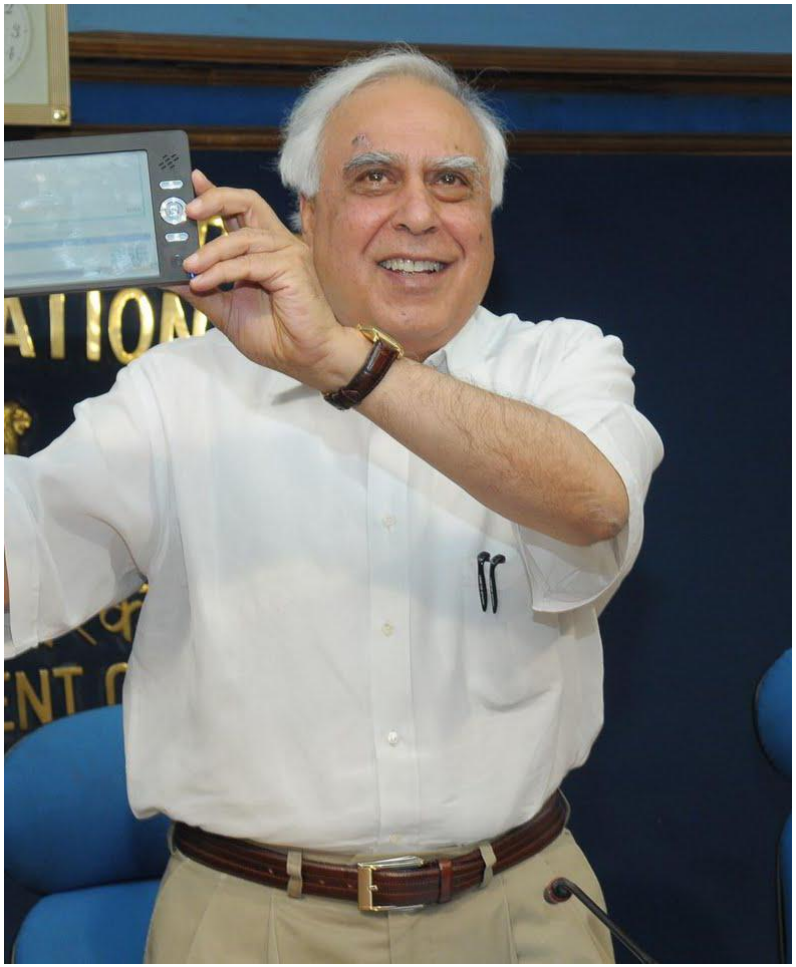
1. Introduction
2. Keyboards and Keypads
3. Pointing Devices
4. Displays

Introduction

- Input and output devices represent the physical medium through which users operate computers
- Only two decades ago, the standard computer platform was the desktop or laptop personal computer equipped with a screen, a mouse, and a keyboard
- Mobile devices have revolutionized the face of computing
  - Many people do not realize that their ever-present smartphones, tablets, or portable MP3 players are, indeed, powerful computers
- The explosion of new and exciting computing technology has increased the importance of interaction design so as to accommodate such a wide diversity of input and output modalities

Device example

- Indian IT minister Kapil Sibal announcing the Aakash, a $35 tablet for the Indian market



Another device example

- The Owlet wearable baby monitor that continuously tracks a baby's heart rate and oxygen saturation using a so-called "smart sock" (left) and wirelessly sends the information to a base station (center)
- The base station is in contact with the internet, and uploads data that parents can access using their smartphone (right)

Keyboards and keypads

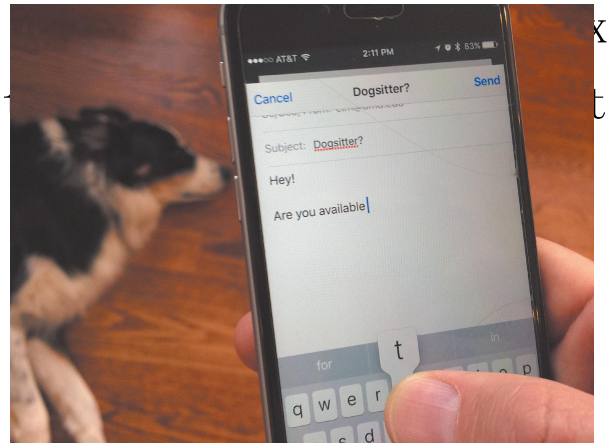
- An Apple Macbook Air laptop with a QWERTY keyboard (left) showing the inverted T movement keys at the bottom right and function keys across the top
- A multi-touch trackpad supports pointing
- On the right, a detail photograph of a Lenovo laptop keyboard shows a pointing stick (also called a trackpoint) mounted between the G and H keys on the keyboard

Accessible “keyboard”

- orbiTouch Keyless Keyboard with integrated mouse functionality
- The orbiTouch requires no finger or wrist motion to operate, yet supports high-performance typing and pointing

(http://orbitouch.org/)

Pointing tasks and control

- Select - Choosing from a set of items.
- Position - Choosing a point in a one-, two-, three-, or higher-dimensional space
- Orient - Choose a direction in a two-, three-, or higher-dimensional space.
- Path - Define a series of positioning and orientation operations
- Quantify - Specify a numeric value
- Gesture - 

xecuting a predefined motion
- Text - En t in two-dimensional space

Pointing devices

http://www.logitech.com/

Direct control devices (easy to learn and use, but hand may obscure display)
- Touchscreen (single- and multi-touch)
- Stylus (passive and active)

Indirect control devices (take time to learn)
- Mouse
- Trackball
- Joystick
- Pointing stick (trackpoint)
- Touchpad
- Graphics tablet

Novel devices and strategies (for special purposes)
- Bimanual input
- Eye-trackers
- Sensors (accelerometer, gyroscopes, depth cameras)
- 3-D trackers
- Data gloves
- Haptic feedback
- Foot controls
- Tangible user interfaces
- Digital paper

Criteria for success
- Speed and accuracy
- Efficacy for task
- Learning time
- Cost and reliability
- Size and weight

http://www.apple.com/

http://www.leapmotion.com/

Characteristics of displays

- Physical dimensions (usually the diagonal dimension and depth)
- Resolution (the number of pixels available)
- Number of available colors and color correctness
- Luminance, contrast, and glare
- Power consumption
- Refresh rates (sufficient to allow animation and
- Cost
- Reliability

Display example (1 of 5)

- The seventh-generation Amazon Kindle Voyage book reader (http://www.amazon.com/) is a six-inch grayscale display with a 330 pixels per inch resolution

Another Display example (2 of 5)

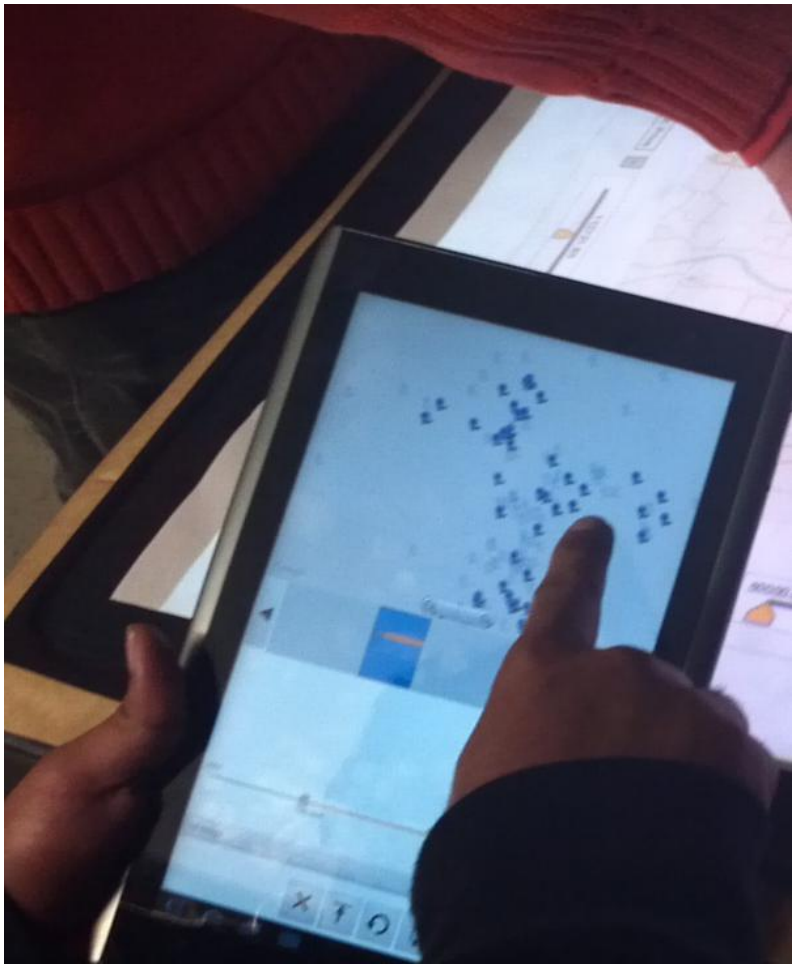
- Users discussing and pointing at details on the Stony Brook University Reality Deck (Papadopoulos et al., 2014), an immersive giga-pixel display consisting of 416 thin-bezel LCD displays and powered by 18 graphics workstations connected using a high-speed network (https://labs.cs.sunysb.edu/labs/vislab/re

Another Display example (3 of 5)

- Two users collaboratively control a lens on a gigapixel image of Paris, France using a tablet touchscreen as well as an interactive cursor (Chapuis et al., 2014)

Another Display example (4 of 5)

- Two people collaborating on a real estate task using a tabletop display and mobile table
- The tabletop serves as a shared and public display where changes affect all collaborators, whereas the tablet is perceived as a private display that

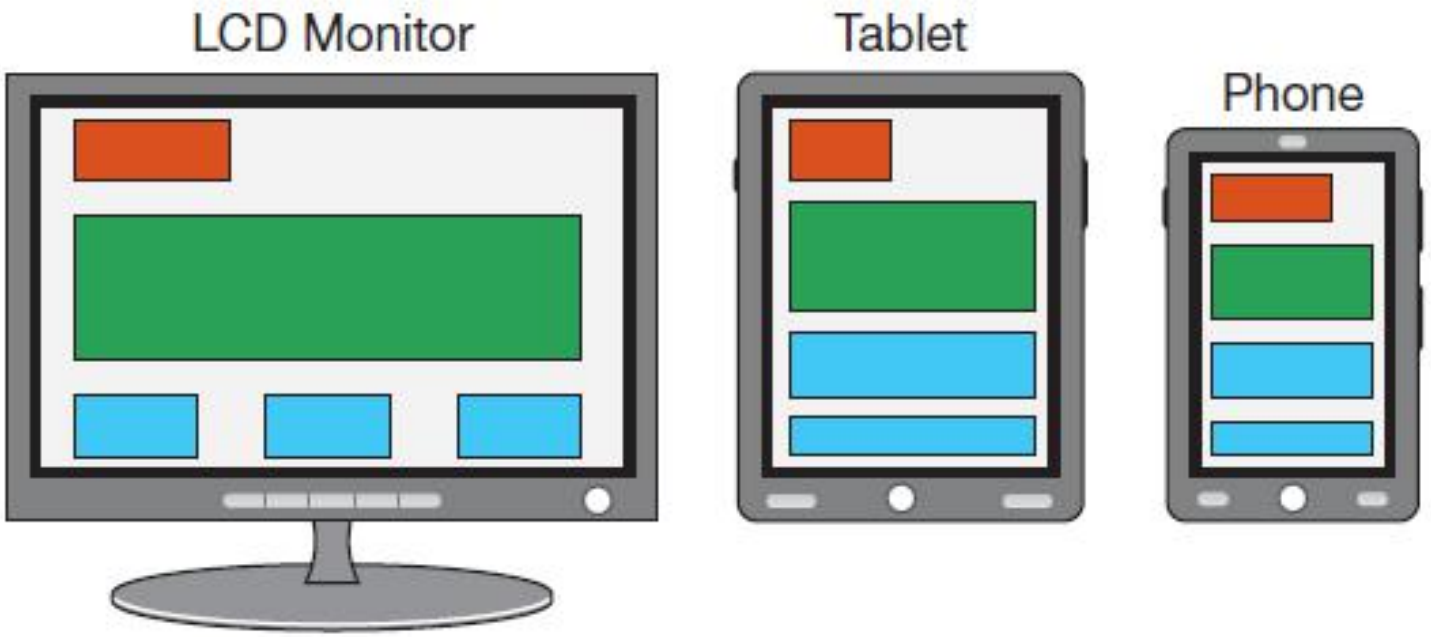


Another Display example (5 of 5)

- The Apple Watch on the left supports both fitness as well as personal information management applications, such as email, calendar, and electronic payment
- The Fitbit Surge smartwatch on the right is designed mainly for personal fitness ap[illegible] and contain[illegible]ter, heart ra[illegible]PS

Responsive Design

- The monitor layout on the left is automatically adapted to the smaller display space of a tablet (middle) and a smartphone (right)



Deformable and shape-changing display examples

- The left image shows a physical bar chart visualization displaying complex data (Jansen et al., 2013)
- The middle shows the tilt display that consists of multiple small displays mounted on actuators (Alexander et al., 2012)
- On the right is the PaperPhone, a flexible s… c… i… l…