CHAPTER 10: Devices

Designing the User Interface:

Strategies for Effective Human-Computer Interaction

Sixth Edition

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Devices

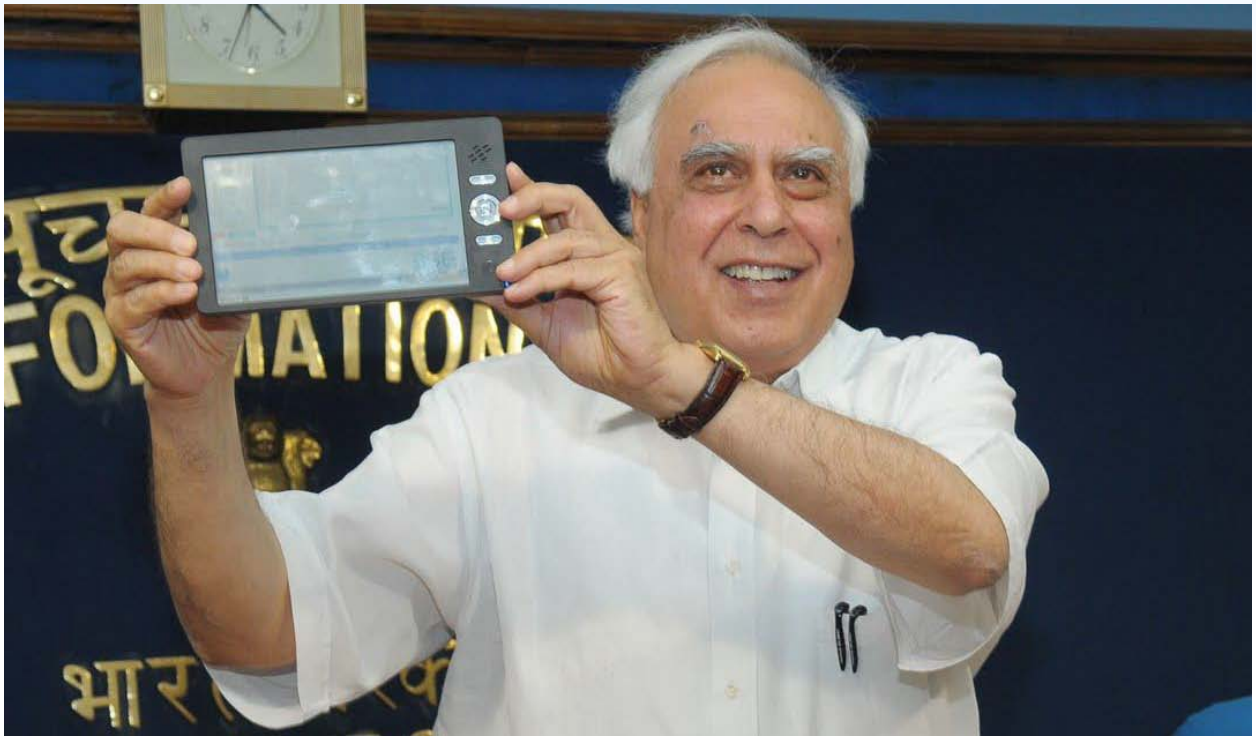
Topics

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)

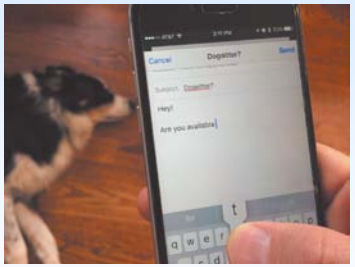
Keyboards and keypads

- 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 – Perform an action by executing a predefined motion
- Text – Enter, move, and edit text in two-dimensional space

Pointing devices

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.razerzone.com/gaming-mice/razer-ouroboros

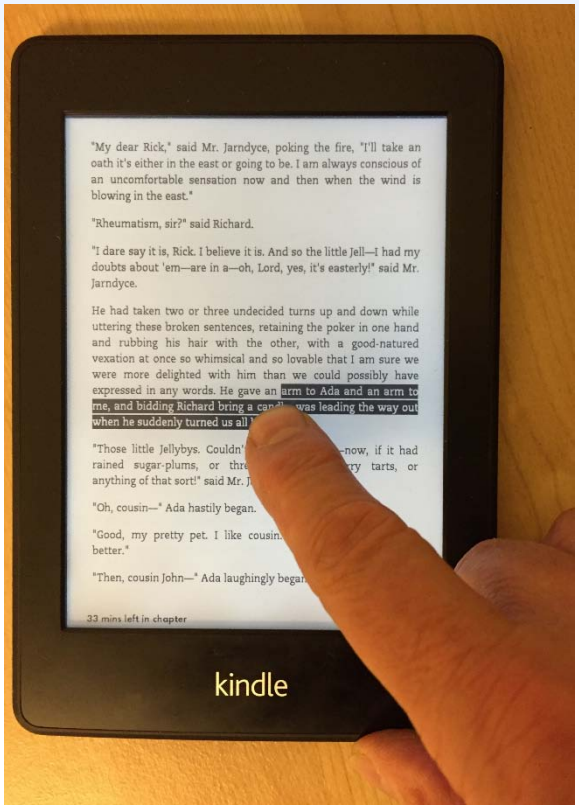
http://www.apple.com/

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 video)
- Cost
- Reliability

Display example



- An Amazon Kindle (http://www.amazon.com/) book reader being used to browse Bleak House by Charles Dickens.
- The Kindle uses E-Ink® technology (http://www.eink.com/), providing a bright display that uses power only when the display changes, and can be read in direct sunlight and at varying angles, which can improve reading comfort (see Section 14.4 for a discussion of reading on paper versus on a display).

Another Display example

- 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/reality-deck-home/)

Another Display example

- 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)

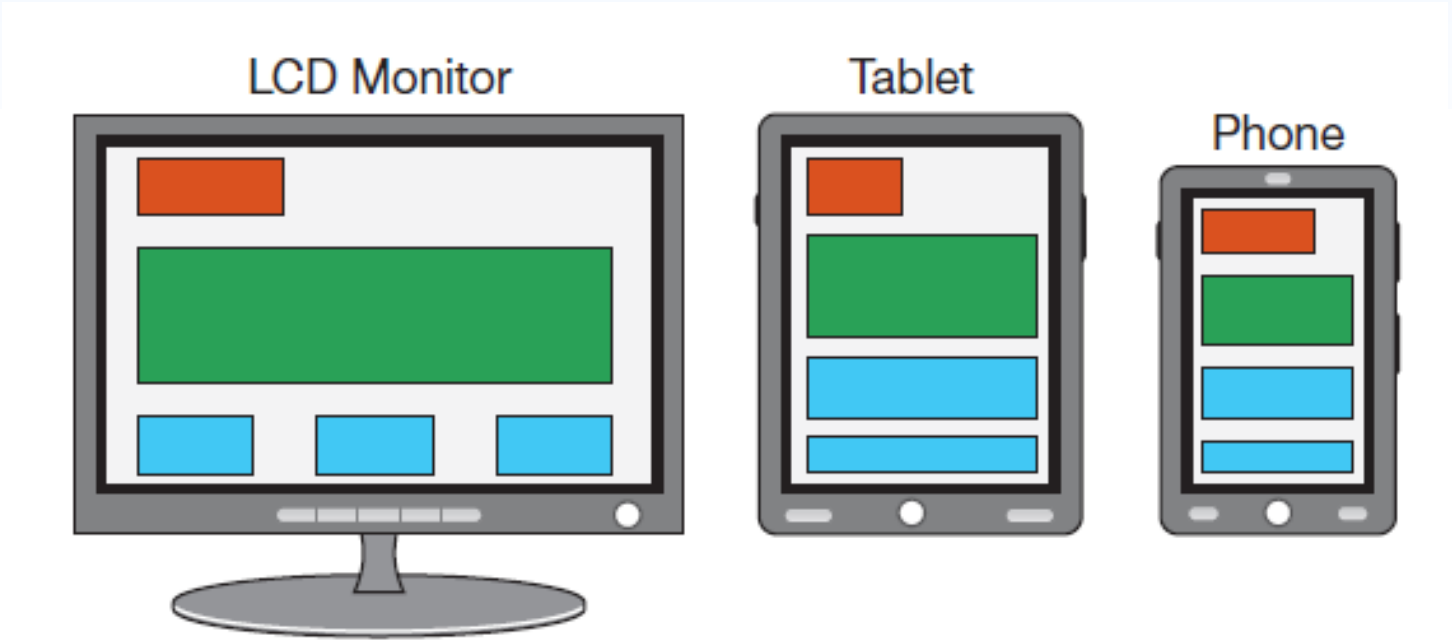
Another Display example

- 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 allows users to work independently
    (McGrath et al., 2012)

Another Display example

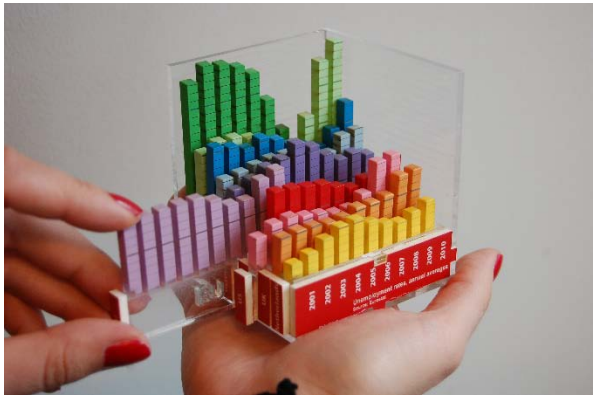
- The Apple Watch on the left supports both fitness as well as personal information management applications, such as email, calendar, and electronic payment
- The Fitbit Surge smartwatch on the right is designed mainly for personal fitness applications, and contains a step counter, heart rate monitor, and GPS

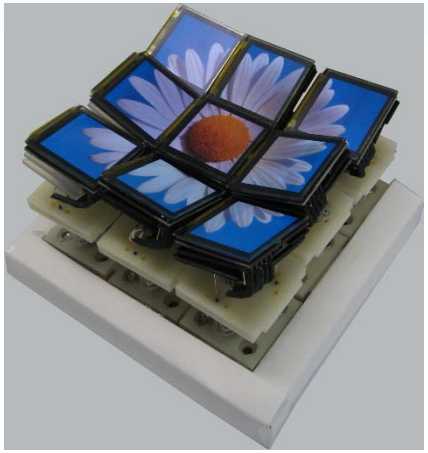
Responsive Design



- The monitor layout on the left is automatically adapted to the smaller display space of a tablet (middle) and a smartphone (right). Also see Chapter 8.

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 smartphone prototype that supports bending interaction (Lahey et al., 2011)