Touch and Tangibles on Large Interactive Surfaces

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Multi-touch Surfaces

- Technologies
- Workplaces
- Tangibles on Interactive Surfaces
Why Multi-touch Surfaces?

• Single-touch is already very intuitive
  • Touch at locus of attention (direct touch)
  • No additional device is necessary

• Richer and more natural interactions
  • Multiple fingers of one hand
  • Two-handed interaction

• Further step towards Ubiquitous Computing
  • Enables multi-user interaction
  • Tabletops already convenient working environment
  • Awareness
Problems with Touch Input

- Fat finger problem
- Fast but in inaccurate

[Holz and Baudisch CHI '11]

[Forlines et al. CHI '07]
Technologies

- Resistive
- Vision-based
  - Frustrated Total Internal Reflection (FTIR)
  - Diffuse Illumination (DI)
  - Pixel Sense
- Capacitive
Resistive Touch Screens

- Flexible hard-coated outer membrane
- Conductive coating
- Insulating spacer dots
- Conductive coating
- Glass substrate
Resistive Touch Screens
Vision-based Touch Screens
Frustrated Total Internal Reflection (FTIR)
Background
Background Subtracted
Thresholded
Diffuse Illumination (DI)

Tabletop

Projector

IR Camera

Screen
Example of DI: Microsoft Surface 1
Diffused Surface Illumination
Reduced Form Factor

FiberBoard

Microsoft Surface (Pixel Sense)
Capacitive touch
Transmitting Electrodes

Receiving Electrodes
Transmitting Electrodes

Receiving Electrodes
In-class Exercise: Predicting Future

Will multi-touch interaction replace the desktop metaphor?
Multi-touch Workspaces

The DigitalDesk (Wellner, CHI '91)

Living with a Tabletop
Multi-touch Workspaces
Vertical vs. Horizontal Surfaces

- **Vertical**
  - Good for reading task
  - Good for overviews
    - Gorilla arm effect

- **Horizontal**
  - Annotation task
  - Placing everyday object on it
    - Neck pain
Combining Horizontal and Vertical Surfaces

Tilted Tabletop
(Müller-Tomfelde, '08)

ViCat (Chen, Tabletop ‘06)
Curved Surfaces

Sun Starfire (Tognazzini, CHI ’94)

BendDesk (Weiss, ITS ’10)

Curve (Wimmer, NordiCHI ’10)
BendDesk System Overview

vertical
curve
horizontal
Interaction on Curved Surface
Interaction on Curved Surface

- Curve influences dragging performance
- Body mechanics matter
- Continuous gestures work, but haptic barrier
- Different cognitive mappings between 2D vs. 3D space
- **Vision-based touch screen!**
In-class Exercise: Predicting Future

Try to type on your smartphone without looking at the screen.
Limited Haptic Feedback
Tangibles on Interactive Surfaces
Tangible User Interfaces

- **Urp** Underkoffler, Ishii CHI’99
  - Urban planning simulator
Tangible User Interfaces

*reactTable* Jordà et al. TEI’0
SLAP Widgets

Keyboard
Knob
Keypads
Slider

[Weiss et al. CHI '09]
SLAP Keyboard
SLAP Knob

jog wheel mode

menu/value mode
Multi-Focus Policy
Pairing
Pairing
Multi-Touch Table

Tabletop

raw

Projector

background subtracted

IR Camera

connected components

FTIR

oriented spots

raw background subtracted connected components oriented spots
Widget Detection

Tabletop view

IR camera view
(640x480, 120fps)
Widget Detection

Keyboard

Slider

Keypad

Knob
The eLabBench

[Tabard et al. ITS '11]
The eLabBench

[Tabard et al. ITS ’11]
Tangibles on Capacitive Touch Screens

Capstones [Chan et al. CHI 2012]

CapWidgets [Kratz et al. CHI 2011]
Summary

- Technologies
- Multi-touch Workspaces
- Tangibles
  - On optical systems
  - On Capacitive systems