Surface Computing

Holowall, ’97

DiamondTouch, ’01

FTIR Display, ’06

Perceptive Pixel TouchWall

TouchLight, ’06

Apple iPhone

Smart Table
Microsoft Surface
Surface Computing

An interface where instead of through indirect input devices (mice and keyboard) the user is interacting directly with the content on the screen’s surface.

Direct un-instrumented interaction!
Surface Computing

“Surface computing is the term for the use of a specialized computer GUI in which traditional GUI elements are replaced by intuitive, everyday objects.”

Wikipedia

Content is the interface!
Digital vs. Real
Beyond Flat Surface Computing

Transcend the flat two-dimensional surface and typical 2D media associated with it and explore the curved, three-dimensional interfaces that cross the boundary between the digital and physical world.

- Direct un-instrumented interaction
- Content is the interface
Two Approaches

1. Non-flat interactive surfaces
2. Depth-aware interactions above the surface
Approach #1

Enable touch and gesture interactions on non-flat surfaces.
Projection

Diffuse ball

Wide angle lens

Projector
Projection + Sensing

Diffuse ball

Illumination ring (IR LEDs)
Wide angle lens
Cold mirror
IR pass filter
IR cut filter
IR camera

Projector
Reusing the Optical Path

Projection path (Visible)

Tracking path (IR)
Sensing & Projection Distortions
Unique Properties = Opportunities

- Borderless, but finite display
- Non-visible hemisphere
- No master user position/orientation
- Smooth transitions between
  - Vertical and horizontal
  - Near and far
  - Shared and private
Sphere Interactions
OmniDirectional Projector

- Illumination ring (IR LEDs)
- Wide angle lens
- Cold mirror
- IR pass filter

- Projector
  - IR cut filter
  - IR camera
Everywhere Displays

Pinhanez et al. ‘01
Pinch-the-Sky Dome
Omni-Directional Content

- WorldWide Telescope
- Graph visualizations
- Panoramic images
- Immersive animations
Pinch-the-Sky Dome
Gesture Delimiter Problem
Freehand Interactions
Approach #2

Enable freehand gesture interactivity in mid-air above the display.
Depth Sensing Camera

- Gives depth map + color
- RGBZ pixels

Infrared camera + GaAs solid state shutter
RGB camera
Pulsed infrared lasers

3DV ZSense Camera
How does it work?
DepthTouch

Benko & Wilson, Tabletop 2008
Beach Volleyball
MicroMotoCross
Above the Surface Interactions

Hilliges, Izadi, Wilson, Hodges, Butz, & Garcia-Mendoza, ACM UIST2009
Project Natal for Xbox
Project Natal
Challenges

- Preserving the direct experience
  - The only experience the user needs is *life experience*
- Finding applications and appropriate content
- Facilitating the ecosystem of heterogeneous devices
Trends That Will Help

- Mobile pico projectors
- Displays with sensor in pixel
- Flexible eInk or OLEDs
- “Cheap” computation
Vision

We live in the non-flat world.

Our computer interfaces will become non-flat too.

This is NOT the end of 2D interfaces. They will continue to be very useful.

But, the standard computer interface is changing: Content is the new interface.

Challenges are in finding and adapting the content and the interactions to the new form factors.
Contact

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Surface Computing Research

Holowall, '97
Augmented Surfaces, '99
DiamondTouch, '01
PlayAnywhere, '05
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