Multi-touch

- “Intuitive”, easy, powerful
- Widens computing for both novices and experts
- Non-traditional form-factors require non-traditional input
- Rich new undiscovered territory for UI innovations
- Multi-touch inherently implies multi-user
Multi-touch is NOT...

*(just because it uses both hands)*

completely distinct interface (and associated issues)
Overview, Culture

• Perceptive Pixel is dedicated to the research, development, and deployment of multi-touch/multi-user interfaces for the knowledge worker

  • First public demonstration at TED conference in February 2006
    – Founded in June 2006 by Jeff Han (Chief Scientist)
    – Venture backed
    – 4 offices, headquartered in NYC, along with DC, Portland, Palo Alto

  • Leadership role in this growing ecosystem
    – Very strong recognition for innovation, excellence

  • Both research and product engineering
    – Hardware and software
    – Strong research heritage, aggressive green field capture
    – Strong IP culture

  • Strong IP portfolio, > 40 patents in both hardware and software
    – Contributions in sensors, optics, mechanics,
    – Interaction techniques ("gestures")

• Markets
  – Primary markets: government/defense, broadcast
  – Secondary markets: energy, medical imaging, finance, engineering
  – Horizontal corporate application (business intelligence, collaboration,

Overview - Solutions

The most advanced user-interface solutions available, tightly integrating both hardware and software together to literally define the market

- First to market for large-format multi-touch with unprecedented fidelity
- 100” Wall (flagship) started shipping in Jan 2007
- Patent-pending FTIR hardware technology
- Unlimited simultaneous points (“true”)
- High spatial and temporal resolution
- Low latency
- True hover discrimination (eliminates false triggers)
- Pressure/force sensing
- Usable with bare hands, gloves or stylus
- Scalable from 55” to 200”, HD to QFHD
- Proven mission-critical reliability
Jeff Han is about to change the face of computing. Not even the big boys are likely to catch him.

Emerging Companies Summit 2010
Overview - Solutions

• First to market with large-scale true multi-touch HD LCD (55’’)
  – No compromises in features or functionality
  – Every spec has been improved from RP Walls
  – Scalable from 42’’ to > 108’’, QFHD resolutions

• Complete Solution Offering
  – Form-factors spanning the full range
  – 100” Wall, 55” LCD, desktop
  – High-performance Software
    • Advanced core middleware
    • Rich SDKs (C++, Java, Flash, etc.)
    • Integrations with key 3rd party apps
    • Out-of-box Applications
  – Implementation/Services Capability
    • Unrivaled know-how, expertise in user interface technology
Solutions – Integrated Middleware

- High-performance graphics engine, scene graph
  - Novel event architecture
  - Special considerations for simultaneity, concurrency

- Gesture recognition system
  - Broad library of basics (taps, flicks, drags, chords, double/triple, etc.)
  - Novel, non-trivial gestures (e.g. “menu loop”, etc.)
  - Extensible

- Direct Manipulation Controllers
  - Sophisticated common mathematical framework
  - 2D, 3D, geo, volumetric, slicing planes, etc.

- Rich Dataset Viewers

- Widget library
  - Completely new multi-touch enhanced widgets/controls

- Market Specific Modules: Geo-Spatial, Broadcast, Weather

- High performance Browser

- Multi-device synchronization across network
  - Scalable, down to AIO, laptop, and mobile devices

- C/C++, Java, .NET

- Operating System Agnostic:
  - Runs on all flavors of Windows (XP/Vista, not just 7)
  - Mac OS X
  - Linux
  - both 32 and 64-bit

- Alternative software platforms
  - Flex/AIR/Flash
  - VizRT

- Considering:
  - iPhone/iPad
  - MeeGo
  - Android
  - HTML5
  - Silverlight
Defense/Government
Medical Imaging
Emerging
Other form-factors
Demo/Video
FTIR sensing technology
FTIR Approaches

• Total Internal Reflection (TIR)
  – Light meets an interface into a material of lower index of refraction
  – This is said to be *frustrated* when another material interferes
Sensing Theory of Operation
Optical Schematic

- Total Internal Reflection
- Acrylic Pane
- LED
- Baffle
- Diffuser
- Scattered Light
- Video Camera
Raw Infrared View
Raw Infrared View, Pressure Sensing
LCD55
Desktop LCDs, multi-screen
Fundamental Interaction Research

- Hi-DOF dataset direct manipulators
- Multi-user collaboration
- Multi-modal combinations of techniques
Research (2006)

Parameterization Algorithm

Linearized Bending Energy

\[ t^T A t = E = \sum_i \frac{1}{\text{area}_i} \left( \sum_{j \in \mathcal{N}_i} \left( \cot \alpha_{ij} + \cot \beta_{ij} \right) (t_i - t_j) \right)^2 \]

Constraints

Modify system

\[
\begin{pmatrix}
A^e & C^T \\
C & 0
\end{pmatrix}
\]

bending energy Hessian

Need a scheme for quickly updating inverse

Results
Interaction Research (2008)

- Using pressure information to solve the classic 2.5D layering problem

Interaction Research (2009)

- A constraint-based approach to direct manipulation, allowing users to effectively control 3D and higher DOF models with multi-touch

Emergent Interactions
4-point Interactions
Terrain Navigation
“Multi”

Main Entry: multi-

Function: combining form

Etymology: Latin, from multus much, many — more at MELIORATE

1 a: many: multiple: much <multivalent>  b: more than two <multilateral>  c: more than one <multiparous> <multibillion>

2: many times over <multimillionaire>