Motivation, Claim, Related Work

Cynthia Taylor, CSE 118, UC San Diego
Motivation

While touch sensing is commonplace for single points of contact, it is still difficult and/or expensive to construct a touch sensor that can register *multiple* simultaneous points of contact. Multi-touch sensing enables a user to interact with a system with more than one finger at a time, as in chording and bi-manual operations. Such sensing devices are inherently also able to accommodate *multiple users* simultaneously, which is especially useful for larger shared-display systems such as interactive walls and tabletops. Initial investigations, though sparse due to the prohibitive availability of these devices, nonetheless reveal exciting potential for novel interaction techniques [1][2][11][12][19][23][26][27].

Low Cost Multi-Touch Sensing
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Define the problem
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**Define the problem**

- Multi-touch
- Difficult
- Expensive
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**Why should we care about this problem?**
“Multi-touch sensing enables a user to interact with a system with more than one finger at a time, as in chording and bi-manual operations. Such sensing devices are inherently also able to accommodate *multiple users* simultaneously, which is especially useful for larger shared-display systems such as interactive walls and tabletops. Initial investigations, though sparse due to the prohibitive availability of these devices, nonetheless reveal exciting potential for novel interaction techniques [1][2][11][12][19][23][26][27].”

**Why should we care about this problem?**

- Multiple users
- Novel interaction techniques
- References: Lots of other people care about it
Motivation

- Establish the problem you will solve.
  - People Problem
  - Technical Problem
- Show that it really is a problem, and we should care about it.
Claim

We present a simple technique for robust multi-touch sensing at a minimum of engineering effort and expense. It is based on frustrated total internal reflection (FTIR), a phenomenon familiar to both the biometric and robot sensing communities. It acquires true touch image information at high spatial and temporal resolutions, is scalable to large installations, and is well suited for use with rear-projection. It is not the aim of this paper to explore the multi-touch interaction techniques that this system enables, but rather to make the technology readily available to those who wish to do so.

Low Cost Multi-Touch Sensing
We present a simple technique for robust multi-touch sensing at a minimum of engineering effort and expense.
We present a simple technique for robust multi-touch sensing at a minimum of engineering effort and expense.

We have solved this problem!
It is based on frustrated total internal reflection (FTIR), a phenomenon familiar to both the biometric and robot sensing communities.
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This is how we solved this problem.
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This is why it is a good way to solve this problem.
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This is what we didn’t do.
Claim

• Did you solve the problem?
• Did you solve a subset of the problem?
• Did you come up with a new definition of the problem or learn more about the problem?
• How did you solve it?
• Why is this a good way to solve it?
Related Work

- What have other people done that is similar to your work?
- How is your work different?
- What have other people done that you are building off of?
REFERENCES


References

Mueller exploited the phenomenon in 1973 for an imaging touch sensor that allowed users to “paint” onto a display using free-form objects, such as brushes, styli and fingers [17]. In that device, light from the flying spot of a CRT is totally internally reflected off the face of a large prism and focused onto a single photodetector, thereby generating an updating bitmap of areas that are being contacted. Greene rediscovered this method in 1985 in his Drawing Prism [5], but updated in optically inverted configuration, with a video camera and a broad light source replacing the CRT and photodetector.


Lewis¹ has pointed out that pictures of great textural complexity can be painted much more simply with traditional media, which act as gesture amplifiers, than with standard digital paint programs, which ignore most gestures. His paint program provides a digital medium whose texture generating capabilities rival those of traditional media. However, that does not solve the problem of how to control such a texture synthesizer in a manner as powerful as the gesture sensitivity of traditional tools.

Schmandt² has demonstrated the feasibility of tracking all six degrees of freedom of a hand-held stylus, for use in a paint program. Minsky³ described a multi-dimensional input device which was built specifically to be sensitive to some single finger gestures and which implemented a fingerpaint program. However, these devices do not yet provide the same kinds of artistic control as traditional tools. In order to mimic a paintbrush, they would still require the software to simulate, in real time, the behavior of a wet bundle of flexible fibers, bound at only one end to a stylus. Even in such a primal medium as fingerpainting, all ten fingers may come into play, and the ridges and creases of the skin may add an expressive textural element.

8. References


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**The Drawing Prism**
The drawing prism: a versatile graphic input device
Artists using conventional computer graphic input devices cannot produce the same visual effects which they can with traditional tools and media. The drawing prism is a new device which allows people to draw or paint directly into a frame buffer, using brushes, their hands, or a variety...
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Graphical input controller and method with rear screen image detection
Low-cost multi-touch sensing through frustrated total internal reflection
JY Han - Proceedings of the 18th annual ACM symposium on ..., 2005 - portal.acm.org
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ABSTRACT We introduce I/O Brush, a new drawing tool aimed at young children, ages four and up, to explore colors, textures, and movements found in everyday materials by "picking up" and drawing with them. I/O Brush looks like a regular physical paintbrush but has a small ...
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by Mark Hancock, Sheelagh Carpendale

Abstract:

On traditional tables, people frequently use the third dimension to pile, sort and store objects. However, while effective and informative for organization, this use of the third dimension does not usually extend far above the table. To enrich interaction with digital tables, we present the concept of shallow-depth 3D – 3D interaction with limited depth. Within this shallow-depth 3D environment several common interaction methods need to be reconsidered. Starting from any of one, two and three touch points, we present interaction techniques that provide control of all types of 3D rotation coupled with translation (6DOF) on a direct-touch tabletop display. The different techniques exemplify a wide range of interaction possibilities: from the one-touch technique, which is designed to be simple and natural, but inherits a degree of imprecision from its simplicity; through to three-touch interaction, which allows precise bimanual simultaneous control of multiple degrees of freedom, but at the cost of simplicity. To understand how these techniques support interaction in shallow-depth 3D, we present a user study that examines the efficiency of, and preferences for, the techniques developed. Results show that users are fastest and most accurate when using the three-touch technique and that their preferences were also strongly in favour of the expressive power available from three-touch. Author Keywords Shallow-depth 3D, tabletop display, direct-touch, rotation

Citations

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238 DiamondTouch: A Multi-User Touch Technology – Dietz, Leich

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  author = {Mark Hancock and Sheelagh Carpendale},
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Ranjitha Kumar, Jerry Talton, Salman Ahmed, Scott Klemmer, Stanford University (United States)
This paper introduces the Bricolage algorithm for example-based retargeting of Web designs. The algorithm automatically transfers the content of one Web page into the style and layout of another.

Teenagers and Their Virtual Possessions: Design Opportunities and Issues
William Odom, John Zimmerman, Jodi Forlizzi, Carnegie Mellon University (USA)
We report on interviews with teenagers exploring the perceived value of their virtual possessions compared to material things, and detail research and design opportunities and issues in this emerging space.

Mid-air Pan-and-Zoom on Wall-sized Displays
Mathieu Nancel, Julie Wagner, Emmanuel Pietriga, Olivier Chapuis, Wendy Mackey, INRIA; Univ. Paris-Sud & CNRS (France)
Design and evaluation of multiscale navigation techniques for very large displays based on three key factors: number of hands involved, type of movement, type of feedback.

Why Is My Internet Slow?: Making Network Speeds Visible
Manshiri Chatty, Georgia Institute of Technology (USA)
David Haslam, Orange Sparkle Ball (USA)
Andrew Baird, Amazon.com (USA)
Ugochi Ofona, Bethany Sumner, Rebecca Griner, Georgia Institute of Technology (USA)
Describes field trial of home broadband management tool. Can assist Internet policy makers, Internet Service Providers and designers understand home Internet user needs for checking and managing broadband speed.

Synchronous Interaction Among Hundreds: An Evaluation of a Conference In an Avatar-based Virtual Environment
Thomas Erickson, N. Sadat Shami, Wendy Keiload, David Levine , IBM T.J. Watson Research
Multi-touch

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This article may contain excessive, poor or irrelevant examples. You can improve the article by adding more descriptive text. See Wikipedia's guide to writing better articles for further suggestions. (December 2009)

In computing, **multi-touch** refers to a touch sensing surface's (trackpad or touchscreen) ability to recognize the presence of two or more points of contact with the surface. This plural-point awareness is often used to implement advanced functionality such as pinch to zoom or activating predefined programs.

In an effort of disambiguation or marketing classification some companies further breakdown the various definitions of multi-touch. An example of this is 3M defining multi-touch as a touch-screen's ability to register three or more distinct positions. [1]

### Contents

- History
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### History

The use of touchscreen technology to control electronic devices pre-dates multi-touch technology and the personal computer. Early synthesizer and electronic instrument builders like Buchla, Le Caire and Bob Moog experimented with using touch-sensitive control surfaces to control the sounds made by their...
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