Multi-Touch Interaction Wall

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1 Introduction

Touch is a very natural and intuitive way for people to interact. However, typical touchscreen technology, such as that commonly found in kiosks and interactive whiteboards, are limited to detecting only a single point of contact at a time. This makes them completely unsuitable for enabling touch interaction on larger displays designed to accommodate multiple users, since any one touch will prevent any others from being registered at the same time.

The *Multi-Touch Interaction Wall* is a 16-feet long by 3-feet high rear-projection surface that has the unique capability of detecting multiple points of contact simultaneously. At this Emerging Technologies installation, we demonstrate an assortment of innovative applications and user interfaces that leverage this unique device.

Multi-touch sensing enables the user to finally interact with both hands at once, as well as to employ more complex chording gestures, promising great improvements in usability, intuitiveness, and efficiency. Such a system also inherently accommodates multiple users simultaneously, a point that we emphasize through the horizontal scale of this installation, which results in a very inviting environment for multiple attendees to be able to walk up to and interact with the display.

Multi-touch is one of the most exciting fronts in user interface research, and will almost certainly be a component of how we interact with machines in the future.

2 Sensing

Multi-touch sensing for human-computer interfaces has been experimented with since at least the early 1980s. However, previous approaches to this are either too complex to scale practically, limiting them to only small individually-sized implementations, and/or are visually opaque, forcing systems to resort to front-projection.

Other gesture input systems involve (e.g. video) tracking of users' hands or fingertips, but they offer no tactile context or feedback, limiting their real-world usability; the input modalities associated with these gesture based systems are correspondingly vague and imprecise.

We utilize a recently introduced multi-touch sensing technique [Han 2005] which is based on *frustrated total internal reflection (FTIR)*. Briefly, infrared light is introduced edge-wise into a platen waveguide, where most of it stays trapped due to total internal reflection. However, another material in optical contact at the surface-air boundary can frustrate this reflection, causing light to escape there instead. This phenomenon is well known and has been exploited for the acquisition of fingerprint images since at least the 1960s. Here, the technique is scaled up so that we image the fingertips themselves instead of their ridges.

This approach has enormous advantages in simplicity, performance, and scalability, only through which this large scale installation becomes feasible.

3 Interaction

However, the sensing technology merely serves as an enabler for the whole new class of interactivity that now becomes possible, which goes far beyond the usual gross gestural interactions typical of an installation of this scale. Due to space limitations, we describe only a subset of them here:

In our lightbox application, users can not only move photographs around each with both of their hands, but can also use a simple two-point operation to simultaneously pan, zoom, and rotate the object in one natural and intuitive motion. A similar interface is offered in a geospatial browsing application, but along with additional gestures to handle navigation in the 3rd dimension.

In our fluid, smoke, and lava applications, users can sculpt within a physically-based amorphous medium, directly manipulating it in a natural and realistic manner. We also demonstrate a sophisticated sketching/animation tool that allows user to interactively deform and animate a mesh through multiple simultaneous constraints.

Music is also a natural application space since we can capture a greater amount of expression out of the performer, and we demonstrate a variety of polyphonic instruments, as well as a modular synthesis & control application. Finally, gaming and entertainment applications abound from the system's ability to seamlessly accommodate multiple users either collaboratively or competitively.

References

HAN, J. Y. 2005. Low-Cost Multi-Touch Sensing through Frustrated Total Internal Reflection. In *Proceedings of the 18th Annual ACM Symposium on User Interface Software and Technology*. UIST '05. ACM Press, New York, NY, 115-118.

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