

Designing Tangible Interfaces for Richer Media Experiences

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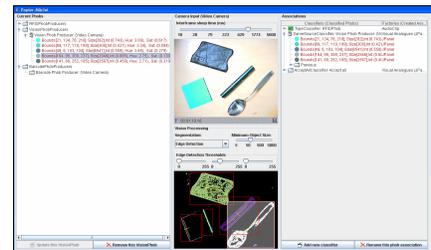
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Tangible user interfaces (TUIs) augment the physical world by integrating digital information with everyday physical objects. Developing tangible interfaces is problematic because programmers are responsible for acquiring and abstracting physical input. This is difficult, time-consuming, and requires a high level of technical expertise in fields very different from user interface development—especially in the case of computer vision. Consequently, only a small cadre of technology experts can currently build these UIs. Based on a literature review and structured interviews with TUI researchers, we created Papier-Mâché [2, 4], a toolkit for building tangible interfaces using computer vision, electronic tags, and barcodes. Papier-Mâché introduces high-level abstractions for working with these input technologies that facilitates technology portability. We evaluated this toolkit through a laboratory study and longitudinal use in course and research projects, finding the input abstractions, technology portability, and monitoring facilities to be highly effective. In this talk, I will discuss new software tools and interaction techniques for tangible user interface input. This work comprises *Papier-Mâché*, a toolkit for building tangible UIs; *Books with Voices*, a system providing barcode-augmented paper transcripts for random access to digital video; and *The Designers' Outpost*, a tangible UI for collaborative web site design.



Papier-Mâché's design has been deeply influenced by my experiences building physical interfaces. Web designers use pens, paper, walls, and tables for explaining, developing, and communicating ideas during the early phases of design. These practices inspired The Designers' Outpost [1, 2, 5, 6]. With Outpost, users collaboratively author web site information architectures on an electronic whiteboard using physical media (Post-it notes and images), structuring and annotating that information with electronic pens. This interaction is enabled by a touch-



sensitive electronic whiteboard augmented with a computer vision system. We conducted several studies of this system that validated that Outpost supports information architecture work practice and led us to develop support for design history, remote collaboration, and fluid interoperability with other design tools.

The second major TUI we developed focused on oral historians. While oral historians consider interview recordings a central historical artifact, these recordings sit unused after a written transcript is produced. We hypothesized that this is largely because books are more usable than recordings.

Therefore, we created Books with Voices [2, 3]: barcode-augmented paper transcripts enabling fast, random access to digital video interviews on a PDA. Our evaluation found this lightweight, structured access to original recordings to offer substantial benefits with minimal overhead. Both the



Designers' Outpost and Books with Voices could have been built in a fraction of the time if the Papier-Mâché toolkit had been available.

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BIOGRAPHY

Scott Klemmer is an Assistant Professor of Computer Science at Stanford University. He received a dual BA in Art-Semiotics and Computer Science from Brown University in 1999, and an MS and PhD in Computer Science from UC Berkeley in 2001 and 2004 respectively. His research addresses tangible user interfaces and user interface software tools. Several of his research systems have had commercial impact: the SUEDE speech design tool has been used and extended by dozens of companies; The Designers' Outpost system for vision-based capture of walls inspired product features at SMART Technologies; and the handheld Books with Voices system helped fuel advanced development at Ricoh Innovations.