

# Around the Table

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## 1 Introduction

Tables are a familiar piece of furniture commonly found in homes, offices, cafés, design centers, show rooms, waiting areas, and entertainment centers. Tables provide a familiar and convenient physical setting for people to meet, chat, look over documents, and carry out tasks that require face-to-face collaboration. Digital documents, on the other hand, are commonly used only on desktop computers and handheld devices. Digital documents are much easier to share remotely than face-to-face, due to a lack of a physical media that contain the necessary computational support for face-to-face around the table applications. For the past two years, our group has designed and built a digitally augmented tabletop environment called DiamondSpin. Our objectives are to research and study new HCI mechanisms that can enable tabletop applications.

## 2 Tables Are Not Desks

Making computation disappear into the architecture space is only one of the challenges in the design of a digitally augmented tabletop environment. At the same time, making the interactions with a digital user interface on the table disappear into and become a part of the human to human interaction and conversation is a bigger challenge. Studies on digitally augmented desks [4] support user activities that are focussed tasks, such as writing, editing, calculation, design and drawing. On the other hand, people usually sit around a table, facing each other, rather than facing the display. A table setting encourages conversation, thus social informality and casualness.

The user interface design and its realization of a tabletop environment should not be viewed as extensions of desktop systems. Tables predate computers, as such, tabletop computer interfaces should preserve much of the familiar and useful properties a physical tabletop affords. These should include the ability to pass objects around the table, and the ease of spreading out, piling and shuffling documents. As with any interactive system, a tabletop application should provide fast response time for these familiar functions.

### 3 DiamondSpin, PDH and DiamondTouch

DiamondSpin is a circular tabletop environment that preserves the simplicity and informality of around-the-table interaction, while at the same time provides a rich set of UI functions for interactive and collaborative document browsing, visualization, manipulation and navigation by small groups of people [2]. DiamondSpin focuses on the study of what affordances an augmented digital table should offer.

When multiple people gather around a table, there is no single directional viewing angle that is ideal for everyone present. We postulate that a polar-coordinate system, which is well suited to a circular display, can provide a continuous orientation among multiple people and can allow sharing of documents by rotating individual items or by rotating the entire display. The key research problems that the DiamondSpin architecture addresses stem from three unique characteristics of a user interface that is circular and is on a tabletop: (1) handling the polar location, orientation and deformation of documents on the table, (2) manipulating, displaying and refreshing large quantities of pixels from potentially many piled and overlapped documents, and (3) managing multi-user collaborative activities. The first application that we have experimented with using DiamondSpin is called PDH – Personal Digital Historian [1,3].

Creating a new type of interface requires addressing many issues. One of PDH's primary focuses is on developing content organization and retrieval methods that are easy and understandable for the users, and can be used without distracting them from their conversation. Rather than a folder&file mechanism, PDH organizes the contents along the four W's of storytelling (Who, When, Where, and What) and allows users to design new contexts for organizing their structures. A second issue we have focused on is affording casual and exploratory interaction with data by combining a multiplicity of user interaction mechanisms including in-place query and in-place pop-up menus, direct manipulation, natural visual query formulation with minimal menu-driven interaction and freeform digital ink strokes. Finally, in order to support the multi-threaded and non-linear progression of group conversation, PDH provides tools to help people navigate a conversation as well as their content.

Recently, we have ported DiamondSpin onto the multi-user touch technology tabletop surface of DiamondTouch [7]. DiamondTouch provides significantly more interactions than conventional input technologies. Most noticeably, two or more users can **simultaneously** operate on the table. Additionally, each user is not limited to a single point of contact. This is drastically different from the sequential turn taking that arises when people use traditional input devices. We thus have started to develop a taxonomy of task elements with respect to the semantics of control sharing, ranging from fully concurrent multi-input to sequential sharing. The affordances of a digital tabletop are new territory; we have much exploration ahead of us.

## 4 Looking into the Future

Research on collaboration with interactive tables is still in its infancy. There is still much to be studied and understood. Together in this workshop, as a starting point, we hope to explore the following open areas:

- as suggested in [5], a taxonomy of group oriented tasks [6].
- a taxonomy of affordances, and their associated behaviors and communication phenomena for augmented architecture spaces.
- evaluation metrics and criteria for these tasks and affordances.
- input methods and devices.

## References

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## Bios

**Chia Shen** is Associate Director & Senior Research Scientist at Mitsubishi Electric Research Labs, Cambridge Research. Her research spans from non-traditional off-the-desktop interactive user interfaces and HCI for multi-user applications, to distributed real-time systems and multimedia systems in wired and wireless networks. Her long term research interest is to facilitate and enrich our communication from both the network level and the HCI perspective. Her most recent research projects include DiamondSpin, Personal Digital Historian(PDH) and MidART (Middleware for Distributed Real-Time Systems).

**Neal Lesh** research efforts aim to enhance (or at least ease) cooperation between people and computers. His current research projects include interactive optimization (the Human-Guided Search project), collaborative interface agents (the COLLAGEN project), and systems for collaborative navigation of digital data (the Personal Digital Historian project). Before coming to MERL Cambridge Research Lab, he studied with Oren Etzioni at the University of Washington and completed a thesis on scalable and adaptive goal recognition and worked as a postdoc with James Allen at the University of Rochester on the TRIPS collaborative planning project.

**Frederic Vernier** has conducted research in many fields of HCI from Information Visualization to augmented Reality. His main current research project is systems for collaborative navigation of digital data (the Personal Digital Historian project). His other on-going projects are related to fisheye views, web search engines interfaces, huge spreadsheet interface, improved treemaps algorithms and semi-mirror digital interfaces for presentation system and remote collaboration using combined gaze, gestures and documents. Before coming to MERL Cambridge Research Labs, he studied with Laurence Nigay at University of Grenoble (France) and completed a PhD thesis on output multimodality applied to information visualization. After his Postdoc at MERL Frederic Vernier has accepted a professor assistant position at University of South Paris (Paris XI - Orsay) starting September 2002.

**Clifton Forlines** is an independent user interface designer working in Boston, MA. Current and past projects include: Alice, an interactive 3D authoring tool for non-programmers; Jam-O-World, a multi-person musical gaming platform currently on display at Ars Electronica in Lenz, Austria; and StudyCards, a study tool distributed by Texas Instruments with their line of graphing calculators for middle and high-school students. Clifton has both a Masters of Entertainment Technology and a Masters of Human-Computer Interaction from Carnegie Mellon University in Pittsburgh, PA.