

The inSpace Table: Weaving Social Space Dynamics into the Design of Augmented Conference Rooms

Matt McKeon

Georgia Institute of Technology
Atlanta, GA

matt.mckeon@gatech.edu

1. INTRODUCTION

The inSpace project is an interdisciplinary collaboration between Georgia Tech and Steelcase, Inc. to design and build a next-generation meeting space. Our present work focuses upon three key elements of enhanced conference room design: supporting activity awareness for those entering the meeting, contextualizing meetings within the overall work environment, and giving the participant direct control over systems within the meeting room.

This last activity has presented us with a series of unique design challenges. Our vision of the “smart” conference room is predicated on smooth integration with the devices carried by meeting participants. In our explorations, we have sought to design an environment that could answer three common questions faced by users of enhanced conference rooms: “What can I do?”, “How can I do it?”, and “What are my colleagues up to?”.

2. BACKGROUND & APPROACH

As we create more sophisticated technologies to support meetings, our users will find themselves mired in increasing complexity. Multiple devices, displays, and services will become available, most of which will be opaque to the casual user without deliberate action on the part of the designer. Efforts such as the Stanford iRoom [1] seek to tame this complexity by creating more flexible and intuitive methods for users to share information between devices. In addition to such methods, we see a clear need for a services environment that provides appropriate transparency to meeting participants. This need becomes particularly urgent as we replace traditional, easily recognizable affordances (such as projector cables) with network-enhanced devices, providing greater flexibility while sacrificing tangibility and physicality.

Several researchers have explored tangible interfaces and nontraditional displays as a means of bringing these capabilities into the recognizable, physical world. Norbert Streitz [2] tackled this problem by creating a variety of “enhanced furniture” that enabled easy display composition and sharing. Our own work on inSpace suggests an approach that may serve as a useful template for building such physical instantiations of digital artifacts.

People use physical space to regulate their social interactions [3]. For example, anything from closing an office door to pushing oneself back from a conference table can serve as a subtle cue for a change in one’s engagement in collaborative activity. Meeting rooms, in particular, are places where social activity is channeled (for better or worse) by the physical environment. Over the course of a long meeting, large conference tables may become partitioned into personal and shared workspaces; as another example, the design of a meeting room’s public / private transition can radically

affect the interruptibility of the participants (and thus, the style of meetings that tend to be held there).

inSpace seeks to turn these points of contact between the physical and the social world to its advantage. Our intent is to carefully introduce certain features of social technologies into selected locations within the conference area, such that these features are congruent with how people use that space for collaborative activity. Our first interactive prototype is a central feature of most meeting rooms: the conference table.

3. THE INSPACE TABLE

3.1 Design process

We began by conceptualizing the table as a “stage” for meeting activities. The table is a single physical object that serves as a transition point between the private activities of meeting participants and their public, shared activities. Devices and objects placed on the table can be seen as “on-stage” and engaged in the group activity. The inSpace table was conceived as a stage that reacted to the devices and objects placed upon it, vividly illustrating how those items participated in group activity. For the initial prototype, we fixated on a particular set of services that had immediate relevance to most users with personal devices: connecting to large shared displays, basic file sharing, and “backchannel” communication (such as IM).

In our scenario of use, meeting participants may place devices or objects on the table in order to bring them into the context of the meeting. The system recognizes the items on the table, and provides ambient feedback on activity associated with those devices. Meanwhile, devices are provided with a fine-grained awareness of their physical context, which they may use to drive spatially-organized GUIs and contextually appropriate services.

Our early design process focused on prototyping various interactions and feedback styles. We kept gestures simple: placing a laptop or other mobile device on the table would “connect” it to the table position, giving the user immediate, visual feedback as to their connection status. We chose gentle, ambient lighting radiating internally from the table (to minimize distraction), and used a lighting arrangement that delineated private spaces while preserving the shared context of the table. Our animations maintain the personal / shared spatial mapping of the conference table: activities that are initiated by the participant (such as connecting to a shared display) animate inward towards the center of the table, while activities that are merely approved by the user (such as receiving a file) animate outward towards the user.

3.2 Table construction

The table itself consists of two layers: a wheeled base and an upper translucent layer mounted on standoffs. The translucent layer can be easily lifted off to expose the base layer, which includes onboard power outlets and wells for larger equipment. Designed and built by the Steelcase members of our team, this platform offers us a great deal of flexibility and reusability.

We selected high frequency RFID-based sensing for devices and objects placed on the table. For the first version, our table uses TI-S4100 multi-function reader modules coupled with home-built antennae mounted directly on acrylic struts. Our lighting system consists of 50 Color Kinetics iColor Flex nodes, mounted in semicircular arcs defining each table position.



Figure 1: Visual feedback on connecting to a shared display

3.3 Software architecture

The inSpace room agents run atop a basic general services platform developed by one of our team members, using Bonjour for naming and discovery and XML-RPC for interprocess communication. Sensing and feedback are coordinated via a *table manager* agent, running on a Mac Mini embedded in the table. Each tagged device runs a *client agent*, which provides a GUI for accessing local services. The client agent also advertises itself on the local subnet, using the unique identifier of its RFID tag as a name. When a participant places a tagged device on the table, the table manager looks up the client agent on the subnet (using the device's unique identifier) and queries the agent for available services. If appropriate, the table manager provides the client agent with location information that it may use to physically orient itself with respect to nearby devices.

A tagged device may vary widely in its capabilities. The device may be directly connected to the wireless network, or it may be proxied through another device via a non-IP protocol (such as Bluetooth or IR). The “device” may even be a non-interactive object (such as a corporate ID card) that serves as a phidget for a service hosted on an external server.

4. OPEN QUESTIONS

The inSpace table represents the first step in our ongoing effort to develop a usable, augmented conference room. Our early work has suggested a number of promising avenues of study and collaboration. First is the identification, characterization, and investigation of some of the social / spatial dynamics mentioned previously. How do people use the design and features of meeting rooms to regulate their social activity, in ways that may not be immediately apparent? How might we alter the meeting room environment to shape social activity? And what further technological interventions might enhance those activities?

Another key issue faced by inSpace is transparency. One of our design goals is to provide visibility into and direct control over the intangible services provided by the room. However, the appropriate choices regarding what to show and what to hide will necessarily vary based on user and context. Addressing this general problem of “translucency” – informing without overwhelming – as it applies to augmented meeting rooms is an important step in improving their usability.

Finally, there is the issue of adoption. A combination of complexity, startup time, and rapid obsolescence has meant that most enhanced conference rooms quickly fall into disuse. We believe that creating smaller and more flexible services, designing gentle environments that avoid overwhelming the user with bells and whistles, and designing upgradeability into the hardware itself are important first steps in addressing this problem. We hope that our own usage of the inSpace conference room will indicate whether these steps are sufficient. Regardless, we trust that this ongoing collaboration will continue to challenge and inspire us.

5. BIOGRAPHY

Matt McKeon is a research assistant at the Georgia Institute of Technology, working with Dr. Keith Edwards to develop ubiquitous computing platforms that go beyond the display and into your furniture. He graduated from Georgia Tech with an MS in HCI in 2006, having previously earned a BS in Computer Science and Poetry from Carnegie Mellon. Matt's other research interests have included reactive environments, pervasive social game design, the anthropology of networked communities, and collaborative visualization. He recently accepted a position with IBM Research's Collaborative User Experience group in Cambridge, MA.

6. REFERENCES

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