Hybrid Spaces of Practice

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Abstract: Research projects in computational design typically view digital tools as existing independently of their physical settings. However, what we witness are hybrid spaces of practice, one in which there is an increasing fusion and overlap of physical and digital objects and environments. Instead of focusing on digital tools and information in isolation, this paper argues for the need to conceptualise and experiment with hybrid work environments through combinations of place, time, scale, resolution and other dimensions to develop hybrid spaces of practice. The paper describes experiments with a work environment that consists of multiple displays and representations to motivate and characterise hybrid spaces of physical and digital work environments.

1 INTRODUCTION

Traditional design office environments consist of documents, notes and memos, drawings, models, and other information. Some of these documents are ready-to-hand, others displayed or stored according to perceived patterns of reuse and access. The tools with which information is created are available in both persistent and flexible ways. The information and tangible objects that result in design settings are part of a larger spatial context in which other objects, actors and phenomena co-exist. Furniture, display surfaces, who occupies which space, lighting conditions, visibility, proximity and sociability among co-workers, and many other factors lend a dynamic and peculiar character to how the work is conducted. Different task contexts lead to different combinations of tangible objects and spatial settings, what may be called spaces of practice in which task, artefacts and environments are in complex dialectical relationships with each other. In contrast, research projects in computational design typically view digital tools as existing independently of their physical settings. However, what we witness are hybrid spaces of practice, one in which there is an increasing fusion and overlap of physical and digital objects and environments. Instead of focusing on digital tools and information in isolation, this paper reports our preliminary findings to motivate a need to characterise hybrid spaces of physical and digital work environments.
There is a steadily growing literature on interactions between and among designers and their work in design studios. Such accounts (Cross et. al. 1996) of what constitutes designing and how it transpires often characterise design studios as variegated, amorphous, and yet purposeful spaces in which work actually gets done. The studio space is occupied by not just the designers but also by artefacts that support designing. Besides the actual work surface on which drawings (as descriptions of designs) are generated, one finds sketches, scale models, material samples, photographs, posters, notes, manifestos, and a myriad of other documents arranged strategically or in close proximity. As Henderson (1995) notes the role of such objects is to express, develop, detail, communicate and present an evolving design idea. As Latour (1986) argues these objects simultaneously support constructing an artefact and staging its performance and understanding by others, in a way that it invites others into a dialogue. These understandings and dialogues occur over a span of time and hence the need for some of those objects to be persistent whereas others are ephemeral.

In addition to the assemblage of objects as one distinguishing feature of design spaces, the other is designing as an act that oscillates between moments of solitary and group work, often interrupted (both accidentally and intentionally) by interactions with colleagues. The informal ways in which collective memories and experiences are retrieved, passed on and built upon in design studios has also led to a number of ethnographic studies and observations (Buscher et al., 2001).

Besides the designers and objects that they construct and surround themselves with, other factors that lend a dynamic and peculiar character to how the work is conducted include furniture, display surfaces, who occupies which space, lighting conditions, visibility, proximity and sociability among co-workers, and many other factors (Figure 1). However, it should be stressed that there is no one uniform pattern of work practice, rather practices that are contingent and constantly evolving, adapting and changing as a function of the particular dynamic of people, places, and
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projects. Secondly, the nature of objects and interactions in design studios are amorphous and has no definite boundaries. For example, where exactly does design work get done? Everywhere and nowhere in particular though one might point to a drafting table or a group discussion space to fixate these activities in space. Thus the objects, places, and work have porous edges, conceptually and literally. Each infuses and flows into the hybrid spaces of practice in design studios.

3 HYBRID SPACES OF DESIGN PRACTICE

If designing extends beyond the edges of the drawing board and partakes objects, places and other people, what happens with the introduction of digital media in this process? How do the dynamics of interaction change in such a context? We first illustrate these possibilities based on increasingly hybrid design studios adopted in our research and teaching.

At one end of the scale, there are computing systems that revolve around one user interacting with a single processor (Figure 2). Such systems exemplify one dominant tradition in computer-aided design research for development of efficient and expressive geometric representations and operations supported by intuitive interaction techniques and knowledge bases. It has resulted in a number of interactive modelling and design support applications of increasing power and sophistication.

![Figure 2 Single User Design Space](image)

However, the focus on single user- single display coupling in such systems can encourage work environments that can feel isolated despite all the shared networked infrastructure and services. If the nature of designing and design practices as noted earlier are to extend beyond single display as the only focus of input or output, we need to find other ways to embed computational support in design studios. An alternative possibility is to invite others into this dialog by reformulating such single user design space into a space for real and virtual collaborations (Figure 3).
A move to such shared workspaces creates intimate pockets of space however it is not easy to maintain and support continuity of space between such pockets and the surrounding work environments. Rather than collapsing ever more operations in a single system around a narrow channel of communication for one or more designers, we expand the space (Figure 4) in which both the design studio environment and social interactions are partly resurrected.

Our experiments in this direction are based the development and use of a large-format panoramic display environment that supports a degree of immersion into the scene (Dave 2001). The qualitative differences we observed while working in this environment compared to desktop small displays are as distinct as the differences in making and appreciating a miniature painting and a large mural. Unlike the 'window-on-the-world' feeling that is associated with small 2D displays, semi-immersive environments foster a sense of 'being-in-the-world'.

An essential feature of our large display environment is that it becomes just one more component of other design activities. It is not a place one goes to but simply an
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extension of other work areas. This arrangement fosters two changes. First, it allows information to be viewed and manipulated at a scale that is appropriate to a task context. Second, it supports display of both persistent and transitory information in design studios and thereby invites others into a dialogue with the flow of ongoing work.

Another possibility afforded by the use of large format displays draws upon pictorial techniques that made possible extensions of space by juxtaposition of physical space, perspectival sight lines, and pictorial representations that embody specific scale relationships. These techniques allow us to extend real space of design studio with extensions into other spaces by way of digital projections (Figure 5). These ideas are also explored in a number of teleconferencing projects to enable a better perceptual alignment between ‘here’ and ‘there’.

Figure 5 Design Studio and Information Assemblage

With large format display used as part of other work patterns, the need for ‘crowding around’ a display is replaced by a shared space for group discussion. Being able to display and navigate through large-scale design information has been useful as it allows consensual perspectives to emerge. For example, in one of the projects it was only when information was thus shared that all the members perceived the spatial depth of a building section, an observation that was not made while viewing the same information on a smaller display.

A further extension of these experiments was interaction support using wireless communication devices. The most crucial benefit of these devices is to encourage more fluid interactions in the design studio by users who are not tethered to a device (e.g. mouse or keyboard) or a fixed location (e.g. a lectern on a podium). It also gives us an opportunity to support alternate representations as part of the co-present collaborations. While the group attention may be focused on one view of the information, an alternate view may be brought up either as a sub-tile of that
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information on the shared display surface or on the personal handheld device (Figure 6). This facility allows individuals and groups to follow multiple threads in design development and collaboration at the same time.

Figure 6 Untethered Interactions and Alternate Representations

The next logical step in this direction of supporting diffused work practices using digital media is to create a tighter loop in moving between physical objects such as drawings or scaled models and digital information. This aspect is not yet explored in our experimental studio space.

4 DISCUSSION

The above possibilities are already being integrated into routine work environments. By acknowledging these possibilities as points along various dimensions, we can establish which of these combinations may engender specific kinds of work environments and practices. Selected dimensions for developing such a matrix of existing and future possibilities include: size of displays; degree of accommodation of digital, immediately proximate and surrounding spaces; locational fixity, flexibility and modal richness of input mechanisms, and others.

Informed by these possibilities a number of research projects are exploring different directions. For example, some of the issues are addressed under research thrusts of ubiquitous and pervasive computing in a number of projects such as Interactive Workspaces project (Fox et al. 2000), Tangible Media projects (Ishii et al. 2002), Roomware (Streitz et al. 2001), BlueSpace (Chou et al. 2001), Augmented surfaces (Rekimoto and Saitoh 1999), and many others. One common feature of these projects is a recognition that physical objects and environments ought to be integrated and exploited together in future software systems, i.e. there is a need to reorient our focus away from task and operator level to social and organisational
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issues (Arias et al. 2000).

Our work and that of many other groups involves simple to complex computing
technologies and infrastructure. However, we think that it is not just the technical
issues that are crucial but also that studying what happens to the established and
emerging practices of design in such environments is just as much if not more
significant. We do not yet have extended ethnographic studies and analyses of such
environments. However, based on our limited experiences of using hybrid
environments, the following section highlights a few issues for closer examination.

4.1 Decentred Foci of Interactions

In co-present collaboration scenarios (such as the one described above), a number of
people may be discussing an information context. The display surface and its
distance from the people using it require interaction mechanisms that are different
from how such interaction happens in traditional meetings as well as those supported
by digital media at close distances.

In traditional meetings when designers gather around a model or a drawing, discuss,
and occasionally draw or move things around, a number of actions unfold in parallel,
all centered on a spatially referenced trajectory. When a member of the group in
discussion moves hands, lifts a block off the model, explaining something at the
same time, and finally moving that block somewhere else, all actions are absolutely
transparent to others. There is no explicit need for declaring a tool to be used, action
to be performed, or location where it is to be carried out. It all seems to happen as
part of a fluid interaction. And others can follow it since hands, location, and object
manipulations are in close proximity.

On the other hand, when we observe similar interactions using large format display
described earlier, we find that interaction among people, input devices and
information can become decentred. It happens partly due to the need to know who
initiates the next action while also maintaining some eye contact, watching gestures
of others, and keeping an eye on the changing information.

4.2 Modular Accessibility

One response is to employ multiple portable input devices. This calls for
fundamental changes in software design to accommodate multiple devices that
support the same functions while communicating with the same scene model (often
at the same time). Ideally, the kind of interaction we seek to support is similar to that
accomplished by a sketch pencil. Every designer carries one, quite often features a
distinctive mark, and is used freely while designing alone and in-group.

To support multiple input devices on multiple output devices, the traditional model
of human-computer interaction may not suffice. Traditionally, software systems
have evolved around a single input and output channel routed through a central
processing unit. In collaborative work applications, it may be modified through
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Multiplexed protocols, e.g. the screen sharing systems such as XMX allowed the same screen to be shared across a number of displays. In single-display groupware applications, e.g. Kidpad (Stewart et al. 1999), a model for co-present collaboration extends traditional computing architecture with provision of similar but multiple privately-controlled eraser tools. If we are to extend this notion to multiple input and output devices then we are looking for loosely-coupled components that allow any number of input devices to be registered with any processor which, in turn, may be directed to one or more output devices.

4.3 Associative Document Spaces

Ideally, we want to support this in a way that requires the least amount of juggling by users so that they can get on with the work instead of dealing with how these components interact and communicate with each other. In this regard, the experiments such as Xerox ParcTab (Weiser 1993) proposed combining user location, profile and access to computing services under the rubric of ubiquitous computing. The next step in this trajectory is to enable contextually driven task support that relies not just on profiles of those who are present but can also retrieve documents on demand that are related to the task at hand. For example, if a group of designers come together in a meeting, it may involve not just the documents they have created but also all other related documents that may have been generated by colleagues who are not present. In order to support such dynamic information spaces, we need an associative layer to continuously bind information as it is generated. At present, we are only just scratching the surface of these issues.

5 CONCLUSION

The work described here is still evolving in a way that emphasizes its integration with routine design activities and spaces. We have drawn upon a number of similar projects for conceptual and technical inspiration including the projects in context-aware and ubiquitous computing. As Grudin noted (Grudin 1990) we are witnessing and working towards ways of integrating computing into routine design culture to develop more interesting hybrid spaces of practice.

At a more abstract level, the kind of computing environment we envisage is the one in which we will hopefully not frame what we need in terms of existing computing architectures and paradigms. Conceptually, our efforts are directed at designing a pool of processors, tasks, displays and interaction devices, all distributed in work environment, and moving information seamlessly among those. Parts of these components are already implemented using standard communication protocols and wireless standards. Some others (e.g. detecting multiple input devices and their owners’ identities and profiles on the run) are still under development.

Besides the small steps we have taken, a final important lesson of our work to date is how the research itself seems to progress. There is no a priori theory we can draw
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upon for exploring integration of digital media in disciplines with established patterns of work. As soon as digital media are introduced in such disciplines, they alter the very practices and hence it is not at all clear if comparative studies alone of before and after digital media are introduced can be illuminating. Hence informed conjecture, implementation, evaluation and observation of tools in use become essential phases in this iterative process.

NOTES

The work described in the paper relies mostly upon off-the-shelf or widely available technologies with some extensions: virtual private network (VNC) by AT&T to link and control computers running heterogeneous operating systems, Bluetooth compliant PDA’s and Windows server machines, hardware-based triple RGB output using Matrox Parhelia card, and Performer-based visualisation software on SGI machines.

REFERENCES


