THE SUNDANCE LAB- "Design systems of the future"

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The last thirty years have seen the development of powerful new tools for architects and planners: CAD, 3D modeling, digital imaging, geographic information systems, and real time animated walkthroughs. That s just the beginning. Based on our experience with CAD tools, analysis of design practice, and an understanding of computer hardware and software, we re out to invent the next generation of tools. We think architects should be shakers and makers, not just consumers, of computer aided design.

We started the Sundance Lab (for Computing in Design and Planning) in 1993 with a few people and machines. We ve grown to more than a dozen people (mostly undergraduate students) and a diverse interdisciplinary array of projects. We ve worked with architects and planners, anthropologists, civil engineers, geographers, computer scientists, and electrical engineers.

Our work is about the built environment: its physical form and various information involved in making and inhabiting places. We cover a wide range of topics —from design information management to virtual space, from sketch recognition to design rationale capture, to communication between designer and computer. All start from the position that design is a knowledge based and information rich activity. Explicit representations of design information (knowledge, rationale, and rules) enables us to engage in more intelligent dialogues about design. The following describes some of our projects under various rubrics.

Under "knowledge-based visualization and modeling" we explore new computational media for producing designs. Architects don t just draw at the drawing board: they draw at the site, on the train, and at the cafe. The Digital Design Sketchbook (1) uses pen based palmtop computers with wireless networking to let designers sketch anywhere and exchange drawings and notes with home base. With Construction Kit Builder (2) an architect programs the assembly and placement rules of a kit of building components, then uses the resulting Lego-like CAD program to produce designs that satisfy those constraints. Modeling Makkah (3) explores strategies for making digital models of historic buildings in the holy city of Makkah in Saudi Arabia, based on the architectural principles of these buildings.

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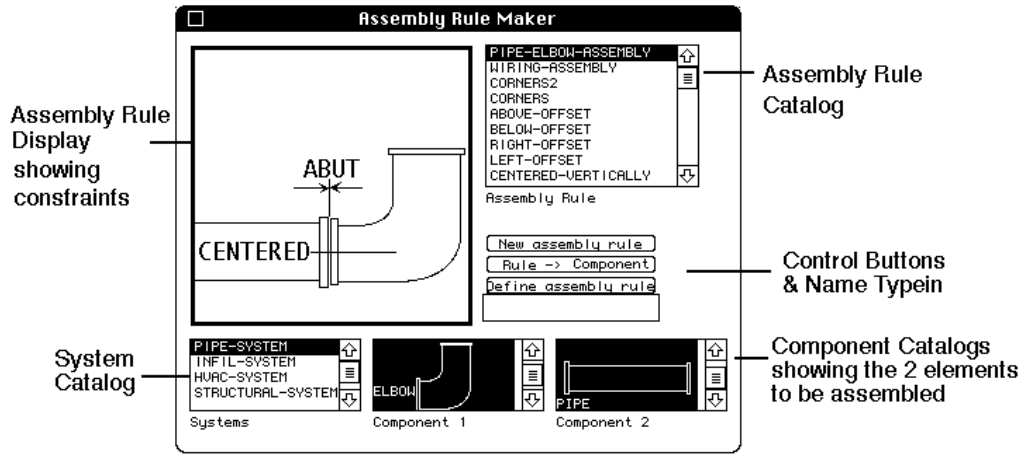

Figure 1. Interface for making assembly rules in Construction Kit Builder (M. D. Gross)

Figure 2. Rendered Roshan panels in Modeling Makkah (N. A. Koshak)

Under "interpreting form," we explore how a computer might read and interpret drawings and models. The Electronic Cocktail Napkin uses pattern recognition and visual language parsing (4, 5) to recognize and interpret drawings people make on a digitizing tablet or whiteboard. The program supports graphical conversations among designers and offers simulated tracing paper, a sketchbook, and graphical search. Designers need different tools for different tasks at different times: The Right Tool Right Time (6) uses drawing to manage these tools. Watching the designer draw, the program tries to guess intent and offer an appropriate tool: visual references, a calculator, technical advice. Digital Clay (7) employs machine vision algorithms to parse a designer s sketch into a three dimensional computer graphics model.

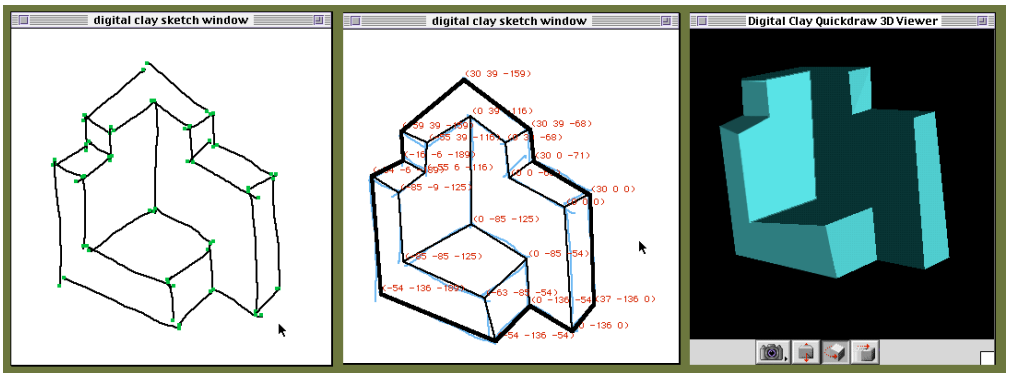

Figure 3. Digital Clay converts freehand sketches into 3D model (E. Schweikardt)

Under observing design cognition, we conduct empirical studies of design to identify appropriate features for more intelligent tools. In What s in a Diagram (8) we surveyed 62 designers making and explaining diagrams and design stories from the case based design aid Archie (9). The Computability of Design Sketches analyzed (10) videotaped sessions of a conceptual design of an architect s office. These empirical studies found that designers used a conventional universe of symbols related to the task at hand. Finally, Hypersketch (11) records and links design documents according to sequence and semantic relationships in a design process.

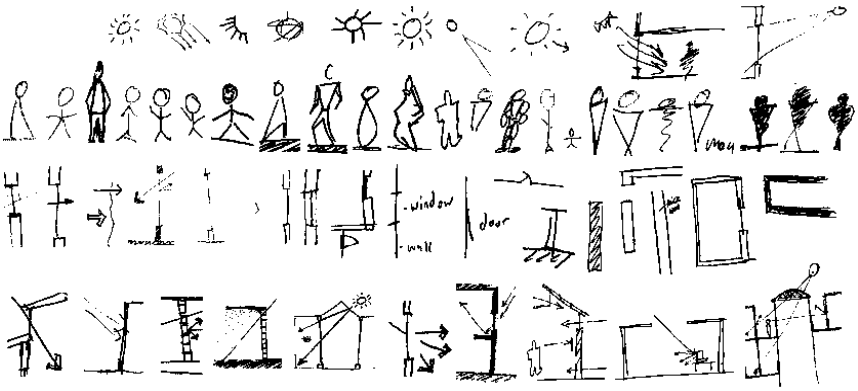

Figure 4. Designers' symbols and configurations, What's in a Diagram (E. Y.-L. Do)

Under "information and argumentation," we integrate designs with rationale and arguments. Web PHIDIAS (12) combines a server side hypermedia database (13,14) of proposals, design rationale, and enables designers to comment via the web. The Ceren Web Resource (15-17) built detailed reconstructions of buildings at the archaeological site of Ceren, an agricultural village in Western El Salvador. The site s photorealistic images provide an interface to interact with a central database. Recognizing that real design problems involve many stakeholders, each with a different agenda, Multi-stakeholder Urban Design (MUD) (18) provides participatory design tools to specify agendas and scoring schemes. Stakeholder-designers express agendas using a simple urban design language:

"a park near the school, shopping near housing" and propose neighborhood designs by placing elements: housing, commercial, park and parking. A set of 'urbo-meters' scores the evolving design for each stakeholder s agenda.

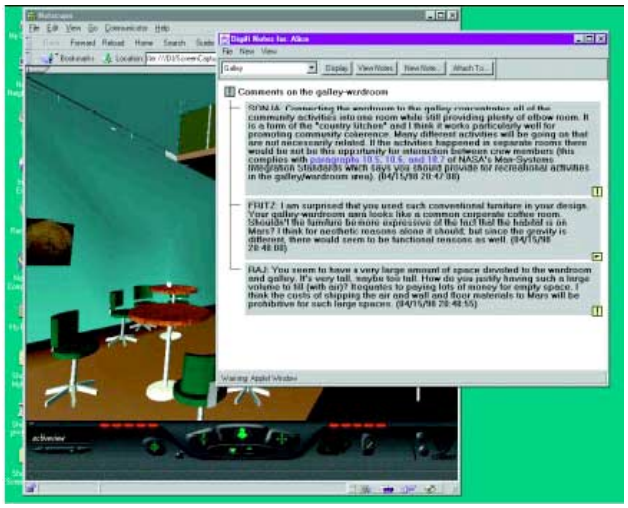

Figure 5. Design proposal linked with critique in Web PHIDIAS (R. McCall)

Under "teaching and learning design" we investigate the pedagogy of digital design media. For example, Isovist and Enclosure (19) visualize spatial perception, calculating degree of openness in a floor plan or virtual environment. The Poetics of Architecture course (20), like the Digital/Analog Civilizations workshop (21) combines analog (photography, photomontage, collage, drawing, physical modeling, etc.) and digital (scanning, video-capture, image manipulation, 3D modeling) techniques in the spirit of Bauhaus craft. Both the course and the workshop won AIA Education Honors awards. Finally, our students have been inspired to use digital modeling in their design work, winning auto**des**sys awards in 1994, 1996, 1997, and 1998.

Figure 6. Video captures of physical models with image processing, Poetics of Architecture (B. Neiman)

In short, the Sundance Lab develops computer based methods for design and planning based on understanding design processes and emerging technologies. Our lab culture of system-building and 'visionary programming' explores possibilities inherent in new design media. Taken together our diverse projects explore a central question: How can computers serve design, and how can they do it better?

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