

# **A PDA-Based Tool for Collaborative Design**

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## **ABSTRACT**

We demonstrate the system described in the short paper, "A PDA-Based Collaborative Drawing Environment", submitted for CSCW '96. We use the domain of architectural design to demonstrate a cooperative drawing environment based on personal digital assistant (PDA) front ends and a host computer back end. The example scenario demonstrates the system's basic drawing and editing features, support for multiple users in different locations, diagram recognition, and retrieval of information from a case library. Although the example scenario is specific to architectural design, the general system organization provides a domain-independent drawing environment.

**Keywords** Personal digital assistants, diagram recognition, collaborative drawing environments

## **DISTINGUISHING FEATURES**

Collaborative drawing systems have been built that run on wired workstations [1]. Our system is a wireless, multi-user drawing environment that supports diagram recognition and information retrieval. Diagram recognition is distributed between personal digital assistant (PDA) front ends and a host computer back end. The PDAs perform low level shape and handwriting recognition, while the host computer provides high level spatial relation analysis of diagrams. The PDAs are lightweight and portable, allowing users to create sketches in the field and transmit them to other users via a wireless connection. Finally, the system is pen-based which gives the user more flexibility when sketching and frees the user from carrying a mouse or keyboard [2].

## **EXAMPLE SCENARIO**

The following scenario uses the domain of architectural design to demonstrate one application of the PDA-based collaborative drawing environment:

A design firm has been contracted to make an existing building comply with the Uniform Building Code's specifications for handicapped access as required by the Americans with Disabilities Act. In particular, a two person design team will redesign the building's restrooms to allow for wheelchair access. One member of the design team has been assigned to survey the existing building; the other remains at the firm.

## **DIGITAL SKETCHBOOK**

The designer assigned to survey the building is equipped with an Apple Newton PDA and a cellular telephone. Arriving at the site, the designer creates a digital sketchbook file within the SmartPad design environment on his PDA. The SmartPad sketchbook functions as a traditional sketchbook, allowing the designer to sketch and make notes (Figure 1). As the designer draws, the SmartPad utilizes the Newton's built-in shape and handwriting facilities to perform low level recognition on the diagrams. The designer can use SmartPad's editing features to manipulate the diagrams, and to create multiple sketches that are organized into pages within the sketchbook. The Newton supports wireless communication allowing the designer to transmit entire diagrams to other PDAs or to transmit shapes and text as they are entered [2].

## **THE ELECTRONIC COCKTAIL NAPKIN**

The designer uses SmartPad and a wireless connection to contact the Electronic Cocktail Napkin, an intelligent design environment running on a host computer located at the design firm. The Napkin supports trainable recognition of freehand drawings and provides access to external databases and case libraries [3]. With a gesture, the designer uploads the current sketchbook file to the Napkin. The Napkin analyzes the spatial relationships in the designer's diagrams for configurations that it has been trained to recognize. The Napkin recognizes the international handicapped symbol in the designer's sketches and looks for links to information about physical disabilities. The Napkin then constructs an archive of information relevant to the project, including links to Sweet's Accessible Building Products file, the Archie case library, and the World Wide Web. The archive is available for the designer to view on demand using the PDA. (We describe this feature in the section, Information Retrieval.)

The designer uses the Napkin to locate scanned images of the building's construction documents on the host computer at the design firm. The designer downloads the documents to the PDA where they are saved as new sketchbook pages (Figure 3a). The documents, including plan, section, and elevation drawings, help the designer navigate through the building. As the designer encounters areas of the building that do not comply with the ADA standards, he sketches possible improvements directly on the drawings. As the sketchbook develops, SmartPad uploads the designer's diagrams to the host computer in real time to be analyzed by the Napkin.

## **COLLABORATIVE DESIGN ENVIRONMENT**

The designer in the field uses a cellular telephone to contact the second designer at the firm. The second designer logs on to the Napkin from a PDA, and the Napkin establishes a wireless link between the two PDAs. The first designer transmits the contents of the active sketchbook to the second designer, enabling them to work collaboratively in real time. Input from one designer's PDA is automatically transmitted to the other's sketchbook. The designers can draw simultaneously without interfering with each other's diagrams [2]. The Napkin records the diagrammatic conversation, keeping track of which diagrams were created by each designer.

With text and sketches, the designer at the firm proposes a solution for enlarging the building's public restrooms to allow for wheelchair access. The diagram indicates enlarging the restrooms by removing a

neighboring storage closet (Figure 3b). The first designer, having toured the building, informs his colleague that the storage closet has since been converted to a small office space. He draws a new solution, enlarging the restrooms by encroaching on the adjacent corridor (Figure 3c). In Figure 3d, the designer at the firm questions whether that approach would give people in wheelchairs sufficient space to maneuver in the corridor and suggests that it would be helpful to view case studies for public restroom design.

## **INFORMATION RETRIEVAL**

The designer at the site clicks a button on the Newton, instructing the Napkin to download data that it has collected pertaining to the project. The Napkin responds with a list of links to various databases. The designer chooses the link to the Archie case library, and the Napkin downloads the case base for handicapped accessible restroom design to both PDAs. Figure 4 shows the Archie text and graphics files saved as new SmartPad sketchbook pages. The Archie case base provides the designers with general guidelines for designing restrooms to accommodate people in wheelchairs. They use the guidelines as a reference as they continue to collaborate on the design until they reach an acceptable solution for enlarging the restrooms.

## **SUMMARY**

The example scenario demonstrates a collaborative drawing environment that supports multiple users in different locations. The system allows users to work together by giving them lightweight, mobile, pen-based devices that can communicate with other devices via wireless connections. The PDA based drawing environment also allows users in remote locations to retrieve information from external databases, including case libraries and the World Wide Web. While the example scenario is specific to one domain, architectural design, the system can be easily applied to other fields of collaborative work. We plan to investigate the use of our system in additional domains including public telecommunications service, archaeology fieldwork, network design, and facilities management.

## **REFERENCES**

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