Sharing Free-Form Ink Notes through the Web

Jason A. Brotherton[1], Richard C. Davis[2], James A. Landay[2], Morgan N. Price[3], Bill N. Schilit[3]

[1] College of Computing
Georgia Institute of Technology
Atlanta, GA 30332-0280 USA
+1 404 894 7512
brothert@cc.gatech.edu

[2] EECS Department
University of California
Berkeley, CA 94720-1776 USA
+1 510 643 7354
{rcdavis, landay}@cs.berkeley.edu

[3] FX Palo Alto Laboratory
3400 Hillview Avenue, Bldg. 4
Palo Alto, CA 94304 USA
+1 415 813 7220
{schilit, price}@pal.xerox.com

ABSTRACT

Personal Digital Assistants (PDAs), tablet computers, and electronic whiteboards allow people to take digital ink notes. Unfortunately these notes are limited to a single application running on a single device: people cannot share notes with each other or view them from desktop computers. This paper describes a system for sharing digital ink notes among PDA and desktop users through a web repository. The system consists of NotePals, a free-form digital ink note-taker for the Palm Pilot PDA; NoteBrowser, a web-based application for browsing and adding to collections of ink notes; and NoteStore, a Web-based repository that allows heterogeneous applications to store and retrieve digital ink notes.

Together these three applications support a novel, lightweight, method of meeting capture based on free form digital ink notes. Notes written on PDAs by meeting attendees are merged together automatically. These notes are viewed from the desktop, organized by time, person, project, and type of note. Thus, wherever people get together for a class, meeting, or presentation, they can walk away with a low-overhead record.

Keywords

Digital ink, note taking, PDA, pen computing, CSCW.

INTRODUCTION

Pen-based computers such as Personal Digital Assistants (PDAs), tablet computers, and electronic whiteboards are common platforms for developing applications that break away from the desktop computing metaphor. A pen interface allows users to take notes on a computer in much the same way as they would on paper. Unfortunately, there is no way for different applications to share these notes either with a desktop machine, or with other applications (possibly running on different platforms). Ironically, their own ink limits ink-enabled applications: heterogeneous PDAs cannot share ink, and the desktop cannot understand ink.

To enable ubiquitous sharing of digital ink we built NotePals, a PDA application for collaborative note taking; NoteBrowser, a web-based note browser; and NoteStore, a Web-based repository that allows heterogeneous applications to store and retrieve digital ink notes.

NOTEPALS

The inspiration for NotePals [1] came from the realization that people often leave meetings without a shared understanding and record of the important points that occurred in the meeting. Assigning a scribe to record the minutes is one solution, but it is onerous and can produce a biased record. Computer-based meeting support tools are another solution, but require an expensive, fixed infrastructure that limits the locations where meetings can be held. Fortunately, the PDAs many people are now carrying can provide a platform for collaborative note taking.

NotePals is a Palm Pilot application for taking notes. Notes are organized into projects. A "note" is a single screen "chunk" of digital ink and text attributes (Figure 1).

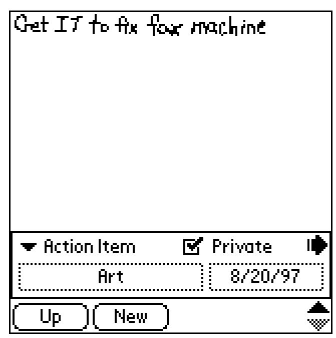

***Figure 1*: Ink plus attributes. Thetype of note is an action item belonging to Art, due on 8/20/97.**

The screen is not scrollable; the entire note is visible at all times. As the figure shows, the user can draw directly on the upper part of this page with the pen; the lower part holds an area for adding attributes.

The attributes that can be entered for a note depend on the note's "stationery" type. There are four kinds of stationery: "Note," "Action Item," "New Meeting," and "Next Meeting." The default type, "Note," is similar to a plain piece of paper with writing. "Action Item" provides a place to enter a due date and "owner" name. For "New Meeting" you can enter a list of attendees. For "Next

Meeting" you can enter a time and date. Finally, each note contains a "Private" checkbox.

When a NotePals user docks his Pilot, the notes are uploaded to a private and a public NoteStore. Since the NoteStore is web-based, it is identified by a URL. For each note, the project name, ink, stationery type, stationery attributes, creation date and author name are uploaded.

NOTEBROWSER

The NoteBrowser lets users interact with the NoteStore using any web browser. The NoteBrowser is implemented as a CGI program, and each screen in the NoteBrowser is a dynamically generated HTML page.

Users start a note browsing session by selecting either "author," "date," "project" or "stationary type." The browser displays all values for that attribute, and users select a value. For example, the user can select "stationery type" and then "action items" in order to see all of the action items in the NoteStore (see Figure 2).

***Figure 2*: A portion of a typical NoteBrowser screen.**

NoteBrowser helps users to keep track of their queries by displaying a telescoping query history (similar to Yahoo!'s topic search) at the top of each page. For example, in Figure 2 the title "Notes: Type: Action Item" indicates that the user is viewing notes of type "Action Item." The user can return to an earlier view simply by clicking on an attribute value anywhere in the title. Below the title is a control for changing how the notes are sorted.

Each note is displayed along with some of the text attributes. To further refine the filter, user can click on any attribute. Clicking on a note brings up a Java applet that allows the user to modify the note or to add more ink to it.

NOTESTORE

The NoteStore is a standards-based repository for ink notes. We created a *note* format that consists of ink data plus text attributes. There are two ways of storing ink data: bitmap, or Jot (a stroke-based standard for digital ink). Since each format has its own advantages, we allow applications to use whichever representation is appropriate. The attributes of a note are arbitrary name-value pairs used by applications. For example, applications can record the context of when the note was created and who created it.

The NoteStore provides three functions for applications: upload, download, and query (see Figure 3).

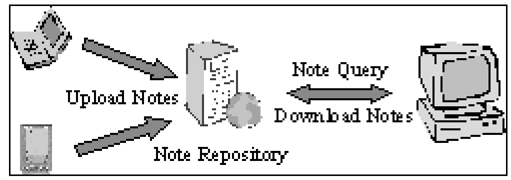

***Figure 3*: Interaction with the NoteStore.**

Applications upload notes to the repository by using the HTML POST command to send a multi-part/form-data MIME message. Thus, any network application that can open a TCP connection can add ink notes to the repository.

Notes are downloaded by using the HTML protocol. The URL specifies the note identifier and whether the application wants the note data or the note attributes. NoteStore transparently converts Jot stroke data into GIF bitmap data. For example, this is how the NoteBrowser can display Jot.

Queries on notes can be specified by sending requested values for note attributes through HTML GET. The NoteStore returns all of the notes that have the requested values for the specified attributes.

CONCLUSION

NotePals, NoteBrowser, and NoteStore together are a "lightweight" system that creates a shared meeting record. Notes are taken in digital ink on a Palm Pilot during a meeting. As attendees dock their Pilots, notes are uploaded to a web-based repository. The notes are automatically combined into a meeting record that can be browsed by time, person, project, or note type.

This meeting capture system is "lightweight" in three ways. No expensive hardware or specially equipped rooms are required, so meetings can happen anywhere. The process of the meeting is not restricted in any way. Taking free form ink notes on hand held PDAs lets users focus on meetings rather than entering information.

Finally, the system provides an open framework for sharing digital ink notes among people, applications, and different types of devices.

ACKNOWLEDGMENTS

Tom Moran and Bill van Melle helped develop many of the ideas in this paper. Thanks to Gene Golovchinsky at FXPAL for his insightful and critical comments.

REFERENCES

1. R. Davis *et al*. NotePals: Lightweight Note Taking by the Group, for the Group. *Submitted to Proceedings of CHI '98* (Los Angeles, CA, April 1998). ACM Press.