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A Framework for Sharing Handwritten Notes

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ABSTRACT

NotePals is an ink-based, collaborative note taking application that runs on personal digital assistants (PDAs). Meeting participants write notes in their own handwriting on a PDA. These notes are shared with other participants by synchronizing later with a shared note repository that can be viewed using a desktop-based web browser. NotePals is distinguished by its lightweight process, interface, and hardware. This demonstration illustrates the design of two different NotePals clients and our web-based note browser.

Keywords

PDA, pen-based user interface, CSCW, informal user interfaces, gestures, digital ink, mobile computing

INTRODUCTION

NotePals is an ink-based, collaborative note taking application that runs on pen-based devices (e.g., PDAs). The system is distinguished by its support for lightweight collaboration at three levels: hardware, note taking process, and user interface. Our initial prototype runs on the 3Com PalmPilot, which weighs only 5.7 ounces (165 grams), easily fits in one's palm, and sells for under $300 USD. The note taking process allows each participant in a meeting to take his or her own notes in free-form ink. NotePals stores these notes in a shared repository so that these notes can augment (or possibly replace) other meeting records.

The NotePals ink-based user interface uses a zoomed view that attempts to overcome problems associated with the small size of PDAs (see Figure 1a). This allows users to focus on taking notes quickly using their own handwriting without relying on error-prone handwriting recognizers or unfamiliar shorthands [1], such as Graffiti.

The drive to create NotePals came from the concern that people often leave meetings without a shared understanding of the important points that occurred. Assigning a scribe to record minutes is one solution, but it is onerous and can produce a biased record. Using computer-based meeting support tools is another solution, but existing tools require an expensive, fixed infrastructure that limits the locations where meetings can be held.

We felt that small, inexpensive PDAs might provide a better platform for meeting support tools. Meeting participants use NotePals on PDAs for taking notes during a meeting. Afterwards, the participants synchronize their PDAs with their own desktop machines, and their notes are sent to a shared repository stored on a server. The participants can then use a web browser on their desktop computer to view these *merged* notes. They can sort and filter the notes by time, project, author, date, and note type. Figure 2 illustrates a merged set of notes taken during the UIST '97 conference.

NOTEPALS

While the Pilot's size makes it easy to carry, it makes it very difficult to draw on. The Pilot's writing surface is so tiny that user's hands obstruct their view of the screen while drawing. In addition, the Pilot's 160 x 160 pixel resolution makes it difficult to write small. This situation is not likely to improve soon, since the Pilot's size is part of what makes it so popular.

PalmPilot User Interface

A NotePals "note" is a single screen "chunk" of text and other scribbles (see Figure 1). Drawing directly on the page of notes works well for sketches, but for text the focus window in the bottom portion of the screen is used. A small box (the "cursor") indicates the focus window's current view in the page of shrunken notes at the top of the screen
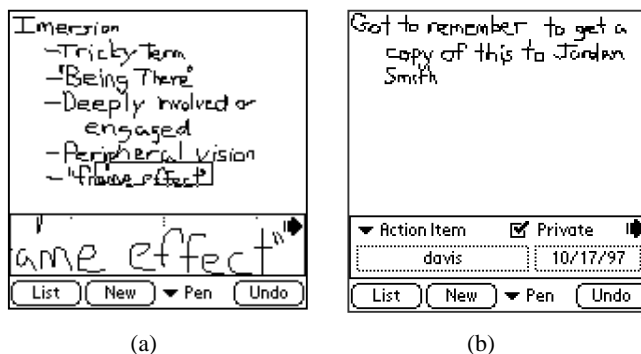

(a)   (b)

Figure 1. NotePals' user interface with (a) focus area active and (b) note attributes area active.

(see Figure 1a). Words written in the focus window will also appear above inside the cursor *scaled down* by a factor of 2½. This gives each page a total resolution of 400 x 273.

This design allows the user to fit more text on a page, and it keeps the user's hand out of the way while writing. As the user writes, he can make a right to left gesture in the focus window to move the cursor forward. A down and then left gesture moves the cursor to the start of the next line. Users can also move the cursor by dragging it in the context area.

A page's "stationery type" indicates what kind of information is in the note. "Note**"**, the default, is the simplest type and is treated like a plain piece of paper with writing. Notes can be given more specific types that include additional attributes, such as "Action Items**"** which have due date and owner attributes (see Figure 1b).

Web-based Note Repository
The note repository is simply a web server that accepts uploaded notes from the desktop that the Pilot synchronizes with. The server is responsible for storing and sorting all the notes uploaded to it.

Notes are interleaved by time on a page by page basis, and can be browsed with a simple web interface that allows the user to filter and sort them (see Figure 2) [1]. The user can *filter* the data by note attributes. Attributes and stationery types allow the user to form more complex queries such as, "Show all the action items Harvey took yesterday." Clicking on one of the attribute names will *sort* the notes by that attribute. While notes may be difficult to read on the Pilot, clicking on a thumbnail in the Note Browser displays the note at full size.

USAGE EXPERIENCE AND FUTURE WORK
We have run an informal study [2] showing that users can take legible notes on the Pilot-based NotePals client in a reasonable amount of time, though for some users it takes much longer than on paper. This result led to our design of a NotePals "client" that runs on the paper-based CrossPad [3]. Users can take meeting notes on paper and after returning to their office quickly upload the notes to the web repository to be merged with notes taken on other devices. The implementation of the CrossPad client is incomplete at this time.

We also ran a group note taking study [4] which concluded that shared notes work better when there is a "document" around which to structure the notes (e.g., an agenda, presentation slides, or typed minutes). This led to novel uses of NotePals that we had not previously considered. For example, six members of our group took over 300 "pages" of NotePals notes at the recent CHI '98 conference. We have merged the notes, organized by paper title, and placed them on "top" of the papers in the electronic conference proceedings.

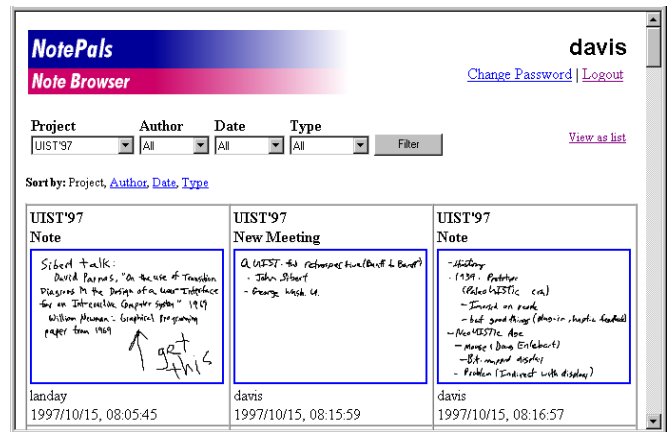[1] Public notes can be browsed at http://guir.berkeley.edu/notes

Figure 2. The Note Browser displaying notes from UIST '97.

We have also been using NotePals for over a year to take notes in small meetings and continue to informally evaluate the design. We have considered adding an ink-based search mechanism [5] and possibly combining off-line handwriting recognition with a clustering algorithm to better group related notes and allow text searches on the notes. We also hope to explore synchronization with other media, such as typed meeting agendas, slides, or audio. The timestamp for each note could be used to link it to a specific event in an audio record or the slide that was being presented at the moment the note was taken [6].

CONCLUSIONS
NotePals offers a lightweight, inexpensive way for people to walk away from any meeting with a *low-overhead* record of what transpired. It uses simple, inexpensive equipment that can be obtained by many workgroups and supports any style of meeting in any setting. NotePals' informal, ink-based user interface combined with a zoomed view avoids many of the problems with taking notes on small PDAs, letting users focus their attention on taking notes.

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