The Pebbles Project: Using PCs and Hand-held Computers Together

Demonstration Extended Abstract

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ABSTRACT

Increasingly, people will be in situations where they have multiple communicating computing devices available at the same time. The Pebbles research project is investigating many ways that a hand-held computer such as a Personal Digital Assistant (PDA) can serve as a useful adjunct to the PC in those situations. We have created a large set of applications to support group work in meetings and individual work at the desktop. These run on both Palm Pilots and Windows CE devices, along with a PC. As an example, each hand-held computer can control the main PC's cursor and keyboard to support collaboration. For an individual giving a slide show, the notes and controls for the show can be on the hand-held, while the main computer is running the show. This demonstration will show the large variety of Pebbles applications.

Keywords: Personal Digital Assistants (PDAs), Hand-held computers, Palm Pilot, Windows CE, Two-Handed Input.

OVERVIEW

The Pebbles project is creating applications to connect multiple hand-held computers such as Personal Digital Assistants (PDAs) to a main computer such as a PC. For the hand-helds, we are currently supporting both 3Com Palm Pilots and various Windows CE devices. We have created a wide variety of applications that exploit multiple computers being used simultaneously in different situations.

One set of applications supports meetings where the participants are co-located [6]. All of the participants' PDAs are in continuous two-way communication with each other, and with the main computer which is often projected on a screen to serve as the focal point of the discussion. Some of our initial applications use the PDAs as remote mice and keyboards so everyone in the meeting can control the main computer, to control a PowerPoint presentation while displaying the slide notes and titles on the PDA, as a shared whiteboard that supports multiple inputs simultaneously, for private side messages via a "chat" program, and to display multiple cursors for pointing and scribbling on arbitrary applications. We used Contextual Inquiry techniques to study how our slide show application would help with presentations and found many ways that it can help avoid problems during talks [2].

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Another set of applications supports a single user using the PDA as an extra input and output device [5]. It makes sense to investigate using PDAs at the desktop since PDAs are easy to connect to PCs, and the newer models such as the Palm V and the HP Jornada 420 have rechargeable batteries so they are *supposed* to be connected to the PC whenever the user is next to the PC. The PDA can be used as a scrolling device, as a general-purpose button panel (to create screens of "shortcuts"), as an index page or table of contents for web surfing, to control music and other programs on the PC, and to cut and paste information back and forth from the PDA to the PC. We performed formal studies to investigate left-handed use of the PDA as a control device, and found that people can reliably select among a small number of buttons without looking, that moving both hands between the keyboard and the devices is only about 10% slower than moving one hand to the mouse, and that scrolling using a PDA in the left hand can match or beat other one-handed or two-handed scrolling techniques [4].

APPLICATIONS

The applications that we have created include:

- **Remote Commander:** Each person in a meeting can use their PDA to control the real cursor and keyboard of the PC, as if they were at the keyboard. Users have to politely take turns since there is currently no floor control. See Figure 1.
- **Scribble:** Everyone has their own simulated cursor on the PC which is controlled by their PDA. Multiple people can point at objects and "scribble" on top of the screen at the same time.

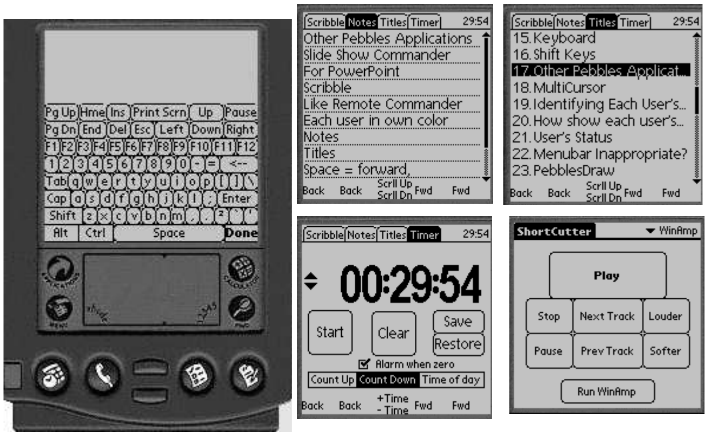

Figure 1. At the left is the Remote Commander's keyboard on a Palm Pilot for controlling a PC. At top right are the notes, titles, and timer panels of the Slide Show Commander program. At the bottom right is a panel created with Shortcutter to control the WinAmp music program which runs on a PC.

- **MultiCursor**: Each person has a separate cursor in custom PC applications that support multiple cursors. The PebblesDraw shared whiteboard application, investigates user interface issues when multiple people sharing a single large display for drawing.
- **PebblesChat:** Users can send messages from one PDA to all others or to a selected one other.
- **Slide Show Commander:** On the PDA, you can see the slide titles, notes for the current slide, and time of the talk (see Figure 1). Using the PDA, you can go forward and backward a slide, jump to a specific slide, or scribble and point on the screen.
- **Scrollers:** Research shows that people can effectively scroll with their left hand while using their right hand on the mouse [4]. The Pebbles scrollers provide various ways to scroll the PC using the PDA: virtual sliders, buttons, and a rate-controlled joystick.
- **Task Switcher:** This combines into one display on the PDA both the contents of the Windows Taskbar and the list of windows in each task (like the Windows menu item in some applications).
- **Remote Clipbook:** It is inconvenient to use the default "HotSync" method to transfer small amounts of information to and from the PDA. The Remote Clipbook connects together the clipboards of the PC and the PDA, so information that is Cut or Copied on one can simply be Pasted on the other.
- **Web Assistant:** Often browsing the Web takes on a "hub and spoke" style, where the user repeatedly returns to a main page of links from an index or the results from a search. The Web Assistant allows the user to display and tap on the links from the "hub" page on the PDA.
- **Shortcutter:** This general-purpose utility allows the user to design screens of keyboard shortcuts, macros, and strings on the PDA, and use these to control any PC application. The Shortcutter can provide customizable interfaces on the PDA even for applications that do not have a customization facility on the PC. Since these are on the PDA, you can take them with you and use them even on other people's computers.

RELATED WORK

Early work on hand-held computers includes the Xerox ParcTab [7] which were custom devices. Palm Pilots are being investigated for disconnected use by many, including NotePals [3], and Georgia Tech's "Classroom 2000" project [1]. None of these have investigated the same kinds of applications as we have created.

STATUS

All of these applications are working now, and can be downloaded from http://www.cs.cmu.edu/~pebbles. These applications have been downloaded a total of over 15,000 times in the last year and a half. The Windows CE version of the Slideshow Commander program won first place in the utilities category of the 1999 ACM Quest for Windows CE Applications contest.

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