Browsing Captured Whiteboard Sessions Using a Handheld Display and a Jog Dial

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ABSTRACT
In previous work we introduced *Total Recall,* a system for in-place viewing of captured whiteboard annotations using a handheld display. To improve on our system we now introduce a method for navigating through time-based whiteboard annotations using a jog dial. By turning the dial, the user can navigate back and forth in time to reach a desired point in the captured session, which is then displayed on the handheld device at the correct location. The tracking system supports drawing as well as erasing, which are both immediately reflected on the handheld display. We argue that our system introduces new application possibilities, e.g. in education.

Keywords
Whiteboard capture systems, ubiquitous computing

INTRODUCTION
During the past few years, several systems have been introduced to augment whiteboards and making them "smart". The reasons are many; being able to keep digital copies of what has been written to the whiteboard, incorporating computer acronyms such as "cut" and "paste" into a non-computer environment, and simplifying drawing in general. Several strategies have been tested to enhance whiteboards. One type of system replaces the entire whiteboard with a digital touch sensitive display. Examples of such system include the *LiveBoard* [4], which was part of Xerox PARC's original ubiquitous computing experiment; and current commercial products such as the *SmartBoard* (www.smarttech.com). Replacing the drawing area with a digital replica provides many possibilities for enhancing the whiteboard, but it is an expensive option that limits its use to specific environments.

An alternative approach is to use a system with pens equipped with built-in positioning systems, such as the commercially available Mimio system (www.mimio.com). To the end-user, using the Mimio system is perceived as using an ordinary whiteboard – the difference is that the coordinates of each pen stroke are captured on a PC, making it possible to create a snapshot of the whiteboard at a specific moment in time. While systems such as the Mimio are portable and can be used in any environment, they do require a separate PC to view the annotations. However, considering the size of an ordinary whiteboard, viewing the notes on a PC usually requires a significant amount of zooming and panning of the captured image.

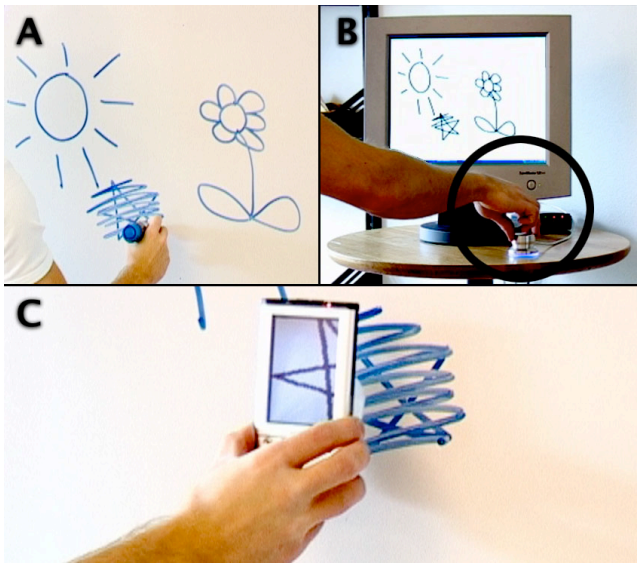

Figure 1. (a) An annotation is created, (b) a jog dial is used to navigate back to a previous position in time, and (c) the session is recalled in its original location.

Total Recall [3] was introduced to provide in-place viewing of captured whiteboard annotations using a handheld display. Using a handheld computer equipped with an ultrasonic positioning system, Total Recall makes it possible to view annotations where they were created – even if they are partially erased! Total Recall can be seen as a physical instantiation of a *Magic Lens*, an operator that is positioned over an onscreen area to change the view of objects in that region [1]; other similar approaches include *Peephole Displays* [5]. We have now extended the Total Recall system by introducing a jog dial (as seen in Figure 1) that can be used to view how the whiteboard state looked at a specific moment in time. By turning the dial, the user can navigate to different point in time during the digitization. The effect is similar to *Time-machine Computing* [2], since the user can always go back in time and for instance easily retrieve previously erased content.

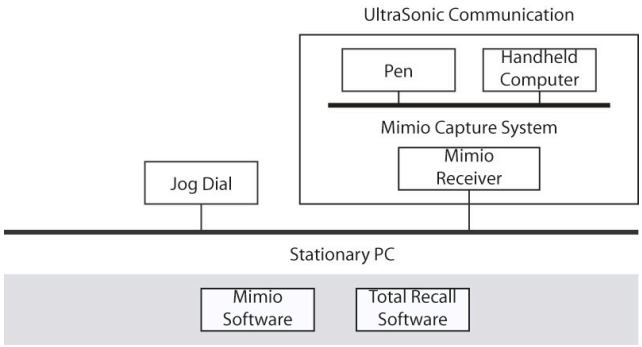

Figure 2. The improved Total Recall architecture.

ARCHITECTURE

The Total Recall architecture comprises two parts: a server software installed on a stationary PC to capture whiteboard annotations, and a client software installed on a handheld computer to view the annotations. The system has two "modes": in one mode coordinates are received as paint or erase strokes when pens or the eraser are used to draw on the whiteboard. In the other mode coordinates are received from a handheld computer equipped with an ultrasonic and infrared transmitter in the form of continuous XY-coordinates. The user switches between these two modes by pressing the top of the jog dial that is shown in Figure 1b. Using our server software, the XY-coordinates received from the pens are sent as drawing coordinates to the handheld computer when the user changes modes. The coordinates received from the handheld computer are sent back to the device in a compressed form over a wireless connection, where the client software periodically redraws the image to reflect the whiteboard using the current XY position.

The jog dial shown in Figure 1B was added to support time-based browsing of the drawing session. In normal use, the stationary PC will continuously send the XY-coordinates it receives back to the handheld device. The handheld display will then draw a brush or erase stroke depending on the current stroke type. When the jog dial is turned counter clockwise, the display of the handheld device is cleared and the entire canvas is redrawn from the beginning up to the coordinate at the current position in time. When the jog dial is turned clockwise, the server software will simply send out the brush or erase strokes that were drawn since the last update.

IMPLEMENTATION

We used the Mimio sensor and pens to get positioning information for both the PDA and the stationary PC. To get the handheld computer to send XY-coordinates to the PC we extracted the interior of a Mimio pen shell and attached it to the back of a handheld computer. Using a switch attached to the back of the handheld computer it is possible to manually enable / disable sending of coordinates.

APPLICATION SCENARIO: DRAWING CLASS

The new system could be used as support in a learning situation, such as a drawing class. Looking at a finished image does not tell the student very much about how it was drawn, nor does it show how much time was spent on each specific detail. Through the ability of time-based browsing, Total Recall could make it is possible for students to first watch a tutor complete a drawing, and then go back in time using the jog dial to study in detail how a specific section was achieved. Unlike on a stationary PC, the student could study the drawing process on the position where it actually happened, using the finished drawing as a frame of reference.

DISCUSSION AND FUTURE WORK

In the current implementation of time-based browsing we experienced issues with captured sessions with large amounts of data. When the jog dial is used to move backwards in time, the stationary pc needs to resend the entire coordinate list up to an exact moment for the handheld computer to redraw the canvas. We are currently working on optimizing the system where the stationary pc is responsible for creating "bitmap snapshots" when a specific number of coordinates have been received since the last snapshot. Using this approach it would only be necessary to transfer the bitmap snapshot together with the coordinates received since last snapshot to the handheld device.

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REFERENCES

1. Bier, E.A., et al. (1993). Toolglass and Magic Lenses: The See-Through Interface. *Proceedings of SIGGRAPH 1993.*
2. Rekimoto, J. (1999). Time-machine Computing: a Time-centric Approach for the Information Environment. *Proceedings of UIST 1999.*
3. Sanneblad, J., L. E. Holmquist (2003). Total Recall: In-place Viewing of Captured Whiteboard Annotations. *Extended Abstracts of CHI 2003.*
4. Weiser, M. (1991). The Computer for the 21st Century. *Scientific American,* 1991, 265 (3), 94-104.
5. Yee, K.P. (2003). Peephole Displays: Handheld Computers as Virtual Windows. *Proceedings of CHI 2003.*