Point and Share: From Paper to Whiteboard

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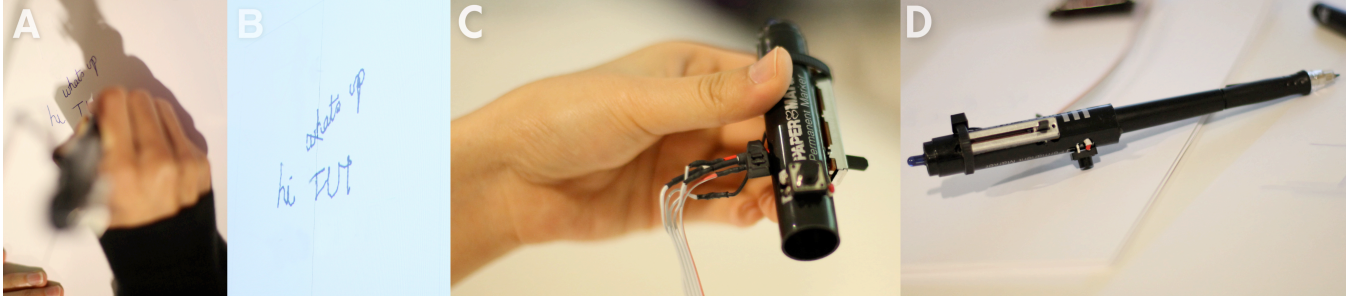
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Figure 1: A user writes on paper as the text appears on the whiteboard in real time (A, B). Customized pen cap with an infrared led, an actuator and a switch (C). The customized pen cap as it fits on the digital pen (D).

ABSTRACT

Traditional writing instruments have the potential to enable new forms of interactions and collaboration though digital enhancement. This work specifically enables the user to utilize pen and paper as input mechanisms for content to be displayed on a shared interactive whiteboard. We introduce a pen cap with an infrared led, an actuator and a switch. Pointing the pen cap at the whiteboard allows users to select and position a "canvas" on the whiteboard to display handwritten text while the actuator enables resizing the canvas and the text. It is conceivable that anything one can write on paper anywhere, could be displayed on an interactive whiteboard.

ACM Classification: H5.2 [Information interfaces and presentation]: User Interfaces. - Graphical user interfaces.

General terms: Design; Human Factors

Keywords: tangible interaction; pen and paper; collaboration; interactive whiteboard; multiuser

INTRODUCTION

Interacting with traditional media utilizes natural skills deeply embedded in our minds and bodies as we use our hands, arms, fingers, 3D vision and, memory [1]. In addition, traditional media are ubiquitous and provide rich and fluid interactions during collaboration. Similar to paper, the whiteboard is pervasive and an appealing platform for sharing and amending ideas quickly.

In this paper we explore and prototype an alternative approach to data input and collaboration that uses pen and paper to author content on a whiteboard.

In this way we retain all of the benefits of writing on paper while simultaneously expanding the capability of the written text and enriching the collaborative experience by eliciting participation from users who employ traditional media. We believe contributing to the whiteboard from a distance and with the comfort of writing on paper is an important context for participation and interaction design. A key contribution of our work is augmenting traditional media tools with new abilities while retaining their affordances. Wellner's DigitalDesk [1], which reads and interprets information created with a standard marker on paper and Shared Design Space [2] are examples of physical objects retaining their affordances and participating in a digital environment.

POINT AND SHARE

Our system consists of four principal components. First is a digital pen [3] with a customized pen cap. The pen cap provides the ability to point at the whiteboard, select and anchor a "canvas" on the whiteboard to display handwritten text and scale the canvas and text size. The pen cap is connected to an Arduino microcontroller and a laptop.

The second key component is a Wiimote, which is used to detect the location of the pen cap and to it to mouse coordinates on the interactive whiteboard. This allows the user to position the "canvas" on the whiteboard for displaying text. The calibration method for the gestural pointing input using the Wiimote is based on open-source IR detection software called Wiimote Whiteboard [4].
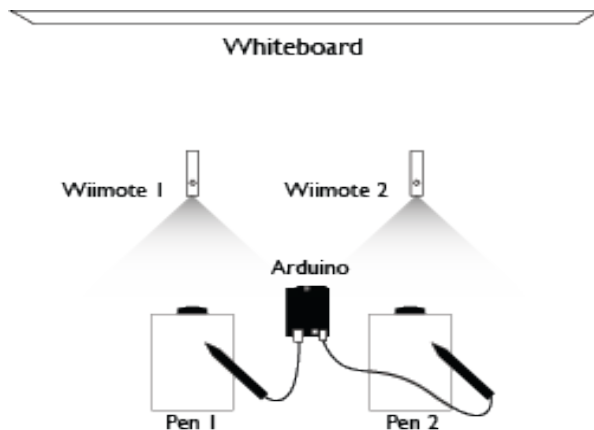
Figure 2: Setup for the Point and Share system.

A projector, which is the third component, is connected to the laptop to display the digitized handwritten text on the whiteboard.

Finally, a laptop acts as the central server for collecting the digitized content from the digital pen and projecting it on the whiteboard at the "canvas" selected by the user. Our software enables the display of handwritten text on the whiteboard and drives the interaction mechanisms described below. It also takes snapshots of the whiteboard automatically for archiving the content.

INTERACTION
We've designed two primary mechanisms for using Point and Share. They are (1) write first then share; (2) write and share in real time. Authorship, turn taking, and attention during the participation using Point and Share are also illustrated.

Write first then share
Utilizing this mechanism, users can write freely on paper without revealing the content until they are ready to share. When ready, they point to the whiteboard with their pen to select an area where their writing is then displayed.

Multiple users can start writing at different times on their paper and make their text appear without conflict at their chosen spots on the whiteboard. Once the content is displayed on the whiteboard, it gains the affordances of a digital entity and can be moved, scaled and deleted. The users can resize and position their "canvas" on the whiteboard to best place their text relative to existing content on the whiteboard allowing for seamless integration.

Write and share in real time
Using this mechanism, users first select an area on the whiteboard to define the location and size of their "canvas". Once the "canvas" is anchored to the whiteboard, they can write on paper and each pen stroke will appear in the corresponding canvas area on the whiteboard.

Multiple users can anchor their canvases to create intersecting areas on the whiteboard. At the intersections, users can collaborate as if they were writing on the same piece of paper, even though they may not be in physical proximity in the meeting room. Users can also co-create content with the person writing with markers on the whiteboard in real-time.

Participation and attention
Content from each individual is color-coded and usernames displayed on each "canvas" to easily identify authorship and is especially useful while retrieving archived material.

In the design of our system we chose to integrate and display updates from each user on the whiteboard, but not on each user's paper. By doing so, the central focus remains on the whiteboard. In addition, the pointing interaction also directs user focus to the whiteboard as it signals an intention to share.

FUTURE WORK
Several avenues for future work are immediately apparent. For e.g. we can extend the current system's capabilities over the network to enhance remote collaboration or add mechanisms to edit and delete content after it has already been placed on the whiteboard or add the ability to select, sort and retrieve archives by username. The system can also be extended for use in scenarios other than meetings for example, a class quiz or a group vote.

CONCLUSION
In this paper, we described our implementation of Point and Share. Although our current prototype is wired and uses several components, are no significant barriers to going wireless and smaller. It is entirely possible that all future pen caps could come with the necessary components and whiteboards could have infrared detectors. The chief goal of the present work is to demonstrate that we can retain the affordances of traditional media and with few enhancements enable new interactions.

ACKNOWLEDGMENTS

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