

DigiPost: Writing on Post-its with Digital Pen to Support Collaborative Editing Tasks on Tabletop Displays

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ABSTRACT

This paper presents DigiPost, a system for collaborative editing around a tabletop display. In DigiPost, a physical posting gesture links a post-it note with a location on the interactive tabletop. The user uses a digital pen to write on paper post-its as text input, and issue gesture-based commands to the document. DigiPost can be further summarized into “4C”: Connect, Control, Combine and Collaborate. It leverages pen-paper interaction as a tangible input in the context of editing a shared environment. Also, post-its can be easily passed between co-located users to promote collaboration. We implemented DigiPost into a map annotating task and conducted an informal lab test to collect feedback. The observation from the test revealed the improvements yet to be made.

ACM Classification: H.5.2: User Interfaces—Input devices and strategies. H.5.3: Group and Organization Interfaces—Collaborative computing.

General terms: Design, Human Factors

Keywords: Post-it, tabletop, collaborative, editing

INTRODUCTION

Collaborative editing of digital documents has been extensively studied in research. For that, a co-located work style around a horizontal large display is commonly used—tables afford stable placement of objects, and encourage communication in a face-to-face manner. However, tabletops, even with interactivity on the surface, cannot be solely used in editing tasks. This is because it lacks a precise channel for text input, which can be indispensable in editing tasks. Secondary electronic devices, such as PDAs, can be used as input sources, but digital text input approaches require attention and can distract user.

We present DigiPost, a pen-based approach to facilitate collaborative editing around tabletop. This is enabled by digital pens that capture real-time strokes on the paper. Post-it notes are leveraged as a tangible information carrier and posting the note onto the table sends input from the paper note to the target document on the digital table.

RELATED WORK

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UIST'07, October 7-10, 2007, Newport, Rhode Island, USA.
ACM 978-1-59593-679-2/07/0010

Of the many approaches that aim at easing the interaction and collaboration in SDG (single display groupware) setting, the two that inspire us most are Designers' Outpost [2] and Shared Design Space [1]. In Outpost, users design website architectures by manipulating physical media (notes and images) on the interactive wall. In Shared Design Space, where virtual paper (tabletop) and physical paper overlap, writing on them using a digital pen provides both digital and physical feedback at the same time.

DigiPost extends previous work by equipping the lightweight post-it note with digital functionalities. This makes it possible for the note to serve as a remote control to the document on the table, which saves physical movements. Also, the notes can be easily passed and edited between users to facilitate collaborative editing.

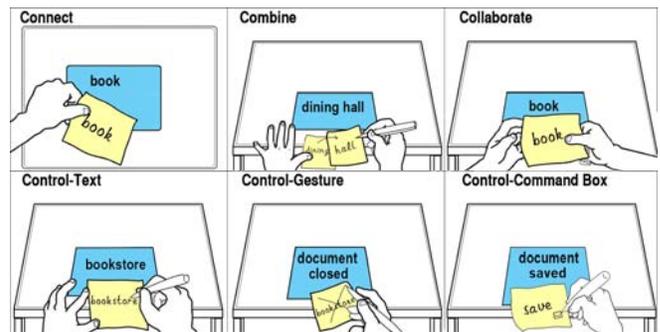


Figure 1: “4C” in the DigiPost. Yellow: Paper post-it notes. Blue: Documents displayed on tabletop

DIGIPOST

In the DigiPost, an interactive tabletop shares documents between co-located users to provide a collaborative environment. It enables direct manipulation on the surface through direct touch. The digital pen, which captures handwriting, along with the post-it note, serves as a tangible user interface to access and edit documents on tabletop. Posting the note bridges the two parts above together. DigiPost is further summarized into the following “4C”:

Connect

The connection between a post-it note and a document window on the tabletop is built through two steps. First, a user writes on a post-it note. A digital Anoto pen with a built-in camera identifies the ID of that note through the unique patterns printed on it, and pairs the pen ID (i.e. user ID) with the note. The user then initiates a new document window or selects an existing one by sticking the note to the

target position on the interactive table. This posting gesture pairs the user ID with the targeted window, connecting the note with that window. Once connected, strokes on the note are directed to the document, and the post-it note may be removed by the user.

Control

After connection, the note can serve as a “remote control” for the digital document: annotation on the note reflects real-time revisions of the physical document. DigiPost enables three types of input to the document: text, gesture, and command box. Sent through handwriting recognition, the streamed pen stroke data is recognized as text and transferred to the attached document. Gesture input mimics the ways people annotate paper documents. For instance, drawing a circle around some strokes on the post-it will highlight respective text in the digital document, and a big cross on the note will result in the deletion of the document on the tabletop surface. Also, checkboxes can be printed onto the layout of the note and assigned different action commands—an action is fired when a user checks the corresponding box on the note.

Combine

In paper-based interaction, people sometimes write on a new page, either due to the fixed size of the paper, or because it is clearer to start a new page. To address similar issues in the DigiPost, different post-it notes can be combined and attached to the same digital document. This combination can be achieved in two ways: a user connects a new note with the same document on the tabletop by posting the note to the document, or by putting the new note next to the old one and tapping them with the pen in turn. After combination, inputs and revisions on the new note will also affect the document it connects to.

Collaborate

DigiPost promotes collaborative work as the light-weight post-it notes can be easily passed between group members. The user receives the note is able to continue editing on it.

SCENARIO

We demonstrate DigiPost in a map annotation task: A group of students are collaborating in front of a digital campus map to label important places on campus, either landmarks or facilities, to help visitors. For each place, they need to identify its name and category, and optionally write down a comment. At the end of the task, a tourist’s guide is automatically constructed from their annotations.

The application is written in Java and deployed on a DiamondTouch tabletop. A Nokia Digital SU-1B Pen with Anoto technology is used with the PaperToolkit [3] to provide real-time digitized pen strokes via Bluetooth. The stroke data is sent to a gesture recognition server and a handwriting recognition server (Microsoft TabletPC) to achieve textual and gestural input.

Post-it notes are designed to be 2.5x2.5 inches and printed with Anoto pattern. Three labeled text boxes guide users to

fill information in the respective areas. For this task, there are no checkboxes printed on the note because we intend to encourage the free-style input on the note.

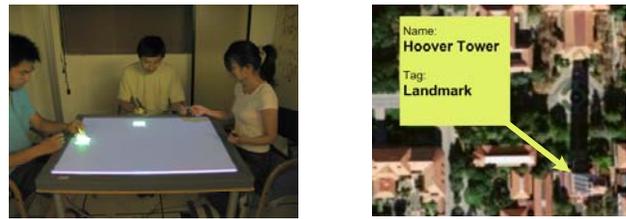


Figure 2: Map annotation task. Left: Task overview. Right: A virtual label on the map after posting.

USER FEEDBACK AND FUTURE WORK

Three groups, of three members each, participated in a preliminary user test. In each 10 minutes’ test, they were asked to mark up at least 30 places on the map.

We received positive feedback from users that posting and manipulating remotely saved a significant amount of physical movement on the tabletop. Also, we recorded that groups passed notes averagely 16 times per session, which indicates the collaborative work that DigiPost facilitates.

The study revealed two major problems. First, it does not allow users to edit the position, size, and orientation of digital post-its on the tabletop—for now these tasks require direct manipulation on the tabletop surface. Four users reported this during the test. Second, when handwriting recognition fails, it’s hard to revise on the original note and get it recognized again correctly. The user has to start a new note, attach it to the old one and delete the old. Our system needs methods for correcting text on the digital note, to account for recognition failure. These problems will be addressed in future work.

ACKNOWLEDGMENTS

The authors would like to thank Andreas Paepcke for the helpful tips in the environment setup phase, and Shengbo Li and Yan Xu for the organization of the user study. This work is supported by National High-Tech Research and Development Plan of China under Grant No. 2006AA01Z131.

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