

**Purpose:** to define the specifications of the initial prototype.

**Expiration:** as soon as any user research is conducted, this document will evolve with their recommendations

**Fidelity:** This document is for high-level prescriptive purposes. Interactions will be described in enough detail to be roughly implemented, but look-and-feel, transitions, pixel precision or specific details should not be considered in the overall evaluation.

**Scope:** should describe all major views and interactions as storyboarded steps.

## 0. Definitions

- User-added content (Markup): anything that's user-added. All markup is anchored to a range of text.
- Select: Using a cursor to select a range of text without adding markup.
- Annotation (markup): user-added extra text with a category, privacy setting and optional tags
- Highlight (markup): a range of text has a coloured background, with a category, privacy setting and optional tags
- Drawing (markup): freehand (cursor or touch controlled) indication with a category, privacy and optional tags
- Anchor: piece of text that a markup object relates to
- Range: the starting and ending character of an anchor
- Category: single membership category for markup elements associated with a particular colour and user-defined title. E.g., important, question, follow-up
- Tag: additional meta-information about each markup object, user-defined. Implemented through hashtags
- Page: legacy or user-defined
- Structure: titles, headers and sections
- Text: <p> tags :P
- Tethering: optional connection between two views

## 1. Panels and Views (Main, Main + Right, Split View):

Top view: immutable status/login/logo/search bar

Main panel is always the reading pane.

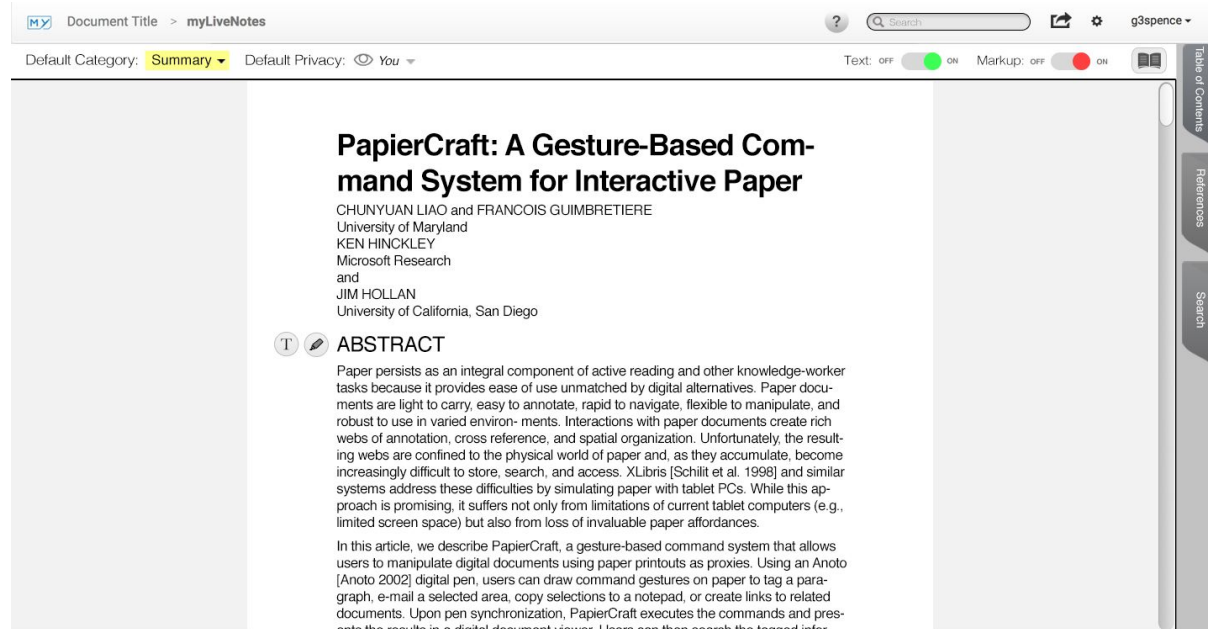
Right panel can be of the following:

- References
- Search Results
- Table of Contents

Split View shows two different sections of the document side-by-side

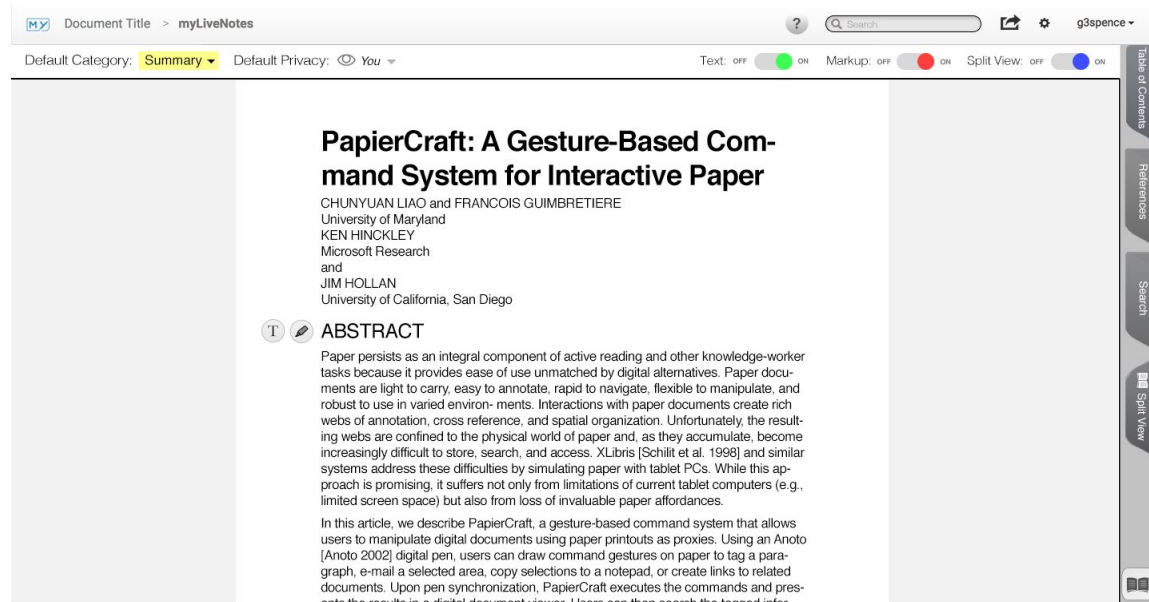
## 2. Views

### Single Panel View



### Single Panel with different options for placement of split view button

- Toggle in top bar
- Button on sidebar at bottom
- Tab



## One Markup Element Inline

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### PapierCraft: A Gesture-Based Command System for Interactive Paper

CHUNYUAN LIAO and FRANCOIS GUIMBRETIERE  
University of Maryland  
KEN HINCKLEY  
Microsoft Research  
and  
JIM HOLLAN  
University of California, San Diego

**ABSTRACT**

Paper persists as an integral component of active reading and other knowledge-worker tasks because it provides ease of use unmatched by digital alternatives. Paper documents are light to carry, easy to annotate, rapid to navigate, flexible to manipulate, and robust to use in varied environments. Interactions with paper documents create rich webs of annotation, cross reference, and spatial organization. Unfortunately, the resulting webs are confined to the physical world of paper and, as they accumulate, become increasingly difficult to store, search, and access. XLibris [Schilit et al. 1998] and similar systems address these difficulties by simulating paper with tablet PCs. While this approach is promising, it suffers not only from limitations of current tablet computers (e.g., limited screen space) but also from loss of invaluable paper affordances.

In this article, we describe PapierCraft, a gesture-based command system that allows users to manipulate digital documents using paper printouts as proxies. Using an Anoto

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Categories and Subject Descriptors: H.5.2 [Information Interfaces and Presentation]: User Interfaces—Graphical user interfaces (GUI)

General Terms: Management, Documentation, Design, Human Factors

Additional Key Words and Phrases: Paper interfaces, ubiquitous computing, marking interfaces, tablet computers, paper-augmented digital documents, gesture-based

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limitations of current tablet computers

|                             |            |     |
|-----------------------------|------------|-----|
| Citation                    | Annotation | You |
| Useful to know              |            |     |
| Summary                     | Annotation | You |
| Paper is outdated. #insight |            |     |
| Summary                     | Annotation | You |
| Limits                      |            |     |

1. INTRODUCTION

In the age of personal computers, PDAs, tablets, smart phones, and a growing variety of ubiquitous computing devices, knowledge workers strongly prefer paper for many tasks [Sellen and Harper 2001]. Paper is comfortable to read, easy to annotate, light to carry, quick to access, and simple to use. Paper's multiple strengths highlight the weakness of current digital alternatives.

While digital devices will continue to improve, paper offers several distinctive advantages. The key affordances of paper are well adapted to the combination of reading, understanding, critical thinking, annotating, summarizing, elaborating, linking, writing, organizing, and sharing that comprise active-reading tasks [O'Hara and Sellen 1997; Sellen and Harper 2001]. For example, during active reading, users annotate specific text regions with handwritten notes, circle and connect sections of documents, cut and paste information between documents, attach post-it notes, and spatially array documents by placing them side by side. These annotations and physical arrangements comprise a web of information. While the creation of this web is facilitated by the affordances of paper, the information involved is confined to the physical world of paper, making access to computer affordances (e.g., search, navigation, and remote sharing) a problem.

Three approaches have been proposed to address this problem. One is to augment paper with video projection and other digital facilities. For example, the Digital Desk [Wellner 1993] projects interactive feedback directly onto paper, and the A-book system [Mackay et al. 2002] uses an overlaying PDA to interleave paper and computer-based interactions. Despite recent advances in projection and vision systems [Lee et al. 2004] and the processing power of computers, these approaches limit the portability of the pen and paper interfaces.

An alternative approach attempts to transfer tasks now accomplished with paper into

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ABSTRACT

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XLibris [Schilit et al. 1998]

limitations of current tablet computers

| Citation       | Annotation |
|----------------|------------|
| Useful to know |            |

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| Summary | Annotation |
|---------|------------|
| Limits  |            |

1. INTRODUCTION

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2. RELATED WORK

Three main areas of work have influenced the development of PapierCraft

| Notes                       | Annotation |
|-----------------------------|------------|
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2.2 Marking-Based Interfaces

2.3 Distributed Interaction

3. DESIGN GOALS

4. DESIGN OF PAPIERCRAFT INTERFACE

4.1 Distinguishing Annotations and Command Gestures

4.2 Specifying Command Scope

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4.6 Command Modification



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Fig. 1. Copy/Paste Interaction in PapierCraft. A picture is copied from a printout (left), then pasted to a note (center). The result is shown on the PapierCraft viewer after pen synchronization (right). Marks are highlighted for clarity. Page taken from Open Access document <http://genomebiology.com/2003/4/8/R47> © 2003, Cheung et al. Used with permission.

A third approach explored by the Paper-Augmented Digital Document (PADD) system [Guimbretiere 2003] is to put the digital and paper world on a more equal footing so that changes made on one media can be easily transferred to the other. While using PADD, paper printouts and computers are simply two different ways to interact with documents during their life cycle. If paper affordances are needed, a document is printed on specially patterned paper. Using a digital pen, one can interact with paper as usual but the strokes are automatically recorded by the pen. Upon pen synchronization,

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#### ABSTRACT

Paper persists as an integral component of active reading and other knowledge-worker tasks because it provides ease of use unmatched by digital alternatives. Paper documents are light to carry, easy to annotate, rapid to navigate, flexible to manipulate, and robust to use in varied environments. Interactions with paper documents create rich webs of annotation, cross reference, and spatial organization. Unfortunately, the resulting webs are confined to the physical world of paper and, as they accumulate, become increasingly difficult to store, search, and access. XLibris [Schilit et al. 1998] and similar systems address these difficulties by simulating paper with tablet PCs. While this approach is promising, it suffers not only from limitations of current tablet computers (e.g., limited screen space) but also from loss of invaluable paper affordances.

In this article, we describe PapierCraft, a gesture-based command system that allows users to manipulate digital documents using paper printouts as proxies. Using an Anoto [Anoto 2002] digital pen, users can draw command gestures on paper to tag a paragraph, e-mail a selected area, copy selections to a notepad, or create links to related documents. Upon pen synchronization, PapierCraft executes the commands and presents the results in a digital document viewer. Users can then search the tagged information and navigate the web of annotated digital documents resulting from interactions

An alternative approach attempts to transfer tasks now accomplished with paper into the digital world. The Xlibris [Schilit et al. 1998] system, described as an “active reading machine,” is one example. More recently, other systems, such as Microsoft OneNote [Microsoft 2003], have adopted this approach to support notetaking and the ability to assemble information collages on tablet computers. Moving into the digital world facilitates capturing user interactions and makes possible “linking by inking” [Price et al. 1998]. It also confronts limitations of tablet computers. For example, one can either look at small parts of many documents or flip between multiple windows. While multi-display configurations and large resolution displays, such as the Stanford mural [Guimbretiere et al. 2001], address this problem, they face portability and cost issues.




Fig. 1. Copy/Paste Interaction in PapierCraft. A picture is copied from a printout (left), then pasted to a note (center). The result is shown on the PapierCraft viewer after pen synchronization (right). Marks are highlighted for clarity. Page taken from Open Access document <http://genomebiology.com/2003/4/8/R47> © 2003, Cheung et al. Used with permission.

A third approach explored by the Paper-Augmented Digital Document (PADD) system [Guimbretiere 2003] is to put the digital and paper world on a more equal footing so that changes made on one media can be easily transferred to the other. While using PADD, paper printouts and computers are simply two different ways to interact with documents during their life cycle. If paper affordances are needed, a document is printed on specially patterned paper. Using a digital pen, one can interact with paper as usual but the strokes are automatically recorded by the pen. Upon pen synchronization, the corresponding document is retrieved and data captured on paper are merged