How Hiking Bloggers Explore Blogs with Interactive Text Visualization

Shuo Niu
Department of Computer Science
Virginia Tech
Blacksburg, VA 24060, USA
shuoniu@vt.edu

Alan Dix
HCI Centre
School of Computer Science
University of Birmingham
Birmingham, B15 2TT, UK &
Talis Birmingham, B1 3HN, UK
alan@hcibook.com

Ellie Harmon
encountering.tech
ellie@ellieharmon.com

G. Don Taylor
Grado Department of Industrial & Systems Engineering
Virginia Tech
Blacksburg, VA 24060, USA
don.taylor@vt.edu

D. Scott McCrickard
Department of Computer Science
Virginia Tech
Blacksburg, VA 24060, USA
mccricks@cs.vt.edu

Abstract
Temporally-connected online repositories, such as blogs and tweets about events and experiences like long multi-week hikes, provide opportunities and challenges when exploring and reflecting and planning new experiences, both for readers and for the bloggers themselves. Exploring large text repositories have benefitted from interactive text visualization on large touch displays, but little is known about how bloggers understand blogs through visualization and how system design could support a variety of exploration activities. This position paper presents ways that blog authors explore their own long-term hiking blogs, and discusses future directions for using interactive text visualization on surface devices to support data exploration, information organization and knowledge sharing.

Author Keywords
Visualization; multi-touch display; text-mining; casual infovis; reader; author; blog visualization.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
Online broadcast mediums encourage people to document their life and share important experiences.

Web blogs have emerged as a mainstream platform to convey knowledge and understand opinions. In August 2017, bloggers on the popular site WordPress posted 80 million new blog entries and attracted more than 409 million people and 22.5 billion page views [14]. Many people post blog entries for others to enjoy, but it is also used to manage information for their own purposes. Exploring and finding interesting information from loosely-organized blogs is difficult and time consuming—even for the authors themselves.

Recent advancement in text mining, text visualizations, and interaction techniques offers new opportunities to address this issue. Text mining such as topic modeling can automatically detect document topics and themes and indicate key words and phrases. Interactive text visualization incorporating text mining can identify and abstract useful information, and provide intuitive manners for users to explore large data sets. Large interactive surfaces have the nature of attention attracting, which encourage people to interact with the text visualization and obtain unique experience in blog exploration and reflection.

This paper presents an exploration by blog authors using a touch-based interactive text visualization system, AwareCloud, to explore temporally-connected blog data. This work leverages the Munzner framework [1,11] to observe and interpret three aspects of interactive visualization during three extended blog exploration sessions – *what* information draws author's attention, *how* authors perform exploration activities, and *why* the authors perform different exploration activities. Based on the experiences we discuss future directions for interactive text visualization of temporally-ordered datasets like hiking blogs.

Text Visualization on Large Multi-touch Displays

Information visualization (infovis) systems implemented on large interactive screens not only have clearer high-density views, but also allow users to express interaction intents through flexible touch input [8]. Typical text visualization techniques reveal text content by summarizing a single document, processing content at word level, identifying topics, and showing interesting topics through keywords, events, and storylines [2]. In this process, many text-mining approaches such as term frequency-inverse document frequency (TF-IDF) [9], document cosine distance [10], and other topic modeling techniques such as NMF [12] and LDA [3] can be applied to refine the results for the text visualization.

The eventual outcome of text-mining is visualized with textual and graphical representations, which draw hints on the statistical features of text data and shows interesting information. The visual representations and cues can be used for a variety of exploratory tasks such as clustering, comparison, and navigation. This study considers a common and popular casual infovis technique, the word cloud, to probe blog author's perception and interaction with the text visualization. Word clouds are a common approach for depicting document themes and topics [6,13]. This technique, and arguably other text visualizations, needs to incorporate human intent in text processing and visualization [4]. Factors such as familiarity and diversity of the topic words affect different users' understanding and exploration to the documents [4]. These factors should be considered in the text-mining and word layout methods.

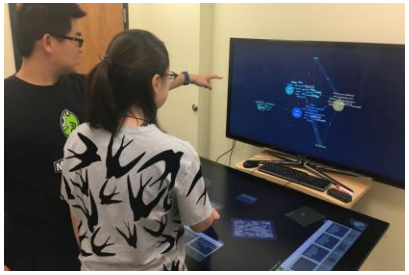

Figure 1. The AwareCloud System. The multi-touch tabletop display supports document searching, viewing and organizing. The vertical display shows a connected word cloud reflecting the interactions on the blog cards.

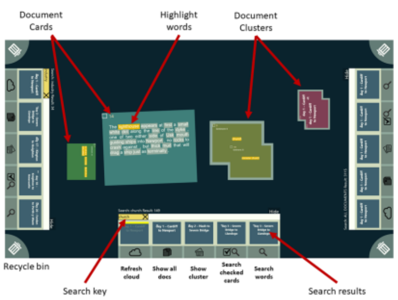

Figure 3. Touch interface of AwareCloud which runs on the tabletop display.

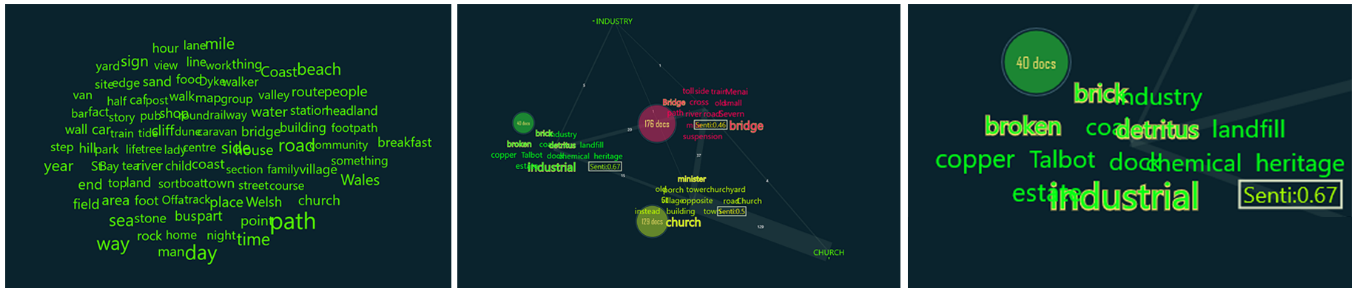

Figure 2. Left: The initial word cloud from words in the entire document collection. This visualization is generated from a hiking blog from an author (author A1 in the study). Middle: Connected word cloud visualizing semantic groups and connections between groups and search keys. Right: Word cloud for one semantic group

Interactive Text Visualization - AwareCloud

We leverage a card-based tabletop platform built in previous work to implement the touch-based interactive text visualization: AwareCloud . The system is implemented on dual-display setting: a tabletop and a vertical display (Figure 1). The tabletop is a 55′ multi-touch display with the capability to track 100 simultaneous touch points. The vertical display is non-interactive, showing text visualizations (Figure 2). The document viewing and organizing tools are on the touch tabletop. A text-mining pipeline runs in the background and captures users' actions to identify key words. A word cloud on the vertical display visualizes text-mining results for reflection.

Semantic (Touch) Interaction

The touch interface implemented on the tabletop display allows users to search, view, and organize text document units (Figure 3). Each document unit is presented on a digital card. The digital cards can be moved, zoomed, and rotated with common touch gestures. Four touch-based semantic interactions (see Figure 4) adopted from prior study [5] are supported. *Zooming* the card with a two-finger pinching gesture shows the document content in multiple levels of details. *Highlighting* by single-tapping on the words marks important content. *Clustering* by dragging and grouping cards together forms *semantic groups*. *Coloring* is done automatically by assigning different colors to different semantic groups.

On three sides of the tabletop, three identical menus enable users to search among documents, view clusters, and refresh the visualization (Figure 3). *Refresh cloud* resets and reloads the visualization. *Show all doc* loads all document cards in the card list and shows a keyword cloud of the corpus on the vertical display. *Show cluster* shows document cards in each semantic group. *Search word* shows a virtual keyboard to allow users to type a search word or

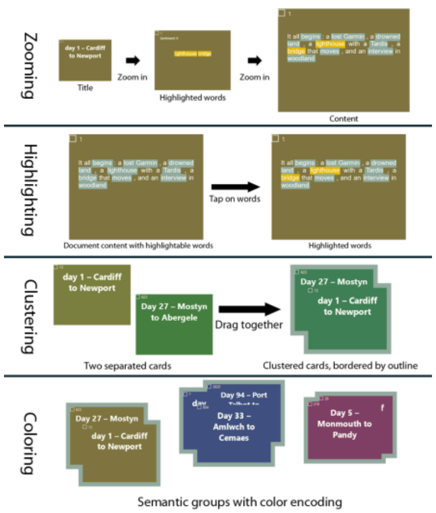

Figure 4. Touch-based semantic interactions used in AwareCloud.

Figure 5. Word cloud of "picnic" generated by A2.

phrase, with matched cards (sorted by similarity to search key) loaded in the scrollable card list. Searched words are automatically highlighted on the cards in the card list. *Search checked card* is similar to the search button but will only search among the checked semantic groups.

Author Session

In the author session, each blog author spent 30-40 minutes using AwareCloud to explore their own hiking blogs. During the workshop, other attendees occasionally joined the conversation and engaged with the system. However, the blog author remained the primary user of the system throughout the session.

What was Explored

The blog authors showed stronger motivation to perform more exploration on their own blog. In the author session, **three authors were interested in exploring unique experience-centered topics**. A1 suggested the visualization should highlight more special moments and landmarks that appeared in the blogs. He remembered special landmarks such a bus shed (boundaries which are easy to walk across, but hard to return by the bus) and a unique cliff road (a path on the cliff that is gradually narrowed). He would like to see words pointing to interesting things to encourage exploration. A2 explored event-related content. She searched for a "picnic" (Figure 8), and the cloud identified "chip" and "table" from the highlighted "picnic". The author found these words related to the search key and helped her reflect on her picnicking experience.

Instead of using the system for broad exploration, blog authors asked about technical implementation of text-mining and visualization. A1 and A2 asked about the text-mining techniques and the methods to generate the visualization. **They asked how the selectable words were identified and how the highlighted words were used by text-mining to generate word clouds**. The strips connecting word clusters were not straightforward for A1 and A2, as they noted that the strips have different widths and numbers, but could identify no explanation for this difference. A3 successfully used the strips to identify similarities between topics.

During the exploration, **the three authors were actively interpreting words that appeared in the word cloud**. For example, when A1 searched "tear", the visualization shows "dead" and "porpoise" as keywords in one semantic group. One attendee asked whether seeing "dead porpoise" made A1 sad. A1 could not remember the event and searched "porpoise" to learn that he blogged about cracked wood that looks like "curved tearing teeth", and reminded him of the "*snout of a dead porpoise I had seen a day before*". The visualized terms serve as meaningful cues to recall a lost memory. A3 searched the word Jersey and several people's names came out. He searched a name among the "Jersey" cluster and recalled the moment he met people from New Jersey. A3 suggested "*I wish I could update visualization just with the search words, so I don't have to drag the cards onto the table every time (to update the visualization)*".

How Authors Use the System

The machine learning and visualization enhanced approach arouses author interest in exploring the personal experience. In contrast to expo visitors, **blog authors could quickly identify interesting words**

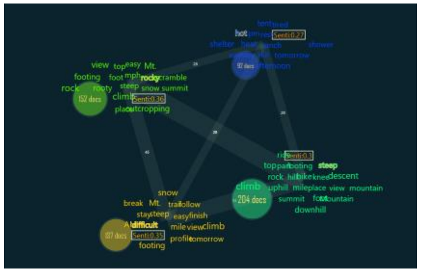

Figure 6. Four semantic groups created by A3.

to search. These words reflected the topics they want explore. Blog authors annotated their semantics mostly with a single keyword or phrase, by directly typing the terms into the search bar. They rarely highlighted words on the document cards to describe or refine the search result. For example, A1 wanted to explore blog entries for emotional moments from his hike and searched for "tear" and "cry". A3 looked up several names of the states he has visited and names of interesting people he has met.

Though they wrote the blogs themselves, authors viewed some posts to recover forgotten past experiences. When exploring documents, authors were not certain that reading a single paragraph would be enough to recover a memory. A1 and A2 wanted to read consecutive paragraphs to help remember what they had written about, perhaps with a "before" and "after" button. A2 suggested an additional layer of semantic zoom showing the whole blog entry. A3 wanted recall entities related to the search words, as he recommended, *"I wish the visualization could tell me what is difficult when I search the word 'difficult'".* Three authors did not pay much attention to the initial overview visualization or common hiking-related words. Words appeared in the word cloud were used to arouse curiosity more than facilitate document understanding.

Authors identified flexible ways to utilize the visualization to examine hypotheses based on past experiences. After forming two topics with cards, A2 examined the connections between the two word clouds and hoped to see terms appearing in both topics. A3 used the visualization to compare recurring experiences. He searched "difficult", "rocky", "steep", and "hot" and created four corresponding semantic groups. After reading the connecting strips (Figure 6), A3 commented "*it makes sense to me since 'steep' is more related to 'rocky' and 'difficult' than 'hot'*". A3 also did pair-wise comparisons on topics such as cold/hot and bike/scooter. Because A3 used either a bike or a scooter in coordination with a car to reach both ends of the trailhead when hiking solo. He also speculated that "cold" is mentioned more than "hot" because it took him more time hiking the colder north part of the trail than the warmer south.

Interpretation of Why

Blog authors were able to perform tasks with mid- and low-level specificity. **Authors did not engage in consuming basic information but were more interested in activities like searching specific topics and comparing elements across entire collection**. The authors noted that the tool provided an intuitive and attractive way to manipulate and organize their blog. They commented that the text-mining techniques helped them find the documents to read. Blog authors were able to use the AwareCloud meaningfully to explore and reflect on their own hiking experiences.

Blog authors have broader knowledge of the content of their own blogs, though they still need help recalling certain memories. However, these blogs total dozens or hundreds of posts, yielding tens of thousands of words, suggesting authors won't remember everything in their blogs. The semantic groups created by the authors reflect their own hiking experiences. Special landmarks and significant emotional status distinguished their hiking experience and were worth reflection. **Authors could quickly identify several specific elements to explore and made use of the high-level visual**

abstraction to discover and compare the derived information. Instead of highlighting words on the document cards, authors tend to express their semantics with the search tool and making sense of the text visualization. The digital document cards were used to solve curiosity and recover memory.

Future Directions

Through three extended observation sessions, we examined how blog authors use touch-based semantic interaction and visualization to explore hiking blogs. This section discusses future directions for supporting text exploration with text-mining, visualization, and large interactive surfaces.

Support Understanding

Text mining and topic modeling approaches in AwareCloud should support basic understanding of the meanings delivered by topic visualizations. From our observation, this has two aspects: understanding the abstraction and understanding the interaction. Despite authoring the blogs, bloggers generally do not remember every detail about the content. Visual representations should inform and call out past experience to support further exploration. As the topic modeling approach incorporates user interaction to derive topics, the mapping between user actions and changes in topics and representations should be enhance sense-making. Future work will investigate methods to associate and present topic information for more intuitive understanding of the large document content.

Support Creativity

During the exploration, bloggers use the system in creative ways. Activities such as solving an unexpected word co-occurrence or comparing different topics raise curiosity and encourage iterative explorations. We notice the differences in the “value” of topics. Some topics are straightforward but boring, while topics centered on experience and emotions are more interesting for further exploration. Comparing the value of topics and suggesting interesting information will lead to creative exploration experience. Future work will look into dimensions to evaluate the creativeness of the topics and representations to express the potentially interesting information.

Support Orienting Sense-Making

Sense-making is a process for foraging raw data, organizing key information, forming storytelling knowledge, and interpreting and sharing conclusions. In this process, user interactions play a key role in guiding the system to process textual data. The outcomes of the machine learning in turn inspire the users by new knowledge and encourage next-up sense-making activities. How to interpret user intent and integrate the intent into text-mining process, and how to describe the identified information, will affect effectiveness and seamlessness of sense-making. Future work will probe methods for user-directed topic modeling and visualization on key topic components, focusing on technologies supporting various sense-making activities.

Support Conversation

Large interactive surfaces allow multiple users to view and interact with the system at the same time. The conversation and collaboration that happens in the co-located workspace enrich collaborative exploration experience by enhancing interpersonal knowledge sharing and communication. It is human nature to communicate and share interesting things to others when new knowledge is discovered [7]. During co-located topic exploration, future work will investigate how the visual representations helps explain meaning and how topic modeling identifies and suggests information that is more likely to be discussed.

References

1. Matthew Brehmer and Tamara Munzner. 2013. A Multi-Level Typology of Abstract Visualization Tasks. *IEEE Transactions on Visualization and Computer Graphics 19*, 2376–2385. doi: https://doi.org/10.1109/TVCG.2013.124
2. Nan Cao and Weiwei Cui. 2016. Overview of Text Visualization Techniques. In *Introduction to Text Visualization*. Atlantis Press, Paris, 11–40. doi: https://doi.org/10.2991/978-94-6239-186-4_2
3. Allison June-Barlow Chaney and David M Blei. 2012. Visualizing Topic Models. In *Sixth International AAAI Conference on Weblogs and Social Media*.
4. Jason Chuang, Christopher D Manning, and Jeffrey Heer. 2012. "Without the Clutter of Unimportant Words": Descriptive Keyphrases for Text Visualization. *ACM Transactions on Computer-Human Interaction* 19, 3: 19:1--19:29. doi: https://doi.org/10.1145/2362364.2362367
5. Alex Endert, Patrick Fiaux, and Chris North. 2012. Semantic interaction for visual text analytics. In *Proceedings of the 2012 ACM annual conference on Human Factors in Computing Systems (CHI '12)*, 473–482. doi: https://doi.org/10.1145/2207676.2207741
6. Jonathan Feinberg. Wordle - Beautiful Word Clouds. *Wordle*. Retrieved from http://www.wordle.net/
7. Eva Hornecker. 2016. The To-and-Fro of Sense Making: Supporting Users&Rsquo; Active Indexing in Museums. *ACM Trans. Comput.-Hum. Interact.* 23, 2: 10:1--10:48. doi: https://doi.org/10.1145/2882785
8. Bongshin Lee, Petra Isenberg, Nathalie Henry Riche, and Sheelagh Carpendale. 2012. Beyond mouse and keyboard: Expanding design considerations for information visualization interactions. *IEEE Transactions on Visualization and Computer Graphics* 18, 12: 2689–2698. doi: https://doi.org/10.1109/TVCG.2012.204
9. Jure Leskovec, Anand Rajaraman, and Jeffrey David Ullman. 2014. Data Mining. In *Mining of massive datasets*. Cambridge university press, 1–19.
10. Jure Leskovec, Anand Rajaraman, and Jeffrey David Ullman. 2014. Finding Simliar Items. In *Mining of massive datasets*. Cambridge university press, 73–170.
11. Tamara Munzner. 2014. *Visualization analysis and design*. CRC press.
12. Pentti Paatero and Unto Tapper. 1994. Positive matrix factorization: A non-negative factor model with optimal utilization of error estimates of data values. *Environmetrics* 5, 2: 111–126. doi: https://doi.org/10.1002/env.3170050203
13. Fernanda B. Viegas, Martin Wattenberg, and Jonathan Feinberg. 2009. Participatory Visualization with Wordle. *IEEE Transactions on Visualization and Computer Graphics* 15, 6: 1137–1144. doi: https://doi.org/10.1109/TVCG.2009.171
14. WordPress.com. 2017. A live look at activity across WordPress.com. Retrieved from https://wordpress.com/activity/