

# ZOOMABLE MAP-READING EXTENSION FOR WEB BROWSERS

KAPIL KUMAR<sup>1\*</sup>, SUMBUL GHULAMANI<sup>2</sup>, MUHAMMAD ALI QURESHI<sup>3</sup>

<sup>1</sup>Department of Computer Science, Shaheed Zulfikar Ali Bhutto Institute of Science and Technology (SZABIST), Hyderabad Campus, Pakistan

\* Corresponding author: [sumbul.ghulamani@hyd.szabist.edu.pk](mailto:sumbul.ghulamani@hyd.szabist.edu.pk)

(Received: 13<sup>th</sup> May 2019; Accepted: 8<sup>th</sup> April 2020; Published on-line: 30<sup>th</sup> May 2020)

---

**ABSTRACT:** This research paper proposes an innovative and interactive navigation technique which allows users to navigate without clicking on a hyperlink. In this technique, users simply hover and the contents of the destination link will be displayed. One hundred and seventeen students were selected from 3 universities to evaluate the zoomable map reading extension and their responses against this extension were recorded. A majority of the students' responses was found to be positive and promotes the idea for further improvement with respect to user's interaction. Thus our findings indicate the vital role of interactive navigation techniques.

---

**KEY WORDS:** *Hyperlink Navigation, Webpage Zooming Navigation, Browser Navigation, Zoom and Browse.*

## 1. INTRODUCTION

The design and development of user interface is one of the most common research areas in human computer interaction (König, 2009). The design process is essential for the end users, visitors or the readers, because they require a lot of interaction with the system (Lin, 2008). To ensure efficiency and ease of web navigations, users' cognitive overhead should be reduced (Omari, Conrad, & Duesseldorf, 2006). Map-Reading refers to the navigation technique of webpages. In the past a variety of navigation techniques has been introduced, and adding map-reading extensions through hyperlinks has shown superior performance compared to other approaches. Using the concept of zoomable map-reading allows the users to visualize the whole page through a hyperlink without clicking the link. Conversely, it serves as a great comfort to the users and can be potentially enhanced in the future.

## 2. RELATED WORKS

### 2.1 Zoomable Navigation Techniques

The work of Billah, Ashok, Porter, & Ramakrishnan (2018) introduces the magnification interface for low vision web browsing named as 'SteeringWheel'

used for magnifying the contents with the help of physical dial consisting of simple press and rotate gestures. The contents can be customized and navigation is easily possible. User can interact with the user interface in two ways - first is through gestures by means of rotating and second is through actions by means of pointing, scrolling or clicking. User can comfortably adjust the interface parameters like zooming or contrast. The research took 15 low vision participants and shown that their web browsing efficiency increased at least by 20 percent.

A study by Rástočný, Tvarožek, & Bielikova (2013) investigated search results based on the zoom-based navigation with the help of hierarchical clusters. Graph visualization was introduced for handling information overload. The attribute graph is shown by zooming on to an image from the search results and as the zooming is increased, more attributes of related results are visible to users. The visualization of cluster and graph technique is useful for touch devices because of its highly focused user interaction.

In the context of Zoomable User Interface (Billah et al., 2018; Rástočný et al., 2013), low-vision users frequently struggle to browse the web with screen magnifiers. Firstly, magnifiers occlude significant portions of the webpage, thereby making it cumbersome to get the webpage overview and quickly locate the desired content. Further, magnification causes loss of spatial locality and visual cues that commonly define semantic relationships in the page; reconstructing semantic relationships exclusively from narrow views dramatically increases the cognitive burden on the users. Secondly, low-vision users have widely varying needs requiring a range of interface customizations for different page sections; dynamic customization in extant magnifiers is disruptive to users' browsing. The SteeringWheel is a magnification interface that leverages content semantics to preserve local context. In combination with a physical dial, supporting simple rotate and press gestures, users can quickly navigate different webpage sections, easily locate desired content, get a quick overview, and seamlessly customize the interface. A user study with 15 low-vision participants showed that their web-browsing efficiency improved by at least 20 percent with SteeringWheel compared to extant screen magnifiers (Billah et al., 2018). Information seeking on the Web has become day-to-day routine for more than two billion human beings most of who use traditional keyword-based search engines. Developers of these search engines stress personalization, prediction of users' next actions and mistake correction. But they are still struggling with results presentation and support for users, who make atypical queries or do not exactly know what they are looking for. We address these issues via a novel approach for exploring web repositories, which naturally combines user search activities – look up, learning and investigation. We achieve this via view-based navigation in hierarchical clusters and two-dimensional graphs of search (Billah et al., 2018; Rástočný et al., 2013), user's browsing data is saved in the hierarchy and the page is shown in the canvas of the browser. For the browsed page, zooming or panning is performed by the users along with fundamentally hierarchical browsing (Khawaja, Shah, & Khowaja, 2007). In this way, the organized information is managed by applying zoomable user interface technique.

For a device or the web browsers, the enlarging, zooming or magnifying is an important key factor for the user interaction and provides convenience of its own. In most cases related to the zoomable user interfaces, the web browsers contain

such problems of enlarging the text or the images up to the user's desired sizes, for that reason the users face some problems while perceiving the information from the system. For that particular need, the reasons for enlarging the texts or images and their solutions have been proposed (Tsuchida & Ono, 2016).

Operations performed by the users such as methods which are computerized, media as computer storage and the navigation semantics with the contents are using the zooming or magnifying operations for better navigation use (Wong, 2017). In Zoomable User Interfaces (ZUI), the details are set more or less to view by the users, where they can watch or browse different sort of images, documents, texts and zoom-in or zoom-out with the ZUI features (Hu & Hu, 2015). As far as the zoom operation is concerned, it is used for the visual items of the webpage to map-read the depth of the context and different visual items have their own visual resolutions and dimensions (Rothbart et al., 2016).

## 2.2. Hyperlink Navigation

The works by Wen-Long Lin et.al. (2008) exemplified an effective web navigation enabled through a novel website structure optimization model. In this research, the topology for the website's access efficiency serves as a guidance for optimizing the website's hyperlink structure. The approach is found efficient and practical for the adaptive website as shown during experiments with distance education website.

Navigation techniques changes with advancement of the needs based on user's ease of interaction. The early hypertext systems used hyperties, followed by the introduction of tooltips and hover text in pop-up windows. Coupled with existing conventional methods of navigation, researchers have explored fluid links and fluid documents which resulted in an alternative approach for navigation currently termed as zoomable navigation (Paek, Dumais, Logan, & Minhas, 2016).

## 3. METHODOLOGY

The browser extension was developed using JavaScript. A function named "mouseOver" allowed navigation to the destination page without clicking on the hyperlink. Fig. 1 shows the zoomable navigation link was opened and displayed the contents of that link without clicking. In another instance (Fig. 2) upon hover of a menu item called *about*, the colour of the menu item changed into grey colour. Consequently, without clicking on the *about* menu item, a zoomable interface for the webpage is displayed. On the displayed zoomed navigated page, user has hovered over another option named *team*, where it can be navigated within the corresponding zoomable interface.

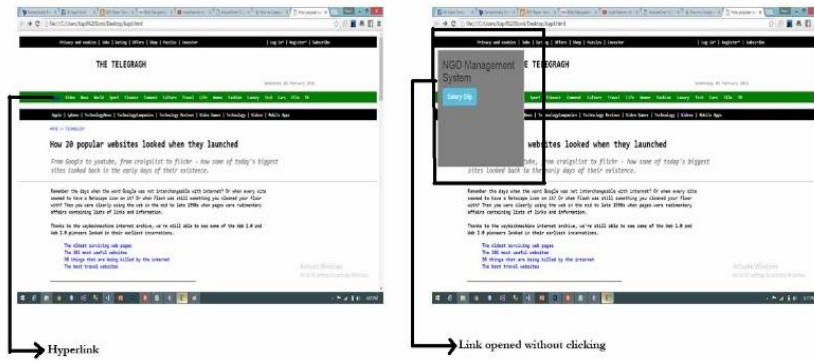


Fig. 1. Zoomable navigation link.

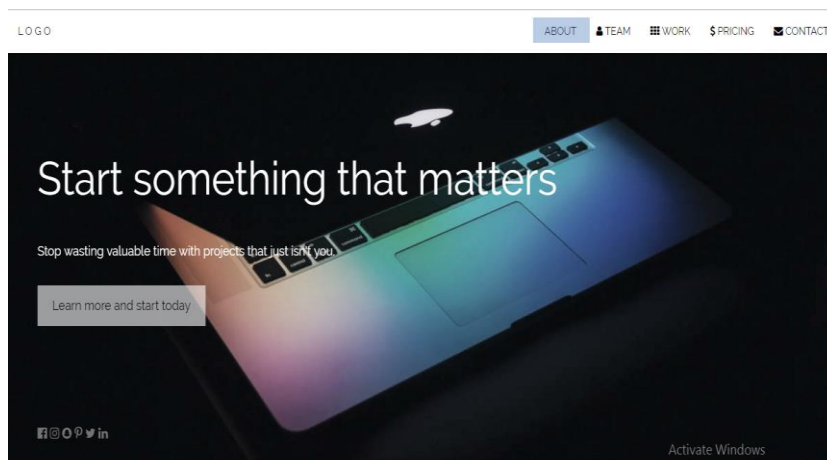


Fig. 2. Another zoomable navigation link.

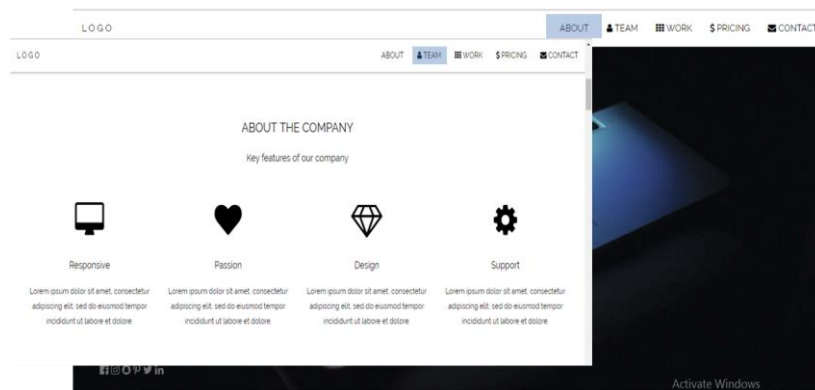


Fig. 3. Zoom able webpage.

### 3.1. Creating the manifest file

For this navigation design, extension was developed. The manifest file was created, describing the name and description for the browser that will support the extension using plugin.

### 3.2. User Interface

After the plugin was developed, its user interface was designed to be later embedded as a browser extension (Fig. 4), enabling user interaction.



Fig. 4. User interface for the browser extension

### 3.3. Testing the extension

As the extension was added to browser, the browser was expected to perform zooming and magnifying operations on the webpage. Similar to a Facebook zoomer, webpages became zoomable upon hover on a hyperlink, and navigation to another page can be carried out from the zoomed webpage. The size of a zoomed webpage was set to one-fourth of the computer screen allowing clear display of texts and images.

### 3.4. Survey

A survey was conducted among 117 computer science undergraduate students from 3 universities. The survey targeted computer science students considering their understanding on computer systems and user interfaces compared to students from other fields. Selection of participants is based on the level of study, in which 50% students were seniors from higher semesters while the rest were juniors from lower semesters.

Among these participants, 54 students were selected from Mehran University of Engineering and Technology, Jamshoro, another 39 students from University of Sindh, Jamshoro and the the rest were selected from SZABIST, Hyderabad. The number of students from these universities varies due to differing population size. Experiments were performed in universities' labs with computers installed with the browser extension. Using the extension, students were instructed to navigate a variety of websites such as e-commerce, social media and blogs. Each experiments lasted for 30 minutes. Student responses in terms of user interaction, functionality and flexibility were captured using paper-based forms. All responses were compiled for further analyses.

## 4. RESULTS

Out of 117 students, 48% considered the extension as a new innovation for their browser, especially among the senior students. This finding suggested that the zoomable extension feature must be rapidly enhanced for user convenience. Fig. 5 summarizes participants' responses to the map-reading extension technique.

From the results, 32% of the participants found that the browser's loading time is fast and robust. Whereas, another 15% found the technique to be highly interactive and convenient compared to other navigation techniques.

Finally 5% of the participants were not interested with the feature since due to the novelty of the approach. From the analyses, a majority of participants showing lack of interests were first year students who were more familiarized with conventional navigation. Thus, although the feature was perceived to be exciting by a huge majority, the same feature could be perceived as challenging and frustrating by novice users.

Overall, the results indicated that the proposed technique has gained positive feedback from a majority of the participants.

Currently, the proposed zoomable map-reading technique is only available as Google Chrome browser' extension. Further research shall covers design and development for cross-browser compatibility.

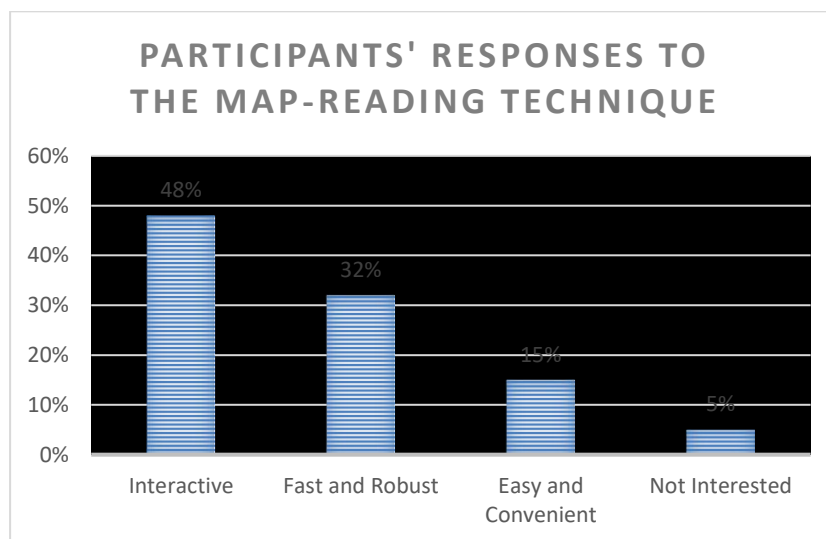


Fig. 5. Participants' responses to the map-reading technique.

## 5. CONCLUSION AND FUTURE WORK

In conclusion, the proposed technique provides an easy and interactive alternative for webpages navigation since it enables zooming on the destination page without clicking on the hyperlinks. This functionality is considered as an emerging idea for web navigation, and contributes towards the design and development of Zoomable User Interfaces (ZUI). Future works shall be performed to address issues related to cross- browser compatibility.

## ACKNOWLEDGEMENT

The authors would like to thank the participants from Mehran University of Engineering and Technology (MUET), University of Sindh and Shaheed Zulfiqar Ali Bhutto Institute of Science and Technology (SZABIST).

## REFERENCES

- Billah, S. M., Ashok, V., Porter, D. E., & Ramakrishnan, I. V. (2018). SteeringWheel: A Locality-Preserving Magnification Interface for Low Vision Web Browsing. *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems - CHI '18*, 1–13. <https://doi.org/10.1145/3173574.3173594>.
- Hu, B., & Hu, B. (2015). ( 12 ) *United States Patent*. 2(12).
- Khawaja, S., Shah, A., & Khowaja, K. (2007). Alternate Paradigm for Navigating the WWW Through Zoomable User Interface. *Advances and Innovations in Systems, Computing Sciences and Software Engineering*, 417–420. [https://doi.org/10.1007/978-1-4020-6264-3\\_72](https://doi.org/10.1007/978-1-4020-6264-3_72).
- König, W. A. (2009). *Squidy: A Zoomable Design Environment for Natural User Interfaces*. 4561–4566.
- Lin, W. (2008). *2008 Workshop on Knowledge Discovery and Data Mining*. (70672097), 36–41. <https://doi.org/10.1109/WKDD.2008.77>.
- Omari, A., Conrad, S., & Duesseldorf, H. (2006). *On the Usage of Data Mining to Support Website Designers to Have Better Designed Websites*.
- Paek, I. T. S., Dumais, S. T., Logan, R. K., & Minhas, M. (2016). (12) *United States Patent*. 2(12).
- Rástočný, K., Tvarožek, M., & Bielikova, M. (2013). *Web Search Results Exploration via Cluster-Based Views and Zoom-Based Navigation*. *Journal of Universal Computer Science*, 19(15), 2320–2346. <https://doi.org/10.3217/jucs-019-15-2320>.
- Rothbart, A. B., Us, W. A., Lin, J. M., Us, W. A., Weinstein, D., Us, W. A., ... Minhas, M. (2016). ( 12 ) *United States Patent* ( 10 ) *Patent No .:* 2(12)
- Tsuchida, H., & Ono, Y. (2016). ( 12 ) *United States Patent Ag :* 2(12).
- Wong, T. (2017). *United States Patent*. 2(12).