



The effects of zoomable user interfaces and user age in searching for a target with a mouse on a two-dimensional information space

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ARTICLE INFO

Article history:

Received 6 August 2010

Received in revised form

23 November 2010

Accepted 2 January 2011

Available online 28 January 2011

Keywords:

Zoomable user interface

Zoom focus

Zoom scale

Older adults

Information search

ABSTRACT

A zoomable user interface (ZUI) is a useful function to help users deal with large information spaces displayed within a screen. Although used in many applications, ZUIs have not been sufficiently studied in terms of usability. Usability problems may be more crucial for older people than younger ones. The objective of this study is to examine the effects of a combination of two zoom factors (three zoom focus methods: original-center, re-center, and aiming-point; and two zoom scales: +100% and +400%) for two age groups (younger and older adults) on mouse-based information searching tasks in a map-type two-dimensional information space. Twenty four volunteers (twelve users per age group) participated in the experiments by answering a pair of questions about fifty movie information topics. Task completion time, number of operations, and number of errors were selected as performance measures, and a subjective assessment of satisfaction was collected. Older adults used the tested ZUIs less efficiently and precisely than younger adults. The effects of zoom focus methods vary with zoom scale levels regardless of the age groups. The participants also preferred using the aiming-point focus regardless of zoom scale and using the re-center focus with the +400% scale. We discuss potential implications of the age-related performance differences and the effects of ZUI functions, and suggest some ZUI design guidelines in conclusion. We expect that the findings can be used as basic resources in designing various web services and applications for older computer users.

Relevance to industry: Given that a zoomable user interface is widely used in basic geographic information systems, web services, and various applications, using a selective-focus method such as the aiming-point focus can improve computer users' usability; in particular, the zooming functions will greatly help older people to explore large information spaces quickly and easily.

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1. Introduction

Computer users handle large information spaces that can't be fully displayed within a viewport or a screen (Jones et al., 2005). Geographic information systems (GISs) such as web maps (e.g., Google Maps; <http://maps.google.com/>) as well as many web pages and documents are representative examples dealing with such information spaces. Thus, it is increasingly important for users to be able to explore the information spaces efficiently within a limited viewport (Nekrasovski et al., 2006). Some studies and guidelines have suggested various zoomable user interfaces to help users navigate the information spaces easily (Bederson and Hollan, 1994; The European Commission, 1998; Guo et al., 2000; Bederson et al., 2004; You et al., 2007).

A zoomable user interface (ZUI) allows users to interact with an extensive information space directly by changing the scale of the viewed space to explore more detail or less and by panning the viewed space with a mouse or hot keys (Bederson and Hollan, 1994; The European Commission, 1998; Hornbæk et al., 2002; Büring et al., 2006). This ZUI is considered an intuitive and reality-based interaction style due to the behavior metaphor where people approach an image (zoom-in) to obtain a larger or more detailed view, or they withdraw (zoom-out) to make it smaller or less detailed (Nekrasovski et al., 2006; Geiger et al., 2009). This behavior metaphor suggests that usability may be significantly affected by several zoom-related design factors such as focus, scale, and speed.

Based on previous studies including guidelines for UI functions of a GIS (The European Commission, 1998; You et al., 2007) and various applications such as word processing, image editing, and web browsers and maps, ZUIs can be divided into fixed-focus methods and selective-focus methods by whether users can locate the zoom focus in a desired position. The fixed-focus methods always use the same location in a viewport as the zoom focus.

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