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Designing A Virtual Reality Interface for Children's Web Portals

Abstract
A non-immersive virtual reality interface is conceptualized and developed to augment a conventional children's web portal. Two focus group studies were undertaken to evaluate the interface, the result of which show that children endorse and embrace enthusiastically the concept of browsing for information in a virtual environment.

Résumé : Une interface virtuelle non immersive est conceptualisée et développée pour améliorer un portail Web traditionnel pour enfants. Deux groupes de discussion ont entrepris l'évaluation de l'interface. Le résultat démontre que les enfants approuvent et adoptent avec enthousiasme le concept de furetage de l'information dans un environnement virtuel.

1. Introduction

Children use search engines and portals such as Google and MSN fairly extensively and on a regular basis to find educational and entertainment materials. They are one of the fastest growing groups of Internet users (Vise, 2003). Although some studies (Bilal, 2001) show children are versed in the mechanics and feel comfortable with search engines they do not always succeed in satisfying their information needs. They use incorrect search syntax, and inappropriate terminology, and face a host of other problems, when attempting to retrieve information (Bilal, 2002a; Large, 2005; Shenton & Dixon, 2004). While training may alleviate some of these problems, systems by design should support learning by doing (Shneiderman & Plaisant, 2004), or at least they should be intuitive enough to minimize the need for learning and retraining.

The purpose of this study is to design, test, and evaluate a novel non-immersive virtual reality prototype interface for a portal, as an alternative retrieval mechanism to alleviate problems and obstacles that children face in finding information.

2. Browsing

In many situations, studies into the information seeking behaviour of children suggest that browsing may be the preferred mode of searching with little use of Boolean operators or other advanced search features (Bilal, 2002; Cooper, 2002; Large, Beheshti, & Moukdad, 1999; Schacter, Chung, & Dorr, 1998; Shenton & Dixon, 2004). Children and to some extent adults have a "natural tendency to explore" (Borgman et al, 1995, p.665) and are constantly browsing to discover the unknown (Chang, 1995). Browsing can be used for a range of information seeking activities from well-defined tasks (known titles

and authors) to semi-defined (specific subjects), and ill-defined (something of interest). In the past emphasis has been given to keyword searching features but at the very least "both structured searching and browsing (are) equally valid and efficient methods of accessing information" (Druin et al., 2001, p. 401). Browsing also helps in serendipitous or chance discovery of information that proves useful either for the task in hand or for some other purpose (Large & Beheshti, 2000). This type of event is usually encountered when browsing through varied information such as the library stacks or bookstore shelves. When a precise objective is imposed (such as a class assignment), serendipity might be "applauded as enriching the learning experience or denigrated as offering an all too attractive source of distraction" (Large & Beheshti, 2000, p. 1075).

3. Familiar Visual metaphors and related affordances

Browsing is mainly a visual activity (Cove & Walsh, 1988), and is based on recognition rather than recall. In a digital environment, familiar metaphors may be used to support recognition. Generally, computer users try "to understand computers as analogical extensions of familiar activities and objects" (Carroll, 1997, p. 505). Providing a familiar interface metaphor capitalizes on artefact and context affordances (Norman, 1988) and renders the human-computer interaction more intuitive and natural. Affordances designate an attribute of design, which communicate intrinsically different interaction patterns that require little or no user training. In the past decade or so, shopping cart and notebook metaphors have been used successfully to make the interfaces more "comprehensible and fun". (Shneiderman, 2004, p. 49)

Interfaces that utilize less text and rely more on visual information seem to be a design goal for children (Druin et al., 2001, p. 402). Indeed children and young adults tend to rely on visual information or visual cues rather than textual information (Fidel et al., 1999; Hirsh, 1999; Large & Beheshti, 2000) and according to developmental theories, visual experience plays an important role in middle childhood development (Bee & Boyd, 2002).

4. The Library metaphor

Walter states that on a typical day in a typical public library up to 60 percent of users are likely to be under the age of 18 (Walter, 2003). While young people are increasingly using the electronic resources and the internet, they still rely on the traditional libraries for information and leisure reading. This familiarity with the library leads us to believe that a virtual reality representation of a library building using the natural affordances of known physical objects may provide a familiar environment for the young users. For example, users know a book can be picked up, opened and read. Shelves contain books which can be browsed by reading the spines. These interactions do not need to be specifically taught to users.

When children are confronted with using a library catalogue they "prefer to go directly to the shelves to find books" (Walter, Borgman, & Hirsh, 1996, p. 109). Several researchers have studied the library metaphor in the context of online catalogues and digital environments (Beheshti, 1992; Beheshti, Large, Bialek, 1996; Borgman et al, 1995; Das Neves & Fox, 2000; Hirsh, 1997; Kamiya, Lu, Hara, & Miyai, 2001; Rauber & Merkl, 2000). The book metaphor has also been used successfully in online information systems to assist users in search and navigation, again offering known interaction

patterns provided by this universally recognized artefact (Card et al, 2004; Chu et al, 2004; Cubaud, Stokowski, & Topol, 2002; Russell, 2001). For example, the Science Library Catalog Project, designed for elementary schoolchildren ages 9 to 12 (Borgman et al., 1995; Hirsh, 1997) provided access to a limited number of bibliographic records using a bookshelf metaphor to correspond to children's mental models of a library catalogue. The results of the experiment showed that children had success rates averaging 80 percent with the Science Library Catalog. The results also demonstrated that children do not like using tools such as catalogues and prefer to browse directly at the shelf, and they find familiar metaphors highly appealing.

Using a commercial first person shooter game engine (www.idsoftware.com), Christoffel & Schmitt (2002) developed a realistic virtual environment of an existing library building and performed preliminary user acceptance tests. They report that users very quickly and without any assistance learned how to navigate in the virtual environment. Although no attempt was made to record interaction success or engagement, this study shows initial user reactions were positive among high school and university students.

5. The Design

This study is related to another project, the objective of which is to design and develop a portal for grade six elementary school students to help them find information for their class assignments and projects (Large et al, 2004). The topic of the portal is Canadian history. An intergenerational team using the Bonded Design methodology as its framework was formed to conceive the portal. The Bonded Design methodology is a modified version of the Cooperative Inquiry approach of Druin (1999), bringing together adults with expertise in human-computer interaction and children who are experts in being children in a design team (Large et al, in press).

The conventional portal originally designed on paper, was later modified and developed into an operational portal: the *History Trek*. A database of approximately 2500 links to web sites in English, French or both, deemed to be appropriate in content and language for elementary students and on Canadian history was created during summer of 2004. Each record in the database includes the title of the site, a brief description, broad and narrow subject headings in a hierarchy (referred to as *Topic* and *Subject*, respectively), appropriate grade level, language of the site, and the developer of the site. At the top of the subject hierarchy are eight assigned broad *Topics*. Selecting the sites, writing the descriptions, and assigning subject headings were undertaken by the researchers, professional librarians, and graduate students in library and information studies. The portal is aimed mainly at grade six students who are interested in finding web-based information about Canadian history. The retrieval mechanism of the portal consists of: keyword searching, a hierarchically (to four levels) organized subject directory, alphabetical word search, 'natural-language' question searching, advanced keyword searching, and a scrollable timeline.

During one of the sessions conducted as part of the Bonded Design methodology, discussions revolved around a novel three-dimensional (3D) interface design based primarily on first-person 3D computer games. Based on the earlier research on the use of familiar metaphors, browsing, and visualization, we were primarily interested in provoking the students to engage in debate and brainstorming on a different and non-conventional approach to designing a portal for children. The intergenerational team

proposed two design ideas: a relatively conventional portal as described above, and a more radical 3D design where users would move through a first-person 3D (or virtual, as children called it) environment browsing for information. In the 3D interface, rather as in a computer game, users would explore the web by moving through virtual space. All but one student were extremely enthusiastic about such an approach. All agreed, however, that in order to meet the needs and requirements of all the users the 3D interface should complement rather than replace any conventional portal interfaces.

6. The Virtual Library

A Virtual Library was designed based on earlier research on representing books and bookshelf in a 2D environment (Beheshti, 1992; Beheshti, Large & Bialek, 1996), research conducted on familiar metaphors of library and books, and the use of virtual reality in such environments. A prototype was developed and implemented during winter of 2005 (Figure 1). Approximately 550 records were selected from the Canadian history database to represent eight broad *Topics* in our virtual library. Eight shelves corresponding to the eight topics were constructed, each containing links related to the topic. In this virtual environment, links are presented as books, with the title appearing on the spine. Within each shelf, the 'books' or the links are sorted based on the second level of the *Topic* or subject hierarchy. Navigation through the virtual library is possible by using a combination of mouse and keyboard. One click of the mouse button on a book shows the title and the description of the site (Figure 2); two clicks opens the browser and shows the site (Figure 3).

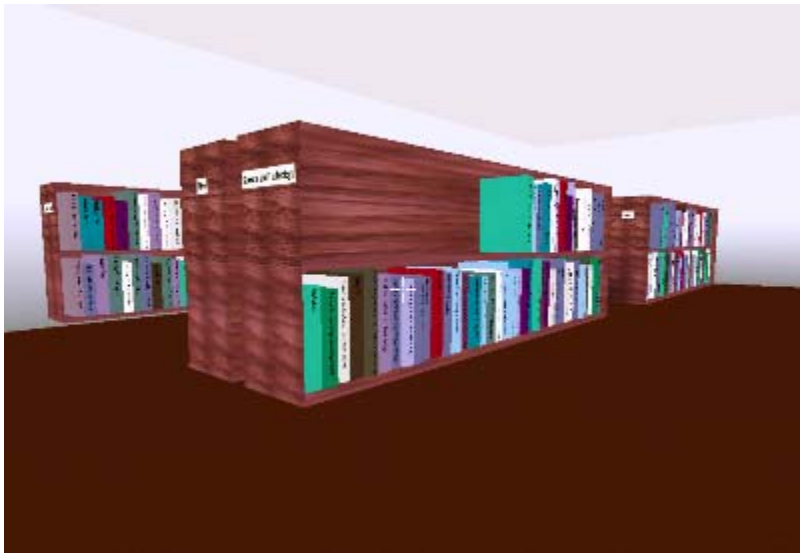

Figure 1. The Virtual Library

Figure 2. The title and brief description of a link

Figure 3. Browser window

7. Methodology

Focus groups provide a cost affective method to gain user feedback early in the design process (Large, Beheshti, & Rahman, 2002a). Through such an activity, researchers seek targeted and general feedback concerning the design of an application and its future direction. The elaboration of inquiries for focus-group participants can be supported by the use of the Information Architecture Matrix (Large, Beheshti, & Cole, 2002) which proposes a typology of design options to be covered. For example, this would result in questions pertaining to the navigation, style and interactiveness of the software tool.

During the first week of April 2005 two focus groups consisting of eight students were formed to evaluate the virtual interface. In an attempt to have a gender-balanced study,

both groups consisted of equal number of boys and girls, even though ideally it might be more desirable to have separate groups of males and females (Large, Beheshti & Rahman, 2002b). The two groups differed in their ages: the first group (Group 1) comprised of students ranging in age between15 and 16, while the second group (Group 2) consisted of children ages 11 and 12. All participants were volunteers. At the beginning of the focus group session, the participants filled a demographic questionnaire (Table 1), followed by a brief interview.

sex	Age	Grade	How often do you use computers	Use computer for	How often do you use internet	Where do you use Internet	Use Internet for	Favorite search engines
girl	16	11	Every day	School	Every day	Home	School work and fun equal	Google Yahoo!
girl	15	11	Every day	School work, more fun	Every day	Home	School work and fun equal	Google, AskJeeves, Yahoo
boy	16	10	Every day	School	Every day	Home	School work and more fun	Google, Altavista, Ditto, Yahoo, MSN
boy	15	9	Every day	Fun	Twice per week	Home	Fun	Google, Altavista, AskJeeves
girl	11	6	Every day	School work, more fun, talk to my friends	Every day	School but more home	Fun	Google, Yahoo, AskJeeves
girl	12	6	Twice per week	School work more, fun less	Twice per week	Home	School work	Google, Yahoo, AskJeeves
boy	12	6	Every day	School work and fun and more	Every day	School, home, friend's home	School work, fun and more	Google, AskJeeves, Yahoo
boy	12	6	Every day	School work, more fun	Every day	School, home, friend's home	School work and more fun	Google, Yahoo, AskJeeves

Table 1. Characteristics of the focus groups participants

All the students in the Group 1 attended the same school and knew each other. They all used computers everyday, mostly for school work but also for playing games. Except

for one boy, the remaining three used the Internet everyday, again for both school work and pleasure. Google was the number one choice for a search engine among this group, followed by a variety of portals such as Yahoo!, Altavista, and Ask Jeeves.

While Group 2 participants attended different schools, they were all in grade six. With one exception, they all used computers everyday for school assignments as well as leisure. They also used the Internet everyday, with one exception, for both education and entertainment. They rely heavily on Google, as do the older students, followed to a lesser extend by Yahoo! and Ask Jeeves. Participants in both groups were from a fairly affluent middle-class suburb of Montreal, who had access to the Internet from home.

The questionnaire contained an open-ended question about the participants' favourite computer games. Although no trends can be derived from such a small non-random sample, the 4 boys listed over twice as many games as the girls regardless of age. The younger girls (Group 2) showed very little gaming experience during the focus-group and their questionnaire answers confirmed this observation. Generally, the boys played all styles of computer games but favoured strategy games (*Starcraft*, *Age of Empire*, etc.) involving military conquest and resource management. The two older girls indicated they played adventure (*Myst*, *Uru*, etc.) and simulation (*Sims*) games which offer riddles and numerous opportunities for exploration and discovery.

Three adults were present during focus group sessions: a facilitator, a note taker and an observer. Almost all the interactions with the group were conducted by the facilitator, with only occasional interventions from the other two adults where clarification was desired. The sessions were audio-taped. Internet access was via a high-speed connection.

A brief interview preceded the sessions. Participants in both groups were asked about their information seeking habits and their views on libraries and the web. Group 1 participants suggested that they do not use their school or public libraries and instead use the Internet as it is a faster and more convenient way of finding information. The web also allows them to search a much larger information bank, including a variety of materials, that can be shared with their friends. They noted that Google provides them with the required information at their convenience. Group 2 participants reiterated the views and opinions expressed by students in Group 1; Internet provided faster method of finding the required information than traditional libraries. Both groups emphasized speed and accessibility as the primary reasons for using the web.

The interview was followed by a very brief introduction to the project and a description of the virtual library. In order to encourage evaluation of the interface, the four students in each group were asked to undertake a task. The tasks were:

1. Find a bookshelf on *Transportation*?
2. Find a book on *Wayne Gretzky*?
3. Find a book on *New France*?
4. Find a book on *sailing*?

Students chose a number from a hat to randomize task assignment. The first task was

designed to familiarize the students with the virtual environment and the navigation features. Other tasks were similar to those assigned in our previous research utilizing focus groups (Large et al, in press).

8. Results

Once the preliminary preparation was completed, Group 1 participants were shown the interface. Within a few seconds, and without any prompting from the facilitator, all the students realized that they were in a library environment. Their first reaction was: "cool", expressed enthusiastically and unanimously by all. As many observers have pointed out first impressions matter (Neilsen, 2002). The first task was completed within five seconds by a boy, who learned how to navigate with ease. The second task was also completed within a very short time by a boy, who first found the '*Famous Canadian*' bookshelf and by browsing quickly the book spines found a book on *Wayne Gretzky*. The third student, a girl, found a book on *New France* in less than five seconds. The fourth girl attempting to find a book on *sailing* first located the *Transportation* shelf, and then began to browse the spines of the books, until she found the desired book.

Group 2 students had a similar experience. With one exception, the two boys and the girl completed their tasks quickly. One girl had trouble navigating with the combination of the mouse and keyboard. This girl had the least amount of exposure to the computers, the Internet, and particularly to the games, and was not accustomed to a virtual environment. Nevertheless, she did not find the interface difficult to use and did not seem to be discouraged by the experience. On the contrary, she, like her colleagues, enjoyed exploring the virtual library.

All the students in both groups agreed that the interface is:

- "cool"
- more "fun" than search engines like Google
    - "*would always be more interesting than Google*"
    - "*If I have an option between Google and this, I would use this. Lots more fun… it is different*."
- very interactive
- very simple to use and navigate through
- browsing and exploration is more "fun" in this environment
    - "*like to move around and look for books*"
    - "*moving around is fun*"

In addition, students offered many suggestions for improving the virtual library:

- For a small collection such as the prototype virtual library, no other navigational tools are necessary. However, for a larger collection a map or similar tools may be helpful.
- While students in Group 2 suggested that a keyword search 'box' should appear on a wall or the top corner of the screen, older students in Group 1 did not consider such an option necessary.
- Both groups recommended that realistic sound and animation be added to enhance the experience of browsing around the virtual library. These should include removing a book from the shelf, opening it, and flipping through the pages. Group 1 participants did not recommend adding other sounds, whereas younger

children in Group 2 wanted footsteps to be added, so that they could hear themselves walking through the library.

- Both groups said that the walls were too plain and "ugly". Yet, none wanted a very busy environment. They recommended a "realistic" environment, with options for personalization, such as the ability to change the colour of the walls. Younger children also would like to see windows with outside sceneries that perhaps could be personalized. The same children expressed their interest in having furniture and other realistic objects in the library. Both groups, however, cautioned us that personalization should be limited – they did not want to spend much time setting up the environment.
- Both groups were concerned about adding too many gaming features, which they thought might distract the user from searching for information.
- When prompted by the facilitator to solicit their opinion about using avatars, the older students did not see a need for having them within the environment, whilst the younger participants were keen to see a few "people" in the library. Neither group was interested in seeing themselves, they rather liked the idea of first-person view point.
- Both groups suggested that they preferred in-context help to static text-only conventional help facilities available in many systems. Avatars may be used to depict librarians, who would provide in-context assistants when needed.

9. Conclusion

Systems designed for children must be engaging. Engagement may be indicative of likes and dislikes of children and their level of satisfaction, which can be measured by observing their behaviour (Hanna, Risden, & Alexander, 1997). Indeed, "children are strong in their declaration that they expect to have fun using technology" (Shneiderman, 2004, p. 49) and they often link the idea of fun to challenges, social interaction, and control over their world (Druin & Inkpen, 2001). Failure to consider engagement results in low children-computer interaction, which is detrimental to overall satisfaction of the system. Bilal (2002b) argues persuasively that designers of children's search engines and interfaces ensure that their products are "cool" and offer high usability.

In this study, we have designed a non-immersive virtual reality prototype interface based on a library metaphor. Two focus group studies involving a total of eight children ranging in age from 11 to 16 were undertaken to determine the feasibility of implementing a virtual library. The studies show that children's first impressions of the virtual environment are very positive (they think the virtual library is 'cool'), and have fun using the software to find information. While these children were not randomly selected and may not represent the population, given their computer experience they bring forth the "best practice" in using the technology. The children made a number of valuable recommendations to improve the interface, which will be incorporated in the next version of the virtual library to be linked to the conventional *History Trek* portal.

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