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Web Accessibility for Users with Motor Disabilities

One of the most common and helpful applications of today is the Internet. While browsing the internet, we can shop, run a business, get an education, plan a trip, stay in touch with friends and family, and many other activities, right from our own home. A population that greatly benefits from this convenience is those who have a motor impairment, allowing them to more easily accomplish what could normally be a physical burden on their part, or an inconvenience to another who would have to help them. Unfortunately, Internet browsing itself entails physical difficulties for users with motor impairments, requiring precise accuracy in target hitting to effectively peruse web pages. This results in frustration and often, a reluctance to take advantage of the internet's capabilities. As a solution to this problem, I have illustrated basic requirements that web pages must meet in order to be accessible to users with a motor disability, as well as created a web proxy server that can take in a web page and modify its HTML to meet those requirements. The web proxy works without requiring authors to change the way they write web pages, nor modify what they have currently written.

The goal of universal access is to make services and information accessible to everyone. Because of this, much research in accessibility has focused on developing guidelines and tools in support of universal web access. Examples include accessibility guidelines and numerous services for vision-impaired users. However, few of these systems consider motor impairments, and none address the needs of low bandwidth users: users who can only produce one or two signals when communicating with a computer. Though the number of low bandwidth users is small compared to the number of people with vision impairments, its need is profoundly great. A motor-impaired user generally has limited mobility, and access to the services and resources on the web can give him or her increased independence. The goal of this project is to improve the accessibility of the web to people with motor disabilities who cannot easily use a keyboard, speech, or a mouse or mouse substitute.

In general, web pages are designed with a mouse in mind. The mouse is used to click on links, move the scroll bar, and utilize the navigation buttons at the top of the browser. Although these actions can be performed via keyboard shortcuts, most people do not know this, or they often find it easier/more intuitive to use a mouse. For example, if there is a link at the bottom of a page that is of interest to a user, he will have to tab through every single link on a page in order to get there; using the space bar or down arrow to scroll through a page does not change the link focus, whereas a mouse can scroll and click on any link, regardless of where the current focus lies.

However, users with motor impairments may find both the keyboard and the mouse difficult to use. Those with Parkinson's disease, for example, often suffer from a resting tremor and a difficultly in initiating movement. With this kind of difficultly, a mouse and

keyboard interface can present a problem, often creating a need for an interface that requires less input activity. Even voice oriented communication tools can prove useless, as speaking ability is also affected in many motor impaired users. People with motor impairments often use alternative solutions to interact with their surroundings and environment. These solutions often include a "switch," the most basic of which is like a light switch, with simply two states: "on" and "off", comparable to a keyboard with as few as one key. This population is referred to as low-bandwidth users, because their input abilities are so limited that they can only produce one or two signals when communicating with a computer.

Approach

This summer's research produced a solution for low bandwidth accessibility. Considering that very little can be done on the user's part to change how they use the internet, the burden of communication was put upon web pages. Keeping in mind that the web page authors should not all need to change the way their pages already look, I sought to instead, create a proxy that modifies HTML and transform pages' formats into a more accessible layout, easily navigated by one switch. This idea for a proxy also allows for portability, so that those who would like to use it are able to, at home, in a library, or anywhere they find an internet connection. Most importantly, it means that it is available to any user without requiring extra software to be installed.

Requirements for Low Bandwidth Input

Before a user may begin browsing, he creates a one-time login that contains his profile information (name, address, phone number) and a categorized bookmark file with all of his personal bookmarks. This information is stored on the proxy so that it can be accessed from anywhere. Users can either login on their own computer, in which case the login will be stored on a cookie, or at a public terminal (ex: library), in which case they will need to login every time they open their browser.

The following are three basic requirements that must be met in order to allow for true web access.

1. **The currently selected link is visible.** The HTML highlights each link as it is selected. This required the use of JavaScript. (Figure 1)

2. **The user can read and navigate text that contains no links.** Page Up and Page Down buttons are added after a certain amount of text to move the screen focus up and down the page. This is also a good way to skip unwanted links. (Figure 2)

3. **The user can traverse the history list forward and backward.** Back and forward buttons are added to the top of each page so that they can be selected via single switch input. (Figure 3)

In addition to these basic concerns, there are also four secondary requirements that, while not entirely imperative, also work to aid in web browsing.

4. **The user can access bookmarks and add to them.** Buttons on each page allow the user to add the current page to their bookmarks or to view their bookmark list. Bookmarks can then be organized into categories. As stated before, these bookmarks are stored on the server for each login name created with the proxy.

5. **The user can quickly access text and links of interest.** A "Skip to Content" button is added at the top of each page. Clicking on this button will move the current screen focus and selected link past any menu bars to the first paragraph of content.

6. **Users are given information about link targets.** Each link (that is not determined to be in the menu bar) is described in a short parenthetical statement proceeding the link consisting of the first few words of content, or the page's title, form the linked page (figure 4).

7. **The user is given alternatives for form elements.** This is where profile information becomes most useful. In areas titled "name" "address" and "phone number", profile information will automatically fill in those spaces. There is also a pull down menu at the side of each text box where the most commonly typed phrases are stored. A third alternative is a soft keyboard implemented with a scanning interface.

These requirements are complimentary to those recommended by the W3C for supporting users with disabilities. The W3C suggests providing shortcut keys to access important links, ensuring a logical order for tabbing through links, and ways of dealing with image maps and scripts, clearly identifying the target of each link (priority 1 for this paper) and providing navigation bars and grouping related links.

Browser Redesign

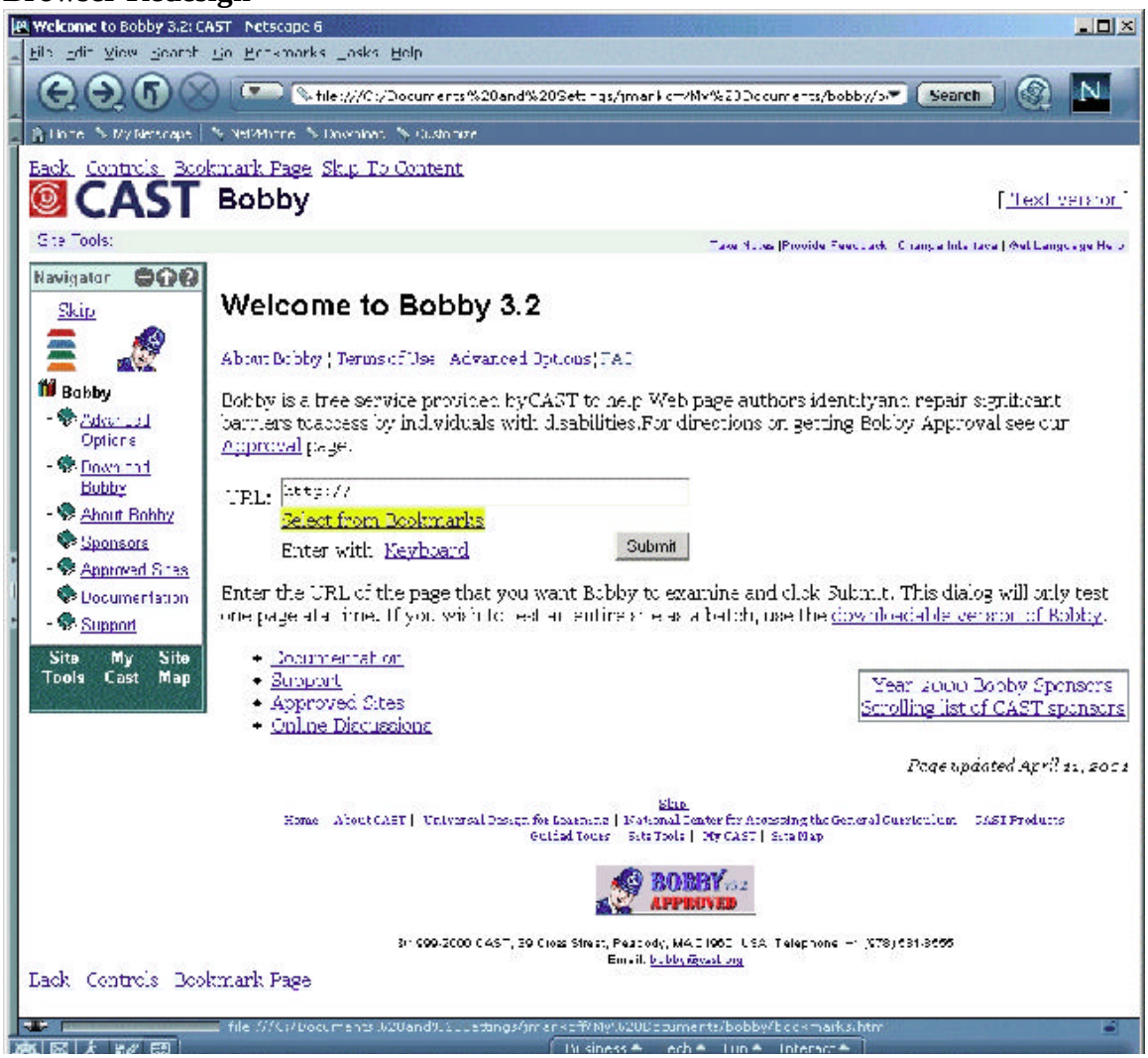

Figure 1. The currently selected link is highlighted.

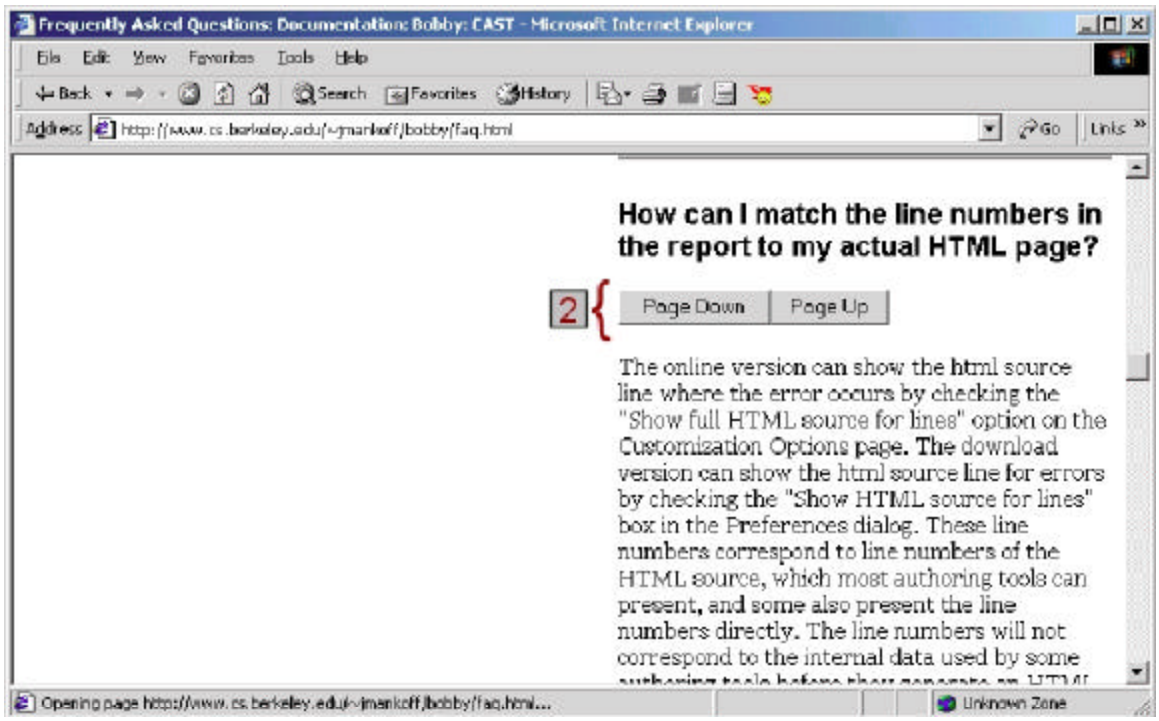

Figure 2. Page up and Page down buttons embedded in the web page. These are accessible through single or double switch input.

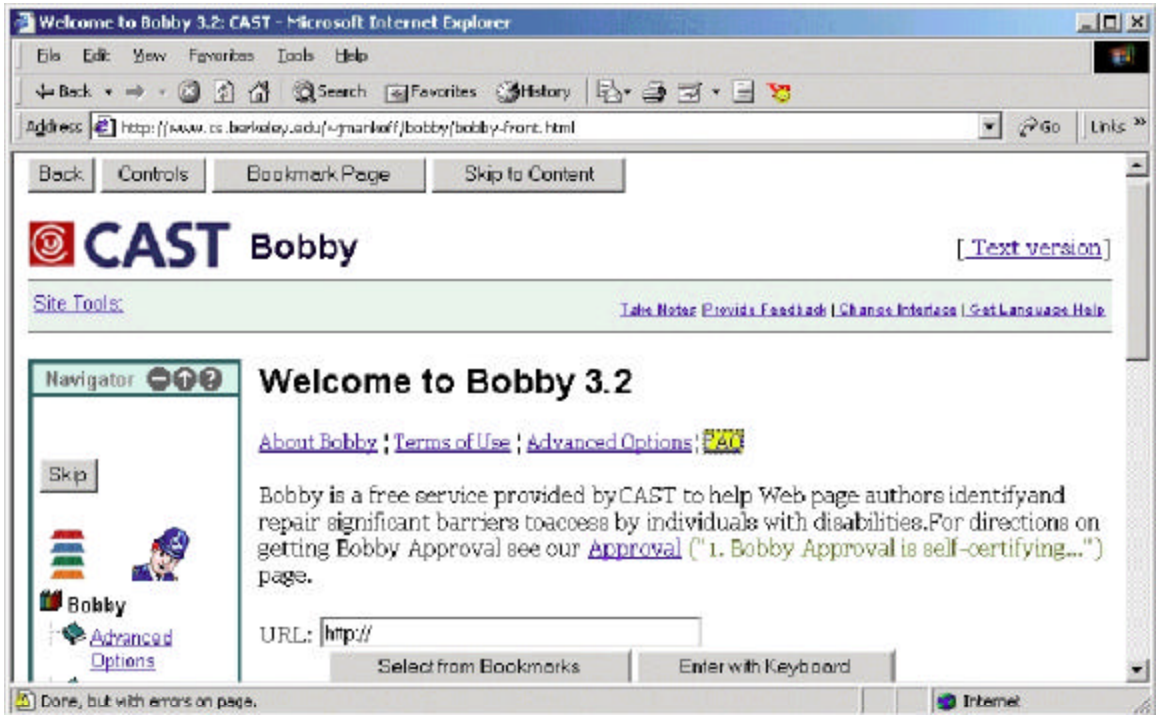

Figure 3: Navigation buttons are added at the top of every page for quick access.

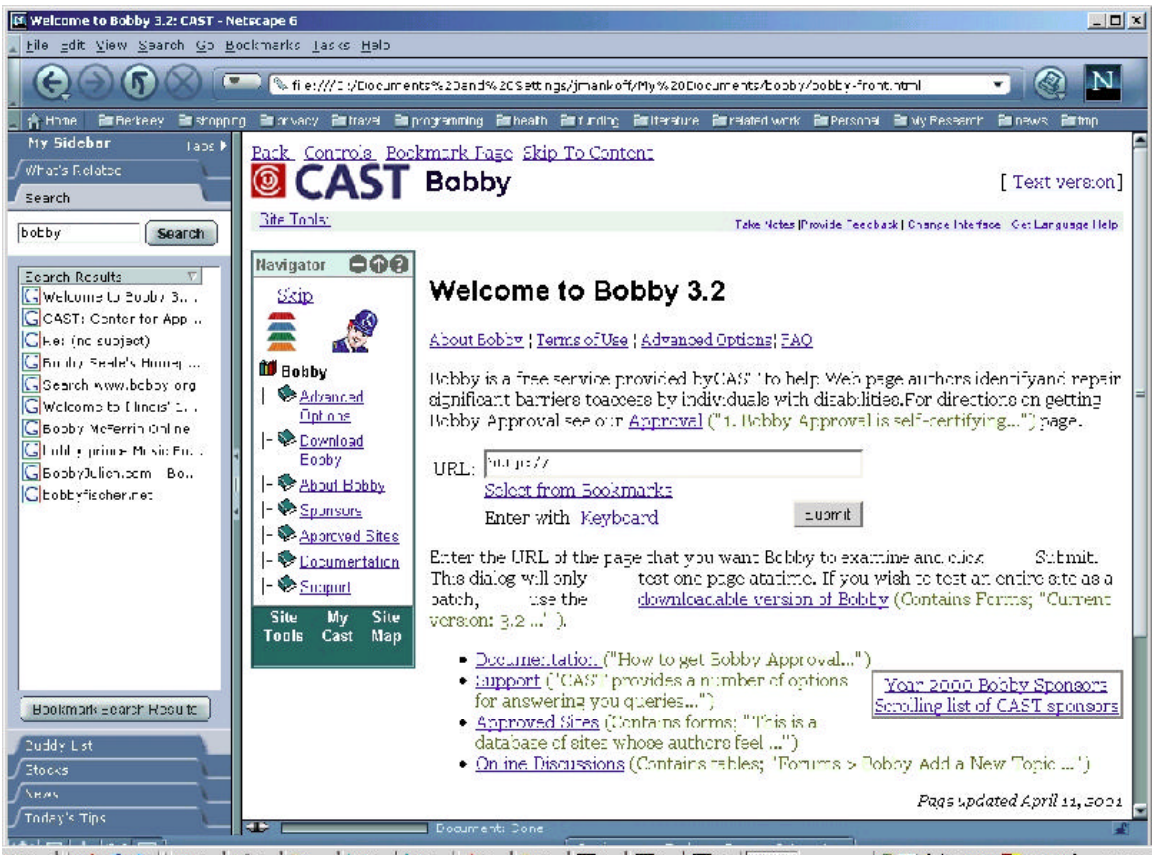

Figure 4. Link information is given in a parenthetical statement after each link.

User Population

A variety of degenerative diseases and other conditions or injuries may impair motor function. Example disabilities include cerebral palsy, ALS (Lou Gehrig's Disease), brain stem strokes, Parkinson's Disease, and certain spinal cord injuries. For this study, I chose a population of Parkinson's Disease patients and one patient with damage in the C5/C6 vertebrae of his spine (he was a quadriplegic).

Results of the User Survey

In conducting this user study, the main issue that this research found was that web browsing, for the purposes of this proxy, is geared toward the more severely impaired, such as users with locked-in syndrome who have only neural control of signal output. These users can modify their brain signals by increasing signal characteristics such as frequency or amplitude.

The most common problem found was that typing was too difficult. Using the mouse was second in line of complaints: users found it challenging to double click, scroll, and accurately hit targets. For web use, a "favorites" or "bookmarks" option was frequently used, but those users did not know how to modify those lists; they received help from family. One of the users stated that computer use in general quickly became "painful."

Other high level points noted are:

1. All participants perceived the mouse to be non-problematic and preferred it, even though they found it troublesome
2. Mouse trouble included scrolling and clicking; more specifically, releasing the mouse without dragging.
3. Keyboard trouble was generally that typing was slow, and that more than one key is easily hit.
4. All participants used the internet for tasks that required typing and mousing.

My larger goal is to develop a user model that incorporates information about fatigue, cognition, and a wider variety of input devices. This model will be used in developing a general tool in support of automatic modification of a variety of interfaces beyond just web browsers. Examples include drawing programs, spreadsheets, email and other commonly used applications.

While this proxy caters more towards the severely impaired, new guidelines for moderately impaired users lay in wait. Ultimately, the goal is to develop a system that can be used by anyone with one or more signals at his or her disposal. This system will be expanded to make use of scanning and prediction, and will meet all seven requirements. Scanning will be turned on at user request. Prediction will be used to help the user when filling out forms. The expanded browser will also handle frames and other common HTML usages robustly.

In conclusion, this paper has shown a browser and a web proxy—approaches to increase web accessibility in the face of low bandwidth input and demonstrated how they can address a host of problems.

Note: To use this proxy, use IE 5.5 and login to proxy kettle.cs.Berkeley.edu, port 4000.