

## SUMMARY

The goal of universal access is to make applications accessible to everyone. One of the first, most common, and most useful tasks done by today's computer users is World Wide Web (web) browsing. Because of this, much research in accessibility has focused on developing guidelines and tools in support of universal web access. Examples include the W3C accessibility guidelines [41, 36] and numerous services for vision-impaired users [31, 35, 18, 2, 42, 9, 15, 38, 14], the people most obviously in need of support when dealing with graphics and text contained in web pages.

However, only a few of these tools [14, 15] address the needs of motor-impaired users. A motor-impaired user often has limited mobility, and access to the services and resources on the web can give him or her increased independence. In this work, we focus on a particular subset of motor-impaired users, those who can only produce a few signals when communicating with a computer.

The *low bandwidth* input these users produce may not match the number of interface elements the user wants to control. A single switch is appropriate to control a single light in a room, but not well suited to controlling a house full of lights. An interface must multiplex a small number of input signals onto a large number of controls to support low bandwidth input. Unfortunately, most graphical user interfaces are designed to do the opposite: They expect a user to be able to select any of the 600x800 (or more) pixels on the screen, and then narrow this down to a smaller set of functions with the use of menus, buttons, & *etc.*.

Although our target population is small, it is not easy to design for. The capabilities of users with these types of motor impairments vary wildly. The addition of one new signal may double the available control signals, with a correspondingly large impact on the optimal interface. The frequency of errors has an equally large impact on interface design. Finally, the issue of fatigue may require an interface that adjusts to the user over time. From a Computer Science perspective, this represents a challenging problem.

We propose to create a tool that can model users with severe motor impairments and automatically make the adjustment necessary to provide access to the web. For example, a web page may be modified to show preview information about a selected link to user to avoid the cost of following a wrong link and then backing out again. [43, 28]. We have identified seven requirements for such a tool, ranging from navigation support to dealing with forms, and we expect to add to and refine these requirements as this work progresses. We will build two complementary systems that meet these requirements. One is a dynamic browser interface and leaves the actual HTML unchanged. The other is a proxy server that modifies HTML to be more accessible. Neither requires the authors of web pages to make changes.

The first approach will allow finer control over modifications and provide a platform in which we can experiment with different mappings between input signals and action based on errors and fatigue. The modified browser will be able to track errors and adjust its interface accordingly. It will also allow us to experiment with different approaches to avoiding errors such as confirmation dialogs. The second approach will be platform independent, and available to any user without requiring that any special software be installed. It will allow us to test our modifications on a much wider scale.

We chose these automatic approaches because it is unrealistic to expect that web designers will hand-code the necessary modifications into their websites. There is a rich history of proxy-based and other automatic approaches to supporting accessibility [15, 38, 12, 32, 39, 35, 18, 28]. Additionally, our approach lets us explore the feasibility of automatically generating user interface modifications based on a user model, something we plan to apply to other common and important applications such as email and word processing. Both our web accessibility work and this larger goal have applications outside of assistive technology. For instance, they may be used to increase accessibility of the web to other users with limited input capabilities, for example, to mobile phone users with limited (9-key) keyboards.

We will develop and test these systems first with abled and then motor-impaired users. We will deploy them publicly and study their impact over time. Finally, we hope to impact accessibility guidelines, so that more web pages and other applications can support low bandwidth accessibility. The contribution of our work will be a set of techniques for making the web more accessible in conditions where input is extremely limited and errors are likely. This system may be useful to people with motor disabilities, or any user with access to limited input devices, such as a wearable computer user. In contrast, past work has looked at low bandwidth or alternative output modes, with some related input issues that overlap and inform our work.