ACCESSIBILITY AND COMPUTING

A Regular Publication of the ACM Special Interest Group on Accessible Computing

June 2005 Number 82

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A regular publication of the ACM Special Interest Group on Accessible Computing

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Who we are

SIGACCESS is a special interest group of ACM. The SIGACCESS Newsletter is published regularly in January, June, and September. We encourage a wide variety of contributions, such as: letters to the editor, technical papers, short reports, reviews of papers of products, abstracts, book reviews, conference reports and/or announcements, interesting web page URLs, local activity reports, etc. Actually, we solicit almost anything of interest to our readers.

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Finally, you may publish your work here before submitting it elsewhere. We are a very informal forum for sharing ideas with others who have common interests.

Anyone interested in editing a special issue on an appropriate topic should contact the editor.

Accessibility and Computing

The Newsletter of ACM SIGACCESS

NUMBER 82, June 2005

A note from the Editor

Dear SIGACCESS member:

Welcome to the first on-line version of the SIGACCESS Newsletter. For readers who wish to maintain a hard-copy catalogue of Newsletters, a downloadable PDF version is available ready for printing.

If you prefer to browse the articles on-line, we also have an HTML version, with active hyperlinks to supporting material.

Back-copies of the Newsletter can still be obtained through the ACM Digital Library, although this will only include the PDF versions. The ACM currently has no mechanism for storing HTML versions. However, we will maintain an archive of back-copies that will be available via the SIGACCESS web-pages (http://www.acm.org/sigaccess/).

About this issue

This issue has been inspired by the launch in February of this year of a new British Standard, BS7000 Part 6 – Guide to Managing Inclusive Design. The first article, by Alan Topalian, describes the new standard, its aims and objectives. This standard is important because it is possibly the first attempt of its kind to look at how a corporate entity should structure its business practices to support and nurture Inclusive Design.

Continuing on from this theme are four articles from authors based in industry. The first of these discusses a new initiative being put into practice internally by IBM, that of Ease of Access. This initiative recognises that accessibility needs to be implemented in active concert with usability to develop products that are genuinely usable and accessible by as many people as possible.

The second article is from Rob Haverty of Microsoft and is about User Interface (UI) Automation, which is the new accessibility framework for Microsoft Windows® and is destined to replace Microsoft® Active Accessibility® (MSAA). His article provides an introduction to the concepts underlying UI Automation and its cross-platform implementation.

Marguerite Bergel, Ann Chadwick-Dias and Tom Tullis of Fidelity Investments discuss their work on leveraging Universal Design approaches in the financial services sector. Their work has a particular focus on the e-commerce area and their article highlights the research and development activities that Fidelity is undertaking to maximise their ability to meet the needs of their customers. In their conclusion, Bergel et al. echo the Ease of Access concept from the IBM article, that usability and accessibility need to be addressed together.

Finally, in this section of the Newsletter, Jon Dodd of Bunnyfoot Universality writes about his personal experiences working in this area for a consultancy. He describes the rationale that prompted Bunnyfoot to move into the accessibility domain and the progress that he, as a practitioner, has seen over the past 5 years. Again, he echoes the argument that usability and accessibility both need to be addressed explicitly to meet the needs of the end-users.

The final two articles in this issue are from the Doctoral Consortium held at ASSETS 2004. In her article on mu-based Brain-Computer Interface systems, Adriane Davis of Georgia State University investigates whether training some to use such a system can improve physical performance. Although this work is inspired by improving athletic performance, the underlying principles are equally applicable to physical therapy and rehabilitation.

The last article in this issue is from Haixia Zhao and introduces his research at the University of Maryland, College Park, into the use of non-speech sound to assist blind or low vision users navigating through information spaces.

And finally…

Just a reminder that registration for ASSETS 2005 is still open at:

http://www.acm.org/sigaccess/assets05/

Simeon Keates

Newsletter Editor

New British Standard on Managing Inclusive Design

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A new British Standard, *BS7000-6 Guide to managing inclusive design*, was published in February 2005. This provides extensive guidance to help private enterprises, public sector and not-for-profit organizations to introduce a professional approach to inclusive design.

Why inclusive design needs to be addressed

Disability is not a simple consequence of an individual's impaired capability, but results from a failure to take proper account of the needs, capabilities and preferences of all potential users when designing products, services and facilities. Legislation, regulations and changing attitudes around the world are generating increasing pressures for more inclusive societies.

Inclusive design is comprehensive, integrated design that encompasses all aspects of a product (or service) throughout its lifecycle from conception to final disposal. The goal is to meet the needs of consumers of diverse age and capability in a wide range of contexts because appropriate access to information, products, services and facilities is a fundamental human right.

Inclusive design needs to be a key element in an inclusive business strategy. Organizations that adopt a pro-active approach based on a better understanding of consumer needs and aspirations stand to benefit from:

- higher quality products, services and facilities;
- increased sales, customer satisfaction and loyalty;
- stronger brand values and enhanced brand recognition;
- greater profitability and improved returns on investment.

Broadly, everyone benefits through inclusive design.

By contrast, failure to act could expose organizations to the possibility of litigation and damage their reputations. In the UK this is an important consideration, especially since the Disability Discrimination Act, 1995 came fully into force last October.

What the standard provides

This standard provides a framework by which executives (owner-managers, board directors and principal officers down to supervisory staff) as well as design / technical specialists can understand and respond to the needs of diverse users without stigma or limitations. These may include people who:

- have impaired vision and/or hearing (including colour blindness, etc.);
- are from different cultures (with different languages, values and/or customs);

- have language and/or speech impairments (resulting in difficulties with reading, comprehension and in expressing themselves);
- have physical limitations (whether due to temporary or permanent reductions in strength, movement and/or co-ordination; allergies, sensitivity to electromagnetic radiation, etc.);
- are of different ages;
- have varying cognitive abilities;
- have different dietary requirements for medical reasons or through choice;
- have different requirements because of their gender.

BS7000-6 concentrates on providing guidance for those with responsibilities for an enterprise's overall approach to design and managing inclusive design activities. Their understanding and direction are critical to success in effecting organization-wide changes and championing design initiatives across product ranges.

Introducing a professional approach to inclusive design at the organization level

The standard sets out a comprehensive framework for introducing a professional approach to inclusive design into an organization which requires more than an adjustment of processes and guidelines. Preparatory groundwork and changes are required to organizational culture and infrastructure which may have far-reaching effects and extend beyond design to other mainstream disciplines. Therefore, clear direction and support are needed from senior executives.

Issues clarified include top-level responsibility for inclusive design, and the formulation of a business case for adopting an inclusive approach that is tied closely with an organization's core objectives, strategies and plans.

Guidance is also provided on how current operations and facilities might be reviewed to check their appropriateness, and how experience and best practices elsewhere might be harnessed effectively. Development and marketing strategies are outlined relating to new products and services.

The standard highlights the importance of conferring with target customers to ensure approaches and solutions are appropriate. Emphasis is placed on ensuring close co-ordination during the development process so all disciplines contribute effectively at all stages, before and after introduction to market. The importance of preparing markets for new products and services is highlighted. Getting the launch right is crucial to raising the profitability of the product, as is ensuring that promotion, distribution, customer support are all harnessed effectively throughout its lifecycle.

Communicating the central messages about the 'inclusive design' approach is essential to get the early backing of key staff. Specialist terms are defined towards the beginning of the standard to facilitate comprehension and enhance communication inside an organization and with outside audiences.

Other issues covered include the legal aspects, drawing up and reviewing investment programmes, and evaluating corporate performance.

Readers will find a useful diagram and checklist that provide summary overviews of what needs to be done by senior executives and officers at the organization level.

All about the prime stages of inclusive design projects

The section on managing inclusive design at the project level is taken up largely by figures on all prime stages of inclusive design projects. Each includes details of the stage aims, inclusive design tasks to be undertaken, tools and techniques that facilitate work, key outputs, and the basis on which a project might progress to the next stage.

Guidance also covers the focus and iterations between stages, and the importance of concurrent working, stage gateways and reviews. Stress is placed on the quality of project proposals as these can do much to stimulate fresh approaches and encourage new terrain to be explored, so raising the chances of creating innovative solutions that are attractive to target markets.

A diagram provides a useful overview of prime project stages, while a checklist summarises the main factors to be considered at project level.

Extensive annexes and links to practical references

Two annexes include further evidence to reinforce the case for adopting a professional approach to inclusive design. One summarises trends in population, society and legislation, providing some insights into the diversity of society, different kinds of impairments and the implications for work and public environments. The other outlines the tools and techniques that facilitate work at different project stages, some developed specifically for inclusive design work.

This new British Standard includes a brief bibliography plus links to the websites of key organizations – for example, Royal National Institute of the Blind, Royal National Institute for Deaf People, Design Council, and so on – to guide readers to an extensive range of up-to-date practical references.

How to order

BS7000-6 is available in standard and large print (14 point) versions: price £122 or £61 for BSI Subscribing Members. (P&P £3.90 UK, £5.45 overseas; free P&P to BSI Subscribing Members). Other formats may be available in due course.

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Introducing Ease of Access into IBM

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Introduction

IBM has a long history of addressing the issues of employees and customers with disabilities through hiring and workplace practices, and through research and productisation of accessibility technologies. In 1999 IBM established an Accessibility Center with a focus on making our offerings accessible, exploiting accessibility technologies developed in IBM Research, and improving IBM's internal IT tools and work environment for employees with disabilities. IBM's product development organisations have made significant progress enabling their offerings and addressing some of the more difficult architectural issues associated with product accessibility.

However, making products accessible does not necessarily mean they are easy to use for users with disabilities. Access in this context, means just that: users with disabilities have been provided access to the function and information offered by a product. Mere access is the measure of success set by most accessibility standards such as Section 508. IBM development organisations have learnt this over the last three years and have begun to address this issue. IBM has started to deal with this issue by leveraging the overlap of its work on accessibility and user experience / ease of use. This convergence is referred to as Ease of Access.

Ease of Use within IBM

Within IBM all major product development efforts employ a formalised user-centred design (UCD) process that integrates user input and user interface evaluation and design methods into the development process, and user and customer satisfaction is tracked over product releases and against competition. Including users with disabilities in this process, however, has been rare with a few notable exceptions.

Until recently, the practice of making products easy to use has focused on the average, or the most common, or most influential user of the product being designed. This has translated into testing and designing products for the most common human characteristics and thus excluding users with most disabilities. Even typical UCD selection methods (representative sampling of the user population) work against including users with disabilities because of the large under representation of persons with disabilities in the work force.

In response, IBM is undertaking efforts to include persons with disabilities in its product design and development process, to define sets of best practices for doing so, and to make its offerings easy to use for users with disabilities.

Current accessibility guidance within IBM

As with most other companies in the IT industry, IBM's accessibility practices have been influenced heavily by recent legislation, such as Section 508 [1] and the Americans with

Disabilities Act [2]. Prior to 2004, IBM's accessibility efforts were focused on meeting accessibility standards which enables our products to work with assistive technologies used by people with disabilities.

One of the consequences of the way that current legislation is framed is that accessibility issues have largely been reduced to "Is (*X*) accessible?" If it is, then the product passes that particular check, if not then it needs to be revised. In response to this, IBM has developed checklists for product developers covering the following topics:

- Software accessibility – e.g. (1) Keyboard access –
  - (1) Provide keyboard equivalents for all actions.
  - (2) Do not interfere with keyboard accessibility features built into the operating system.
- Web accessibility
- Java™ accessibility
- IBM Lotus Notes® accessibility
- Hardware accessibility
- Peripherals accessibility
- Documentation accessibility

These checklists are available via the Accessibility Center web-site at:
http://www.ibm.com/able/guidelines/index.html

Taking accessibility forward within IBM

IBM recognises that accessibility goes beyond issues of compliance and the adoption of a holistic approach is required. To this end, a four tier framework has been adopted – see Figure 1.

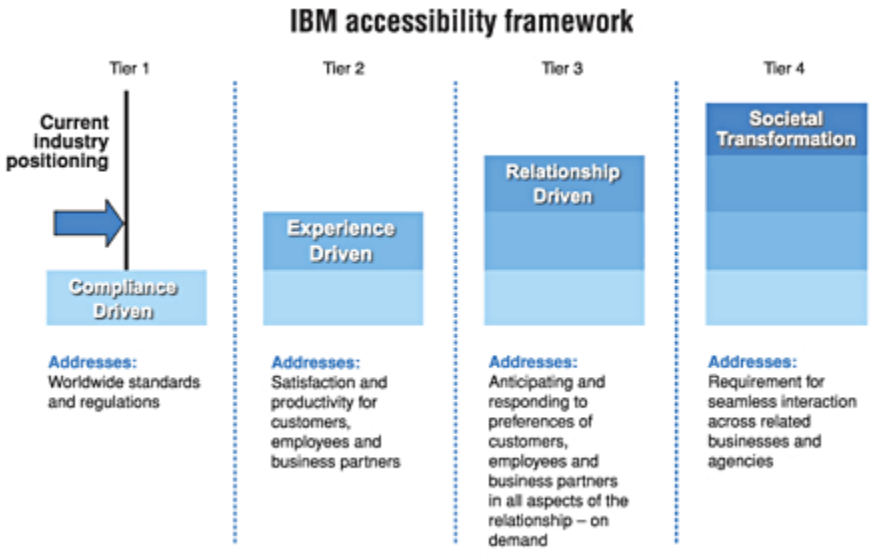

Figure 1. The 4 tier IBM accessibility framework

From the framework it can be seen that the current level of industry's response to accessibility is focused squarely on compliance (Tier 1). While meeting compliance requirements is of some use to end-users, the real benefit to the overall user experience comes when industry looks beyond compliance towards a person's total quality of life.

Implementing this framework begins with implementing accessible technology infrastructure and ends with business transformation. An important step on that way fro IBM is the Ease of Access initiative.

What is Ease of Access?

Ease of Access is a joint initiative of the accessibility and ease of use communities in IBM, chartered to focus on ease of use for people with disabilities. It is intended to bring together best practices from the fields of accessibility and usability into a single framework for implementing the goal of Ease of Access.

To address this issue, the Ease of Access work group was formed in 2004 as a cross-IBM team representing many areas in IBM that have been involved in accessibility and ease of use. Members of the team have been drawn from groups such as the Accessibility Center, Accessibility Research (based at TJ Watson), Software Group and hardware divisions.

The goal of the work group is to develop Ease of Access best practices that can be deployed by IBM development teams. These Ease of Access best practices will be used to expand the focus of User Centred Design and User Engineering methods to be inclusive of all users and to expand the focus of accessibility from product enablement and interoperability with assistive technology (AT) products to include ease of use.

While work has been done in some academic and research labs, this focus on Ease of Access is relatively new within commercial product development organisations. As IBM develops and enhances its Ease of Access methods, best practices will be published and integrated into its User-Centred Design and User Engineering methods and tools.

Ease of Access best practices

The root cause of industry producing products that are difficult to access even when they are accessible is twofold. First, people with disabilities are not normally included in the product user-centred design process and the typical user interface designer does not understand the unique characteristics of people with disabilities. Second, the general approach to making products accessible pose challenges to designing ease of use for people with disabilities. Product designs that assume one set of input/output capabilities (e.g., visually oriented GUIs) are difficult to retrofit for easy use by users with different sensory and manual capabilities (e.g., screen reader based non-visual interfaces).

Based on these considerations focus was placed on the following areas:

- Product evaluations with users with disabilities
- User interface design and implementation techniques for people with disabilities
- Use of personae of users with disabilities
- Complex visualisation applications
- Hardware enablement issues
- Lessons learned from developing IBM assistive technologies

The first two areas represent a great deal of experience across IBM, industry, and academia that could be leveraged and documented. The use of personae is a user-centred design technique in IBM that could easily be adapted for use with people with disabilities.

Complex visualisation applications, such as visual editors, are an increasingly important technique used in the industry to provide significant enhancements to a user's ability to create new applications and deal with very large amounts of data. Visually impaired users, however, not only cannot take advantage of these enhancements, they are also prevented from participating in work where teams of fellow workers use these visual tools to do their work. Therefore, the Work Group decided to initiate work to understand how to make such applications fully accessible and easy to use.

Much of the ease of access work described above focused on software products, and so the Work Group initiated a focus on unique hardware products issues. Finally, IBM has a long history of developing assistive technologies, such as IBM Home Page Reader and the IBM Java Self-Voicing Development Kit. Through the development of these technologies and through supporting interoperability with individual product teams a number of important lessons have been learned about making product user interfaces easier to use through assistive technologies.

Output of the work group

Sub-groups of topic specialists were formed to address each of the areas identified above (user evaluations, use of personae, etc.). Each sub-group in turn produced a white paper that summarised the state-of-the art of existing best practice and also how such practice should be applied with the product development process within IBM. Where appropriate and available, specific examples of the best practice in use were given. For example, sample personae were described in the personae paper.

The white papers produced were reviewed at both the sub-group and work group levels and revised iteratively. In November 2004, the white papers were then made available to other groups within IBM as part of a wider consultative phase to determine whether product development teams were able to use them in the format provided.

As a second-phase step of the consultative process, the white papers are being prepared for externalisation, i.e. making them available to people outside of IBM. It is expected that the white papers will complete this process shortly.

Expanding the focus

Looking beyond the existing white papers, future work will focus on:

- validating this early work,
- including an even broader range of user evaluation techniques,
- providing further enhancements to the user interface design methods,
- integrating with user engineering methods and tools

The IBM Accessibility Center has developed a Strategic Framework which views the development of this confluence of accessibility and ease of use as a natural evolution of the IT industry's focus on accessibility. Our industry is moving to this focus now. It is imperative that from a business point-of-view that IBM leads this development.

Summary and conclusions

Despite an increased focus on the accessibility of Information Technology offerings, IT products are typically not easy to use for users with disabilities, even when they are "accessible". One of the major root causes for accessible, but difficult to use, products is, simply put, ignorance of the requirements and characteristics of people with disabilities.

Recently IBM has undertaken efforts to change this, by defining a set of relevant best practices and integrating a focus on users with disabilities into its product design and development processes. This issue is being addressed by providing guidelines for incorporating users with disabilities into usability and user-centred design evaluations, by providing guidance and a set of templates for developing personas for users with disabilities, and by providing a set of user interface design and implementation guidelines.

Obtaining feedback from users about product design through sessions that allow current and prospective users to exercise early product prototypes is critical to making products easy to use.

While testing individual products is critical, translating feedback into useful designs will be enhanced by the user interface design guidelines and techniques that have been developed under this initiative. As user interface designers employ these guidelines, and temper their designs with the input from usability evaluations with users with disabilities, IBM will gain the additional knowledge needed to improve and extend the current set of guidelines.

It is recognised that this is just the beginning of this work and it is expected that there will be a period of intensive learning over the next few years where the guidance needs to be improved. Support mechanisms will be established with the dual purpose of helping IBM user experience and accessibility professionals employ these guidelines, and collecting the data needed to make continuous improvements. As part of this areas will be identified to improve deployment, particularly in the area of tools, and to develop more advanced best practices in ease of access.

As the IBM internal methods improve and products come to embody Ease of Access principles, it is expected that IBM's ability to provide not only exemplary product user experience but also consulting services to our full range of customers will be enhanced. The potential impact on the lives of persons with disabilities is significant.

References

1. 1998 Section 508 of the Rehabilitation Act (29 U.S.C. 794d) – as amended by the Workforce Investment Act of 1998 (US Public Law 105-220). Available at: http://www.section508.gov

2. 1990 Americans with Disabilities Act (US Public Law 101-336). Available at: http://www.usdoj.gov/crt/ada/adahom1.htm

New Accessibility Model for Microsoft Windows and Cross Platform Development

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Abstract

Microsoft® Windows® User Interface (UI) Automation is the new accessibility framework for Microsoft Windows, which will ultimately replace MSAA, and is intended to address the needs of assistive technology products and automated testing frameworks by providing programmatic access to information about the user interface. UI Automation will be fully supported on Microsoft Windows XP and the next version of the Windows desktop operating system code-named "Longhorn". Support will continue for MSAA in the Longhorn timeframe as well. UI Automation will also be made available for cross platform development via a royalty-free license.

Introduction

In 2003, Microsoft Corporation commissioned Forrester Research, Inc., to conduct a study to measure the potential market of people in the United States who are most likely to benefit from the use of accessible technology for computers (see *http://www.microsoft.com/enable/research/*). Accessible technology enables individuals to adjust their computers to meet their visual, hearing, dexterity, cognitive, and speech needs. It includes both accessibility options built into products as well as specialty hardware and software products (assistive technology products – see *http://www.microsoft.com/enable/at/types.aspx*) that help individuals interact with a computer. Overall results show that 57% (74.2 million) of computer users in the United States are likely or very likely to benefit from the use of accessible technology due to experiencing mild to severe difficulties or impairments (see *http://www.microsoft.com/enable/research/computerusers.aspx*).

With the current technology, assistive technology vendors (ATVs) are required to use many different approaches to obtain and present information about the UI to the end user, thus spending an inordinate amount of time and resources on providing this basic information. With such a large percentage of users needing accessible information it is becoming increasingly important to make it easier for an ATV to programmatically obtain information about the UI.

The new accessibility model for Windows, UI Automation, is designed to provide a single reliable source of UI information to assistive technology products and automated test scripts. It provides programmatic access that allows automated tests to interact with the UI and allows assistive technology products to provide information about the user interface to their end users. UI Automation also provides means for manipulating the UI.

UI Automation has two main audiences: UI Automation providers and UI Automation clients. UI Automation providers are applications such as Microsoft Word, or third-party applications. UI Automation clients are assistive technology applications, such as screen

readers, screen enlargers, or others. Automated test scripts can use UI Automation for automated testing and are also considered clients in the UI Automation framework.

This article includes information on the namespaces that the UI Automation framework uses as an organizational system – a way of presenting program components that are exposed to other programs and applications – as well as information on the following UI Automation features:

- automation tree;
- control patterns;
- properties;
- events; and,
- input.

Please note that the description of UI Automation presented here is preliminary and is subject to change.

UI Automation Namespaces

The following table lists the namespaces used in the UI Automation framework, as well as the audience that uses each namespace.

Table 1. UI Automation Namespaces and related audiences

Namespace	Audience used by
System.Windows.Automation – see [1]	Clients for finding automation elements, registering for events and working with control patterns.
System.Windows.Automation.Provider – see [2]	Providers for implementing UI Automation on "Avalon" controls or applications.

UI Automation Tree

Standard Windows programming has always exposed the relationship between elements in the user interface in a parent/child relational structure. UI Automation clients view the UI elements on the desktop (a UI element would be, for example the "OK" button) as a set of automation elements which are arranged in a tree structure. Automation elements are referenced through a common object (the *AutomationElement* – see [3]) to enable consistent information, interaction, and a navigation model. UI Automation unifies disparate UI Frameworks such as Avalon, Trident, and Win32 so that code can be written against one API rather than several.

Within the automation tree there is a root automation element which represents the current desktop and whose children represent application windows on the desktop. Each of these child elements can contain automation elements representing the UI elements comprising their UI, such as menus, buttons, toolbars, and others. Each piece of UI can contain automation elements representing their content, such as menu items, or list items. Even a button, which does not contain any items, may have children automation elements

which represent the basic UI components that comprise the button, such as text and rectangles.

It is important to note that the automation tree is not a fixed structure. For performance reasons it is built on demand starting with an automation element which the client specifies.

Views of the Automation Tree

The automation tree can be filtered to create customized views of the tree which contains only those automation elements that are relevant for a particular client. This approach allows clients to customize the structure presented through UI Automation to their particular needs. Default views are provided by the UI Automation framework, but clients can also define custom views.

Raw View

The raw view of the automation tree is the full tree of elements for which the desktop is the root. The raw view closely follows the native programmatic structure of an application and therefore is the most detailed view that is available. It is also the base on which the other views of the tree are built. Because this view depends on the underlying UI framework, the raw view of an Avalon button will have a different view than a Win32 button.

Control View

The Control View of the automation tree simplifies the assistive technology product's task of describing the UI to the end user and helping that end user interact with the application because it closely maps to the UI structure perceived by an end user.

The control view includes all elements from the raw view that an end user would understand as interactive or contributing to the logical structure of the control in the UI. Examples of elements that contribute to the logical structure of the UI but are not interactive themselves are item containers such as list view headers, toolbars, menus, and the status bar. Non-interactive elements used simply for layout or decorative purposes will not be seen in the control view. An example is a panel that was used only to layout the controls in a dialog but does not itself contain any information. Non-interactive elements that will be seen in the control view are graphics with information and static text in a dialog.

Content View

The content view of the automation tree contains elements that convey the true information in a user interface. For example, the values in a drop-down ComboBox will appear in the content view because they represent the information being used by an end user. In the content view, a ComboBox and ListBox are both represented as a collection of items where one or more items can be selected. The fact that one is always open and one can expand and collapse is irrelevant in the content view because it is designed to show the data, or content, that is being presented to the user.

Custom Views

The UI Automation framework also allows a client to create a custom view of the automation tree by specifying the desired match conditions and scoping information. This also allows clients to build their own interaction models for the application using just the data that they need.

Automation Tree Structure Example

The following example compares the control view and content view of the automation tree for the same application:

Table 2. Comparison of two Automation Tree structures

Automation Tree (Control View)	**Automation Tree (Content View)**
The *Control* view of WordPad shown from the Desktop has the following structure: • Desktop o Window "*Notepad*" ▪ TitleBar "*Notepad*" • SystemBar o MenuItem • Button AutomationId = "*Minimize*" • Button AutomationId = "*Maximize*" • Button AutomationId = "*Close*" ▪ MenuBar "" • MenuItem "*File*" • MenuItem "*Edit*" ▪ ToolBar "" • Button "*New*" • Button "*Open*" ▪ Text "" ▪ StatusBar • Edit • Edit	The *Content* view of WordPad shown from the Desktop has the following structure: • Desktop o Window "*Notepad*" ▪ MenuBar "" • MenuItem "*File*" • MenuItem "*Edit*" ▪ ToolBar "" • Button "*New*" • Button "*Open*" ▪ Text "" ▪ StatusBar • Edit • Edit

UI Automation Control Patterns

UI Automation uses control patterns to express the functionality contained in each control. UI Automation differentiates between what a user would call the control and what can be programmatically done with the control by using control patterns to express only functionality, separate from the type or name of that control.

Providers implement control pattern interfaces on UI elements. Control pattern interfaces are found in the *System.Windows.Automation.Provider* namespace [2] and have names that include the suffix "*Provider*" (for example, *IScrollProvider* [4] and *IInvokeProvider* [5]).

Clients access methods and properties of control pattern classes and use them to access information about a UI element, or to manipulate the UI. These control patterns classes

are found in the *Systems.Windows.Automation* namespace [1] and have names that include the suffix "*Pattern*" (for example, *InvokePattern* [6] and *SelectionPattern* [7]).

Control Pattern Components

Control patterns may define the structure, methods, properties, and events supported by a control:

- The structure includes the parent, child, and sibling relationships of elements for that control pattern.
- The methods provide the ability to programmatically manipulate the control.
- The properties and events provide rich information and notifications relevant for that control.

Control patterns relate to UI as interfaces relate to COM objects. In COM, you can query an object to ask what interfaces it supports, and then use those interfaces to access functionality. In UI Automation, clients can ask a control which patterns it supports and then interact with the control through the properties, methods, events, and structure of the supported control patterns. For example, providers implement *IScrollProvider* [4] for a multi-line edit box. When a client detects that a UI element supports *ScrollPattern* [8], it can use the properties, methods, and events from that class to gather scroll-specific information or programmatically scroll its content to a new position.

Standard UI Controls and Their Control Patterns

Controls can support zero or more control patterns. For example:

- The image control does not support any control patterns.
- The button control supports *InvokePattern* [6] to correspond to the functionality that it can be clicked.

To define the full set of functionality for a control, providers implement multiple control patterns. The following table shows more examples of standard controls and the control patterns they support.

Table 3. Controls and their Control Patterns

Control Type	Relevant Control Patterns
Button	*Invoke* or *Toggle*
CheckBox	*Toggle*
ComboBox	*ExpandCollapse*, *Selection*
Edit	*Value*, *Text*
List	*Selection*
ListItem	*SelectionItem*
Tree	*Selection*
TreeItem	*SelectionItem*, *ExpandCollapse*

Control Patterns

The following table lists some of the key control patterns and their classes and interfaces.

Table 4. Control Patterns and their Classes and Interfaces

Control Pattern	**Client-Side Class –** details available via [1]	**Provider-Side Interfaces –** details available via [2]
Dock	*DockPattern*	*IDockProvider*
ExpandCollapse	*ExpandCollapsePattern*	*IExpandCollapseProvider*
Grid	*GridPattern*	*IGridProvider*
GridItem	*GridItemPattern*	*IGridItemProvider*
Invoke	*InvokePattern*	*IInvokeProvider*
MultipleView	*MultipleViewPattern*	*IMultipleViewProvider*
RangeValue	*RangeValuePattern*	*IRangeValueProvider*
Scroll	*ScrollPattern*	*IScrollProvider*
ScrollItem	*ScrollItemPattern*	*IScrollItemProvider*
Selection	*SelectionPattern*	*ISelectionProvider*
SelectionItem	*SelectionItemPattern*	*ISelectionItemProvider*
able	*TablePattern*	*ITableProvider*
TableItem	*TableItemPattern*	*ITableItemProvider*
Text	*TextPattern*	*ITextProvider*
Toggle	*TogglePattern*	*IToggleProvider*
Transform	*TransformPattern*	*ITransformProvider*
Value	*ValuePattern*	*IValueProvider*
Window	*WindowPattern*	*IWindowProvider*

UI Automation Properties

UI Automation properties are a set of standard properties that expose information that is important to assistive technologies. Frequently, this information is exposed differently for each UI framework.

The following table shows how one standard UI Automation property maps to multiple property names in other UI frameworks.

Table 5. Mapping UI Automation Properties to Other UI Frameworks

UI Automation Control Type	**UI Framework**	**Framework Property**	**UI Automation Property**
Button	Avalon	Content	*NameProperty*
Button	Win32	Caption	*NameProperty*
Image	Trident/HTML	ALT	*NameProperty*

By implementing UI Automation, providers map unique UI framework properties to standard UI Automation properties. When this done, it allows clients to query for property information using one API call for a UI Automation property

UI Automation Events

UI Automation offers an event mechanism similar to WinEvents in the current Windows platform. However, unlike WinEvents, UI Automation's events are not based on a broadcast mechanism. Clients register for specific event notifications and can request that specific UI Automation properties and control pattern information be passed into their event handler. This provides a much more powerful mechanism than WinEvents because clients make fewer calls to retrieve the information they require, which results in fewer cross-process calls, and therefore better performance. UI Automation provides event notifications for logical structure changes, control pattern changes, focus changes, property changes, and multimedia events.

Conclusions

UI Automation is a key part of the new accessibility model for Windows, gathering information about and interacting with the UI. Adoption of this technology will improve product quality for Windows applications and reduce the time to market for assistive technology products. Additionally, by implementing UI Automation, ATVs reduce the resources invested in obtaining UI information allowing them to improve and expand on the products that they offer.

References

3. http://winfx.msdn.microsoft.com/library/default.asp?url=/library/en-us/cpref/winfx/ref/system.windows.automation.asp
4. http://winfx.msdn.microsoft.com/library/default.asp?url=/library/en-us/cpref/winfx/ref/system.windows.automation.provider.asp
5. http://winfx.msdn.microsoft.com/library/default.asp?url=/library/en-us/cpref/winfx/ref/ns/system.windows.automation/c/automationelement/automationelement.asp
6. http://winfx.msdn.microsoft.com/library/default.asp?url=/library/en-us/cpref/winfx/ref/ns/system.windows.automation.provider/i/iscrollprovider/iscrollprovider.asp
7. http://winfx.msdn.microsoft.com/library/default.asp?url=/library/en-us/cpref/winfx/ref/ns/system.windows.automation.provider/i/iinvokeprovider/iinvokeprovider.asp
8. http://winfx.msdn.microsoft.com/library/default.asp?url=/library/en-us/cpref/winfx/ref/ns/system.windows.automation/c/invokepattern/invokepattern.asp
9. http://winfx.msdn.microsoft.com/library/default.asp?url=/library/en-us/cpref/winfx/ref/ns/system.windows.automation/c/selectionpattern/selectionpattern.asp
10. http://winfx.msdn.microsoft.com/library/default.asp?url=/library/en-us/cpref/winfx/ref/ns/system.windows.automation/c/scrollpattern/scrollpattern.asp
11. WinFX Software Development Kit: http://winfx.msdn.microsoft.com/library/
12. Microsoft research results: http://www.microsoft.com/enable/research/
13. Microsoft Accessibility home page: http://www.microsoft.com/enable/

Leveraging Universal Design in a Financial Services Company

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Introduction

E-commerce companies must strive to understand the changing physical, cognitive, and social requirements of their customers. The older demographic is the fastest growing worldwide [10, 15, 16, 20] and also the fastest growing online [8, 13]. In many countries, this aging trend is driven by the increase in birth rate that occurred after World War II. This generation is often defined as those born between 1946 and 1964 and includes the US “baby boomers” and the Japanese “dankai no sedai” (clumped generation). As this generation ages, the average age of the population will rise, and so will the incidence of impairments that influence how people use the Web including visual (cataracts, diabetic retinopathy, glaucoma, etc.), auditory (presbycusis, otosclerosis), motor (arthritis, stroke), neurodegenerative (Parkinson’s disease), and cognitive (Alzheimer's disease) impairments. In the U.S. alone, over 14 million adults have some type of visual impairment and 28 million have some type of hearing loss (10 million of whom are over the age of 65). In addition to the changing demographics, international and domestic laws [12, 17, 18] are becoming ever more stringent, requiring equal access to information on the Web for all users, including those with disabilities. These changing demographics and sociopolitical issues, combined with a gradual trend toward corporate social responsibility, will likely encourage more companies to integrate universal design standards into their internal and externally-facing Web sites.

Providing accessible Web content to a much wider range of potential customers is critical in the financial services industry. As the baby boomers approach retirement, they will likely look for ways to invest and manage their assets as they adjust to a new phase in life. They are also a demographic with a lot of money. Estimates suggest they represent $20 trillion in potential assets [1]. Accordingly, it makes good business sense for us to explore universal Web design to expand the reach of our business. Furthermore, as we explore more universally accessible approaches to design, there is greater likelihood of devising interfaces that work more effectively on a broader range of hardware. As people worldwide continue to access the Web increasingly via portable devices such as smart phones, PDAs, in-car browsers, and portable media centers, it also makes good business sense to move away from optimizing sites for desktop computers with conventional browsers. In fact, forecasters predict that PDA sales will more than double in the U.S. by 2008 (and that sales in Europe will more than triple those in the U.S.) lead primarily by sales of Web-enabled cell phones [8]. Early adopters of this cutting-edge technology also tend to be high-net-worth individuals. Naturally, retirees and the growing numbers of portable device users are potential customers we hope to be able to accommodate.

At Fidelity Investments, most of our business occurs online. Ninety-four percent of our commissionable trades (more than 78,000 per day) are placed online. Our retail site alone

supports an average of 1 million contacts per day. Customer assets at Fidelity total $2.1 trillion as of January 31, 2005, including $1.1 trillion in managed assets. Apart from servicing individual investors, a significant part of our business stems from management of retirement plans of institutional clients like businesses, government agencies, and non-profit institutions. Almost 12 million U.S. employees save through a Fidelity-administered plan, which comprises over 43% of our customer assets. The institutional side of our business has grown exponentially and now accounts for over half of our annual revenue. Accordingly, Web sites that support this part of our business already must comply with Section 508 standards wherever they have any indirect or direct relationship with the government. But given that the Web is our primary medium for conducting business, we cannot assume that complying with Section 508 standards in limited areas of our business is enough.

Educating ourselves and our firm

Before we can begin designing our Web sites to meet the needs of customers who use specialized technology to access them, we must learn what their requirements are. Establishing relationships with local area organizations servicing people with disabilities has proven the most important element in our learning about the needs of these users. Our association with groups like the National Braille Press [11] , and a local users' group called VIBUG (Visually Impaired/Blind Users' Group) [19], have been instrumental in helping us begin to understand the unique challenges and concerns of this population online and elsewhere. For example, our interactions with these groups have enabled us to learn many of the specific strategies these users employ when navigating the Web with various assistive technologies. These groups have also proven invaluable in recruiting for usability studies and focus groups at Fidelity involving low-vision and blind Web users.

Internally, our user-centered design group works to spread what we learn about accessible design to designers and developers throughout Fidelity. We disseminate findings from our usability and accessibility research internally via an online and printed quarterly newsletter, and through our Web Design Guide (both online and print versions) that we are now augmenting with accessibility guidelines.

We also lead tutorials on accessible Web design for developers and designers where, among other exercises, we ask participants to wear glasses (simulating macular degeneration) and thick gloves (simulating arthritis and difficulty with fine motor control) when working on tasks at the computer to get a better sense for the challenges faced by our aging and visually impaired customers (Figures 1 & 2). Recently, several accessibility experts have come to Fidelity to teach our developers about the more technical aspects of accessible development including advanced HTML and CSS coding. Later this year, we plan to have an Accessibility Day involving tutorials and invited speakers who will talk to the importance of accessibility in technology from a variety of perspectives.

Figure 1. Fidelity Web developers wearing thick gloves while using a mouse to simulate fine motor control issues.

Figure 2. A Fidelity Web developer attempting to use the Web while wearing glasses with solids dots placed in the middle of the lenses to simulate macular degeneration.

Currently, we are preparing to build an accessibility lab with a physical layout and a range of assistive technologies that will enable us to more effectively conduct research with users of all abilities. In addition to research, the lab will serve as a resource to Fidelity developers who, for example, will be able to arrange to hear how various screen readers will read their particular site. In the meantime, our group is striving to develop proficiencies with the technologies we will make available in our lab to not only be better able to assist those internally who have questions, but more importantly, to help us better connect with our customers who use them. This month, members of our human interface design group will learn how to navigate the Web using JAWS during a day-long training at the Carroll Center for the Blind [3].

Our user-centered design research

While our approach to accessibility at Fidelity is multifaceted, we continuously try to involve users of all abilities in forward-looking, user-centered research.

For the past four years, we have been studying how to better meet the needs of our aging Web customer base [4, 5, 6, 7, 14] (Figure 3). Our research has shown us consistently that improvements intended to enhance ease of access and usability for the aging Web user, also improve the ease of access and usability for all users. Similarly, our recent work with blind and low-vision users indicates that design decisions intended to improve Web accessibility for that demographic improves accessibility for other demographics including novice Web users and those with low levels of financial expertise.

Figure 3. A woman over the age of 65 works at a computer during a usability study of a Fidelity prototype.

Our recent preliminary studies with low-vision [2] and blind users taught us a specific challenge both populations encounter when coming to unfamiliar Web pages is learning the primary functions and overall hierarchy of that page. While sighted users quickly visually scan a page to understand its overall content and hierarchy, visually-impaired and blind users must gather this same information either through magnification or screen reader software, both of which make this task far more challenging and time-consuming.

Page Overviews

Based on suggestions from users in our preliminary studies, we began to consider the potential advantages of providing some sort of page overview function that would be accessible to both sighted and non-sighted customers. We developed some prototype pages and conducted focus groups with blind and low-vision users to gather feedback on this concept (Figure 4).

Figure 4. Fidelity focus group with blind and low-vision users.

Low-Vision Users

For sighted users, the prototype pages provided visible, keyboard accessible controls that allowed users to play recorded audio page overviews. One prototype had an overview conveying information about the page and site in one generic, recorded audio file. A second prototype "chunked" the information into the following "chapters": a general description of the site, a general description of the page, a list of site-wide and page-specific access keys, a description of the main navigation, and a description of the page's visual layout.

Blind Users

For blind users, we placed an invisible GIF file at the top of the page. For the prototype that had one long overview, we added a long description to the image file that allowed blind users to hear the overview read by JAWS. For the "chaptered" prototype, we added five GIF files to the top of the page. Each file had alt tag text that corresponded to the chapters described above. JAWS would read each alt tag in order thereby allowing blind users to control access to this information. Each GIF file was also assigned an access key.

Preliminary Results and Follow-Up Research

All user responses were uniformly positive to the concept of page overviews. The majority of users preferred the "chaptered" version. We are currently planning a follow-up study with blind users that will have them using a prototype that utilizes page overviews in addition to several other assistive features suggested by our focus group participants. We will then directly compare their performance on a similar prototype that is Section 508 compliant, but does not provide page overviews.

Much of what we aim to learn in our current research is what we can do "beyond Section 508" compliance that will improve accessibility of information for all customers. We believe investigating other more universally accessible design principles than are called for in Section 508 or the W3C will one day help all of our customers to have more satisfying experiences on our sites no matter what their capabilities or technological constraints.

Future Research Questions and Directions

There is an abundance of research yet to be conducted on practical issues related to universal design and access, such as the following:

- **Understanding how best to design for low-vision users.** More research has been conducted attempting to understand the requirements of blind users than those who have various types of visual impairments, but still use the graphical interface. These two populations likely have very different requirements and more needs to be understood about how best to design for both populations.
- **Learning more about using aural style sheets.** Most screen readers currently do not support the use of aural style sheets, but should, and likely will in the near future. Since very little is currently understood about how aural style sheets may best assist screen reader users, there is much work to be done in this area.

- **Working towards incorporating accessibility and usability into corporate culture and processes.** Just as usability practices vary from firm to firm depending on many factors, accessibility practices face the same challenges. A true user-centered design approach would naturally incorporate both usability and accessibility into design and development cycles. Understanding how best to incorporate these practices and demonstrate a high ROI is a critical research question.
- **Understanding more about audio interfaces.** While the Web is currently primarily driven by visual interaction, there will be increasing demand for more interactive content as companies attempt to meet the needs of various demographics, including, younger, older, and visually-impaired users. Audio interfaces (meaning audio output) provide potential advantages for all users.
- **Moving towards voice-mediated interface design.** Voice-mediated interfaces (audio input and output) offer advantages for not only blind and visually-impaired customers, but also sighted customers who may require a hands-free means of interaction (mobile, PDA, etc.). While technical constraints are still a major factor in this area of research, it is likely to be the future of interaction on the Web. While there are obvious advantages of being able to interact with the Web via voice, much research remains on how to optimally design such interfaces.

Conclusion

Usability issues have traditionally been studied via a user-centered design approach, where representative users provide input during all phases of the design and development process to ensure a usable design. To date, accessibility issues have often been addressed more by applying heuristics than by actually working with the various user groups. Our approach is to actively involve users who have these disabilities in the design and evaluation process. Accessibility is not different from usability; it just means including the right users in your user-centered design approach. Much work remains to understand how to better meet the changing needs of our internal and external customers. Fortunately, our preliminary efforts at incorporating accessibility into business and development practices at Fidelity are already helping us understand more about potential strategies for universal interface design.

References

1. Amend, James M. (2005) Retiring Boomers Represent Next Big Windfall for Fund Industry. April 11, 2005. Available at http://www.financialplanning.com/pubs/fpi/20050411102.html

2. Bergel, Marguerite, Chadwick-Dias, A., & Tullis, T. (2005). Web Accessibility for the Low Vision User. To be presented at the *Usability Professionals Association Annual Conference*, Montreal, Canada. June 2005.

3. Carroll Center for the Blind, Newton, MA. Available at: http://www.carroll.org/

4. Chadwick-Dias, A., Bergel, M., LeDoux, L., and Tullis, T. (2005). How to Improve Web Usability for Older Users. To be presented at *Human Computer Interaction International*, Las Vegas, July 2005.

5. Chadwick-Dias, A., McNulty, M., Tullis, T. (2003). Web Usability and Age: How Design Changes Can Improve Performance. *Proceedings of the 2003 Conference on Universal Usability,* November 2003, 30-37.

6. Chadwick-Dias, A., Tedesco, D., and Tullis, T. (2004a). Demographic Differences in Preferred Web Site Content. *Proceedings of Usability Professionals' Association Annual Conference*, Minnesota, June 2004.

7. Chadwick-Dias, A., Tedesco, D., and Tullis, T. (2004b). Older Adults and Web Usability: Is Web Experience the Same as Web Expertise? *Proceedings of ACM 2004 conference on Computer-Human Interaction*, 1391-1394.

8. Etforecasts Press Release on June 16, 2003. Smartphones Have Started to Impact PDA Sales: Most Future PDA Sales Increases Will Come from Smartphones. Available at: http://www.etforecasts.com/pr/pr0603.htm

9. Fox, Susannah (2004). Older Americans and the Internet, Pew Internet & Family Life. Available at:1. http://www.pewinternet.org/PPF/r/117/report_display.asp

10. 2. INSEE France. France in Figures, Edition 2004. Annual census surveys: Preliminary findings of the 2004 census - Principal population and housing characteristics Available at http://www.insee.fr/fr/ffc/docs_ffc/IP1001.pdf

11. 3. National Braille Press, Boston, MA. Available at: http://www.nbp.org/

12. 4. New British Standard – BS 7000-6:2005: Guide to Managing Inclusive Design. Available at: http://www.hhrc.rca.ac.uk/resources/publications/BS7000-6.pdf

13. 5. Nielsen NetRatings Report (2003). Senior Citizens Lead Internet Growth, November.

14. 6. Tedesco, D., McNulty, M., and Tullis, T. (2005). Usability Testing with Older Adults. To be presented at Usability Professionals Association Annual Conference, Montreal, Canada. June 2005.

15. 7. U.S. Administration on Aging and U.S. Bureau of the Census. A Profile of Older Americans: 2001.

16. 8. U.S. Bureau of the Census, The 65 Years and Over Population: 2000. Census 2000 Brief. October 2001.

17. 9. US Americans with Disabilities Act (ADA). Available at: http://www.usdoj.gov/crt/ada/adahom1.htm

18. 10. US Section 508 of the Rehabilitation Act: Electronic and Information Technology Accessibility Standards. Available at: http://www.section508.gov/index.cfm?FuseAction=Content&ID=12

19. 11. Visually Impaired and Blind User Group (VIBUG), Boston, MA. Available at: http://www.vibug.org/

20. World Health Organization, Press Release, April 1999 Available at http://w3.whosea.org/prsrles/

Accessibility from the front line – a UK industry perspective of web accessibility

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In 1999 when I started my usability consultancy, web accessibility was in a very sorry state. So has anything changed in the intervening five and a bit years?

Well I'm happy to report things are improving steadily, but there is still much to do, particularly if we are to receive the benefits of accessibility above and beyond just ticking the boxes to achieve mere technical compliance. In the following short article I describe some of the progress that has been made, and some of the challenges and potential solutions for the future of web accessibility and web design in general.

Accessibility five years ago

Five years ago I started a new usability consultancy. We needed to find a niche in the market because we were newcomers and had not spawned from an existing agency with the benefit of taking clients with us. We decided to specialise in accessibility, as well as usability, for two main reasons. Firstly, the state of web accessibility was woeful, as even a cursory browse of pretty much any site would testify. Secondly, no UK usability company was doing accessibility, whereas we saw it as a vital factor that would increase in prominence and importance as the industry developed.

Many of the barriers we had to promoting our accessibility services were born out of a widespread ignorance and misunderstanding within the industry of the whole accessibility issue. In the end it boiled down to the fact that clients were not requesting accessibility and therefore agencies were not delivering it.

Increased awareness and education was what was required. We tried to give a more commercial slant to the great efforts of organisations such as the Royal National Institute of the Blind (RNIB – [1]). We ran business focused seminars, generated PR through a concept piece that required good accessibility to work (the UK's first Internet enabled car), and targeted large organisations through innovative (or so we thought) Braille mailings. In those days though the thing that created the most impact were videos from user testing sessions involving people with disabilities. These videos were viewed with fascination and were often greeted by comments such as "I really didn't know blind people could use computers or the net". Clearly we had a long way to go.

The accessibility landscape now

So how far have we come? Well quite far but not far enough.

Thankfully base level awareness is now not such an issue. The videos still go down extremely well but the level of ignorance surrounding the whole issue has declined massively. Evidence for this includes:

- The ubiquitous presence of accessibility in most web site requirement specifications – clients have clearly caught on.
- The increased number of specialised agencies out there to assist with accessibility – this would not have happened if there was not the demand.
- The increased promotion of accessibility by industry media and by design agencies in their marketing – clearly it is being viewed as an issue of importance.

Much of this increased awareness, I think, has been stimulated by threat of penalties or legal action under legislation such as section 508 of the rehabilitation act in the US, or the Disability Discrimination Act in the UK. Although accessibility provides many positive benefits to organisations which implement it, it is still the stick of legal action that appears to be hitting home the most.

Despite the increase in accessibility awareness, misunderstanding and misapplication still appear to be a big issue. The main evidence for this is the still woeful general level of accessibility. For example, in the UK in 2004 a formal investigation of 1000 sites by the Disability Rights Commission revealed that 81% of UK sites failed even the most basic of accessibility checks [3]. The picture is likely to be similar, if not worse, in most other countries. You can test this easily yourself by using a text browser such as lynx, just surf a typical selection of sites and see how you get on. In addition, from personal experience I still frequently encounter remarks such as "it's OK we have text only", "better accessibility will just make it boring though", "we will make it accessible afterwards".

So some progress then, but still a long way to go.

Some leading lights

Some organisations have produced sites that stand as examples of what you can achieve as long as you tackle the issue seriously and make accessibility an inherent part of the development or redevelopment process. One thing about the best of these sites though is that unlike five years ago, where you could usually spot an accessible site a mile off by the way it looked, these sites have not compromised on brand or aesthetics in order to deliver exemplary accessibility.

My favourite best practice web accessibility example is the UK local search engine site 'yell.com' (see screenshot, Figure 1 – [2]). All pages exceed the double-A accessibility level with many achieving triple-A compliance. Importantly though Yell.com commissioned user testing with a broad range of participants, including users of adaptive technology such as screen readers. The findings from the user testing were used to improve Yell.com's practical accessibility. So not only does it conform to technical accessibility standards, the site works in practice too – and this is an important distinction.

The best sites do more than just tick the boxes to get a badge of conformance. Inclusive user testing like that performed by Yell.com is the key to this. Not all sites that achieve technical accessibility compliance are actually usable by people with accessibility needs. I have seen triple-A (the highest accessibility conformance level) conformant sites that were practically unusable by anyone, but particularly so for those using adaptive technologies such as screen readers and screen magnifiers.

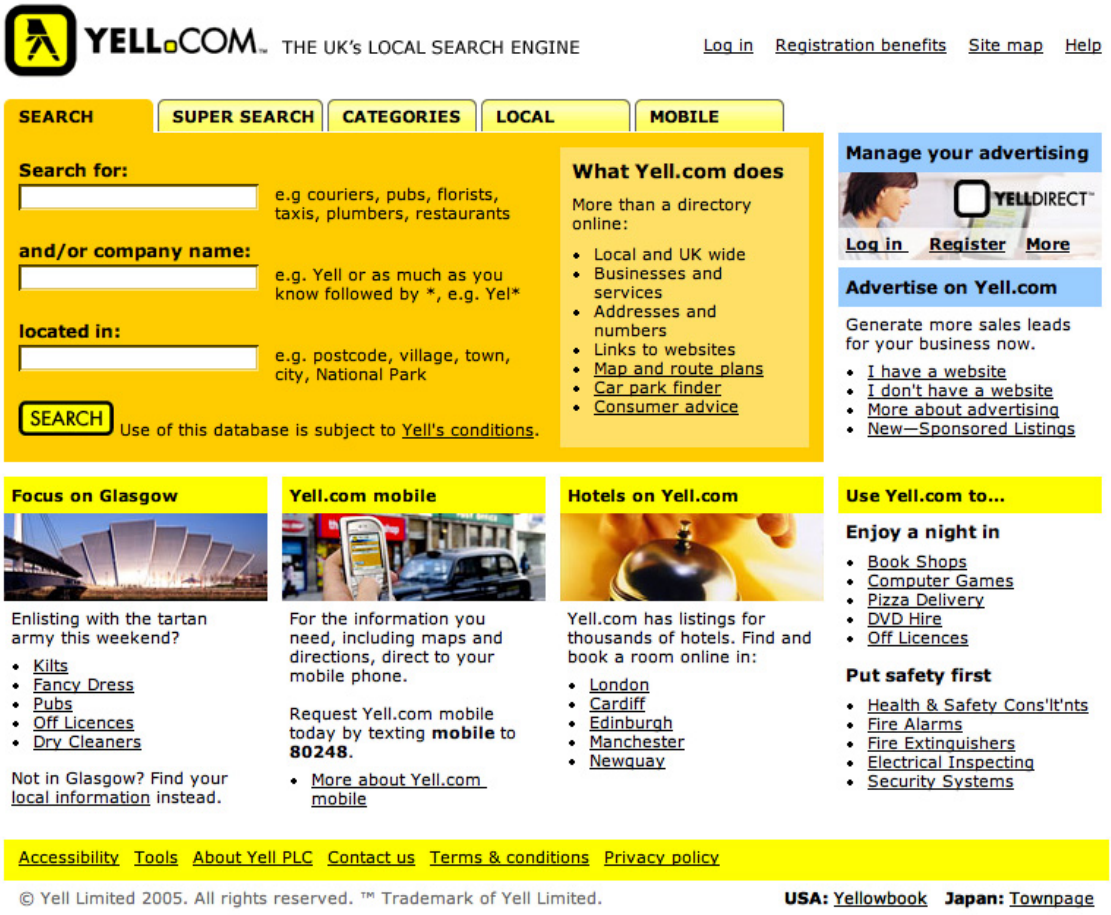

Figure 1. A screenshot of yell.com

Conversely some sites that do not achieve technical conformance are actually very accessible in practice. An example of this is evidenced from the above mentioned DRC accessibility investigation [3]. Five of the 1000 sites tested received special praise for being highly accessible as tested by a review panel of users with disabilities. One of these sites was an online only bank, egg [4] ,that actually failed the technical compliance check. Those responsible for the egg.com site knew of the technical failures which were caused by legacy back end systems but had prioritised fixes to the most important issues in order to make the site accessible in practice. Further, the real accessibility had been checked through user testing.

In my experience the approach that egg took is quite rare; the majority of site owners are more concerned with conformance than reality of use. This is understandable when conformance itself is the most 'accessible' accessibility benchmark a site can have. Alas there is still currently a problem with even the notion of conformance.

The difficulty organisations face over knowing what to do

There is a plethora of information available that pertains to web accessibility. Some of it is very technical and not easy for non-techies to evaluate, much of it is unofficial and difficult for non-specialists to determine the validity of the advice and techniques.

Organisations have difficulty knowing what to do, even if they are highly motivated in addressing the accessibility of their sites.

The most 'official' global web accessibility guidelines are the Web Content Accessibility Guidelines version 1.0 (WCAG 1.0). These guidelines were produced by the Web Accessibility Initiative (WAI – [5]) part of the World Wide Web Consortium (W3C). The problem with these guidelines is that they are out of date (1999), are long and unwieldy and can be difficult to understand and interpret. Furthermore they are difficult to test against objectively – even so called accessibility experts disagree on some of the finer points, sometimes heatedly. Most other current standards are based heavily on WCAG 1.0.

Some potential solutions

In the absence of any clear guidance some large organisations have undertaken to produce their own best practice standards and processes for ensuring web accessibility. For those with which I have been involved they have lead to clear long term accessibility improvements, but have required a significant investment of time and money. Unfortunately most organisations are unable to support this level of investment.

The update to the WAI standard, WCAG 2.0, is in draft form and indeed has been for a number of years. The intention for this version is that it should increase the clarity and ease of application of the accessibility guidance, and make the job of conformance testing easier and more objective. Unfortunately, it is still unclear when WCAG 2.0 will be finally published as an official recommendation, and indeed how much of an improvement it will prove to be for organisations wishing to seriously tackle accessibility at a practical level.

In the UK the Disability Rights Commission has commissioned the British Standard Institute to produce a new guidance document aimed at informing website commissioners and developers of their obligations and of good practice for web accessibility [6]. This guidance takes the form of a Publicly Available Specification (PAS). A PAS is not a full British Standard but is developed using the same rigorous processes. The advantage of a PAS is that it can be introduced more quickly than a British Standard and that it can be updated frequently. The PAS is due to be published in autumn 2005 and will be updated approximately every 2 years. It is certainly hoped the PAS will provide organisations with a source of authoritative, practical and up to date guidance.

A new European initiative has begun developing a European Quality Mark for Web Accessibility. The Quality Mark will be awarded by accredited assessment bodies that will use a common testing methodology which will be based on assessments against current WAI guidelines. One of the key aims is to reduce possible fragmentation that may be introduced if many different localised standards begin to emerge. If successful this is likely to stimulate the take up of web accessibility, and also simplify the task of web site owners in ensuring accessibility conformance.

I would certainly hope that some if not all of these authoritative and soon to be publicly available standards will actually start to bring about real improvements in web accessibility. Accessibility can be a complex business but there are often clear and unambiguous solutions – as long as people know what to do.

The next stage – great design through accessibility

I believe that accessibility from a technical perspective will relatively soon cease to become much of an issue. There are now plenty of talented designers and coders who have the skills to implement web pages that are well coded and conform to standards. Hopefully this will become the norm rather than the exception.

If my company ceases to be needed to provide advice on these technical issues I will be very happy. I for one would much rather devote time and energy to ensuring great design and great usability rather than spotting trivial coding omissions. The next challenge is to stretch our understanding of what constitutes great design. Accessibility considerations can help here.

Testing an interface with people with different perceptual needs can reveal key insights that can bring about better design. Testing a site with someone who relies on screen magnification, a screen reader or who has dyslexia reveals usability issues that may be obscured by more typical users. Fixing the issues typically leads an increase in effectiveness and efficiency for all. In my experience 'accessibility user testing' is a sharp usability tool.

Conclusion

Accessibility has improved over the last five years, but not nearly enough. With any luck technical accessibility will soon cease to be such a big an issue as it is currently. Up to date authoritative accessibility guidance materials and standards will help with this, and they look like coming fairly soon.

In five years time I hope to be reporting that people with accessibility needs are typically considered at all stages in the production cycle, and routinely involved as participants of website usability testing. I hope we will all be more focussed on great inclusive design rather than the trivialities of things such as missing alt text.

Reference links

1. http://www.rnib.org.uk – select 'good design' for information on their campaign for more accessible design.
2. http://www.yell.com – a great example of maintaining brand and great usability whilst delivering very high accessibility.
3. http://www.drc-gb.org/publicationsandreports/report.asp - The UK Disability Rights Commission formal investigation into the accessibility of 1000 sites.
4. http://www.egg.com – an on-line bank
5. http://www.w3.org/TR/WAI-WEBCONTENT - Web Content Accessibility Guidelines 1.0
6. http://www.bsi-global.com/PSS/press_releases.xalter/pas78.xalter - Press release announcing the UK Publicly Available Specification (PAS) for web accessibility in the UK.

ASSETS 2004 Doctoral Consortium

Investigating the Mutual Effects of Physical Training and Mu-Based Brain-Computer Interface Systems

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Abstract

This research seeks to investigate the possible interactions between physical training and mu-based control of brain-computer interface systems. The results of this work will provide new avenues for physical therapy and rehabilitation and spotlight the benefits of neural control of computers for both disabled and able-bodied people.

Introduction and problem description

Brain-computer interfaces (BCIs) provide an alternative means for controlling computers using neural input. Instead of using traditional mouse and keyboard devices that require physical input, users can employ their brain signals to accomplish a range of tasks such as environmental control and communication [3]. Various types of brain signals serve as the input to BCI systems. One such brain signal, the mu rhythm, is based on real and imagined movement. BCIs can take advantage of the difference in signal properties between idle and active imagery within the motor cortex to produce a control signal [3].

BCIs offer users with severe motor disabilities a nonmuscular channel for communication and control. However, the optimal brain signal for BCI control may differ between able-bodied users and physically impaired users. Recent studies have found that the mu rhythm weakens as physical ability declines [2]. Given the apparent ties of mu to physical ability, it may be possible to improve mu-based BCI control with increased physical activity.

Furthermore, an opposite correlation may be found where physical ability increases with training on mu-based BCIs, opening possibilities for therapy and rehabilitation. These critical research questions remain unanswered. Therefore, my dissertation work seeks to investigate the possible interactions between physical activity and mu-based BCI control.

Background

The relatively new field of brain-computer interfaces spans many disciplines including computer science, neuroscience, and electrical engineering. Most applications target disabled users who are cognitively intact but have such severely limited mobility that system input through physical movement is infeasible. Applications traditionally provide feedback to users through auditory and visual cues but some testing methods allow for tactile feedback [1]. Some teams have embraced the need for usability testing to determine what forms of feedback are most effective [3].

Furthermore, humans range in their physical abilities amongst disabled and able-bodied individuals; there are people who are completely locked into their bodies and those who excel at physical feats. No correlation has yet been made as to whether increased physical activity (for able-bodied users) or simply increased movement (for rehabilitative users) has an effect on the ability to control one's brain signals and certainly not vise versa.

Research questions

My research seeks to resolve the overall question of how mu-control and physical ability, or athleticism, relate. The primary questions are:

- Q1: What is the correlation of intrinsic ability for mu-control to athletic ability in humans?
- Q2: Can athletic training affect mu-control?
- Q3: Can training with mu-based BCIs affect athletic ability?

Research approach

To answer these questions, I must determine how the athletic ability of untrained users of BCIs relates to mu-based control, test the effects of physical training on mu-control, and test the effects of training with mu-based BCIs on athletic ability. First, before making any claims about users' ability for mu-based BCI control, we devised a set of objective measures to make cross-comparisons between users. The result was the BioGauge Study at the GSU BrainLab conducted in partnership with the Neil Squire Foundation in Vancouver, Canada which sought to establish a series of gauges which could be used for characterizing the technical capabilities of BCI systems.

These gauges alongside related experimental protocols formed a baseline for comparing human control of BCI systems. Each gauge was designed to characterize the controllability of a BCI system. Figure 1 illustrates the system setup for one particular gauge where the user tries to obtain a target by manipulating their mu-based brain signal to control the cursor's movement. The BioGauges Study focused on "capability" not "application." As a result, I have a set of tools to use for making comparisons of human ability to control their mu-based brain signals.

Next, I will conduct a mixed methods study (qualitative and quantitative approach) to determine the correlation between athletic ability and ability to control a mu-based BCI. I will survey participants to determine their regular engagement in various levels of fine and gross physical activity and then test their inherent, untrained control of a mu-based BCI. Then, I will conduct a study to determine if increasing physical activity in one area (e.g., adding more hours of tennis practice) has the desired effect of increasing mu-based BCI control as measured by the tools from the BioGauges Study. Finally, I will see if the opposite may be true by increasing the amount of training on mu-based BCI systems and testing for a possible increase in athletic ability (e.g., the user returned more backhand shots).

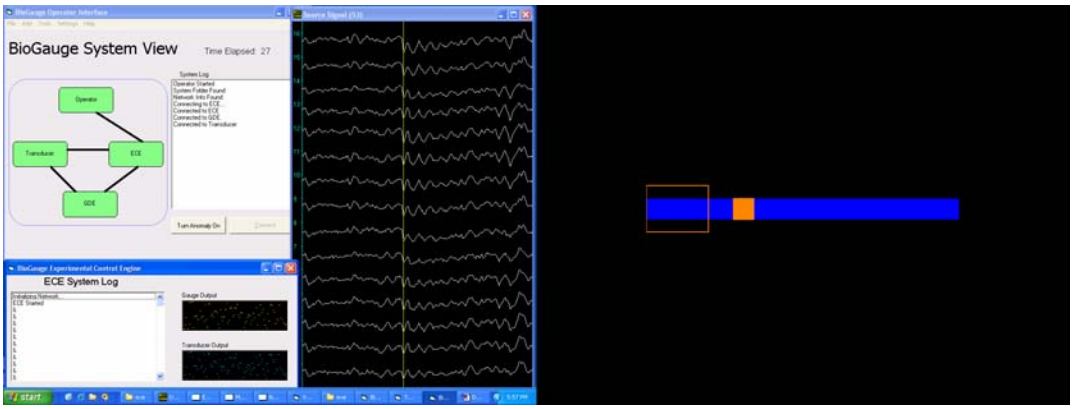

Figure 1. Illustration of system setup for the Attain Target Gauge

Current stage in program of study

In Spring 2004, I will complete my second year of studies in the doctoral program at Georgia State University in their Department of Computer Information Systems. I will have the opportunity to officially defend my dissertation proposal in Fall 2004 upon successful completion of my preliminary exams.

Acknowledgments

I would like to thank my advisor, Dr. Melody M. Moore, for her unwavering support and encouragement.

References

1. Birbaumer, N., Kübler, A., Ghanayim, N., Hinterberger, T., Perelmouter, J., Kaiser, J., Iversen, I., Kotchoubey, B., Neumann, N. and Flor, H. The thought translation device (TTD) for completely paralyzed patients. IEEE Transactions on Neural Systems and Rehabilitation Engineering, 8 (2). 190-193.

2. Tran, Y., Boord, P., Middleton, J. and Craig, A. Levels of brain wave activity (8-13 Hz) in persons with spinal cord injury. Spinal Cord, 42 (2). 73-79.

3. Wolpaw, J.R., Birbaumer, N., McFarland, D.J., Pfurtscheller, G. and Vaughan, T.M. Brain-computer interfaces for communication and control. Clinical Neurophysiology, 113 (6). 767-791.

ASSETS 2004 Doctoral Consortium

Interactive Sonification of Geo-referenced Data

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Abstract

This paper describes an investigation of using interactive sonification (non-speech sound) to present geo-referenced statistical data to vision-impaired users for problem solving and decision making. By working with vision-impaired users, the work will identify effective interaction and sound designs for geo-referenced data, and derive principles that can guide general interactive data sonification designs for auditory information seeking.

Introduction

For people with vision impairment, audio is an important alternative or supplementary information channel. The current support for vision-impaired users to access geo-referenced statistical data (e.g., the population distribution or election results of US states) relies on screen readers to linearly speak the data presented as tabular records. Such linear textual presentation makes it hard for blind users to locate a specific data item and understand data trends, especially in the geographical context. Sonification is the use of non-speech audio to convey information [4]. Effective data sonification can help vision-impaired users to explore data collections for problem solving and decision making. As a result, it promotes equal working opportunities.

In my thesis research to improve vision-impaired users' access to geo-referenced data, I first propose an Action by Component taxonomy to guide interactive sonification designs that are helpful to exploratory tasks. Guided by the taxonomy, I then systematically explore the design space for geo-referenced data. Through user studies with both vision impaired and blindfolded sighted users, guidelines are being derived and insights are obtained regarding people's abilities to perceive complex information through interactive sound. Third, a customizable tool is being developed both for vision-impaired users to explore geo-referenced data collections and for researchers to investigate new sonification designs.

Related work

Ramloll et al. [6] found that using non-speech sound significantly improved vision-impaired users' comprehen-sion of 2-D numerical tables. Research in [2, 3] showed that users can interpret a quick sonified overview of bivariate scatterplots and 2-D line graphs with one or two data series. Alty and Rigas [1] found blindfolded sighted users can recognize simple 2-D graphical shapes presented by musical pitches tracing the outlines. Meijer [5] sonified images with time-multiplexed sound. Several data sonification toolkits have also been developed, such as Sandbox [7]. My work is distinct from

previous ones in the emphasis on supporting task-oriented user interactions with the data instead of passive listening.

Taxonomy of interactive sonification

The Action by Component taxonomy includes a set of Auditory Information Seeking Actions (AISA) to interact with the data and a set of Design Components involved in the interaction process. An exploratory data analysis task can be accomplished through a sequence of AISAs. For example, a gist gives a quick grasp of the overall data trends and patterns. Users can navigate the data collection to closely examine portions of interest, and may need to situate self during the navigation. Searching and filtering are used to seek data items by query criteria. Select is to collect data items for later revisit. Details-on-demand gives detailed information about data items.

Each AISA is an interaction loop of the user issuing a command and the system giving an auditory feedback. A visual interface allows users to directly manipulate any part of the data display. However, in auditory displays, information is presented over time. The system needs to help users continuously explore, construct and maintain a mental representation of the data. Interactive sonification designs need to consider the following components. An Abstract Object is a representation form of the data items and their relations, such as a scatterplot or a map. A Navigation Structure in an abstract object defines the paths by which users can move around in the data. Users specify their interaction intentions via Input Devices and receive Auditory Feedback about the data items of interest.

Design space for geo-referenced data

Guided by the taxonomy, the design space for geo-referenced data is being systematically explored. The choice of Abstract Object needs to reflect the data relations that are most helpful to the task. Maps and tables are currently being explored. Navigating maps with irregularly shaped and sized regions imposes special challenges. Good navigation designs should maximize user orientation to help constructing their mental representations of the data space. Regarding Input Device and Auditory Feedback, a range of choices is being investigated, in order to reduce the dependency on special devices and to provide a thorough understanding of human perceptual abilities under varieties of situations. The investigation expands from standard input devices (e.g. keyboard) and MIDI sound to special devices (e.g. tablet) and advanced virtual spatial sound techniques. Proper sequencing of multiple data items is a challenge, since there is no natural mapping from geo-referenced data to the time dimension. For a large number of geographical regions, data aggregation may be necessary before the data is mapped to sound.

The design options are being systematically evaluated through user studies, in the forms of both controlled experiments and observational studies. Three blind people work with us regularly and we will reach more blind people through the National Federation of the Blind in Baltimore and online communities.

Customizable tool

Based on the design space, a customizable tool iSonic (Interactive Sonification) is being developed for both researchers to investigate new sonification designs and for vision-

impaired users to explore geo-referenced data collections. By providing synchronized visual and auditory displays, iSonic will allow low vision users to use both their vision and hearing, and improve the collaboration between vision-impaired users and sighted users.

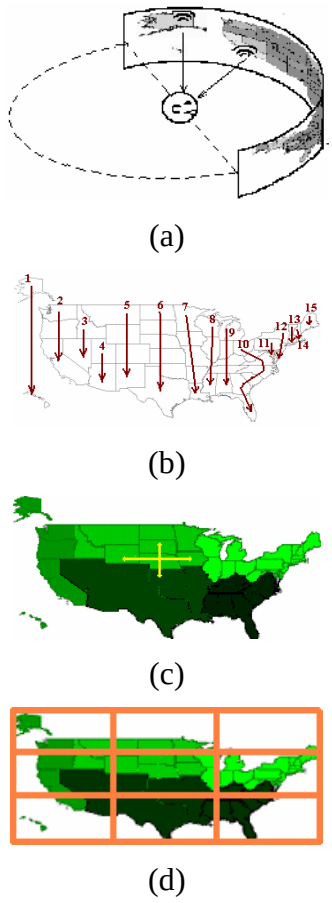

Figure 1. (a) Spatial sound creates a virtual map. (b) Automatic spatial sweep. (c) Relative movements by states using a keyboard. (d) Explore by map ranges using a keyboard.

Status

Several studies with both blindfolded sighted users and blind users have already been done to compare different design options in the design space and to examine users' abilities to recognize the geographical distribution patterns of a 5-category data set [8, 9, 10]. The studies compared two abstract objects (map and table), five navigation methods using either a keyboard (e.g., Figure 1c, 1d) or a tablet, and three auditory feedback encodings. For example, in one of the interfaces, spatial sounds were tied to the map to create the effect of a virtual map surrounding the user at the center (Figure 1a). For each region, a string pitch is used to indicate its geo-referenced data. Using a keyboard, users can start an automatic spatial sweep (Figure 1b) from the west to the east to listen to a 25-second gist of all the regions, navigate the map to explore individual regions (Figure 1c), and request spoken details of interesting regions. In another keyboard-based interface, users can use a 3 x 3 numeric keypad to explore nine fixed map ranges (Figure 1d). The

exploration can be done recursively. In a tablet-based interface, users can drag their fingers or press spots on a smooth surface touch sensitive tablet to explore. Studies have shown that subjects were able to perceive patterns on both familiar and unknown maps. Some designs (e.g., absolute navigation via a tablet or a keyboard (Figure 1(d))) were better than the others (e.g., relative navigation via a keyboard (Figure 1(c))) for pattern recognition and learning new map geography.

Acknowledgments

I thank my advisor Ben Shneiderman and co-advisor Catherine Plaisant. The work is supported by NSF grants EIA 0129978 & ITR/AITS 0205271 and US Census Bureau.

References

1. Alty, J. L., Rigas, D. Communicating graphical information to blind users using music: the role of context. Proc. ACM SIGCHI 1998

2. Brown, L., Brewster, S. A. Drawing by ear: interpreting sonified line graphs. Proc. ICAD 2003

3. Flowers, J.H., Buhman, D.C., and Turnage, K.D. Cross-modal equivalence of visual and auditory scatterplots for exploring bivariate data samples. Human Factors, 39, 3 (1997), pp 340-350

4. Kramer, G., Walker, B., Bonebright, T., Cook, P., Flowers, J.H., Miner, N., Neuhoff, J., et al. Sonification report: status of the field and research agenda (1997). Available at: http://www.icad.org/websiteV2.0/References/nsf.html

5. Meijer, P.B.L. An experimental system for auditory Image representations. IEEE Trans. Biomedical Engineering, 39, 2 (1992), 112-121

6. Ramloll, R., Yu, W., Riedel, B., and Brewster, S.A. Using non-speech sounds to improve access to 2D tabular numerical information for visually impaired users. Proc. BCS IHM-HCI 2001

7. Walker, B. N. and Cothran, J. T. Sonification Sandbox: a graphical toolkit for auditory graphs. Proc. ICAD 2003

8. Zhao, H., Plaisant, C., Shneiderman, B., Duraiswami, R. Sonification of geo-referenced data for auditory information seeking: design principle and pilot study. Proc. ICAD 2004

9. Zhao, H., Smith, B.K., Norman, K., Plaisant, C., Shneiderman, B. Interactive sonification of choropleth maps: design and evaluation. IEEE Multimedia, Apr-June (2005)

10. Zhao, H., Plaisant, C., Shneiderman, B. "I hear the pattern" - Interactive Sonification of geographical data patterns, Proc. ACM SIGCHI Extended Abstracts, 2005

Project web-site

Available at: http://www.cs.umd.edu/hcil/audiomap