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Accessibility and Computing

20 Years after Dexter Hypertext Reference Model

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A Note from the Editor

Dear SIGACCESS member:

Welcome to the new look of the online edition of the SIGACCESS Newsletter – with new layout, the use of sans-serif and larger font throughout, left-justification, and the inclusion of authors' short biographies and photographs (so that you can say hi when you meet them in meetings and conference).

In 2008, the Dexter Model of Hypertext will be 20 years old. Therefore this issue focuses on what's going on since then, including a report on the International Cross-Disciplinary Conference on Web Accessibility 2007

This issue also reports the accessibility research initiatives in Malaysia, continuing the idea of reporting work on accessibility and assistive technology around the world

Sri Kurniawan

Newsletter editor

SIGACCESS Officers and Information

Chairperson

Vicki Hanson
IBM T.J. Watson Research Center
19 Skyline Drive
Hawthorne, NY 10532, USA.
+1-914-784-6603 (work)
chair_SIGACCESS@acm.org

Vice-chairperson

Andrew Sears
Information Systems Dept.
UMBC
1000 Hilltop Circle
Baltimore, MD 21250, USA.
+1-410-455-3883 (work)
vc_SIGACCESS@acm.org

Secretary/Treasurer

Noelle Carbonell
LORIA,
Campus Scientifique
F54506 Vandoeuvre-lès-Nancy
Cedex
France
treasurer_SIGACCESS@acm.org

Newsletter Editor

Sri Kurniawan
Dept. of Computer Engineering
University of California Santa Cruz
SOE-3, 1156 High Street
Santa Cruz CA 95064, USA
+1 831 459 1037
editors_SIGACCESS@acm.org

Who we are

SIGACCESS is a special interest group of ACM. The SIGACCESS Newsletter is a regular online publication of SIGACCESS. 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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We encourage submissions as word-processor files, text files, or e-mail. Postscript or PDF files may be used if layout is important. Ask the editor if in doubt.

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.

20 years On: The Dexter Model of Hypertext and its Impact on Web Accessibility.

Robert Dodd

Accessibility Research Centre, University of Teesside, UK

r.dodd@tees.ac.uk

In 2008 the Dexter Model of Hypertext will be 20 years old. Even after 20 years, the structure of Web documents, and the syntax we use to describe them and their relations to one another is still noticeably bound up with that 1980's view of content navigation. With the W3C having launched a consultation exercise on HTML 5, and a browser war imminent over the future of ECMA/Java Script, it is time to reconsider what the discipline of accessibility requires of a hypertext model. This article considers both the original Dexter Model, and, briefly, the related Amsterdam Model of Hypermedia, in terms of the needs of assistive technology, and proposes an alternative, extended view of Hypertext of which the original Dexter Model can be considered a subset.

Introduction

Web page accessibility is usually considered in terms of the WAI guidelines for constructing accessible websites [1] when using existing web mark-up languages, particularly HTML [2]. HTML itself is one of a family of hypertext mark-up languages that express the characteristics of the Dexter Reference Model of Hypertext [3]. The Dexter Model is a view of navigation between, and within, electronic documents, and is intended as a reference set for the character and capabilities of hypertext, rather than as a notation in itself.

HTML is one of a number of competing hypertext systems that originated in the late 1980's. At that time, the capabilities of these emerging hypertext systems varied widely. For example in some systems, links could be navigated bi-directionally (HTML has only unidirectional links). Some systems also allowed for 'dangling' links that were resolved at run-time. In 1988 an attempt was made to define the meaning and character of hypertext systems as expressed by the most prominent hypertext systems of the time, with the Dexter Hypertext Reference Model as the result. Consequently, Dexter became the superset of what hypertext can be, with individual hypertext systems considered to be implementing subsets of these defined capabilities.

Even today, almost 20 years after those initial discussions at the Dexter Inn, New Hampshire (hence the name), a casual search of the ACM digital library brings up over 100 references to the model, including some dated 2007. In those 20 years, amendments have been suggested to the Dexter Model, particularly with regard to the demands of multimedia. One notable multimedia variant of the Dexter Model is the Amsterdam Model of Hypermedia [4], and reference will be made to the Amsterdam Model throughout this article.

The Dexter Hypertext Reference Model

A simplified conceptual diagram of the Dexter Hypertext Reference Model, created for this paper, is shown in Figure below. The key element is *Component*. A component is a document that a user may navigate from or to. That document may be an *Atom* or a *Composite* component. An Atom Component would be a simple web page. A Composite

Component would be a web page that included a <frameset>, an <iframe>, or a link to another <object> such as a video clip.

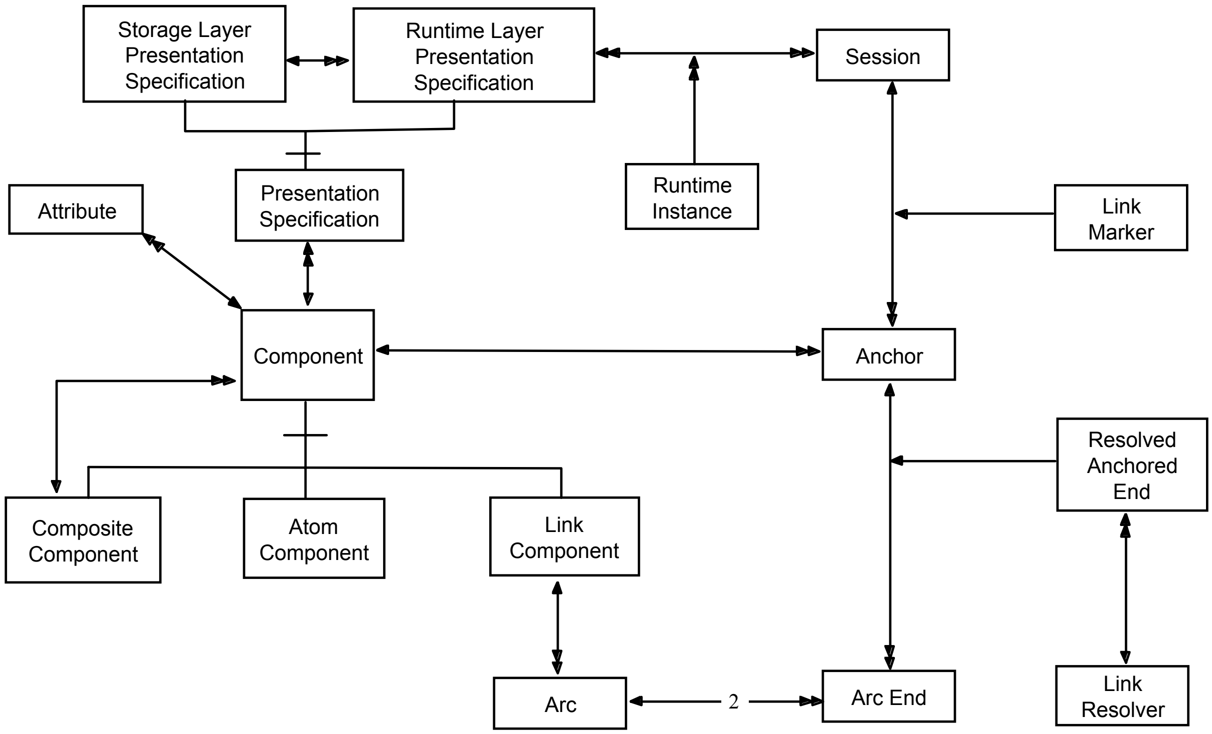

Figure 1 – The Dexter Reference Model of Hypertext

One further type of component is shown: the *Link Component*. The Link Component is where the simple analogy with HTML breaks down. In the Dexter Model, a hyperlink is itself a component that describes the possible navigation between other components. Links are not limited to describing a hyperlink between two documents, it may describe a link between many documents. A web example would be clicking on a link in one <frame> that caused multiple frames to reload with new content; in HTML this can only be achieved through the use of additional scripting, but is supported directly by the Dexter Model. This of particular interest to assistive technology, where it may be necessary to augment the target of a hyperlink to trigger, say, additional ear-cons for users with low vision or dyslexia.

Links between components are formally between *Anchors*. An *Anchor* expresses the fact that there is location within a component that may be the endpoint of a link. The Dexter Model itself, does not consider the internal structure of the component, but only identifies that there are locations within the component that are navigable. All documents have at least one anchor: their start. Figure describes the relationship between Link Components and Anchors in terms of *Arcs*. The term Arc does not appear in the Dexter Model, but is used here to describe potential navigation between any two components referenced by a Link Component. An Arc is considered to have two ends: a source and a target.

The Dexter Model allows for hyperlinks to be resolved at runtime. That is to say, a Link Component may define the linked components by use of a rule or formula. This would be equivalent to a hyperlink with a target *Arc* that is "the results of a Google search on the term accessibility". In this case, each result of the search would be a Link Component, with the source being the original target *Arc*, and the target being the link returned by Google. This capability within the Dexter Model comes from allowing hyperlinks to be components, so that a Link Component may reference another Link Component. Such resolution, at runtime, is the responsibility of *a Link Resolver* that resolves *Arc Ends* to *Anchors*. This capability is of interest to assistive technology, in that an insight into the *Link Resolver* provides an insight into the semantics of the rendered content; in this case that it is an arbitrary length ordered list of navigable links, rather than, as with HTML, a table of links without an understanding that the table may continue onto further web pages.

Figure expresses the Dexter Model as a single relational diagram. In fact, the Dexter Model is formally expressed as three distinct layers as shown in Figure below; the relevant items from Figure are listed for each layer.

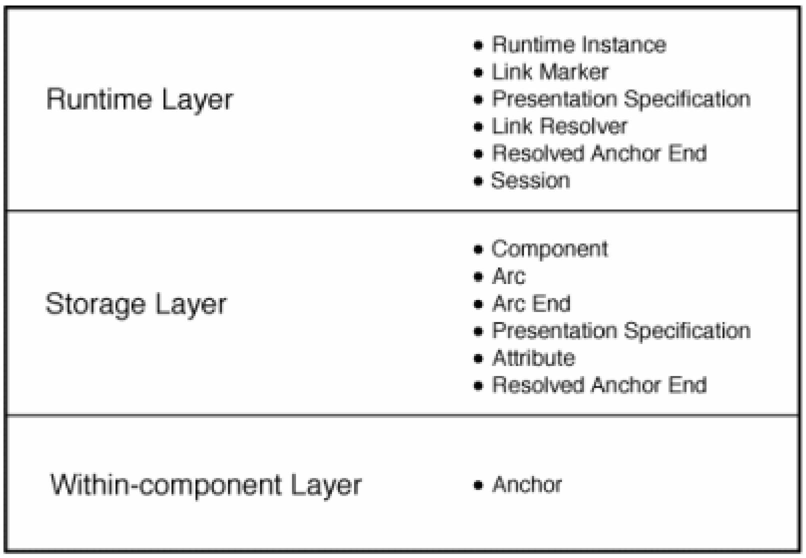

Figure 2 – The three layer Dexter Model

Each Component within the Dexter Model is associated with a *Presentation Specification*. The Presentation Specification describes how an individual component should be rendered to the user. A web example would be the styles assigned to the content of a web page (the actual content and its semantic meaning are contained within the Within-component Layer for that component).

There are two types of *Presentation Specification*: those within the Storage Layer, and those contained within the Runtime Layer. Those within the Storage Layer provide hints to the Runtime Layer. Those in the Runtime Layer define precisely how the component is to be rendered. When there is more than one Presentation Specification for a single component, it is for the Runtime Layer to resolve any conflicts, either through a selection, or a merge, process. Presentation Specifications are of direct interest to assistive technology, in that they help separate content from presentation. Further, the concept of multiple Presentation Specifications provides the capacity to offer multiple alternative representations of content within the one model, selected at runtime to match user capability and preference. An example within HTML is the ability to provide alternative Cascading Style Sheets.

Any Component may have a Presentation Specification including Link Components. Presentation Specifications can describe the rendering of, say, an individual web page, some composite web pages such as <frameset> based menu systems, or describe the presentation of a hyperlink. Note that this is the entire presentation of the link, and not just the anchors within the documents.

Components are represented at runtime by *Runtime Instances*, and Anchors by *Link Markers*. There may be multiple Runtime Instances for a single Component. A web example of this would be when text is presented visually and concurrently as text-to-speech assistive technology. Similarly there may be multiple Link Markers for a single Anchor.

The Dexter Model also provides the concept of a *Session*. A Session represents a single user interacting with the content, and includes a history of user interaction during the session. Selection decisions between competing Presentation Specifications may use this history to help guide the selection process. That is to say, the Dexter Model allows for adaptive behaviour in content presentation and user interaction.

Adaptation and adaptivity are further supported in that not all components or links need be presented at runtime. The Dexter Model allows for a comprehensive collection of Components, with selection of a subset made at runtime, based on Presentation Specifications, Session history, and component *Attributes*. Attributes are name/value pairs that help describe a component. The Dexter Model does not specify any Attributes, it simply allows for them to help inform and guide the selection of Presentation Specification and Runtime Instance. Note that Anchors cannot take attributes directly; attributes relating to Anchors belong to the Link Components that reference them. This capacity to tag a component with attribute values is of particular use in assistive technology in that it allows for equivalent meaning between individual Components to be identified, for example to say that an item of text is equivalent to an image; the 'alt' tag in HTML is an example of this.

Expressing Hypermedia

The sheer number of papers published that set out to modify or extend the Dexter Reference Model points to a number of underlying problems with the model. Perhaps the most common complaint is that the Dexter Model does not have the concepts of time and synchronization; this is particularly a problem for multimedia applications. One of the proposed solutions to this is the Amsterdam Model of Hypermedia [4]. The Amsterdam Model extends the Dexter Model by adding *Synchronization Arcs* to the model. Figure shows a simplified Amsterdam Model, with modifications to the Dexter Model highlighted in blue.

Synchronization Arcs allow components to be described in relation to each other e.g. "starts 3.5 seconds after" or "finishes at the same time". This is particularly useful for assistive technology where captioning is required, or where text and image animation is augmented with ear-cons.

Related to synchronization is the issue of competition for resources; the resource may be screen acreage, or audio channels, or haptic feedback. The approach taken in the Amsterdam Model is to provide *Channels* through which Component communicate with the user. Channels are described within the Storage Layer, as is the allocation of Components to Channels. It is the responsibility of the Runtime system to regulate competition for channels with regard to the defined Synchronization Arcs.

The Amsterdam Model extends the concept of the Atom Component, providing two sub-types: *Text Component* and *Media Component Reference*. This distinction exists in modern versions of HTML such as HTML 4, which uses the <object> tag to identify external media. This extension is necessary as the Dexter Model maintains all content within the model which does not sit well with streaming media where the content may play out from a remote source.

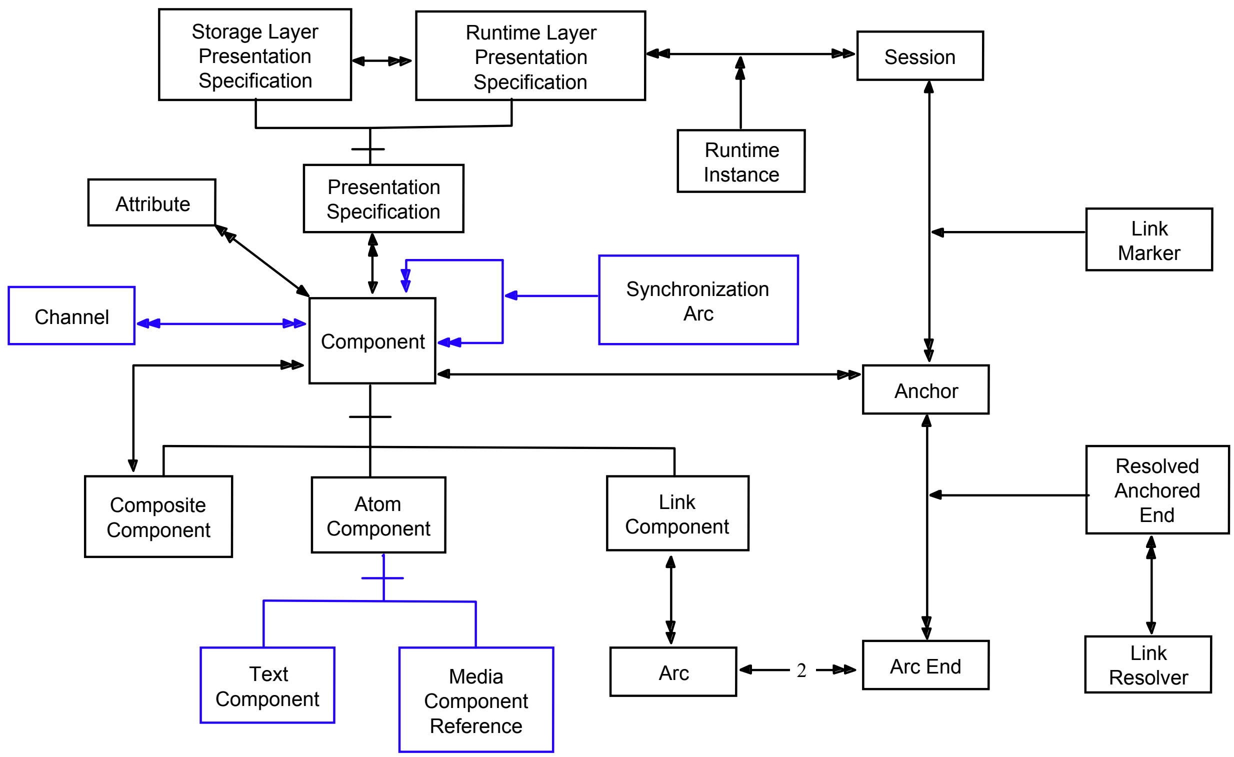

Figure 3 – The Amsterdam Model of Hypermedia

A recurring issue with the Dexter Model is effective selection of alternate content. This is possible through judicious use of Component Attributes to identify equivalent content. The Amsterdam Model formalizes this further, by limiting equivalent content to the contents of a *Composite Component*. In this scenario, a video clip available in 320x240 and 640x480 formats are both Atom Components contained within a Composite Component. The Runtime Layer chooses the appropriate format based on device capabilities; this is an important feature for assistive technology where alternative content well beyond simple alt text may be required.

Adaptability Issues

Even allowing for Hypermedia extensions to the Dexter Model, significant outstanding issues remain when adapting content.

The first, and most significant issue revolves around the stability of Components. The Dexter Model describes navigation between and within components, and it is possible to augment the model with additional Link Components, with user-appropriate sets of Link Components chosen at runtime. However, problems occur with Composite and Atom Components.

Consider as an example a bus timetable website. How the timetable should presented to the user will depend upon a number of factors, including for example screen size and resolution, required font size for the user, and the level of detail to be presented. In the case of screen resolution, the smaller the screen resolution, the less information that can physically fit on the screen at any one time. Depending upon the chosen solution, the number of required web pages to present the timetable will vary, yet the underlying content remains the same. If the point at which further adaptation for the user occurs, is after the division into web pages, there is no practical way to "knit" the timetable together in alternative forms. At beast, the adaptation process can restructure the individual web page. Whilst website design is not normally expected to adjust to radically different screen sizes and shapes, assistive technology often is.

A second issue revolves around the synchronization of contemporaneously presented content. The Amsterdam Model goes some way towards addressing the issue, but is constrained by a lack of semantic knowledge. Taking adaptation using text-to-speech as an example, if some components are already generating audio, it is difficult to know when and how to present audio content, or know the relationship between presented text and existing audio. Consider an on-line immersive game, where characters speak out loud within a soundscape of ear-cons (say providing city-like, or jungle-like noises). Augmenting such an environment requires an understanding what audio may be safely removed or faded, what audio may be delayed, and what audio is already text-to-speech. Whilst it is possible through judicious use of component attributes to provide this information, there is no formal mechanism to dynamically route content between Amsterdam-like Channels. A second example is a mobile phone: how, in the Dexter Model, can the user interface be augmented with text-to-speech without an understanding that a "new message arrived" ear-con may be delayed until the end of speaking an email, or that text-to-speech of an email is less important than an "incoming call" ear-con? In each case a clear semantic model is needed.

A third issue concerns how alternate content is identified and selected. As noted earlier, judicious use of component Attributes can identify equivalent components, and this can be formalized further, as in the Amsterdam Model, by grouping alternate content within a Composite Component. The primary objection to this approach is that only like-for-like alternatives are supported; whilst a video clip may be replaced with text, or subtitles played with the video, you cannot restructure the content. As a simple example, the ordering of content in a list may need to vary between visual and audio design spaces: in text-to-speech environments, the most important menu options may need to be listed first, but in a visual environment the menu may be required to be grouped more logically. Resolving this case within the Dexter Model requires duplication of content to create two Components, one for each view, each with its own set of Link Components. Any further decomposition of content below the menu (however presented) requires further duplication.

All three issues stem from a common complaint: it is not possible to describe content navigation entirely independent of content semantics. How content is organized into components for presentation, and factors such as the relative importance of each component, impacts upon the identification of Atom and Composite Components in the Dexter Model.

HTML

HTML is the World Wide Web Consortium's (W3C) primary mark-up language for the web. It is based on a book metaphor of pages of content that is further organized under sub-headings within a page (sub-headings do no cross page boundaries, which is where the metaphor begins to break down). As a notation it addresses a number of concerns: content structure, presentation, interaction, and navigation.

In terms of the Dexter Model, HTML content exists partly inside the "Within Component Layer", and partly as a hierarchy of *Composite Components* in the "Storage Layer" as websites and web pages. It is only the component hierarchy that is directly addressed by the Dexter Model. One complication with HTML is that it allows for dynamic modification of web pages using scripting languages such as ECMA/JavaScript; scripting is typically attached to user actions such as the "onMouseOver" and "onClick" attributes of many HTML elements. If the result is effective re-presentation of content, then there is navigation to a new component within the Dexter Model. So *Components* are not only web pages and websites, they may also be regions of an individual web page; so-called Ajax-based web pages can be considered to follow this model. Having the component hierarchy expressed within the scripting language is a significant concern for existing assistive technology that cannot access the underlying semantics of such nested components. A practical example of the problem is " Google Suggest" [6], a version of the Google search page which provides dynamic hints to the user as they enter search terms. Screen reading application Jaws for Windows [5] and VoiceOver [7], both fail to handle the dynamic page updates correctly on what is otherwise a trivial web page.

Presentation within HTML is guided by a combination of explicit elements such as <b> (meaning bold), and attributes describing presentation style for individual elements and classes of element. All such presentation information is formally only a hint to the web browser, and consequenly are *Presentation Specifications* within the Storage Layer of the Dexter Model. As with the Within-Component Layer, the exact details of how presentation specifications are described is considered outside of the general Dexter Model, however, it is important to note that the use of scripting in HTML means that such presentation information may change, or be constructed, dynamically, affecting *Runtime Instances.* This means that *Presentation Specifications* can be hidden in the scripting, resulting in assistive technology such as screen readers working with the *Runtime Instances*, and not selecting from, say, a choice of *Presentation Specification*.

User interaction with HTML is provided through pre-defined elements that allow for list selection, text entry, button presses, image maps, and anchors. Only anchors and buttons can directly cause navigation; their existence is represented by *Anchors* within the Dexter Model. List selection and text entry may also represent *Anchors* indirectly through the use of scripting, As with hiding component hierarchy within scripting, hiding *Anchors* and the associated *Link Components* in this way, also effectively hides them from existing assistive technology.

The principal form of navigation within HTML is the hyperlink and causes (re) presentation of a web page potentially embedded within existing presented web pages. An HTML hyperlink is unidirectional *Link Component* in the Dexter Model, although some web browsers use *Session* history to provide a 'back' button and/or a breadcrumb trail. HTML follows the Dexter convention of navigation between uniquely identifiable *Anchors*. HTML itself has the concept of an 'anchor' represented by the <a> and <area> elements, however it is also possible to cause navigation to a web page programmatically using ECMA/Java scripting attached to interactive elements as described above; script-level changes are not guaranteed to appear in *Session* history, and are therefore not always visible to assistive technology.

HTML 5

The HTML notation is now 16 years old, and reflects a subset of the Dexter Hypertext Reference Model, which itself is 20 years old. Over the 16 years, HTML has undergone a number of revisions and spawned several complementary and replacement specifications. HTML version 5 [8] is now out for discussion and, "intends to replace HTML 4, XHTML 1.x, and DOM2 HTML specifications". As the dominant mark-up language for the Web, any changes to HTML will have a knock-on impact on the effective accessibility of the Web, both directly in terms of web pages as scripted by their designers, and indirectly in terms of adaptation by assistive technology on behalf of disabled users.

There are currently over 20 additional tags in the HTML 5 recommendation compared to HTML 4.01 [9]. Some of the new elements provide additional presentation hints (*Presentation Specifications* in Dexter Model terminology), others are concerned with content semantics.

Multimedia was not addressed by previous versions of HTML beyond the <object> element (resulting in SMIL [10], an XML notation to describe multimedia closely resembling the Amsterdam Model of Hypermedia). For HTML 5, two new multimedia elements have been included, <audio> and <video>, with <video> allowing control of embedded captions/subtitles. Both the <audio> and <video> elements allow for manipulation of *cue ranges* within the elements, and match the general thrust of the Amsterdam Model of Hypermedia as *Media Component References*, with embedded <source> elements locating the target content. On first reading of the current draft is unclear whether multiple sources may be included within a single audio or video element. It is possible to synchronize multimedia content, but synchronization is hidden within scripting with the equivalent of "onMouseUp" events on cue range completions. This means that, unlike the Amsterdam Model, there are no explicit *Synchronization Arcs* for assistive technology to follow; they do exist, but programmatically. Also missing is the Amsterdam Model's concept of *Channels*; the audio and video elements carry a large number of attributes to help with play-out and synchronization, but there is no explicit concept of queuing content on specific channels, again leaving all such work at resolving contention for resources to the browser and to explicit scripting, effectively hiding it from 3rd party assistive technology.

After the addition of multimedia to HTML, perhaps the most notable additions are elements that describe semantic meaning. Of particular interest is the <section> element which "provides thematic grouping of content" [8]; existing HTML groups content using the <div> element which in HTML 5 is limited to marking up a "group of consecutive elements" [8]. For adaptive assistive technology, thematic grouping of content may help in terms identifying groups of content that that should appear conceptually "close" during presentation, for example on the same page if content needs to be split over pages, or spatially close on a page that uses scrollbars. Associated with <section> is the <nav> component, which may exist only as a sub-element of <section>, and describes a section of a page that "links to other parts within the page" [8]. This more clearly exposes anchors and their thematic relationships to assistive technology, allowing for example, the restructuring of a web page by a screen reader. Whilst such adaptations are already possible, with anchors moveable to the beginning for a page say, the <nav> element more clearly associates with the parent section and its descriptive attributes, allowing for more informative restructuring. Also of interest are the <command> and <menu> elements that identify and group navigation within, and between pages. As with the <nav> element, this helps expose the underlying *Link Components* in a structured fashion.

Underlying Assumptions

The underlying model of hypertext, as expressed in the Dexter Model, begins with three assumptions; (i) that navigation of content can be described independently of content structure, (ii) that content structure is static, and (iii) that navigation can be described as data elements and the relationships between.

The bus timetable example given earlier demonstrates the some of the limitations of these assumptions. Whilst the bus timetable is certainly static in this context, how the timetable is to be presented affects the organization of content. Can the timetable fit on one screen? Does it need to be presented in both a detailed and a summary form? For the Dexter Model, the content (the *Components*) is only considered static once such decisions have been made, as content structure in terms of components is not at the abstract level of bus stops and times, but is at the level of groups of content (pages in HTML) that may be navigated. Any assistive technology that begins with the Dexter Model, and hence HTML, is already beginning with important organizational details pre-defined, and with the underlying abstract model (in this case busses, bus routes and times) unavailable; assistive technology can only work within the pre-defined groups/pages.

Further, the manner in which real-world bus timetable systems, such as Travelline [11] in the UK, are constructed also demonstrates limitations in the underlying assumptions. Timetable websites, and many corporate websites, are constructed using content from databases, with the specific web page presented to the user being generated on-the-fly by a web server; the layout of that web page is specified by a template that describes the page in terms of fixed content and "holes" to be filled with database content. None of this construction process is visible to the web browser, nor consequently to client-side assistive technology: all semantic meaning between pages is lost. The final constructed pages do follow the Dexter Model, but the overall *Component* hierarchy within the website is obfuscated. In practical terms, assistive technology is constrained to the current page.

HTML itself starts by constraining its use of the Dexter Model further by use of a book metaphor, with each page of the book constructed of headings, sub-headings and content (text, image, tabular) . This already promotes the importance of page composition over the headings; it is the printer's view of a book, not an author's or a reader's. The hierarchy and division of *Components* becomes, largely, a collection of pages, not a collection of content. A user navigates from page to page, not chapter to chapter. Consequently, design of a website begins with choosing the number of pages independently of consideration of the user's device capabilities (e.g. screen size), or consideration of the needs of the user. HTML 5 contributes many more semantic and thematic constructs to describe content within a page, but it is still entirely concerned with that specific page.

A developing trend over the last two years has been the promotion of so-called Ajax websites. In simple terms, an Ajax website is one that replaces the "book" metaphor with a "screen" metaphor and turns web pages into computer programs. The web page is still presented to the web browser as an HTML web page, but its construction is heavily based upon ECMA/JavaScript running within the web page. Ajax web pages are also more active than traditional web pages, in that they can communicate with a web server without the user selecting a hyperlink. As with the simple template approach above, the final presented page follows the Dexter Model, but the construction process, and any semantic relationships involved are obfuscated from both the browser and any assistive technology.

An alternative view

An alternative view the Dexter Model is as one layer of a larger document model; Figure describes documents within a five-layer model.

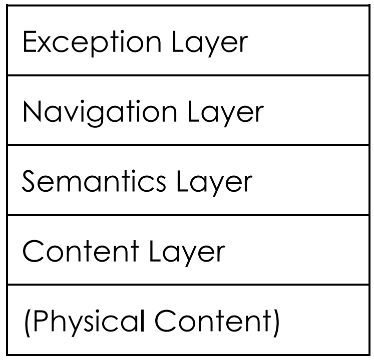

Figure 4 – The Dexter Model in context

At the lowest level of the five-layer model is physical content such as text, images, video and audio clips which may reside anywhere within the related electronic network.

The Content Layer provides identifiers for all used content. This is equivalent to the *Media Component Reference* in the Amsterdam Model shown in Figure , and equivalent to the <source> element of HTML 5, and the "src" attribute of the <img> element in HTML, but also encompasses text fragments.

The Semantics Layer provides for document composition, and for description of relationships of elements in individual documents, and between documents; the Semantics Layer may reference the same content in the Content Layer multiple times.

The Navigation Layer represents navigation within the Dexter Model, but with each *Component* in the Navigation Layer referring to an element of the Semantics Layer. Many Components may reference the same element in the Semantic Layer. An example would be multiple views of a bus timetable.

The Exception Layer provides for the Dexter Model's *Link Resolver* and *Resolved Anchor Ends*. The layer exists to illuminate the case where links break, or adaptive systems identify problems with user navigation within a website.

Separate, and in parallel with this five-layer model is the Runtime System described by the Dexter Model. The *Session*, *Runtime Instances*, *Link Markers*, and *Runtime Layer Presentation Specifications* all belong to the Runtime System. *Presentation Specifications*, as hints, may exist in any of the four layers top layers.

The five-layer model is a useful reference model in that it encompasses the entire scope of notations such as HTML, rather than only the navigation aspects. The migration of HTML 4 to 5 into this view also becomes clearer, with the new semantic elements strengthening the Semantics Layer, the <source> element strengthening the Content Layer, and the <nav> element strengthening definition of *Composite Components* in the Navigation Layer.

The enduring strength of the Dexter Model is also apparent. With Dexter *Components* in the Navigation Layer considered as counterparts to elements within the Semantic Layer, the model of Components, Arcs and Anchors remains intact. The Exception Layer provides for clarification of link resolution issues, and as an anchor for adaptive systems, but the Dexter Model's link resolution principals remain intact.

The five-layer model also highlights inconsistencies within HTML 5, notably the new <source> element exists only for audio and video clips, but not for images or text (text may be quoted or cited, but never referenced for inclusion as an image or video clip may be). Another inconsistency within HTML 5 is the drift towards scripting rather than expressing direct document structure which can be seen in the synchronization of media in the Navigation Layer, and link resolution in Exception Layer when there is more than one arc per link(for example when reloading multiple frames). With the increase in semantics-related elements such as <section> this leaves the Semantics Layer expanding the direct description of content, and the Navigation and Exception Layers retreating into the obfuscation of scripting.

Summary

The Dexter Reference Model of Hypertext provides a view of how users may navigate electronic documents. HTML builds upon that view, using a book metaphor to describe the content of each document, and providing hints to the web browser to help in presenting content to the user. Both the Dexter Model and HTML both date from the late 1980's and embody the view of content and content navigation prevalent at the time. HTML has undergone a number of revisions since its inception, with discussion of HTML 5 ongoing. A number of variants, and extensions to, the Dexter Model have been proposed, a notable example being the Amsterdam Model of Hypermedia.

HTML itself is part of a family of mark-up languages for the web, each supporting a subset of the features of the Dexter Model. Key constraints include unidirectional hyperlinks and simplified link components. The use of scripting within an HTML page tends to obfuscate the underlying Dexter Model, for example anchors may be hidden in script attached to attributes such as "onMouseUp" and "onBlur". Practical use of HTML when pages must be constructed from database content and/or through templating, also tends to obfuscate the underlying Dexter Model; the constructed web pages follow the Dexter Model, but may obfuscate the semantic relationships that hold the page elements together.

The current version of HTML 5 available for review, adds multimedia capabilities to HTML, and in the process extending the Dexter Model. The current proposals approximate to a simplified version of the Amsterdam Model of Hypermedia, but with synchronization left to scripting, rather than using explicit synchronization arcs. This leaves HTML 5 as being more than Dexter, but less than Amsterdam in terms of capability. HTML 5 has also begun to address a deficiency in describing semantic relationships between content, although only for content within an individual web page.

The stability of the underlying content below the Dexter Model's navigable components is a cause for concern. This instability stems from describing navigation based upon a single concrete realization of content decomposition. A simple example, showing the impact upon HTML, is the splitting of search results across web pages in Google. If the content requires restructuring for a particular visual or cognitive impairment say, restructuring becomes limited to the predefined individual page, not to the search results as a whole. With online searching, and the results, forming a significant part of modern web usage, the quality of assistive technology for the web is directly affected.

Whilst all rendered HTML web pages do conform to a subset of the Dexter Model, the visibility of that model may be obfuscated by the use of scripting within the page, for example when changing the content of multiple frames of a frameset, or implementing synchronization arcs in HTML 5. With the advent of Ajax-based web scripting, visibility problems for assistive technology have increased significantly.

The observations expressed about the Dexter Model, and about HTML 5, become clearer when the Dexter Model is viewed in a broader context. The proposed five-layer model is an attempt to do so, placing Dexter within a layered model capable of expressing both content and navigation. In doing so, the enduring quality of the Dexter Model becomes clear, as do some of its limitations.

Conclusion

Even after twenty years, the Dexter Reference Model of Hypertext still forms the core model for web content navigation. Only with the advent explicit multimedia elements within HTML version 5, is the model challenged, and even then the underling model requires only minor modification. Those changes move the model towards a simplified view of the Amsterdam Model of Hypermedia, with synchronization and sequencing issues left to the browser and web scripting.

The Dexter Model was always designed to be a universal set of hypertext features, of which individual systems and notations implement a subset. This is certainly the case with HTML, including HTML 5. Of the subset implemented by HTML, the use of scripting sometimes obfuscates the underlying model (both content and hyperlinks). Further, some of the non-implemented features, such as multiple alternate presentation specifications, and limited runtime link resolution, limit the capabilities of browsers to adapt to user needs.

Hypertext benefits from being placed into a broader model of context, rather than simple navigation of pre-defined content groupings as in the Dexter Model. The five-layer model presented here, showing the relationships between content, navigation, and exception is one example of such an approach, demonstrating the enduring strengths, and some of the weaknesses of Dexter, notably the instability of the model in an adaptive environment.

The five-layer model also helps to place notations such as HTML in context, allowing all the features of the notation to be discussed, rather than only navigation. Placing the proposed HTML 5 within this model helps identify inconsistencies and omissions. A more detailed model with each layer describe similarly to Figure , would go some way to providing a broader reference model for electronic documents and user interfaces.

Continuing Work

The five-layer model presented in this article forms part of a study of adaptable hypermedia at the University of Teesside. Detailed models of each layer are used, in conjunction with semantic models of device and user capability, to allow automated construction of hypermedia interfaces adapted to user needs. Associated with this, is a prototype XML notation for describing such a system that allows for limited transcoding of HTML directly into the notation.

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About the author

Robert Dodd's PhD focuses upon models of user interaction that allow hand-held mobile devices to self-adapt to individual user capabilities, with the goal being to widen access to established content, and to establish a framework for future content design that will further widen access. The key output of the work is a user-centred model of adaptable hypermedia that is structured around the visual, audio, haptic, cognitive, and learning design spaces. Supporting, and driving this approach is a model of portable user profiling that provides the raw information upon which the adaptation is based

Mobile Web: Reinventing the Wheel?

Simon Harper

Information Management Group, School of Computer Science University of Manchester, Manchester, M13 9PL, UK

simon.harper@manchester.ac.uk

Tagline: Reusing the lessons learnt in achieving Web accessibility can speed the Mobile Web to fruition.

It shouldn't come as any shock to realise that the Mobile Web doesn't really work just yet. However, mobile content is currently under intense development as the drive toward the mobile Web is pushed by both the World Wide Web Consortium (W3C) and mobile service providers; with an eye on increasing mobile content sales.

We ask, will this drive lead to a race toward techniques, best practice, and technologies; miss those already developed in different domains? Are we in danger of repeating the same old mistakes by ignoring research and development from other fields? If we don't take a more holistic view, we think that we are.

Web based mobile content has no fixed structure and has no fixed target. It can consist of many different elements that are not of the same kind or nature, and needs to be displayed on many different types of devices all with their own egocentricity's. These issues form both the problem, and point to the universality of the solution required.

One of the key ideas of the Web, as articulated by Tim BernersLee, is exactly this idea of universality, many different kinds of Web pages viewable on many different devices. Indeed this vision so pervades the Web ethos that it also extends into the real world by suggesting that every Web page should be designed so that not just all devices, but all people, can access content regardless of any sensory or cognitive impairments.

But there is a Web outthere characterised by devices with small to nonexistent screen size, low bandwidth, and different operating modalities. It too doesn't work properly just yet but it's a lot further along the path to universality then we may imagine. It's called the 'Accessible Web' and its had its own share of setbacks and successes that we can all learn from. Indeed, it is important in the context of the Mobile Web because with the move to mobile technologies, devices are, in effect, simulating the problems faced by disabled users within the wider population of mobile users.

So what can the Mobile Web, learn from the Web accessibility, and what resources created to support Web accessibility can be used by designers in their support of the Mobile Web? To cross–pollinate we need to rethink our view of accessibility and begin to realise that 'accessibility' is in effect a misnomer; what we really mean is 'completeness'[1] of the content to enable complete content to be rendered on any device. Indeed the Web accessibility rests on the twin pillars of completeness and standardisation and these concepts are key to how accessibility practitioners build their Web sites. As the number of mobile devices increases and the Web evolves to be truly mobile we think these twin pillars will become the two most important concepts for the Mobile Web practitioner too.

The Mobile Web Initiative [2] is still in its infancy. Views common in general mobile device design are still prevalent and the device (ergo user agent) itself is still the focus of many manufacturers. In an area where corporate interests still weigh heavy 'How can Web content be accessed *on MY device*?' is often the question being considered. However, when the aspiration of the Web is truly understood the only question to ask is 'How can the content of the entire Web be accessed *by ALL devices*?' Paradoxically, finding the solution to this question is exactly how a commercial advantage could be achieved.

Bespoke solutions of the kind currently under investigation by the fledgling Mobile Web community, suggesting Web content can be tailored serverside [3], is not the path to follow. While trying to make information universally usable through bespoke device descriptions seems reasonable on first inspection

Completeness (as in 'integrity') n. : the state of being complete and entire; having everything that is needed.

it is not and cannot be supported in practice. Building device descriptions is a risky strategy at best and by trying to address all device needs in one design the technologist is apt to address non. Indeed, if Web accessibility is any indicator, device descriptions will become less desirable due to both cost of maintenance and increasing client side support requirements. While it may be possible for mobile device manufacturers to provide highly tailored client solutions for their specific device, painful experience has taught accessibility professionals that bespoke clientside solutions are often created when an area is en vogue but support dwindles as products move into the mainstream.

This is exactly our experience with common accessibility technologies which cannot keep pace with mainstream browsers. The answer, that is beginning to dawn on certain parts of the accessibility community, is to forget accessibility persay and concentrate on building complete documents while moving accessibility into the browser, in effect choosing the generic over the bespoke. Web accessibility professionals know that complete but device neutral information is the only sustainable development route. Indeed, many have already tried creating separate information resources, subsites, and accesstechnology friendly areas, all with limited success. Infact so limited has their success been that most practitioners have now moved to a 'one document' solution and rely on the ability of user agents to use each Web document as required.

One complete document following the current standard is the only workable solution. This approach is supported by researchers in the Computer Human Interaction field who have long expounded the principle of 'Universal Usability'. A universality which suggests to most designers and engineers that the solutions they come up with must best fit most of the population most of the time. Indeed, many practitioners follow the viewpoint that universal usability means designing to support all users and devices [1]. Indeed if we do not heed their call the Mobile Web stands to be mired in the retrofitting and rehashing common in Web accessibility. Interestingly we can see this view being adopted by progressive mobile companies already. With the launch of the Nokia S60 mobile browser, which is really a user-agent with a built in screen magnifier, we can see that device independent content can be accurately rendered on a small screened device.

To create universal documents by including complete information involves making no-generalisations regarding users or devices. Indeed, it is precisely because previous models made so many generalisations that users not fitting these assumptions have been excluded from the technological world in the first place. Do not misunderstand, visual and auditory styles are quite acceptable as long as they are overlays and do not alter the document or its objects, singularly or in combination.

So how can the Mobile Web mirror the completeness and standardisation of Web accessibility without 'reinventing the wheel', so to speak? Help is at hand. Enter the 'Web Content Accessibility Guidelines' (WCAG) [4] which we could call 'Web Content Completeness Guidelines' because in reality they do not discuss accessibility but more accurately completeness. Completeness of the foundational models, completeness at the metadata level, completeness of the information (or Document Objects), and finally limited semantic completeness.

By using these guidelines along with general good practice and validation of the Web foundational, core, and domain technologies and standards, Mobile Web practitioners can ensure that documents are complete, standard, and device neutral.

In practice there is a tremendous commonality between the Mobile Web and Web accessibility, and this is why lessons learned creating Web accessibility are important for the Mobile Web. Accessibility practitioners have been researching, innovating, and building device independent resources for years and their expertise can, and should, be leveraged into the Mobile Web effort. Conversely, the Mobile Web is important from an accessibility standpoint because the Mobile Web is Web accessibility but with a stronger business case. Therefore, by building the Mobile Web we can also ensure that the entire Web, mobile or desk bound, is accessible.

Building content that allows for heterogeneity, flexibility, and device independence is incredibly difficult, incredibly challenging, but incredibly necessary. This looks good for the Web accessibility practitioner who may find new avenues opening up for their skills in Mobile Web content creation. But we must remember that we will never accomplish the task if we forget the first rule of the software engineer, reuse.

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About the author

Simon Harper has been a Lecturer in the Information Management Group of the School of Computer Science at the University of Manchester since 2006, and Research Lead for the Human Centred Web Laboratory since 2001. He is interested in how disabled users interact with the Web and how the Web, through its design and technology, enables users to interact with it. He believes that by understanding disabled--users' interaction we enhance our understanding of all users operating in constrained modalities where the user is handicapped by both environment and technology.

Web 2.0 and the Semantic Web: Hindrance or Opportunity?

W4A – International Cross-Disciplinary Conference on Web Accessibility 2007

Conference Report

Yeliz Yesilada and Simon Harper

School of Computer Science, University of Manchester, UK

http://www.w4a.info – chairs@w4a.info

Abstract

The World Wide Web (Web) is in transition; a fundamental evolution of the model which underpins the traditional Web. This new Web, Web 2.0, is a mesh of enhanced semantics, push application widgets, and embedded scripting languages and was developed to pursue the promise of enhanced interactivity. The possible benefits of Web 2.0 are great, but it seems that without timely and prompt action disabled users will be barred from these benefits. Indeed, using sites such as: Flicker, YouTube, MySpace, Google Maps, and Google Portal will rapidly become 'offlimits' to disabled users. Semantic Web technologies have already shown themselves to be useful in addressing some issues of Web Accessibility. However, this new technology has not yet started to make its way into mainstream applications. Without change, will the benefits of the Semantic Web be lost? Will the promising enhanced interactivity of Web 2.0 technologies become increasingly inaccessible to disabled users? We pose the question:

"Web 2.0 and the Semantic Web: Hindrance or Opportunity?"

The conference was held on Monday the 7th and Tuesday the 8th of May 2007 at the Fairmont Banff Springs Hotel in Banff National Park. We welcomed 65 attendees pursuing research on Web accessibility. We accepted 40.3% of all submissions, each paper was peer reviewed by the three of our programme committee. In brief, the conference proceedings brought together a cross section of Web design, engineering and Web accessibility research. The papers included report on developments on the Web 2.0 and Semantic Web, discussed the issues regarding the evolvement of the Web, and suggested cross-pollinated solutions. Comments from our attendees suggested that they enjoyed the conference and would be participating again next year. Our social programme also attracted almost all of our delegates, which was a great fun. Overall we judge the conference to be a great success.

Discussion highlights

This year was the first time that W4A was held as a colocated conference as opposed to being a workshop with the World Wide Web conference (WWW). The paper presentations were organised into five technical sessions supported by our keynote speakers: Becky Gibson - "Enabling an Accessible Web 2.0" (IBM Human Ability and Accessibility Center), Mary Zajicek - "Web 2.0: Hype or Happiness?" (Oxford Brookes University, UK), Michael Cooper "Accessibility of Emerging Rich Web Technologies: Web 2.0 and the Semantic Web" (WAI, W3C) and Ian Horrocks "Semantic Web: The Story so Far" (University of Manchester, Manchester, UK). Throughout the conference, there were a lot of discussions, thus many research questions addressed and raised. The following sections summarise these discussions.

Web 2.0 – Technical Perspective

What is Web 2.0? How does it differ from the Web we all know and use? What are the characteristics that turn an ordinary Web page into a Web 2.0 page? Which technologies are involved in Web 2.0? And how accessible are these technologies? These were some of the questions raised throughout the conference that aim to look at the Web 2.0 from a technical perspective. Our first keynote speaker, Gibson, B. [1] gave an excellent keynote addressing technical issues involved in Web 2.0. She began by defining Web 2.0 and highlighted that Web 2.0 pages have three major characteristics; they are dynamic (e.g., incremental updates), interactive (e.g., maps) and they support collaboration (e.g., wikis, blogs). All other presentations related to Web 2.0 also agreed that Web 2.0 technologies include a number of preexisting Web technologies (e.g., Javascript, CSS, AJAX, Multimedia). Technically speaking, the Web 2.0 accessibility can be addressed in different ways:

Updated Web Technologies New technologies can be introduced to make dynamic content updating accessible to assistive technologies (AT) such as ARIA (Accessible Rich Internet Applications). Thiessen and Chen [2] presented a very good example application where ARIA is used to make a chat application accessible. Existing APIs can also be improved to make applications accessible (e.g., IAccessible2). In fact, Shelly and Young [10] from Microsoft Research demonstrated how existing APIs can be used to make moderately complex pages accessible.

Development Tools We also need to ensure that tools used to design Web 2.0 pages generate accessible content. As an example, Gibson, B. [1] presented her work on Dojo which is a toolkit widely used for developing Web 2.0 applications. Similarly, Power and Petrie [17] showed that toolkits used by nonprofessional designers have high impact on the Web 2.0 accessibility.

Testing Tools Existing evaluation tools need to also evolve to support evaluation of Web 2.0 pages (e.g., evaluating server side dynamic content).

Collaborative Authoring This can be a technique to increase the awareness of accessibility among designers. Bigham and Ladner [4] presented their work on a collaborative scripting framework that aims to bring together designers and users to work together on creating accessible content.

Assistive technologies ATs play a crucial role in ensuring the Web 2.0 accessibility. They also need to be evolved and catch up with the new Web technologies.

Web 2.0 – Social Perspective

Besides the papers that looked at Web 2.0 from a technical perspective, we also had papers and presenters that look at it from a social perspective. Especially, Zajicek, M. [5]'s provided an excellent discussion on "what does accessibility really mean?" and looked at it from four different perspectives: physical disability and Web 2.0 view, visual impairment and accessibility, general public's view on disability, and how older people view Web 2.0. Although her examples were UK specific, she presented a number of good examples of Web sites that aim to support Web accessibility (e..g, BCAB, BBC OUCH). But then she highlighted that there is a danger of ghettoism or isolation where a community of disabled people is created whose culture is unlikely to reach the outside world. She stressed the importance of reaching the general public and making them aware of the issues and such specific cultures.

We also discussed a number of social factors that affect the accessibility of the Web. Especially, Zajicek, M. [5] presented a view from the ageing population. She highlighted that they form a special group because many have lived their lives in a world without the Web. They do not usually see the benefits of the Web, they lack resources, they prefer to socialise in a non Web ways, they are not interested in investing in new relationships and they are not so much worried about the others view on them. These are some of the social factors that affect the accessibility of the Web, but unfortunately they are usually neglected when we talk about the Web 2.0 accessibility.

Semantic Web and Web Accessibility

Horrocks, I. [18] from the University of Manchester presented a broad overview of the Semantic Web. He gave a number of very good examples of where Semantic Web is really successful and a number of examples where it is still developing. As an example Semantic Web application, Lopes and Carrico [12] presented their work on creating a framework based on the Semantic Web technologies to profile users and create custom, rich accessible content to better meet users' needs. Although we had papers like that, from the overall presentations, it was very clear that the Semantic Web is not an area that is very well explored for supporting Web accessibility. This was also highlighted by Cooper, M. [13]. He also stressed that instead of thinking about how developments such as Web 2.0 is not accessible, may be we can start to think how we can use these developments to create accessible content. He gave an example of a "Mashup" that is actually based on a dynamic content (e.g., Web services), to create an accessible shopping site. He also mentioned that technologies such as Microformats in fact provide lightweight semantics that could be used for the benefits of accessibility, but unfortunately the way they are currently used make them inaccessible.

Understanding Web Accessibility

Although Web accessibility is a well established field, we still continue to seek to understand issues, users and technologies involved with Web accessibility. This year, we had a number of papers that looked into the foundations which include accessibility evaluations of Web sites, designing guidelines to support accessibility and experimental research.

Evaluation Vigo et al. [14] presented their work on creating a set of quantitative metrics for measuring Web accessibility. Kane et al. [26] showed that many top universities continue to have accessibility problems and the accessibility varies greatly across different countries and geographic regions.

Guidelines Cooper, M. [13] talked about the components of Web accessibility. He highlighted that content, developers and users are the three main parts of the accessibility and indicated that guidelines are actually required for each of these. Kelly et al. [25] also highlighted that a holistic view is required to achieve Web accessibility and criticised that as the Web accessibility community we have not achieved that yet.

Experimental research This year we also had papers presenting experimental research results. For example, Watanabe, T. [27] presented his work that aims to show that sites marked appropriately with heading elements improve accessibility. His work was excellent and actually won the best paper award.

Best Paper Award Takayuki Watanabe, Experimental Evaluation of Usability and Accessibility of Heading Elements[27]. Watanabe [27]'s experiments show that blind users benefit a lot from the from the appropriately marked up heading elements and demonstrates that this reduces the overall difference in response time between sighted and blind users.

Web accessibility challenge

The Web Accessibility Challenge was organised for the first time this year and was based on the theme “Innovative voice access interfaces for the Web: including browsers, techniques, and transcodings”. It was organised by Chieko Asakawa and Hironobu Takagi from the User Experience and Accessibility technology group in IBM Tokyo Research. It was a session that seek to receive applications towards achieving Web accessibility and the aim was to choose the best, innovative applications. The call was for new, innovative voice access interfaces for Web contents. The aim was to gather various types of next generation voice browsers, and demonstrate the future of more usable voice access systems. Judges scored each system by novelty and achieved usability, and decided on a best access interface award for the submissions. The judges were Brian Charlson (The Carroll Center for the Blind), Jay Leventhal (American Foundation for the Blind) and Simon Harper (University of Manchester). This year we had five submissions ranging from standalone voice browsers, content management systems, natural language interaction with graphical representation of data and making multimedia content accessible. Two prizes were given: one decided by the judges and one decided by the conference participants. It was a great success and the prizes went to:

Judges Award Leo Ferres, Petro Verkhogliad, and Louis Boucher. (Natural language) Interaction with Graphical Representations of Statistical Data [22];

Delegates Award Yevgen Borodin, Jalal Mahmud, I. V. Ramakrishnan, and Amanda Stent. The HearSay NonVisual Web Browser [20].

Research challenges

Here we list some of the research challenges that were highlighted during the conference:

1. Most of the existing accessibility evaluation tools cannot evaluate the accessibility of Web 2.0 pages; How can we create more sophisticated evaluation tools? Do we need to focus on new paradigm for evaluating dynamically updated microcontents or serverside applications?
2. Most of the assistive technologies (AT) cannot handle Web 2.0 pages or other new related technologies. Why AT’s are always behind the mainstream tools? Why do they always need to catch up with the new developments or changes on the Web? How can we ensure that they are more up to date as with the other mainstream browsers?
3. Tools and toolkits that professional designers use to create pages play a crucial role in accessibility; How can we ensure that they generate accessible content? Similarly, the number of nonprofessional designers is increasing tremendously either through the usage of templates, blogs or wikis; how can we ensure that they actually generate accessible content?
4. Accessibility APIs play an important role in the development of assistive technologies; how can we ensure that they enable access to Web 2.0 applications? What can be done with the existing APIs? How can we ensure that the designers have easy access to the capabilities of the existing APIs?

5. Do we need to revisit the description of the "Web accessibility"? What does really accessibility mean? What about social aspects? Have we been focusing on the technical aspect and somehow forgot about the social aspects? We need to think about issues like ghettoism, isolation and mainstreamism.
6. People tend to have the view that "Web 2.0 is just for young people"; How can we ensure that that is not the case? What about ageing population? How can we socially include those people? Web 2.0 has a lot of socialphenonomens associated with it, but ageing population does not see the benefits and cannot associate themselves with these social-phenonomens.
7. Sometimes designing for accessibility can be expensive, how can we design costeffective design methodologies for accessibility? How can we reduce the cost? Do we need to educate designers better or design better ATs or design better authoring tools and toolkits? Are we getting into an era where specialised knowledge is required to design for accessibility?

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Abstracts

Here we list all the technical, communication and keynote papers which were presented at the conference.

Enabling an Accessible Web 2.0 Becky Gibson
http://doi.acm.org/10.1145/1243441.1243442

The next generation of the Web is relying on new technologies to build rich interfaces and applications which enable community, collaboration, social networking and enhanced interactions. This has implication for people with disabilities who have come to rely on the Web to provide more independence, work opportunities, and social interactions. New specifications such as Accessible Rich Internet Applications (ARIA) are being developed which provide more semantic information about Web components and can enable enhanced accessibility. In addition, toolkits and testing tools are making it easier to reach the nirvana of accessibility by default in Web 2.0 projects.

AJAX Live Regions: Chat as a Case Example Peter Thiessen and Charles Chen
http://doi.acm.org/10.1145/1243441.1243450

Web 2.0 enabled by the Ajax architecture has given rise to a new level of user interactivity through web browsers. Many new and extremely popular Web applications have been introduced such as Google Maps, Google Docs, Flickr, and so on. Ajax Toolkits such as Dojo allow web developers to build Web 2.0 applications quickly and with little effort. Unfortunately, the accessibility support in most toolkits and Ajax applications overall is lacking. WAIARIA markup for live regions presents a solution to making these applications accessible. A chat example is presented that shows the live regions in action and demonstrates several limitations of ARIA live regions.

Web Browser Accessibility Using Open Source Software
Z. Obrenovich and J. van Ossenbruggen
http://doi.acm.org/10.1145/1243441.1243451

A Web browser provides a uniform user interface to different types of information. Making this interface universally accessible and more interactive is a long term goal still far from being achieved. Universally accessible browsers require novel interaction modalities and additional functionalities, for which existing browsers tend to provide only partial solutions. Although functionality for Web accessibility can be found as open source and free software components, their reuse and integration is complex because they were developed in diverse implementation environments, following standards and conventions incompatible with the Web.

To enable the integration of existing partial solutions within a mainstream Web browser environment, we have developed a middleware infrastructure, AMICO:WEB. This enables browser access to a wide variety of open source and free software components. The main contribution of AMICO:WEB is in enabling the syntactic interoperability between Web extension mechanisms and a variety of integration mechanisms used by open source and free software components. It also bridges the semantic differences between the high level world of Web XMLbased APIs and the low level APIs of the device-oriented world.

We discuss the design decisions made during the development of AMICO:WEB in the context of Web accessibility, using two typical usage scenarios: one describing a disabled user using a mainstream Web browser with additional interaction modalities; another describing a non-disabled user browsing in a suboptimal interaction situation.

Accessmonkey: A Collaborative Scripting Framework for Web Users and Developers
Jeffrey P. Bigham and Richard E. Ladner
http://doi.acm.org/10.1145/1243441.1243452

Efficient access to web content remains elusive for individuals accessing the web using assistive technology. Previous efforts to improve web accessibility have focused on developer awareness, technological improvement, and legislation, but these approaches have left remaining concerns. First, while many tools can help produce accessible content, these tools are generally difficult to integrate into existing developer workflows and rarely offer specific suggestions that developers can implement. Second, tools that automatically improve web content for users generally solve specific problems and are difficult to combine and use on a diversity of existing assistive technology. Finally, although blind web users have proven adept at overcoming the shortcomings of the web and existing tools, they have been only marginally involved in improving the accessibility of their own web experience.

As a first step toward addressing these concerns, we introduce Accessmonkey, a common scripting framework that web users, web developers and web researchers can use to collaboratively improve accessibility. This framework advances the idea that Javascript and dynamic web content can be used to improve inaccessible content instead of being a cause of it. Using Accessmonkey, web users and developers on different platforms with potentially different goals can collaboratively make the web more accessible. In this paper we first present the Accessmonkey framework, describe three implementations of it that we have created and offer several example scripts that demonstrate its utility. We conclude by discussing future extensions of this work that will provide efficient access to scripts as users browse the web and allow nontechnical users be involved in creating scripts.

Web 2.0: Hype or Happiness?
Mary Zajicek
http://doi.acm.org/10.1145/1243441.1243453

Web 2.0 has initiated a new age of Web interaction. Countless everyday activities such as seeking information, shopping, filling in forms and making appointments can be done effectively and often more cheaply on the Web. However many of the new community sites, and other Web 2.0 sites, do not promote accessibility in terms of inclusivity. They are built for, and are of most benefit to, young socially integrated people who own their own laptop and live in a world of readily available radio LAN and fast access broadband. However many older or disabled people are living on low budgets and do not have access to such things.

Those for whom the Web is inaccessible for whatever reason will become increasingly excluded from mainstream life if it is not made accessible to them. This paper argues for a holistic approach to accessibly which addresses all aspects of the user's life. It tracks the impact of the advent of Web 2.0 on Web accessibility in its widest sense. It starts with a definition of accessibility, which in this context means apart from physical access, inclusion and acceptability. Through the use of case studies it examines worrying trends brought about by Web 2.0, and positive signs of improvement in accessibility, due to Web 2.0.

Accessible Image File Formats: The Need and the Way (Position Paper)
Sandeep R Patil
http://doi.acm.org/10.1145/1243441.1243455

Accessibility is one of the key checkpoints in all software's products, applications & websites. Accessibility with digital images has always been a major challenge for the industry. Images form an integral part of certain type of documents & most of the Web 2.0 compliant websites. Audience challenged with blindness and many dyslexics only makes use of screen readers/ text readers/narrator software programs to access the computer and computer displayed information. Such audience cannot view digital images/pictures. Hence drafting accessible documents or designing accessibility enhanced websites containing digital images representing figures, diagrams, map, snaps etc is a challenges. There are various published best practices for accessibility of documents or website containing images so that they can be better understood by the visually impaired users. But these are truly not enough to cover all kind of practical scenarios and this paper positions a need for a more innovative solutions. The paper also proposes accessibility enhanced image formation technique with relevant modification required in screen readers/narrator software programs and positions its edge over the existing methods.

Capability Survey of Japanese User Agents and Its Impact on Web Accessibility
TL. Coetzee and N. Govender and I. Viviers
http://doi.acm.org/10.1145/1243441.1243456

The National Accessibility Portal initiative is a large initiative aimed at improving the quality of life of people living with disabilities in South Africa. The initiative has several functional components, including the National Accessibility Portal, National Accessibility Portal Centers, research into developing localised client side assistive technologies and devices, advocacy as well as the development of a methodology allowing for replication in other developing countries with similar needs.

The focus of this paper is on the research and development of the portal in the bigger National Accessibility Portal initiative.

The portal's differentiating elements measured against other content portals is the ability to provide a configurable platform (based on the user's profile) for information sharing and communication in an accessible and usable fashion within the constraints of today's technologies, in the user's language of choice and in the most cost effective and sustainable fashion.

In this paper we describe the process involved in developing version 1.0 of the National Accessibility

Portal; from gathering user requirements, addressing the issue of multilingualism, accessibility and usability challenges. We present initial user feedback comments and highlight ongoing challenges. In addition we present the technology stack and implemented functionality.

A Preliminary Usability Evaluation of Strategies for Seeking Online Information with Elderly People Sergio Sayago and Josep Blat
http://doi.acm.org/10.1145/1243441.1243457

This short paper describes an experimental study with elderly users comparing three strategies for seeking online information, Google basic search, the Yahoo! Directory and Google advanced search. The effect or three general usability criteria for the elderly, simplicity, difficulties using the mouse and cautious clicking and reading, on the total search time older people spend seeking complex online information with the three strategies has been studied. The hypothesis that basic search is the fastest strategy because it meets the three usability criteria, unlike the other two strategies, is confirmed. Older people were 3 times faster in basic search than in either advanced search or directory. Advanced search was slower than basic search due to information overload but faster than the directory, which was the slowest strategy primarily due to difficulties using the mouse and information overload.

Personalization of User Interfaces for Browsing XML Content Using Transformations Built on End-User Requirements
Benoitt Encelle and Nadine BaptisteJessel
http://doi.acm.org/10.1145/1243441.1243459

Personalization of user interfaces for browsing content is a key concept to ensure content accessibility. In this direction, we introduce concepts that result in the generation of personalized multimodal user interfaces for browsing XML content. Users requirements concerning the browsing of a specific content type can be specified using userfriendly description languages. According to these specifications, transformation rules are generated in order to produce personalized user interfaces for browsing specific content types. With the emergence of the semantic Web and connected XML applications, such customized multimodal user interfaces can be useful for many kinds of users, especially individuals with various type of impairment.

Accessibility for Simple to Moderate Complexity DHTML Web Sites
C. C. Shelly and G. Young
http://doi.acm.org/10.1145/1243441.1243460

In this paper, we describe specific design and coding techniques for the creation of simple to medium complexity Dynamic HTML and AJAX applications, which are accessible to people with disabilities using mainstream user agents and assistive technology available at the time of this writing.

Leveraging rich accessible documents on the web
Rui Lopes and Luis Carrico
http://doi.acm.org/10.1145/1243441.1243461

This paper presents a new approach on leveraging accessibility for rich document delivery to the Web. The proposal entails a profile modeling task, where multidisciplinary teams can discuss users, devices, and usage scenarios, in order to grasp and synthesise the different document delivery scenarios. A document production framework is presented, which can be configured according to modeled profiles. By using this approach, documents are tailored to users in such a way that rich interaction capabilities are maintained, without sacrificing content accessibility.

Profiling Learners with Special Needs for Custom e-learning experiences, A Closed Case?
Paola Salomoni and Silvia Mirri and Stefano Ferretti and Marco Roccetti
http://doi.acm.org/10.1145/1243441.1243462

Contrary to what commonly thought, profiling users and devices is still a complex issue, especially in the case of learners with special needs, who deserve a customized access to elearning platforms. A plethora of languages, protocols and tools have been proposed which can be exploited to create users' and devices' profiles, separately. Unfortunately, none of them is really effective in capturing the fundamentals of a learner profile, when used in isolation. Here we discuss a practical approach we devised to profile elearners, which is able to meet the variety of requirements providing educational experiences. Our approach is based on the idea to put together the strengths of ACCLIP and CC/PP protocols, while avoiding specification conflicts. A few examples are provided which show the efficacy of the approach.

Accessibility of Emerging Rich Web Technologies: Web 2.0 and the Semantic Web Michael Cooper
http://doi.acm.org/10.1145/1243441.1243463

Web 2.0 is a new approach to Web content, making it more interactive and allowing sites to combine features in new ways. This change in paradigm brings new challenges to people with disabilities. Accessibility advocates must develop solutions rapidly. Semantic Web technologies address some of these requirements, and accessibility innovation may be part of a convergence of the Web 2.0 and Semantic Web.

Quantitative Metrics for Measuring Web Accessibility Markel Vigo and Myriam Arrue and Giorgio Brajnik and Raffaella Lomuscio and Julio Abascal
http://doi.acm.org/10.1145/1243441.1243465

This paper raises the need for quantitative accessibility measurement and proposes three different application scenarios where quantitative accessibility metrics are useful: Quality Assurance within Web Engineering, Information Retrieval and accessibility monitoring. We propose a quantitative metric which is automatically calculated from reports of automatic evaluation tools. In order to prove the reliability of the metric, 15 websites (1363 web pages) are measured based on results yielded by 2 evaluation tools: EvalAccess and LIFT. Statistical analysis of results shows that the metric is dependent on the evaluation tool. However, Spearman's test produces high correlation between results of different tools. Therefore, we conclude that the metric is reliable for ranking purposes in Information Retrieval and accessibility monitoring scenarios and can also be partially applied in a Web Engineering scenario.

Mathematics on the Web: Emerging Opportunities for Visually Impaired People Cristian Bernareggi and Dominique Archambault
http://doi.acm.org/10.1145/1243441.1243466

This paper discusses the state of the art of mathematics on the Web in the context of its accessibility to visually impaired people. It goes on to explain how the use of the MathML markup language to embed mathematical expressions in Web pages could improve the accessibility and usability of Web published scientific documentation when consulted with speech synthesis and/or Braille devices. This work was carried out as part of the @Science project. @Science is a thematic network funded by the European Commission eContentPlus Programme. Its goal is the preparation of guidelines and best practices for production and use of digital scientific documentation accessible to visually impaired university students.

Iconic Communication System by XML language: (SCILX) Nathalie Cindy Kuicheu and Laure Pauline Fotso and Francois Siewe
http://doi.acm.org/10.1145/1243441.1243467

Traditional iconic systems establish direct iconic communication between a user and his environment by translating iconic sentences in sentences of a natural language, or by translating them into SQL (Structured Query Language) queries for relational data bases. This approach is limited because it is not suitable for communicating through the Internet which allows users of diverse background and culture to communicate all over the world. This paper presents SCILX, a XMLbased iconic communication system which in addition to the functionalities of existing iconic systems enables communication through the Internet using the World Wide Web and the XML technologies. The approach has a formal foundation based on formal grammars of icons. A case study of an iconic interface for a multimedia database in traditional medicine (MEDITRA) is presented.

Accessibility in Nonprofessional Web Authoring Tools: A Missed Web 2.0 Opportunity?
Christopher Power and Helen Petrie
http://doi.acm.org/10.1145/1243441.1243468

The advent of Web 2.0 technologies, and the increased participation of users in personalized web experiences, has created a need for new web authoring tools intended for use by nonprofessional web authors. These tools represent a prime opportunity for including accessibility features early in the tool design process. The results from an accessibility evaluation of one of these tools demonstrates that such opportunities could be easily missed.

Semantic Web: The Story so Far
Ian Horrocks
http://doi.acm.org/10.1145/1243441.1243469

The goal of Semantic Web research is to transform the Web from a linked document repository into a distributed knowledge base and application platform, thus allowing the vast range of available information and services to be more effectively exploited. As a first step in this transformation, languages such as OWL have been developed; these languages are designed to capture the knowledge that will enable applications to better understand Web accessible resources, and to use them more intelligently. Although fully realising the Semantic Web still seems some way off, OWL has already been very successful, and has rapidly become a de facto standard for ontology development in fields as diverse as geography, geology, astronomy, agriculture, defence and the life sciences. An important factor in this success has been the availability of sophisticated tools with built in reasoning support. The use of OWL in large scale applications has brought with it new challenges, both with respect to expressive power and scalability, but recent research has also shown how the OWL language and OWL tools can be extended and adapted to meet these challenges.

Making Multimedia Content Accessible for Screen Reader Users
Hisashi Miyashita and Daisuke Sato and Hironobu Takagi and Chieko Asakawa
http://doi.acm.org/10.1145/1243441.1243443

Rich and multimedia content is increasing rapidly on the Web. It is very attractive for sighted people, but it brings severe problems to screen reader users. Once the audio starts playing, it becomes hard for blind users to listen to the screen reader because there is physically only one volume control that cannot control the separate audio streams. Though there are often softwarecontrolled buttons to control the audio, they are often controllable only with a mouse and are not associated with alternative text. Because of the audio conflicts and inaccessible control buttons, the multimedia content is often inaccessible to blind users. In addition, the use of dynamically changing interactive user interfaces is also a critical issue, since existing screen readers cannot detect such dynamic content changes.

We developed an accessible Internet browser for multimedia to address these problems and offer multimedia content as an information resource for the blind. It is characterized by three major features. First, it allows users to control the audio, such as the volume, play/stop, pause, and even the speed. Second, a dynamically adaptable metadata function is added to simplify complicated multimedia pages and to track dynamic changes and effectively inform users about the changes. Third, an audio description function supports Internet movies with a text format described by the metadata. In this paper, after briefly discussing the existing accessibility problems of multimedia content, we describe our accessible Internet browser for multimedia.

The HearSay nonvisual web browser
Yevgen Borodin and Jalal Mahmud and I. V. Ramakrishnan and Amanda Stent
http://doi.acm.org/10.1145/1243441.1243444

This paper describes HearSay, a nonvisual Web browser, featuring contextdirected browsing, a unique and innovative Web accessibility feature, and an extensible VoiceXML dialog interface. The browser provides most of the standard browsing functionalities, including flexible navigation and formfilling. The paper also outlines future work aiming to make the Web more accessible for individuals with visual impairments.

Using a CMS to Create Fully Accessible Websites
Sebastien rainvillepitt and JeanMarie D'Amour
http://doi.acm.org/10.1145/1243441.1243445

This session demonstrates how a content management system (CMS) can facilitate the creation of fully accessible websites for people with disabilities. Throughout this lecture, the participants will access an indepth view of the technical components and solutions adopted by Netic Hypermedia Inc for the development of the content management system Edimaster Plusł which supports the highest Web Accessibility standards. The speakers will demonstrate navigation, dynamic content management and search function tools adapted to different users as well as a wide range of other tools offering advanced functions of text, image, forms, and data table editing. The demonstration will be conducted using assistive technology such as screen reader and screen magnifier software.

(Natural Language) Interaction with Graphical Representations of Statistical Data
Leo Ferres and Petro Verkhogliad and Louis Boucher
http://doi.acm.org/10.1145/1243441.1243446

Numerical information is often presented in graphs to take advantage of the human ability to quickly find visual patterns. Unfortunately, this medium is problematic for people who are blind or otherwise visuallyimpaired. To provide accessibility to graphs published in The Daily (Statistics Canada's main dissemination venue), we have developed iGraph, a system that provides short verbal descriptions of the information depicted in graphs and a way of also interacting with graphical information.

The status of using "Big Eye" Chinese screen reader on "Wretch" blog in Taiwan
YuiLiang Chen and YungYu Ho
http://doi.acm.org/10.1145/1243441.1243447

The "Wretch" Blog (http://www.wretch.cc/) is one of the most popular blogs in Taiwan. Through the Chinese screen reader "Big Eye", visual impaired users are able to interact with ordinary people on the "Wretch" Blog. They can share their experience and feeling via their personal space and forum. In general, most functionality of the "Wretch" Blog works well for visual impaired people except some perception transferred by pictures only. However, originally blog systems are developed for ordinary people, and do not concern the usability for visual impaired users. Lack of the concept of accessibility design brings some obstacle to visual impaired people.

When a blog system is designated, the principles of designing web accessibility should be included. Therefore, visual impaired users are able to surf blogs easily. Many suggestions from visual disability are illustrated below to provide the critical issues for designing blogs by referencing "Wretch" Blog. It is hoped that the suggestions are useful for developing new blogs and/or revising existing blogs.

Ajax Live Regions: ReefChat Using the Firevox Screen Reader as a Case Example
Peter Thiessen and Charles Chen
http://doi.acm.org/10.1145/1243441.1243448

Web 2.0 enabled by the Ajax architecture has given rise to a new level of user interactivity through web browsers. Many new and extremely popular Web applications have been introduced such as Google Maps, Google Docs, Flickr, and so on. Ajax Toolkits such as Dojo allow web developers to build Web 2.0 applications quickly and with little effort. Unfortunately, the accessibility support in most toolkits and Ajax applications overall is lacking. WAIARIA markup for live regions presents a solution to making these applications accessible.

To address this problem we developed an Accessible Ajax chat application called ReefChat and the Fire Vox screen reader. Features include, chat message notification through live regions to notify the AT. As well as keying up and down messages to navigate through chat messages, and keying left and right to filter messages from specific users. In this paper after briefly discussing the problem of Web 2.0, we describe our accessible chat application and screen reader.

Accessibility 2.0: people, policies and processes
Brian Kelly and David Sloan and Stephen Brown and Jane Seale and Helen Petrie and Patrick Lauke and Simon Ball
http://doi.acm.org/10.1145/1243441.1243471

The work of the Web Accessibility Initiative (WAI) is described in a set of technical guidelines designed to maximise accessibility to digital resources. Further activities continue to focus on technical developments, with current discussions exploring the potential merits of use of Semantic Web and Web 2.0 approaches. In this paper we argue that the focus on technologies can be counterproductive. Rather than seeking to enhance accessibility through technical innovations, the authors argue that the priority should be for a userfocussed approach, which embeds best practices through the development of achievable policies and processes and which includes all stakeholders in the process of maximising accessibility.

The paper reviews previous work in this area and summarises criticisms of WAI's approach. The paper further develops a tangram model which describes a pluralistic, as opposed to a universal, approach to Web accessibility, which encourages creativity and diversity in developing accessible services. Such diversity will need to reflect the context of usage, including the aims of a service (informational, educational, cultural, etc.), the users' and the services providers' environment.

The paper describes a stakeholder approach to embedding best practices, which recognises that organisations will encounter difficulties in developing sustainable approaches by addressing only the needs of the end user and the Web developer. The paper describes work which has informed the ideas in this paper and plan for further work, including an approach to advocacy and education which coins the "Accessibility 2.0" term to describe a renewed approach to accessibility, which builds on previous work but prioritises the importance of the user. The paper concludes by describing the implications of the ideas described in this paper for WAI and for accessibility practitioner stakeholders.

A Web Accessibility Report Card for Top International University Web Sites
Shaun K. Kane, Jessie A. Shulman, Timothy J. Shockley and Richard E. Ladner
http://doi.acm.org/10.1145/1243441.1243472

University web pages play a central role in the activities of current and prospective postsecondary students. University sites that are not accessible may exclude people with disabilities from participation in educational, social and professional activities. In order to assess the current state of university web site accessibility, we performed a multimethod analysis of the home pages of 100 top international universities. Each site was analyzed for compliance with accessibility standards, image accessibility, alternatelanguage and textonly content, and quality of web accessibility statements. Results showed that many top universities continue to have accessibility problems. University web site accessibility also varies greatly across different countries and geographic regions. Remaining obstacles to universal accessibility for universities include low accessibility in nonEnglishspeaking countries and absent or lowquality accessibility policies.

Experimental Evaluation of Usability and Accessibility of Heading Elements
Takayuki Watanabe
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Task completion times of sighted and blind users were measured with two kinds of Web sites: sites marked up appropriately with heading elements and sites with the same visual appearance but with no heading elements marked up. The experiment was carried out with user agents that could navigate through heading elements. The results showed that 1) task completion time was reduced by as much as one half with marked up heading elements, 2) the benefits of markup on task completion time were greater for blind users, and 3) the overall difference in response time between sighted and blind users diminished with sites that were appropriately marked up.

About the authors

Simon Harper has been a Lecturer in the Information Management Group of the School of Computer Science at the University of Manchester since 2006, and Research Lead for the Human Centred Web Laboratory since 2001. He is interested in how disabled users interact with the Web and how the Web, through its design and technology, enables users to interact with it. He believes that by understanding disabled--users' interaction we enhance our understanding of all users operating in constrained modalities where the user is handicapped by both environment and technology.

Yeliz Yesilada is a postdoctoral research associate in the School of Computer Science at the University of Manchester. Her research interests include human centred Web, Web accessibility, mobile Web and Semantic Web. She is currently working on the EPSRC funded RIAM (Reciprocal Interoperability between the Accessible and Mobile Webs) project which aims to investigate ways in which to integrate research into the Accessible and Mobile Webs. She received a PhD in computer science from the University of Manchester. She is a member of the ACM (SIGWeb and SIGACCESS)

Accessibility Research in Malaysia

Hasni Hassan[1], Nazean Jomhari[2], Syariffanor Hishyam[3]

[1]Universiti Darul Iman Malaysia, [2]Universiti Malaya, [3]Universiti Teknikal Malaysia Melaka

{Hasni.Hassan, Nazean.Jomhari}@postgrad.manchester.ac.uk, syariffa@cs.york.ac.uk

In recent days, there is a tendency in Malaysia that more and more people are interested the research regarding the use of computing and information technology by the ageing population and people with disabilities. Below are some examples of these projects.

Research on Older Adults and Computer Technology

The first breakthrough in the area of Gerontology is the establishment of the Institute of Gerontology (IG) at the University Putra Malaysia on 1 April 2002. Since its inception, various research and development activities, both at the national and international levels, have been carried out at the institute. The institute has particularly been successful at obtaining several research grants from the Ministry of Science, Technology and Innovations in the categories of Prioritized Research and Experimental and Applied Research. At the international level, the institute received sponsorships from both the United Nations Population Fund (UNFPA) and the United Nation's World Health Organization (WHO). As a result of the confidence shown by these organizations, the University has approved the acquisition of an additional block for the institute to house two laboratories, namely, the Biosocial, Cognitive and Functional Laboratory and the Gerontechnology Laboratory to ensure a more systematic and efficient research activities at the institute.

In an effort to produce quality research, the institute is also actively involved in a variety of collaboration with researchers and agencies from within University Putra Malaysia and outside the university. In addition, the introduction of graduate programmes (MSc and PhD) at the institute is another step towards producing a new generation of researchers in the field of gerontology. The institute is also currently planning a publication programme to enhance the channel of communication to inform on the institute's research activities and findings.

Among the latest research projects that have been granted for the Institute of Gerontology for the year 2007 are : Access and Utilization of Computers and the Internet among Older Malaysian, Assessing Mobility and Behavioral Patterns and Perception of Needs and Barriers of Older Road Users in Malaysia, Development of GIS-based Youth Mapping, Traffic and Ageing in Malaysia, Patterns of Social Relationships and Psychological Well Being among Older Persons in Peninsula Malaysia; and Perception, and Awareness and Risk Factors of Elder Abuse.

Another research work is the design of user interface for Malaysian older adults. The major motivation for this research work is to encourage the adoption of computer technology among older people in developing countries like Malaysia. Regardless of demographic and cultural characteristics, older people share similar age-related difficulties in perception, cognition and mobility which remarkably affect their daily activities including computer tasks. However, the problem is more apparent in Malaysian older adults who are not only struggling with their age-related difficulties but at the same time need to user-interface design which was designed without considering their cultural preferences. Thus, this research work investigates the relationship between ageing and culture and its roles in user-interface design.

Syariffanor's research was partly inspired by the initiative conducted by the former Ministry of National Unit and Social Development in collaboration with The Malaysian Institute of Microelectronic Systems (MIMOS) in 2003 where a one year pilot study namely Warga Emas Networks and Eagle Nest targeted at Malaysian older adults was conducted. This pilot study was aimed at promoting societal inclusion and freelance employment with the use of computer and the Internet among older people in Kuala Lumpur, Selangor and Kelantan. Positive results from this pilot study had initiated more research interests with regards to Malaysian older people and their interaction with computer.

Research on Computer-Mediated Grandparents-Grandchildren Communication

Research on grandparents (GP) and grandchildren (GC) relationship is currently being conducted, focusing on the use of computer mediated communication (CMC) for maintaining long distance GP-GC relationship. In this study, the grandchildren live in the UK and the grandparents live in Malaysia.

In addition to trying to understand the nature of the relationship between grandparents and grandchildren, the objective of this research is to identify the effectiveness of video conferencing technology to mediate long-distance relationship and to develop and evaluate better video conferencing technology to support long distance communication between grandchildren and grandparent. This research is important since currently, there is only one research conducted on grandparent-grandchild (GP-GC) in Malaysia and the research focused on Malaysian Sindhis (in contrast to the Malay population investigated in this study).

At the moment, this study involves children aged between 7 to 11 years old and who have had some experience using video conferencing. All respondents were interviewed about their Internet usage and the nature of communication with their grandparent. Their video conferencing behavior was also observed. The same process was performed with the grandparents. In addition, the grandparents were required to accomplish some specific tasks using video conferencing application. In this study the grandparents was assisted by other family members. The interaction between grandparents, their helpers, the video conferencing application and the grandchildren were observed and analyzed using content analysis technique. This study is a longitudinal study, collecting five data points with seven days interval.

Research on Input Devices for People with Motor Disabilities

Another recently initiated research work is the use of input devices by people with motor disabilities in Malaysia, more specifically on input devices evaluation with motor-impaired people. This research is significant it is the first research of its kinds to be conducted in Malaysia. An experiment was carried out in July 2007 with support from Dato' Dr Zaliha Omar, who is currently the Honorary Consultant and project leader for Malaysian Independent Network on Disabilities (MIND). Potential participants for the experiment were recruited from community centers for disabled people around Kuala Lumpur and Selangor.

The motivation behind the research is the current statistic that those with physical impairments constitute the largest population of disabled people in Malaysia. In Malaysia, a digital divide exists not only among rich and poor, urban and rural but also among populations with and without disabilities. As a result, some segments of society have become disenfranchised by exclusion from access to information and information technologies.

This research would contribute to support e-Khidmat Sosial, an initiative by the government of Malaysia that was introduced in 2006. It is a branch of the government Strategic Planning for target groups such as children, people with disabilities (PWDs), older adults, those from lower income group, families with problems, victims from natural disasters and non governmental organizations (NGOs). The Malaysian government has identified e-Khidmat Sosial as part of strategic initiatives for the implementation of Strategic ICT Plan for Public Sectors.

About the authors

Syariffanor Hisham is a final year PhD student at the Department of Computer Science at the University of York (sponsored by the Government of Malaysia). She has a Bachelor Degree in Information Technology (Universiti Utara Malaysia, Malaysia) and an MSc in Multimedia Technology from the University of Manchester. She is a lecturer from the Faculty of Information and Communications Technology at Universiti Teknikal Malaysia Melaka, Malaysia. Her research interests include user-interface design, older adults, culture and localization.

Nazean Jomhari obtained her BSc Information Science from the National University of Malaysia (UKM) and her Masters Degree (MSc. In Software Engineering) from the University of Essex, United Kingdom. She started her PhD in September 2005 with the School of Informatics at the University of Manchester, UK (sponsored by the Government of Malaysia). Currently a lecturer at the Faculty of Computer Science and Information Technology with Universiti Malaya, Malaysia; her research areas are in Software Design, E-Customer Relationship Management (CRM), Knowledge Engineering, Web Application and E-Learning.

Hasni Hassan started her PhD with the School of Informatics, the University of Manchester in September 2005. She has a Bachelor Degree in Electrical Engineering from the University of South Australia, Australia. She obtained an MSc in Information Technology from the University of Technology MARA (UiTM) and currently being employed as a lecturer with Universiti Darul Iman Malaysia (previously known as Kolej Ugama Sultan Zainal Abidin, KUSZA). Sponsored by the Government of Malaysia, her research interests include computer input devices, motor-impaired people, web information hierarchy and evaluation of users' performance.