Evaluating Web Resources for Disability Access

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ABSTRACT
A majority of Web based information, facilities and services is unnecessarily inaccessible to people with certain disabilities, largely due to a lack of awareness of accessibility issues on the part of developers. This paper argues that currently available accessibility evaluation methods are unsatisfactory in the scope and presentation of their results. Consequently, there is a need for a meta-method which utilises the strengths of current methods, but which also bridges their weaknesses. The paper discusses a comprehensive, yet usable methodology for evaluating web sites for accessibility. Using this methodology, a semi-automatic accessibility evaluation tool is proposed, which will guide evaluators through the auditing process and produce a set of tailored recommendations for making the subject site accessible.

Keywords
Accessibility, Usability, Disability, Evaluation, Web Resources.

INTRODUCTION
The need for World Wide Web (WWW, or Web) resources to be accessible to people with disabilities has always been of vital importance. Recognition of this importance has been increased by past and pending legislation in the US, the UK and other countries, which includes a legal requirement for ensuring accessible resources.

The Web offers one of the best opportunities yet to deliver information inclusively of people with many kinds of disabilities [14]. Yet there remains a high percentage of Web based information that is inaccessible to disabled users; a situation which makes it difficult for people with disabilities to fully participate in the "digital economy" [15]. Ignorance of the issues which cause accessibility problems amongst developers is a prime factor in the current glut of material which is inaccessible to people with visual, hearing, cognitive and motor impairments.

Many Web developers continue to hold the view that the Web is, by nature, a graphical medium and therefore is the domain of the graphic designer. The counter-argument, promoted by the World Wide Web Consortium (W3C), amongst many others, including the authors of this paper, is that the Web can offer a way of delivering content, regardless of format, in such a way as to satisfy a particular user's preference, and that graphic representation should be ultimately under the control of the user. Such a philosophy ensures that users of assistive technology can access material to the same extent as user of standard browsers. This approach, however, need not compromise the goal of visually attractive, innovative Web sites.

The current explosion of commercial interest in mobile Internet devices, and the debate over the nature of the content available though such devices, is good news for disabled users of the Internet. Design challenges presented by the limitations of mobile devices (e.g. small screen, restricted physical interface, limited bandwidth) are very similar to the challenges designers face in providing material which is fully accessible to users with disabilities. Newell and Gregor [8] discuss similarities in designing systems for "extra-ordinary" users in "ordinary" environments and designing systems for "ordinary" users in "extra-ordinary" environments.

There is, thus, a pressing need for the message of accessible design to be delivered effectively to designers, to ensure that they are aware not only of the techniques required to create accessible, yet visually pleasing, resources, but also the reasons behind applying these techniques.

To ensure accessibility forms an integral part of the design process, it is essential that a standard method for evaluating existing material is available.

THE NEED FOR A STANDARD ACCESSIBILITY EVALUATION METHOD
There are currently a number of guidelines for developing accessible sites, most notably the W3C Web Content Accessibility Guidelines (WCAG) [16], and there are also some automatic validation tools available to developers, such as Bobby [1] and Check Your Page [2].

These methods, however, have a number of drawbacks:

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- The results of automatic validation tools present extremely valuable information, but are often overwhelmingly long and detailed, making them difficult to interpret, particularly to non-expert Web developers.
- Automatic validation tools can only detect a limited number of potential accessibility barriers, and thus additional manual inspection is required on the part of developers in order to supplement results. For example, certain visual aspects cannot be checked by an automatic tool - such as assessing whether text alternatives for graphics do in fact provide the equivalent information to the graphic.
- In some cases, automatic validation tools find a resource inaccessible, even though it does reach an acceptable level of accessibility.
- Current accessibility guidelines require developers to fully understand the requirements of each guideline, the reasoning behind that guideline, and the steps to be taken to meet that guideline, and Colwell and Petrie [3] question the effectiveness of the W3C WCAG in successfully helping developers create accessible resources.
- Although checking against guidelines and automatic validation tools provide an approximation of the level of accessibility of resources, they do not, however, give any indication of the usability of resources. It is argued here that any accessibility evaluation should incorporate an evaluation of usability, as there is little value in an accessible resource with a poor level of usability.
- Current methods don't incorporate a set of easily digestible, specific recommendations, tailored to the resource being assessed.

There is thus a need for an all-encompassing method which can be used by designers to fully, yet efficiently, assess material for accessibility. Some way of generating resource-specific recommendations which can be easily interpreted by the designer at the time, yet remain valuable reference material for future design, is also required.

DEVELOPMENT OF A STANDARD METHODOLOGY

The Department of Applied Computing at the University of Dundee [4] has substantial experience in research into computing and communication systems for disabled people [9]. The Department also hosts the Disability and Information Systems in Higher Education (DISinHE) [6] project, which serves as a clearinghouse for information relating to disability and information technology in the UK Higher Education Sector.

Research has been carried out in the Department, by the Digital Media Access Group [5] into the evolution of a suitable procedure which can:

- comprehensively, yet efficiently, uncover all accessibility problems apparent in a subject resource
- present the information uncovered in such a way as to allow the generation of a digestible and usable set of recommendations for improving the level of accessibility.

The authors believe that no one method can satisfactorily convey to developers all issues of accessibility and usability. Therefore a number of methods were considered for their effectiveness in providing information which could be used to raise the levels of accessibility of resources. The most suitable methods were incorporated into a meta-method, which would provide a standard for uncovering all accessibility problems associated with a web resource.

The methodology detailed in this paper was developed during a project to audit accessibility levels of a number of funded UK Higher Educational web resources. These resources included data services, library catalogues and other gateways to information, which would be of use to both academic staff and students. Each subject site is hosted by academic institutions on behalf of the UK Higher Education Community, and therefore it was expected that a high standard of design and usability would be apparent throughout, and that use of the latest technology in the visual appearance of sites would be kept to a sensible level. The level of accessibility of the sample was therefore expected to be of a reasonably high level.

Whilst investigating the various tools and techniques for evaluating the accessibility of web resources, it became clear that none of them were adequate on their own, for reasons already discussed. Therefore, a number of techniques and tools are used in order to fully reveal all of the accessibility barriers contained in the representative sample of site pages checked.

In the case of large sites, it is often impractical to manually check every page. However, an advantage of automatic testing tools, such as Bobby, is that they can check every page automatically and quickly, but for only a subset of barriers. Therefore, a combination of manual and automatic testing techniques allows all pages to be checked for *some* accessibility barriers, and a sample of representative and/or heavily visited pages for *all* accessibility barriers. The results of these manual checks can then be applied throughout the site, using the prioritised recovery plan discussed later in this paper. Whilst a structured methodology is presented, testers are encouraged to be vigilant at all times for any accessibility problem on any given page.

The methodology which was eventually adopted is described below. The steps in the auditing procedure are described in the order in which they are carried out by the authors. However, whilst the Initial Impressions step should always be carried out first, the ordering of the other steps is

not considered essential, but they should all be carried out to ensure that the maximum number of accessibility barriers can be found.

METHODOLOGY

Initial Impressions

The first step in the procedure involves obtaining an initial impression of the accessibility of the subject site, by a group of evaluators browsing the site together, becoming familiarized with the site and discussing any good or bad aspects usability and accessibility which they discover.

Testing with Automatic Validation Tools

Two of the most effective automatic validation tools available for assessing accessibility are used to validate the subject site. The tools used are:

1. ***Bobby*** - a popular automatic accessibility evaluation tool, the results of which provide important, although incomplete, information regarding accessibility levels of a site. As mentioned, Bobby can be relied upon to check entire sites for every guideline that can be validated automatically.
2. ***W3C HTML Validation Tool*** - not an accessibility evaluation tool as such; but it checks the HTML source code behind a web page for compliance with the HTML standard as specified in the code of the page. A key requirement for assistive technologies to correctly interpret web pages is that the pages must be written in valid HTML, and therefore it is important to include an HTML validation stage in the methodology.

Manual Evaluation with Accessibility Guidelines

A sample of pages from the subject site are then evaluated for accessibility, by comparing them to a checklist based upon the W3C's Web Content Accessibility Guidelines Checklist (WCAG). This measure took into account those guidelines that automatic tools cannot validate, such as the contrast of a page's background and text colours.

The WCAG consists of 65 guidelines, with each guideline prioritized according to the negative effect on accessibility resulting from non-compliance of that guideline. For most sites, it would be impractical to check every page against the guidelines; therefore a representative sample of pages is chosen, including the Home page, a page with forms and a search page if available.

General Inspection

As recommended by the W3C [17], the subject site was viewed under various conditions, and any accessibility problems noted. Conditions such as:

- graphics loaded
- graphics not loaded
- frames not loaded
- style sheets not loaded
- scripts disabled

are tested, simulating browsing conditions under which certain users will be forced to work, particularly users of legacy browsing technology.

The ability to access a site without requiring use of a mouse is fundamental to providing access to certain users, particularly those with visual or motor impairments. Therefore an attempt is made to browse the subject site without the use of a mouse, and any information inaccessible without the use of a mouse noted.

Detailed Exploration

A detailed exploration is carried out of the subject site, where an attempt was made to visit every page of the site, This allowed each page to be assessed as a discrete entity, and also as a component of a section of the site, or even as a fraction of the whole site. In this way, not only are quirks of individual pages discovered, but also consistency of appearance, content and general structure of the site could be assessed, and navigational aids tested.

Viewing with Browsers and Assistive Technologies

In order that any platform-specific accessibility problems can be spotted, it is vital that subject sites are viewed under as many different browsing platforms as possible. Again, a manual inspection is performed at this stage. The methodology devised involves browsing subject resources using the following browser platforms: Internet Explorer, Netscape, Opera and the Lynx text only browser.

In addition, the subject site is accessed using a selection of assistive technologies, where, in each case, a disabled user is observed browsing with their chosen assistive technology. During the auditing period in which this methodology was developed, subject sites were browsed using the JAWS screen reader and an 80 character Braille Display.

As a final test in this part of the procedure, the subject site is also viewed at high and low screen resolutions, such as the WebTV resolution of 544x378 pixels, and any diminishment in accessibility noted.

Usability Evaluations

It is vital that usability testing plays an important role in the accessibility assessment procedure. Furthermore it is reasonable to suppose that a site presenting usability difficulties to able-bodied users will contain significantly greater usability problems for a majority of disabled users. Additionally, however, sites with a high level of accessibility can have usability problems that may prevent people with disabilities from finding the information that they need quickly and efficiently.

The methodology therefore includes a Heuristic Evaluation of the subject site – where the evaluation team examined the subject site and judged its compliance with recognised usability principles (the "heuristics"). Nielsen's Ten Usability Heuristics [12], adapted for the Web by Instone [7], were used.

An essential part of the assessment procedure involves both able-bodied and disabled users, particularly visually impaired users, evaluating the subject site. In practice, this vital stage often yielded hitherto undetected accessibility as well as usability problems.

Evaluators carry out a number of tasks identified as being typical of what people would use the site for. Evaluators recorded personal feelings about the site through completion of a questionnaire; additionally evaluators are observed performing the tasks, with notes being taken by the observer. Observation often reveals behavior indicative of usability problems with the site.

An average of five evaluators are used for each site. This is in line with Nielsen's recommendation [11] that, for efficient and productive usability testing, five is the optimum number of evaluators.

Recommendations

Data derived from the various stages described above are synthesized to produce a detailed accessibility audit report for the subject site. The emphasis in this report is formative – it is hoped it will be of use to site administrators not only as an aid to raising the current level of accessibility of the site, but also as a reference for future development. Along with the set of recommendations, a practical solution for applying the recommendations to the site is given in the form of a staged recovery plan as suggested by Nielsen [10], [13]. Such a plan suggests that attention be paid initially to improving the accessibility of the Home page, high traffic pages and all new pages to at least satisfy all Priority 1 Web Content Accessibility Guidelines. In time, developers can work towards the goal of having as many pages as possible comply with as many guidelines as possible.

Clear and digestible recommendations for improving the site's accessibility are set out in prioritised groups. Each recommendation is followed by a rationale for that recommendation, along with, where appropriate, an example of where the recommendation should be applied. Positive as well as negative features regarding accessibility are described.

INITIAL FEEDBACK FROM CLIENTS

Currently, audits have been conducted on seven UK Higher Education Web Sites. These audits have been sent to the clients and the initial informal feedback has been extremely positive. Furthermore, on inspection of the sites which were audited, shortly after submission of the audits, it was noted that some of the most pressing recommendations, as detailed in the audits, had been implemented.

SEMI-AUTOMATIC ACCESSIBILITY AUDITING TOOL

The authors strongly believe that fully automated accessibility auditing tools will never replace human expertise. We do, however, also believe that the development of a semi-automatic tool, based on the manual method just described, which provides a guided tour for evaluators rather than replacing them, would be of value in the drive to raise the profile of accessibility. It was noted during the series of audits that subject sites exhibited a number of similar accessibility problems, and it was felt that an achievable goal was the streamlining and automating, as far as possible, the process of generating recommendations from the evaluation data. A tool which could be used to provide the evaluator with questions, prompts, tips, further details, and explanations concerning each of the stages in the audit, would allow evaluators to be trained more easily, make the production of the audits more efficient, and provide a good level of standardization within and between groups of evaluators.

The tool, which is in the early stages of development, will be used in the production of accessibility audits, where such a tool will make the audit production process more efficient. The level of expertise required to use the tool will not be as great as that required to carry out the audits manually, although a certain degree of expertise will still be required by target users of the tool.

The tool will guide the evaluator through each of the stages in the auditing process, informing them what to do for each stage, and prompting them to enter the results of each stage into the system. Once each stage is completed, the system will generate an audit based on the information entered, containing a prioritized list of recommendations which will need to be implemented in order to make the subject site accessible. These recommendations will be clearly written in such a way that they can be easily understood by developers who do not have a high level of technical knowledge, currently a failing of other accessibility guidelines and tools.

CONCLUSION

Whilst inaccessibility of web based information to people with disabilities remains a serious problem, it can be difficult for resource providers to find out the extent of existing accessibility problems, and how they can be overcome. Currently no single evaluation method exists which will highlight every accessibility issue in a simple and digestible form; instead a procedure combining various methods must be adopted in order to effectively carry out accessibility audits. The methodology described in this paper has been found to be extremely effective in carrying out accessibility audits of web sites, with all feedback received thus far of a positive nature. The receipt of audits produced by the assessment procedure will also encourage easier creation of accessible resources by developers.

The methodology described will be used as a framework for development of an accessibility assessment tool which will provide a "one-stop" solution for developers wishing to gain an idea of the level of accessibility of their resources, and how to improve that level in a practical and pragmatic manner.

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