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Accessibility Issues in HTML5

A Comparison of HTML5 Websites and Those Coded in Earlier Versions

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***Abstract*—** It is estimated that by 2020 there could be as many as 4 million visually impaired or blind people living in the UK. These visually impaired or blind people will use assistive technologies such as screen readers to access website content on the internet. Currently the governing body of the internet, the World Wide Web Consortium has released and continues to develop a new standard of the HTML markup language which is used to code website content. This new HTML standard, HTML 5 has been heralded as a new semantically correct markup language. HTML 5 should be more accessible to users of assisted technologies and should also facilitate the incorporation into websites of rich internet applications and other media in a more accessible way. However the Royal National Institute for Blind People (RNIB) have suggested that the opposite may be proving to be true and that HTML 5 websites may be more inaccessible than websites coded in earlier versions of HTML. This study employs a mixed methods methodology, including screen reader accessibility testing and web developer interviews. This methodology will establish the accessibility of HTML 5 coded websites and prove or disprove the hypothesis of the RNIB while adding granularity and perspective to the results of the testing.

Keywords*-HTML 5; accessibility; screen readers; Web standards; Royal National Institute of Blind People (RNIB)*

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I. INTRODUCTION

Since its inception the World Wide Web (WWW) has evolved from a simple hypertext system into the distributed platform for user interaction seen today. As the WWW has evolved, the web browser software used to access website content has evolved with it, from a simple text viewing tool to a general purpose user interface [1]. Similarly, since its inception in 1989 Hypertext Markup Language (HTML), the code used to create the structure and content of a web page, has also evolved [2]. The World Wide Web Consortium (W3C) is the international body responsible for developing web standards[3]. The last significant release of HTML markup by the W3C, HTML 4 was in 1997 [4]. However, according to [5] in 2008, the W3C published the working draft of a new standard; HTML 5 and although in draft form, certain features were already supported in some browsers. According to [6] HTML 5 is not just an updated version of the HTML standard, but an all-encompassing term describing a suite of technologies which deliver rich interactive web content. Earlier versions of HTML relied heavily on plugins such as Adobe Flash and Microsoft Silverlight to accommodate the inclusion of rich web content[7]. However the new Advanced Programming Interfaces (API) and elements in HTML 5 remove the need for such plugins [8]. This is achieved by introducing new and additional elements, to facilitate the markup of dynamic.

It has been identified that HTML 5 also features improved semantics which makes content more accessible to both humans and computers [9][10]. Indeed, it has also been stated that the new HTML 5 markup tags such as: header, footer, nav, section, article, figure and aside will make web page content more readable to both humans and assistive technologies. However to date the new HTML 5 standard has not yet been ratified [11] and a number of new HTML 5 features are not yet supported by all web browsers and assistive technologies [12]. The primary assistive technology employed by partially sighted or blind users to access website content on the internet are screen readers [13]. Recent discussions with the Royal National Institute of Blind People (RNIB) have revealed that the RNIB is concerned that websites coded in the new HTML 5 markup may currently be, for whatever reason less accessible to screen reader users than those written in earlier versions of HTML. Website accessibility [14] concerns the way in which online information is delivered to users with disabilities.

The aim of this study is to determine the effect of HTML 5 on screen reader website accessibility. The proving or disproving of the RNIB's hypothesis, that websites coded in HTML 5 are less accessible than those coded in earlier versions of the markup will achieve this. Accessibility testing of websites using a screen reader will be conducted to provide data for the testing of the hypothesis. Once the testing has been completed and the data analysed, further research will be undertaken in the form of web developer interviews. It is expected that these interviews will add granularity and perspective to the research and help deliver a deeper understanding of the reasons behind the result of the hypothesis testing.

This research is important as there is it predicted that by 2020 there could be up to 4 million people living in the UK who are blind or partially sighted [15]. Worldwide it is estimated that there are 285 million people who suffer from impaired vision[16]. It is likely that these users will make use of assistive technologies to access website content on the internet. If the emerging HTML 5 standard is less accessible than the earlier versions of HTML it is superseding, the impact

on screen reader users in the UK and throughout the world could be significant and far-reaching.

II. THE DEVELOPMENT OF HTML

Originally created as a language which web browsers could use to interpret static web pages[17], Hypertext Markup Language (HTML) is a structured markup language used by web browsers to identify common sections of a document, such as headings and paragraphs [2]. According to [18] the last major update of the HTML standard, HTML 4 was published by the World Wide Web Consortium (W3C) in 1997 [19]. This standard included the use of the Document Object Model to allow uniform JavaScript application across browsers and the use of external style sheets to control the style of web pages. Two years later the standard was revised to HTML 4.01 [20]. However, the W3C then decided to stop the development of HTML to concentrate on developing Extensible Markup Language (XML). XML itself does not specify pre-defined semantics or tag sets, but rather it is a meta-language for outlining markup languages [21]. As a result of the development of XML, Extensible Hypertext Markup Language Version 1 (XHTML 1.0), defined by the W3C as "a reformulation of HTML 4 as an XML 1.0 application" [22], was released by the W3C in January 2000 [3]. The new XHTML standard demanded certain syntax, such as the correct use of closing tags. This encouraged web developers towards well-structured and syntactically correct markup. After undergoing a number of small revisions, in 2006 the W3C announced the release of a new version of XHTML; XHTML 2.0 [23]. As XHTML 1.0 did not support custom XML tags but XHTML 2.0 did [24] it would have been expected that the new standard should have been well received by web developers. However, according to [25] this was not to be the case. The dislike of XHTML 2.0 was due in part to it not being backwards compatible, but also to it being considered utopian, based on the ideals of the W3C and not on web developers' actual requirements. Unimpressed with this latest W3C offering, a group of industry representatives formed the "Web Hypertext Application Technology Working Group" (WHATWG) to develop their own "Web Applications 1.0" hypertext standard [26]. Up to this point, web browser functionality had been centered on delivering static content, with dynamic content and rich internet applications being facilitated through the use of third party plugins such as Adobe Flash, Microsoft Silverlight and Apple QuickTime [27]. However [28] comments that while HTML 4 and XHTML were developed to handle static documents, Web Applications 1.0 would be developed to handle dynamic content and rich internet applications, to cater for the growing demand of Web 2.0 and a more interactive internet.

In 2007 according to [8], rather than continue the development of XHTML, the W3C decided to support WHATAG in their development. Web Applications 1.0 was subsequently adopted by the W3C and renamed as HTML 5. The new standard would be developed to remove much of the reliance on third party plugins, allowing the browser itself to between the accessibility of Content Management System (CMS) websites and non-CMS websites, a number of Wordpress CMS websites have been included in the study.

deliver interactive features to the user [1]. HTML 5 would also be backwards compatible, so web developers would not necessarily have to learn HTML 5 to use it. Earlier versions of the markup would therefore still work in an HTML 5 environment[9]. HTML 5 would also feature a new and extensive suite of semantic markup tags. These tags would make it easier for search engines and assistive technologies such as screen readers to interpret website content [29].

According to [30] screen readers work by making website content available in a non-visual way and by providing keyboard shortcuts to help users navigate the content of a webpage. It has been stated that users can read webpage content from top to bottom, or use a tab key to navigate from heading to heading or link to link [31]. A screen reader will export data to the format the user has chosen, such as braille or audio [32], with information being delivered sequentially [33]. Screen readers offer an audio output to users by employing a text-to-speech converter to deliver synthesised speech [34]. Screen readers are a useful tool to assist visually impaired users access website content. However, [30] state that browsing websites using a screen reader can be a frustrating task due to constant accessibility problems. This is supported by [35],, commenting that web browsing is ineffective for visually impaired users who suffer constant accessibility problems, with users actively avoiding dynamically updated pages. Equally, [7] agree with this point, commenting that screen readers are particularly poor at dealing with dynamic Asynchronous JavaScript with XML (AJAX) content. However, [36] disagree with this view, stating that all screen readers, with the exception of old versions of JAWS are now capable of coping with dynamically updating web pages. They also comment that the functionality for informing users that page content has been dynamically updated is also improving.

III. METHODOLOGY

The first set of primary data collected in this study was gathered by using an experimental strategy through carrying out website accessibility testing. Testing was conducted on the home pages of randomly selected websites on a desktop computer using Internet Explorer web browser on Windows operating system. To ensure the delivery of consistent data, one blind and highly proficient screen reader user was employed to carry out all of the website testing. Employing a highly proficient screen reader user would ensure that accessibility issues experienced in the testing would highlight issues with the websites themselves and not with the proficiency of the user. This strategy was employed by [37] in their online courses analysis. In this example one of the authors of the paper, a blind and highly proficient screen reader user, was employed to carry out all accessibility testing in the study.

A total of 50 websites were selected for the testing as this should return a good representative sample of data. It was also the number of test websites selected by [38] in their study "Is Your Web Page Accessible". To show a comparison

The websites selected for this study comprised of: 25 HTML 5 sites and 25 sites coded in earlier versions of the markup. These earlier markup sites consisted of 6 HTML 4.01 websites and 19 XHTML websites, marked up in either

XHTML 1.0 or XHTML 1.1. For the purposes of this testing both XHTML versions have been grouped together as XHTML. Websites chosen for the testing were selected at random. This random website selection strategy is the same as that adopted by [7] in their "Accessibility of Websites Using Screen Reader" study. Like the preceding study by [7], this testing is also being conducted using the JAWS screen reader. Websites were presented to the tester in a random fashion, to ensure the tester could not predict any trends in the answers returned. To ensure returning the most meaningful data from the website testing, the latest available software versions were used. JAWS 14 screen reader was employed with a desktop computer using Internet Explorer 11 web browser on Windows 8.1 operating system. This is the most popular combination of screen reader, browser, device and operating system as described by [39] in their Screen Reader User Survey #5 Results. The combination also replicates the sampling strategy of [33] in their study, Accessing Google Docs via Screen Reader, albeit that in this study the most popular web browser was chosen, rather than the two most popular browsers. Only one browser was chosen for this study as the testing was to establish the difference in accessibility between HTML 5 and earlier versions of the markup, not to establish the difference in performance of web browsers.

The questions for this testing offered the user the choice of selecting an answer from a sliding scale. This indicated not only whether a webpage, or feature of a webpage was accessible, but also offered data indicating the degree of accessibility. When analysed, this data would deliver an over-all view of the accessibility of the home pages tested. The data would also help to establish whether any of the HTML 5 home pages tested were benefiting from the use of the new semantic HTML 5 elements and improved APIs.

The second set of primary data in this study was gathered using a survey strategy, by conducting web developer interviews. The number of studies which have taken place to ascertain the needs of web developers in creating accessible websites is surprisingly small. However in this study web developer interviews were conducted to try to ascertain the reasons behind the findings in the website testing. The five web developers to be interviewed were not chosen at random but were selected by the interviewer. A non-probability strategy was therefore used to select the respondents [40] all of whom had experience in coding out HTML 5 websites. Throughout the interview formation process, the nine steps for interviewing were observed. According to [41] these are: deciding the research question, identifying respondents, determining the type of interviews to be conducted, record the interviews properly, use an interview guide, test the refine the interview, decide where to hold the interviews, obtain consent and observe good interview techniques.

IV. RESULTS

The website testing questions can be broken down into two areas: primary questions which query the general accessibility of the webpage and its main elements. This area also queries the opinion of the tester towards the webpage. The questions in the secondary area of the testing rate the accessibility of media which may be contained in the webpage including images, dynamic content, audio and video and forms. This area is concerned with the new HTML 5 features and the implied quality of the coding of the webpage. For the purpose of fulfilling this third objective of the study and thereby providing a simple answer to the hypothesis; a question from the primary area of the testing asks "How do you rate the overall accessibility of the page? All 50 websites were included in the analysis of this question. The cross tabulation table in Table 1 shows the breakdown in the tester's responses. This breakdown shows that while no websites ranked as "Completely Inaccessible", at every other level the HTML 5 websites performed better than those coded in earlier versions of the markup. A total of 20 HTML 5 websites were identified as being "Completely Accessible", while only 13 websites coded in earlier versions of HTML were given the same classification. To show the average response, Figure 1 illustrates the mean accessibility ranking of HTML 5 sites against those of the earlier versions of HTML. This shows that the HTML 5 websites are more accessible than those coded in an earlier version of the markup, but only with an over-all ranking of 5.64, against the earlier version ranking of 5.20.

Table 1: Cross tabulation breakdown

HTML * Qu9 How do you rate the overall accessibility of the page? Crosstabulation

Count

	Q9 How do you rate the overall accessibility of the page?					Total
	Almost Fully Inaccessible	Partially Inaccessible	Partially Accessible	Almost Fully Accessible	Completely Accessible	
HTML 5	0	1	1	3	20	25
Earlier Versions	1	1	3	7	13	25
Total	1	2	4	10	33	50

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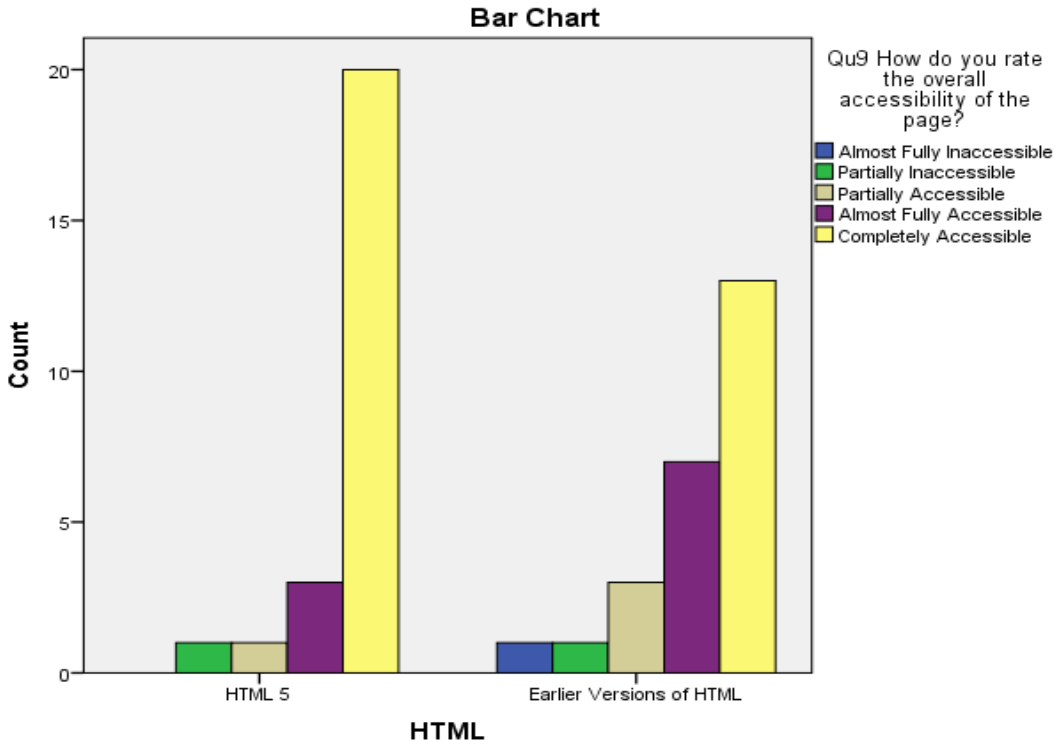

Figure 1: Response count

The analysis can be broken down one stage further to reveal the difference between the accessibility of HTML 5, XHTML and HTML 4.01 websites. The results from this further analysis can be seen in Figure 3.

Again the case processing summary validates the analysis, showing that all 50 websites were included in this second comparison. Interestingly the cross tabulation table reveals that the one "Almost Fully Inaccessible" website was coded in XHTML. The table also reveals that 4 out of the 6, or 66.67% of the HTML 4.01 websites were classed as "Almost Fully Accessible", while only 9 out of 19 or 47.37% of the XHTML websites gained the same classification. This result is an interesting anomaly, as it would be expected that websites coded in the more syntactically correct XHTML would necessarily be more accessible than those coded in standard HTML 4.01.

Further questions explored the difficulty of using dynamic content on web sites. It would be expected that the data from these questions would benefit the HTML 5 webpages, as they can benefit from the new HTML 5 elements which support these application. The results of the analysis shows that only 5 websites contain dynamic content. However the most striking result is that an HTML 5 website registers the only "Extremely Difficult" ranking and a website coded in an earlier version of the markup registers the only "Extremely Easy" ranking.

Table 2: Detailed cross tabulation breakdown

HTML * Qu9 How do you rate the overall accessibility of the page? Crosstabulation

Count

		Almost Fully Inaccessible	Partially Inaccessible	Partially Accessible	Almost Fully Accessible	Completely Accessible	Total
HTML	HTML 4	0	1	0	1	4	6
	HTML 5	0	1	1	3	20	25
	XHTML	1	0	3	6	9	19
Total		1	2	4	10	33	50

Overall, it was clearly evident from this data that HTML 5 websites containing dynamic content are not as accessible as those coded in earlier versions of the markup. When evaluating the integration of media content into a web site, HTML 5 websites are seen to be more accessible, with two of

the earlier HTML version website's audio and video content being shown as being "Extremely Difficult" to use.

When considering the inclusion of images in the web page, the analysis illustrated that the HTML 5 pages were the most accessible with regard to images with a ranking of 5.17 against 4.57 from a possible 6. The final two questions of the study, questions 8 and 10, relate to how much of the webpage the tester can access and whether or not the site would be visited again. Finally, when exploring the application of screen readers to a web site, the HTML 5 websites continue with their small advantage, returning 22 positive responses against the early versions 20 positive responses. However, on asking whether users might return to a site, a surprising climax to the test was returned. Out of the 25 HTML 5 websites, the tester would be happy to re-visit 21 of them, would not be happy to re-visit one of them and could take or leave 3 or them. Of the early version sites, the tester would be happy to re-visit 22 of them, would not be happy to re-visit 2 of them and could take or leave just one of them. While evenly balanced yet again, the early version websites return the most positive results in the last question of the testing.

The website analysis has answered the third objective of the study and established that websites coded in HTML 5 are not less inaccessible than those coded in earlier versions of the HTML. However the testing has also established that the difference between the accessibility of HTML 5 and earlier version HTML webpages and features of webpages is negligible. A further analysis has revealed that websites coded in HTML 4.01 are also more accessible than those coded in XHTML. Perspective has been added to these test results from the analysis of the web developer interviews.

V. Developer Interviews

The objective of the web developer interviews was to gain an understanding of how web development professionals implement HTML 5 and earlier versions of HTML. This adds perspective to the results of the analysis of the website testing. Five web developers were interviewed in this process. The information gathered from the analysis of the web developer interviews was revealing and answered the final objective of the study; to gain an understanding of how web development professionals implement HTML 5 and earlier versions of HTML. In answering this objective the interviews explained why the testing of the HTML 5 and earlier version HTML webpages returned such similar data. The reason for this is because the majority of web developers code HTML 5 and earlier version HTML pages in a similar fashion. While this is a bold and sweeping statement, the web developer interviews illustrate a general lack of understanding of the very nature of the biggest change to hit web development in over 15 years. While there are exceptions to every rule, the small deviations in the testing in favour of the HTML 5 coded sites amply illustrate that exception.

In all these interviews have established a general misunderstanding of HTML 5 and the positive features and benefits it can deliver. Three out of the four developers code using an HTML 5 doc type to help with validation of the website and to apparently aid SEO. Of the two developers who code using HTML 5, one has implied that they do not use the standard exclusively. Both HTML 5 developers stated that they have used little or none of the new and available HTML 5 APIs. However all respondents enjoy using the CSS3 styling tools.

VI. Conclusion

According to [5] the key to creating good website accessibility is by coding websites consistently to current web standards. This is supported by [42] who agree with this, stating that web standards should not be avoided to accommodate imperfect web browsers and that new code should be used for a new job. However from the website testing results returned in this study it has shown an inconsistency in website coding and a lack of new code being used for the new job. Had the HTML 5 sites tested been coded using the new semantic elements available, there should have been a greater disparity in the accessibility results returned between HTML 5 websites and those coded in earlier versions of HTML. Web developers are therefore not using the suite of new HTML 5 features available, or using them as they should be. Instead they are relying on backwards compatibility, using HTML 4.01 and XHTML markup within an HTML 5 document. This allows them to use older versions of the markup while cherry-picking the HTML 5 features they wish to incorporate in the website. The reasons for this as illustrated in the developer interviews is a general lack of understanding of HTML 5 and a fear of perceived browser issues. It was also shown that the HTML 5 doc type was being used to improve search engine rankings and to allow websites to validate which would not validate in earlier versions of the markup. The study also discovered that web developers are excited by the styling possibilities of CSS3 and all developers interviewed was using CSS3 regularly. However they developers appears less excited about the structural and semantic advantages of HTML 5 itself. It therefore appears likely that the similarity in the results returned in the testing are due to the majority of HTML 5 websites being HTML 5 in doc type only. The lack of ratification of the HTML 5 has also lead to web developers avoiding adopting the standard as evidenced in the interviews. However according to [8] most of the current versions of the leading web browsers handle HTML 5 well. So this may not be a major reason for the low frequency of correctly marked up HTML 5 websites found in the study, however this subject did appear in the interview results.

The results of this study answer the aims and objectives and therefore the hypothesis very well. From the hypothesis and RNIB's expected outcome it was proved that the opposite was in fact true, albeit by the smallest of margins. The literature review painted an excellent picture of the semantic differences between HTML 5 and earlier versions of HTML. The literature review also critically assessed how a screen reader navigate s and interprets web pages and this was used as the basis for the website testing. The website testing objective, to rate the performance of screen reader accessibility of websites written in HTML 5 and earlier versions of HTML was fulfilled. The subsequent web

developer interviews delivered an understanding of how web development professionals implement HTML 5 and earlier versions of HTML and therefore fulfilled its objective. The four objectives of the study being fulfilled, the aim of the study was reached; to determine the effect of HTML 5 on screen reader website accessibility.

This study has shown a mistrust and misuse of HTML5, with the standard returning little benefit to website accessibility. The study also revealed that web developers are gathering information about HTML5 not necessarily from source, but through the use of social media. Further research could include more extensive testing of HTML5 screen reader accessibility along with a comparative analysis of the tested websites' structures. Testing could also be improved by taking a larger sample and employing screen reader users with a range of screen reader fluency. Whilst reasonably comprehensive, this study lacked breadth and whilst it disproved the hypothesis, the margin was small and a broader test in the future may provide a different result. It would also add perspective to conduct a detailed study of influences on web developers and possible barriers to their creating properly accessible artefacts.

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