Improving Accessibility Through the Visual Structure of Web Contents

Masahiro Watanabe, Daisuke Asai, and Yoko Asano

Cyber Solutions Labs., Nippon Telegraph and Telephone Corp.,
1-1 Hikari-no-oka, Yokosuka-shi, Kanagawa, Japan
{watanabe.masahiro,asai.daisuke,asano.yoko}@lab.ntt.co.jp

Abstract. Web accessibility has become one of the most popular research targets. Web accessibility means the ability to be accessed by all kinds of people or devices. One problem that some Web pages have rather poor information structures at the HTML source code level, even though the pages are well structured visually. In order to transfer the visual structure to the HTML level structure, we need to identify the graphic design features that influence human understanding. We examined whether several people interpreted a displayed structure in the same way or not. Four subjects participated in trials; they attempted to identify the headers, major items forming the structure of the top page, of the web sites of 7 local governments in Japan. 80 % of the headers were selected by all subjects so most subjects shared the same understanding of what constituted a header.

Keywords: Web, accessibility, information structure, visual structure.

1 Introduction

As Internet access has become more popular, Web sites have become one of the most important methods of distributing information. Therefore, Web contents should be accessed by all kinds of people and devices. A good recommendation for making Web content accessible is to follow effective design guidelines. Accessibility guidelines for people with disabilities and the elderly, Web Content Accessibility Guidelines 1.0, WCAG 1.0 were established by World Wide Web Consortium in 1999 [1]. Since Japanese society is aging rapidly, the concept of Web accessibility has become more and more important. The Japanese Industrial Standard also established guidelines in 2004 [2]. It is now a legal requirement, especially for the Web sites of public bodies such as local governments. We have made our guidelines and encouraged their use throughout our group companies [3, 4].

Owing to progress in assistive technology, Web pages can now be presented not only visually (conventional manner) but also aurally [5]. A common practice is to create different material for visual and aural presentation. This is inefficient as it is difficult to update both contents at the same time. The ideal web site has only one information source but various presentation methods to suit different users and their situations as shown in Fig. 1. This is the universal design concept in Information

C. Stephanidis (Ed.): Universal Access in HCI, Part III, HCII 2007, LNCS 4556, pp. 185–192, 2007.

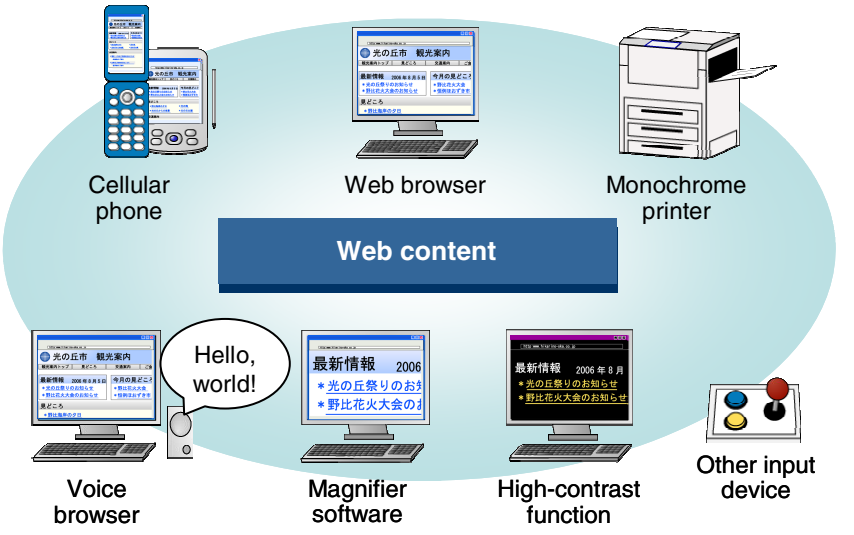

Fig. 1. Concept of universal design in Web content. The ideal web site has only one information source but various presentation methods to suit different users and their situations.

Technology. One problem that some Web pages have is to transfer efficiently the content according to the kind of user agent. User agent means software by which we can browse Web content such as the common Web browser, voice browser, and so on.

In order to transfer Web content according to user agent, the information structure of the Web content itself is especially important, not only for Web sites but also Web pages. Web content is written in (X)HTML which defines the content's structure. If content satisfies HTML grammar and is well structured, it can be well used by a wide variety of user agents including voice browsers. Information structure is the key to Web accessibility. In this paper, we focus on the visual information structure in each Web page. We present a method that assists in the creation of accessible Web pages based on visual structure.

2 Visual Structure and HTML Source Code Structure

If information structure is correctly described in HTML source code, it also present well visually. For example, a word tagged H, header element in HTML source code, is presented bigger than the other words and inserts a line feed. Unfortunately, these features are misused in some Web pages, for example, they use the H element just to increase word size. This is because why some existing guidelines such as WCAG 1.0 suggest using the style-sheet technique to control the appearance. In an ironic twist of fate, the style-sheet technique can yield Web contents that have no information structure at the HTML source code level. We need a well-defined structure at the HTML source code level if assistive technologies such as voice browsers are to present the content efficiently.

In contrast, the visual designs used to present Web content have really become sophisticated recently, because Web sites have become so popular. One problem is that some Web pages have rather poor information structures at the HTML source code level, even though they are well structured visually. This separation needs to be examined and countered.

Our basic idea is to use the visual structure to elucidate the HTML source structure. To do this we need to identify the graphic design features that influence human understanding. Examples include font size, color, and background color. A good visual structure allows all readers to recognize the same part as a header.

To extract information structure from a Web page makes it possible to create new technique that permits users to browse the page easily and efficiently. Extracting the information structure of a Web page has become a popular research target. Some studies proposed extraction methods based on Document Object Model, DOM [6, 7]. Unfortunately, many existing Web sites have poor structure and it is not until the information structure in a Web page is described correctly that the right DOM structure is used. Only if Web sites that have correct information structures become popular will these studies have practical meaning. Some techniques for assisting the design of Web pages that have correct information structures and that satisfy HTML grammar should be developed. Some studies deal with segmentation methods based on pixel position of the words on the page [8]. Other studies deal with the user's expectation of Web elements' locations on a Web page [9]. These studies will contribute to the progress of accessibility techniques.

In this paper, we focus on the H element for discerning the structure of Web pages. The H element in HTML source code is one of the most important elements to show the structure of a Web page. Some guidelines such as WCAG 1.0 note the importance of designing Web page with H elements.

3 Survey of Information Structure in HTML Source Code

We examined the HTML source files of the Web sites of 47 local governments in Japan in order to investigate whether H elements are popular or not. We looked for headers in the HTML source code of these Web pages.

The result shows only 27 sites (57 %) used one or more H elements in the top pages as shown in Table 1. However, only 7 of these sites had correct information structures at the HTML source code level.

The headers illustrated in Fig. 2 were found to be quite common. These results suggest that there are many Web sites that are well structured visually but not at the HTML source code level. These results also show that almost the half sites examined paid little attention to Web accessibility.

Table 1. Existance of H elements in Japanese local governments' Web sites

Sites' types	Number of headers	Percentage
At least one H element used	27	57
No H elements used	20	43
Total	47	100

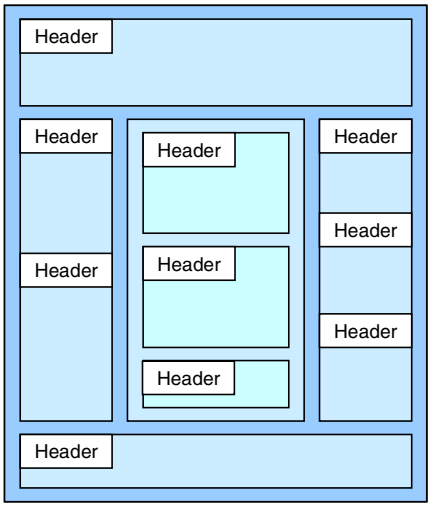

Fig. 2. Visual information structure of a Web page

4 Experiment on Visual Information Structure

4.1 Outline of the Experiment

We examined the agreement between the judgments of several people as to the displayed structure of a Web page. We then examined whether the displayed structure was accepted by several people in the same way or not.

We investigated the 7 top pages of the Web sites of local governments in Japan (Chiba, Gunma, Kanagawa, Saitama, Tochigi, and Tokyo). Four subjects (two females; ages 24 - 40) who use Web browsers in their jobs participated in this experiment; they attempted to identify the headers, major items forming page structure, of the top page, of 7 local governments' sites in Japan as shown in the next section.

4.2 Procedure

The main purpose of the header is to clearly indicate the meaning of each component in a Web page. The subjects separated each Web page into several components and for each component selected the expression that described the component. We defined expression as the "recognized header". For each component, the subjects were told to identify sub-components and the recognized header of each sub-component. They repeated this until no further recognized headers could be found.

First of all, we printed the Web pages adjusted to A4 sheets. The subjects used the procedure shown below to pick up the recognized headers on the printed Web top page. In this experiment, the subject was told to separate the components according to graphic design, not meaning.

1. Separate a Web page into some sub-components, which include as few similar items in each component as possible.
2. Mark only one expression as most representative of the component.
3. Select items from questionnaires as to why the subject marked the expression and put them the order of agreement.
4. Separate each component except the marked expressions into some sub-components similar to procedure 1.
5. Quit this procedure if the subject feels there is no expression that well represents for the component after separating the component, or there is only one expression in a component.

We regarded the expression marked in procedure 2 as a recognized header. We prepared the choices in procedure 3 based on some Web design text books as shown below. If the subjects selected "Others", they were asked to detail their reasoning.

1. Size of characters: bigger than others
2. Color of characters: different from others
3. Font type: different from others
4. Bold characters
5. Icon in front of characters
6. Color of characters' background: different from others.
7. Frame around characters
8. Line separates the word
9. Wide space around the characters
10. Indent of the word
11. Unindent of the word
12. Lists below the word
13. Others

4.3 Results

We investigated the individual differences in selecting recognized headers among the subjects. Table 2 shows how many recognized headers were selected by subjects with the same understanding. As shown in Table 2, 194 expressions were selected by at least one subject. We considered the 194 expressions as recognized headers. All four subjects selected 155 expressions (80 %) as recognized headers so they shared the same understanding of what constituted a recognized header. This result implies that

Table 2. Individual differences among visually indicated headers

Number of subjects with same understanding	Number of headers	Percentage
4	155	80
3	6	3
2	8	4
1	25	13
Total	194	100

there was only a small difference among the subjects and the headers succeeded in being accepted as headers by all subjects.

In further analyses, we used the 155 recognized headers accepted by 4 subjects. We compared the 155 recognized headers to the headers identified by the H element in HTML source code in order to clarify the adequacy of their information structures. Only 4 Web pages among 7 pages used at least one H elements. There are 78 recognized headers in the 4 pages. Table 3 shows how many recognized headers were tagged in HTML source code. It shows that only 60 % of the recognized headers were supported by correct information structures at the HTML source code level. There are at least two reasons why an expression was accepted as a recognized header. An average of 3.3 features were selected as the reasons for recognized header idenitification.

Table 3. Proportion of adequatly tagged recognized headers

Recognized headers' types	Number of headers	Percentage
Tagged in HTML source	47	60
NOT tagged in HTML source	31	40
Total	78	100

We then asked the subjects to explain their selection by selecting from among 12 explanations. Of the 155 recognized headers selected by all subjects, 85 of them (55%) had at least one explanation that was selected by all subjects as shown in Table 4. Table 4 shows the proportion of the graphic features which were selected by the subjects. The proportion of the graphic features that were selected by all of the subjects was 55 % of the all features which were selected by at least one subject.

Table 4. Proportion of graphic features selected by the subjects

Number of subjects selecting the header for the same reason	Number of headers	Percentage
4	85	55
3	57	37
2	13	8
1	0	0
Total	155	100

These results imply that all subjects had almost the same approach to header recognition. Further research is needed to precisely identify exactly which graphic features are important. By the way, the order of subjective evaluation was not the same so we did not analyze the order precisely.

It is interesting to note that 85 recognized headers were selected by all subjects with only 5 features as shown in Table 5. Table 5 shows the graphic features selected by all subjects. Not that this table shows the number of recognized headers according to each feature. Two recognized headers were selected with 2 features each. This is why there are 87 recognized headers in Table 5.

This result shows that the color of character or background has a great impact. It is thought that site designers find it easy to change color as a feature. On the contrary, if the characters were bold, the subjects might select different feature such as size, bold, or font. The choice should not be ambiguous.

Table 5. Features for headers identification

Features	Number of headers	Percentage
Color of characters	36	41
Color of characters' background	30	34
Size of characters	13	15
Icon in front of characters	7	8
Unindent of the word	1	2
Total	87	100

5 Discussion

The result of the survey described in Section 3, shows that 43 % of Web pages do not have any H tags. It means that these Web pages have no information structures at the HTML source code level. This suggests that these sites will not be well handled by voice browsers. Although the Web sites of Japanese local governments follow the guidelines of Japan Industry Standards and have high levels of accessibility, almost half of them have no HTML level structures. This problem is likely to be wide spread. On the contrary, visual structures were recognized in all 47 Web pages examined. This implies that Web designers succeeded in making Web page whose visual structures were easily understood. If they paid more attention to recognized headers and adjusted the structure at the HTML level, the content would become accessible.

The results of experiment, see Section 4, show that there are only small individual differences in recognized headers selection. This suggests that visual design is really sophisticated and users can easily understand the content's structure at the visual level; recognized headers can be identified even if they are not tagged. This indicates the possibility of new header extracting techniques based on human understanding. This idea can also be used to enhance accessibility evaluation tools that are intended to help Web designers to make Web content accessible. If Web sites that have correct information structures become popular, several techniques based on DOM will become effective. To achieve this, we have to investigate the visual features which impact human understanding on Web content in detail. In this experiment, we focused on character features such as font size, color, and background color. We should investigate not only the visual feature of the header itself but also the layout of the header on the page. The difference between the features should be studied in detail.

6 Conclusion

We examined the HTML source files of the Web sites of 47 local governments in Japan and looked for the headers in the HTML source code in these Web pages. Our

results show that only 57 % of the sites used the H element in the top pages which indicates that many Web sites have poor information structures, even though they have good visual structure.

We also examined the agreement between the judgments of several people as to the displayed structure of 7 top pages of Web sites of local governments in Japan. The result showed that 80 % of the headers were selected by all subjects so most subjects share the same understanding of what constitutes a header. This indicates the possibility of new segmentation technique based on human understanding.

References

1. Web accessibility initiative, World Wide Web Consortium: Web Content Accessibility Guidelines 1.0, Web Content Accessibility Guidelines Website (1999) http://www.w3.org/TR/WCAG10/
2. Japanese Industrial Standard Committee: Japanese Industrial Standards X8341-3: Guidelines for older persons and persons with disabilities – information and communications equipment, software and services – Part 3: Web content. Japanese Standards Association, Tokyo (2004)
3. Watanabe, M., Okano, A., Asano, Y.: Universal Design Guidelines for Web Contents. NTT Technical Review 3(11), 17–22 (2005)
4. Asano, Y., Watanabe, M., Hamano, T., Ogawa, K.: Web Accessibility Guidelines that Solve Problems Peculiar to Japanese. In: Proc. WWCS 2004 pp. 601–606 (2004)
5. Asakawa, C., Itoh, T.: User Interface of a Home Page Reader. In: Proc. ASSETS 1998 pp. 149–156 (1998)
6. Lee, A.: Scaffolding Visually Cluttered Web Pages to Facilitate Accessibility. In: Proc. of the working conference on Advanced visual interfaces, pp. 90–93 (2004)
7. Yu, S., Cai, D., Wen, J., Ma, W.: Improving Pseudo-Relevance Feedback in Web Information Retrieval Using Web Page Segmentation. In: Proc. WWW 2003 pp. 11–18 (2003)
8. Krüpl, B., Herzog, M.: Visually guided bottom-up table detection and segmentation in web documents. In: Proc. WWW 2006 pp. 933–934 (2006)
9. Shaikh, A., Lenz, K.: Where's the Search? Re-examining User Expectations of Web Objects, Usability News, vol. 8(1) (2006), http://psychology.wichita.edu/surl/