Web Accessibility Diagnosis Tools

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Enhancing the accessibility of Websites enables persons with visual disabilities, including persons with color blindness, to enjoy the benefits of the Internet in the same way as persons without such disabilities. Under the present circumstances, however, few Websites are sufficiently accessible. To promote enhancement of Website accessibility, Fujitsu developed Fujitsu Accessibility Assistance, which is a tool group that diagnoses the requirements specified in the Fujitsu Web Accessibility Guidelines. This tool group is intended for Web page designers and office workers involved in such work as creating presentation materials. It consists of three software products: WebInspector 4.0, ColorSelector 4.0, and ColorDoctor 1.0. WebInspector 4.0 diagnoses whether Web pages can be read by persons with visual disabilities, including persons with color blindness. ColorSelector 4.0 enables real-time selection of the most suitable combination of background color and character color. ColorDoctor 1.0 simulates the way the coloring of characters and video images is visible to persons with color blindness. This paper describes the current conditions of Website accessibility and introduces the Fujitsu Web Accessibility Guidelines on which this tool group is based. It also looks at the evaluation of criteria from the standpoint of persons with color blindness and introduces the functions of this tool group.

1. Introduction

The proliferation of the Internet has increased convenience in daily life and made information and services on the Web a necessity for everyone. However, the inequality (or Digital Divide) whereby all people cannot enjoy the benefits of the Internet due to physical characteristics, economic reasons, and regional characteristics has become a problem. With the advent of an aging society, this problem has become of paramount concern, and Web accessibility (which indicates whether persons with visual disabilities and those with color blindness can access information and services on the Web without any problem) has become increasingly important.

Fujitsu was the first to promote activities to enhance Web accessibility, and in June 2003 formulated "Fujitsu Web Accessibility Guidelines 1.0" that define the requirements Web page producers should take into account. Fujitsu then developed "WebInspector 1.0," a tool that diagnoses Web accessibility according to these guidelines for ensuring the efficient application of said guidelines to the intra-company production of Web pages. Based on the results of diagnosing the Web accessibility of Fujitsu's Web pages to be made public, Fujitsu also developed "WebInspector 2.0" (originally as a tool used exclusively within Fujitsu), and then in July 2003 commercialized this tool so that as many persons as possible could access it.

In February 2004, Fujitsu developed "Fujitsu Accessibility Assistance," a group of software products that includes WebInspector 3.0 with an enhanced diagnostic function and improved usability (increasingly demanded by many users)

and new software that diagnoses Web accessibility from the standpoint of people with color blindness. Fujitsu Accessibility Assistance consists of the following three software products:

1) WebInspector

Diagnoses the readability of Web pages by persons with visual disabilities and those with color blindness.

2) ColorSelector

Enables Web page producers to select the most suitable combinations of background color and character color for real-time design.

3) ColorDoctor

Simulates the manner in which the coloring of characters and video images on Web pages are visible to color-blind persons.

In Fujitsu Accessibility Assistance, the WebInspector functions are implemented in the Contents Management System (CMS) provided by the Fujitsu Group to ensure the effective diagnosis of Web accessibility.

This paper describes the current conditions of Web accessibility, and introduces the Fujitsu Web Accessibility Guidelines on which to base the diagnosis of Web accessibility, evaluation of criteria from the standpoints of persons with cataracts and those with color blindness, and functions of this tool group of three software products.

2. Current conditions of Web accessibility

Most items of Web information are visual, such as characters, photographs, pictures, and video. Therefore, enhancing Web accessibility requires that more items be judged for persons with visual disabilities, such as the blind and those with poor eyesight. We felt that cataracts and color blindness are not adequately categorized as visual disabilities, and should be considered all the more since many persons suffer from cataracts and color blindness. According to a survey conducted by the Ministry of Health and Welfare in 1996, a total of 1 582 000 patients (433 000 males and 1 149 000 females) suffer from cataracts in Japan, with at least 80% of persons age 70 or older suffering from cataracts, including mild cataract conditions.[1)] There are about 3 000 000 persons with color blindness, which statistically represents 5% of the male population in Japan. Nevertheless, there are many Web pages that use color schemes without due consideration given to persons with cataracts and those with color blindness.

Consequently, the percentage of Web pages that reflect due consideration given to Web accessibility for persons with visual disabilities and those with color blindness is still quite low compared to that of Web pages for less disabled persons. Even many sites of local government agencies (that are required to provide information to residents equally) do not show due consideration given to Web accessibility. Thus, many Web designers and Web managers have yet to fully recognize the importance of accessibility.

However, the convenience of the Internet should be brought into play for persons with constraints on their physical functions. Web accessibility plays a significant role in making it easier for visually disabled people who have difficulty in purchasing desired music CDs, for example, to access Web pages that provide for Web accessibility. Therefore, the need for Web accessibility should be widely recognized and quickly promoted.

3. Fujitsu Web Accessibility Guidelines

Fujitsu has taken the steps shown in **Figure 1** to promote the planning and development of Web accessibility diagnosis and Web accessibility diagnosis services for ensuring efficient diagnosis of the Web accessibility of Websites.

This section introduces the “Fujitsu Web Accessibility Guidelines” on which to base Web accessibility diagnosis.

Fujitsu formulated “Fujitsu Web Accessibility Guidelines 1.0” in June 2002 to make Web pages

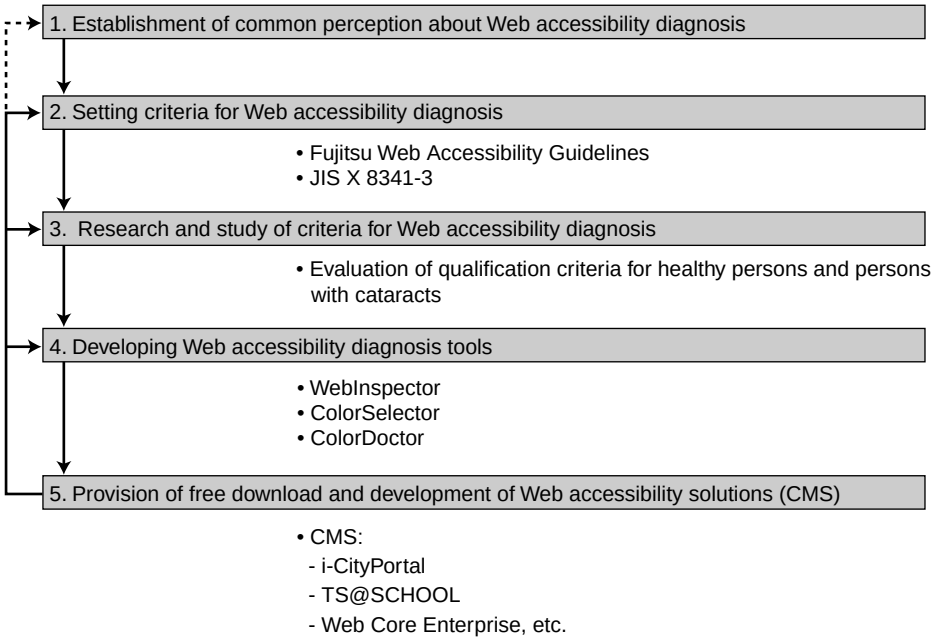

Figure 1
Steps for achieving Web accessibility diagnosis.

accessible by many people, including the disabled and elderly. Then in June 2004 Fujitsu reviewed and revised the content of the guidelines to formulate "Fujitsu Web Accessibility Guidelines 2.0." Fujitsu has promoted the application of these guidelines to all Web pages of the Fujitsu Group, and posted these guidelines on the Fujitsu Website to provide other companies and groups with useful information.

When these guidelines were formulated, the feasibility and effects of implementing these guidelines were verified through interviews with Web designers, knowledgeable outside experts, and users in and outside Japan. The 63 items required for making Web content highly accessible were then summarized as guidelines. These guidelines categorize the effects of implementing each item into three priority levels to increase effectiveness, and contain "Explanatory Notes" and "Examples and Implementation" that show concrete methods of implementation that make the guidelines practical and understandable. These guidelines have also been highly valued by customers who have referred to the understandable and informative "Explanatory Notes" and "Examples and Implementation" included in the guidelines.

To take into account the application of these guidelines in and outside Japan, the guidelines also place importance on compatibility with "Web Content Accessibility Guidelines 1.0" note 1) (recommended by W3C), Section 508 of the Rehabilitation Act, and JIS X 8341-3 "Guidelines for older persons and persons with disabilities — information and communications equipment, software and services — Part 3: Web content" established in June 2004.

4. Evaluation of criteria applied to Web accessibility diagnosis

When the Web accessibility diagnosis tools were developed, the tools were evaluated from the users' standpoint. This section describes the

note 1) Web Content Accessibility Guidelines 1.0 released in 1999 by the Web Accessibility Initiative (WAI), an organization of the World Wide Web Consortium (W3C). These guidelines describe how to make Web content accessible to disabled persons.

criteria by which the results of said evaluation were applied to ColorSelector and WebInspector.

The requirements for character color and background color that can be viewed by persons with cataracts and those with color blindness were examined first to make feasible the requirements specified in the previously described guidelines. Based on the examination results, a function that checks whether characters are readable from the standpoint of persons with cataracts and those with color blindness could then be incorporated into ColorSelector and WebInspector. This proprietary function is not available in other diagnosis tools.

The ColorSelector and WebInspector criteria applied to persons with cataracts and those with color blindness are described below.

1) Criteria of readability of characters by persons with cataracts

Studies on the readability of characters based on the contrast between character color and background color on a display (or screen) have also been conducted,[2),3)] but many such studies have been conducted from the standpoint of less disabled persons. Before ColorSelector was developed, experiments were conducted using test subjects to examine the relationship between characters that are readable by less disabled persons and persons with cataracts, and the contrast between character color and background color.

The contrast required by character color and background color that are readable by less disabled persons was examined first. The 28 combination patterns of characters and backgrounds in eight basic colors (white, red, lime, blue, maroon, purple, green, and black) were presented to the 10 less-disabled test subjects (5 males and 5 females). The readability of the patterns was evaluated at four levels (easy to read, normal, difficult to read, and unreadable). Then an experiment was conducted to examine the contrast required between character color and background color that are readable by persons with cataracts. In this experiment, the same less-disabled test subjects (who wore goggles to simulate the vicarious experience of having a cataract) were assumed to be persons with quasi-cataracts (**Figure 2**).

Figure 2
Goggles that simulate vision of person having cataracts.

The analysis results of the experiments showed a correlation between the contrast between character color and background color, and the readability of characters according to the visual criteria of less disabled persons and persons with cataracts. The persons with cataracts required higher contrast than the less disabled persons. The results assumed that as the contrast on which to base the evaluation of "readability," the contrast of the L*a*b color system[note 2)] was about 53 for the less disabled persons, but needed to be about 62 for the persons with cataracts. The results also assumed that the contrast required for average persons with cataracts was 9 higher than that for the less disabled persons.

Fujitsu plans to add more test subjects with cataracts and various symptoms in order to increase the accuracy of indicators in the future.

2) Criteria of persons with color blindness

ColorSelector used Transformations from

note 2) Coordinate system of typical color created to represent differences in color.

CIE Trichromatic to Dichromatic Color-Matching[4] presented by Günter Wyszecki. Based on this transformation expression, brightness is calculated by transforming the RGB values according to the manner in which persons with first color blindness (red), second color blindness (green), and third color blindness (blue) view the colors. WebInspector uses this calculation expression to obtain brightness from the RGB values of character color and background color on Web pages, and checks whether the brightness is adequate based on the criteria of each color-blind person.

The following sections introduce the functions of WebInspector, ColorDoctor, and ColorSelector that check Web accessibility requirements specified in the Fujitsu Web Accessibility Guidelines and JIS X 8341-3.

5. WebInspector

WebInspector is a software product that diagnoses Web accessibility.

5.1 Function overview

WebInspector operates on Windows PCs and Macintosh computers (**Figure 3**). In addition to Uniform Resource Locators (URLs) and Web pages, the folders on a personal computer can also be specified as targets to be checked. Specifying folders is very efficient because HTML files under the target folders can also be checked at one time. Since many Web designers use Macintosh computers, this software also supports operation for that platform.

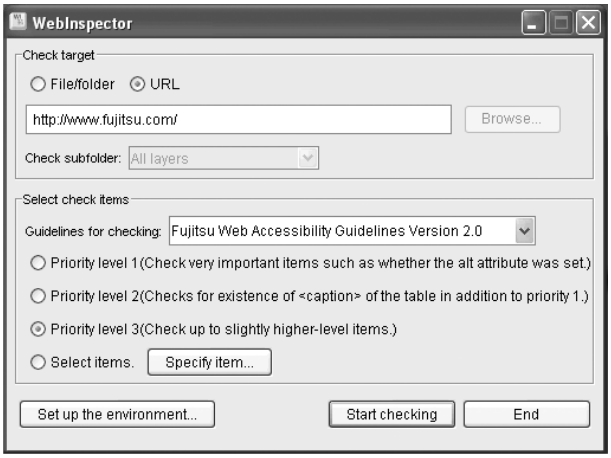

Figure 3
Top screen of WebInspector.

WebInspector analyzes a HTML tag (<tag>) to check Web accessibility. For example, when checking the requirement stating that, "the alt attribute shall be added to an image to precisely indicate image content," this software checks whether text information explaining such image data as <img> (defined in the HTML source) is defined with the <alt=" "> attribute.

5.2 Diagnosis items

WebInspector can check 18 of the 63 items specified in "Fujitsu Web Accessibility Guidelines 2.0" (**Table 1**). This software can logically check these 18 items based on HTML tag information. The items include "16 items at priority level 1" (the highest priority items), "one item at priority level 2," and "one item at priority level 3," based on high priority items that occur with high frequency. Of these check items, 17 items enhance accessibility for persons with visual disabilities; one item enhances accessibility for color-blind persons (with mark ○ in Table 1 applying to said items). Thus, this software enables effective diagnosis of Web accessibility for persons with visual disabilities and those with color blindness.

6. ColorSelector

ColorSelector can diagnose combinations of background color and character color having high Web accessibility in real time by specifying the character color and background color in the top window of ColorSelector (**Figure 4**). The combinations of readable colors can be diagnosed based on the criteria of less disabled persons, persons with cataracts, persons with first color (red) blindness, persons with second color (green) blindness, and persons with third color (blue) blindness. This software product is a powerful support tool for designers because it can also be used for other than Web design, such as the design of software

Table 1
Check items.

Guideline	No.[note)]	Priority	Intended user	
			Persons with visual disabilities	Persons with color blindness
☐Add a title to all pages to enable page identification and precisely indicate content.	8	1	○	
☐Explicitly specify the basic language described on pages.	9	1	○	
☐Provide adequate contrast of character color and background color.	10	1	○	○
☐Do not use the expression that continuously changes the entire screen quickly.	13	1	○	
☐Use the content display area in a browser to display information at an appropriate location.	14	1	○	
☐To provide content required by specific techniques and plug-ins (JavaScript, Java applet, Flash, and PDF), along with alternative means and information.	24	1	○	
☐Make table content easy to identify with the relationship between row and column and display sequence (in cell units, from upper left to lower right) taken into account.	28	1	○	
☐Minimize the use of frames.	30	1	○	
☐Do not hide the frame scroll bar.	32	2		
☐Ensure that all operations can be performed with a keyboard alone without depending on a specific input device.	33	1	○	
☐Display the link to the same site in the same window and minimize the number of times that a new window must be opened.	34	1	○	
☐Clarify the relationship between label and control on the form. Group the input items to make control easy to determine.	47	1	○	
☐Add the alt attribute to all image data to precisely indicate image content (alternative information about image).	54	1	○	
☐Provide an image map on the client side (instead of the server side) and add the alt attribute to precisely indicate link destination content.	55	1	○	
☐To use text decoration (e.g., strikeout) that significantly changes meaning, write meaning along with decoration in the text.	59	1	○	
☐Ensure that the user can change character size, font, and spacing.	60	1	○	
☐To use symbols and abbreviated notation, give consideration to reading using voice.	61	1	○	
☐Do not automatically reproduce sound (e.g., BGM).	69	3	○	

note) Number of “Fujitsu Web Accessibility Guidelines 2.0”

windows.

7. ColorDoctor

ColorDoctor transforms and displays the colors of Web browsers and colors on the display in the manner in which said colors are visible to color-blind people [i.e., those with first color (red) blindness, second color (green) blindness, and third color (blue) blindness] (**Figure 5**). Video data such as Flash can also be transformed in real time. This software product supports the visual checking of less disabled persons for the accessibility of colors. ColorDoctor operates under Windows XP.

This section introduces the video transformation and check function, and the transparent mode function that characterize ColorDoctor.

1) Video transformation and check

Software products that transform and display images in the manner in which color-blind people view images have already been released. However, these software products could only

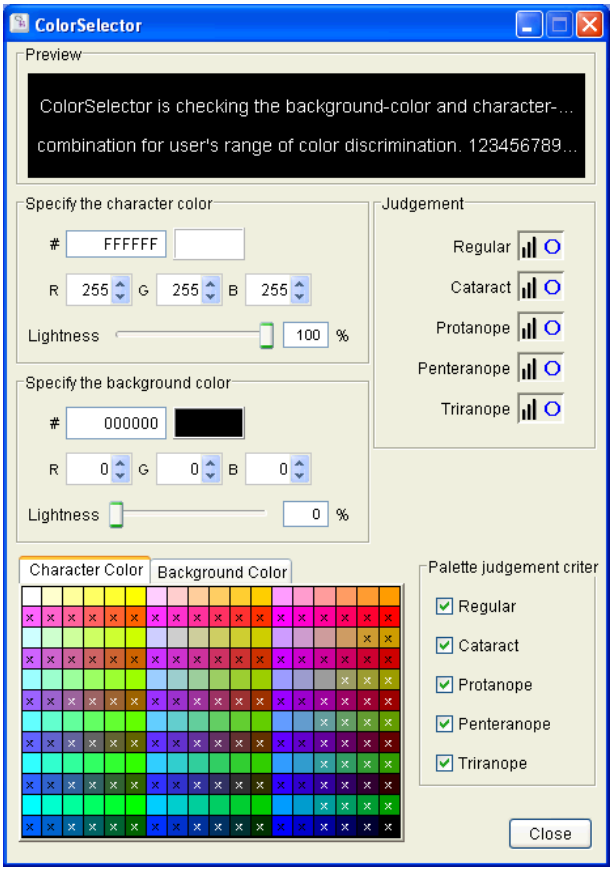

Figure 4
Top screen of ColorSelector.

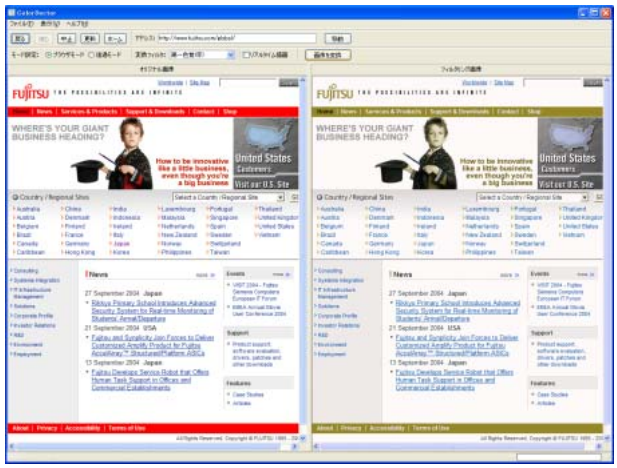

Figure 5
Example of checking Website using ColorDoctor. Display is split into two. Left side shows an ordinary Web page; right side shows appearance to a person with visual disability.

transform characters and static images instead of video data. Many moving Web pages such as Flash have since appeared. ColorDoctor can also transform, display, and check these video pages in real time. Real-time transformation is achieved by continuously transforming static images at short intervals. Because the video data transformed at shorter intervals moves more smoothly, we measured the time required to calculate each transformation and ensured that the intervals are automatically adjusted according to the operating environment where Web pages are displayed.

This is the first function ever made available in Japan that can transform and display images including video data.

2) Transparent mode

ColorDoctor can check Web pages efficiently because it incorporates a browser function. However, colors can also be checked for applications other than a browser, such as image editing software. In such case, "transparent mode" also enables such checking.

In "transparent mode," the left side of the ColorDoctor window is transparent. Displaying an application to be checked in this transparent area enables the checking of any application. Because presentation materials can also be checked, such office workers as the creators of materials can also use this software.

8. Conclusion

This paper introduced the functions of "WebInspector, ColorSelector, and ColorDoctor," the group of tools that checks the requirements specified in the Fujitsu Web Accessibility Guidelines and JIS X 8341-3 to promote the enhancement of Web accessibility of Websites.

We have also released "Fujitsu Accessibility Assistance," a group of software tools that supports the enhancement of Web accessibility so that as many people as possible can access information and services, which will become essential in the Internet society of the future.

Along with the proliferation of the Internet, more elderly and disabled persons will use the

Internet, thus making the Web accessibility of Web pages increasingly important. Moreover, it will be necessary to check Web accessibility for the creation of Web pages.

Fujitsu believes that it must play a leading role in promoting Web accessibility as a Japanese IT manufacturer, and consequently has provided the group of "WebInspector, ColorSelector, and ColorDoctor" tools (developed this time as freeware) to ensure that as many persons as possible can use this tool group.[5)]

Fujitsu plans to develop an English version of this tool group and make it available worldwide in the future. Through extensive use of this tool group for "Web accessibility solutions" such as CMS, Fujitsu will reflect the requests of customers in this tool group with the intention of making the tools easier to use.

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