Browser Extension to Improve Web Accessibility for Visually Impaired

Sittiporn Auchariyabut and Yachai Limpiyakorn

Department of Computer Engineering, Chulalongkorn University,
Bangkok10330, Thailand
Sittiporn.a@student.chula.ac.th, Yachai.L@chula.ac.th

Abstract. An accessible website is a website that can be used by disabled users. However, it is reported that the accessibility of the internet to people with disabilities is still largely unrealized. Some misunderstand that the cost of developing accessible websites is more expensive and time-consuming compared to inaccessible ones. This research work develops the browser extension to adjust the HTML pages of existing web applications based on the recent Web Content Accessibility Guidelines (WCAG) 2.0. The browser extension is applied with Firefox web browser. The process of HTML adjustment consists of two major steps. Starting with the evaluation of HTML tags against the checkpoints defined as XPath 2.0 rules. In case the HTML element is nonconformance to WCAG 2.0, its location will be returned to JavaScript for adjustment using the fixing rule satisfying the success criteria.

Keywords: web accessibility, assistive technology, visually impaired, WCAG.

1 Introduction

World Wide Web and Internet emerge as one of the greatest events of modern history. Most people today can hardly conceive of life without the internet. With the click of a mouse, the world can be "at your fingertips". If you do not have a disability of any kind, you can browse around in the contents of the internet for accessing to news, email, shopping, and entertainment, at any hour of the day or night.

However, referring to World Health Organization (WHO), there are 285 million visually impaired people with 39 million amount to blinds and 246 million classified as low vision people [1]. The web offers unprecedented opportunities, but how people with disabilities use the web. Referring to the findings reported in [2], out of 30 million webpages tested with WCAG 2.0 web accessibility testing standard, there are less than 4% of samples passing the success criteria. The result reflects that the accessibility of the internet to people with disabilities is still largely unrealized.

The World Wide Web Consortium (W3C) launched the Web Accessibility Initiative (WAI) in 1997. WAI is an effort to improve the accessibility of the World Wide Web for people with disabilities.W3C also published Web Content Accessibility Guidelines (WCAG) as recommendations for making web contents more accessible.

Following these guidelines will make web content more usable and accessible to a wider range of people including those with disabilities, e.g. blindness and low vision.

It is untrue that the cost of developing accessible websites is more expensive and time-consuming compared to inaccessible ones. The benefits of providing access to a larger population almost always outweigh the time required by a knowledgeable developer to implement that accessibility. Carter and Markel [3] gave a list of reasons stating the convenience of developing accessible web applications. However, in case of existing websites, it would be impractical to re-implement them in order to satisfy greater accessibility of the web content to everyone. This research work thus develops the browser extension to improve web accessibility, focusing on visually impaired.

2 Web Accessibility

2.1 Web Content Accessibility Guidelines (WCAG) [4]

Web Content Accessibility Guidelines is established by W3C. It provides the requirements for making web-based systems accessible. The recent WCAG 2.0 consists of several layers of guidance, including Principles, Guidelines, Success criteria, and Sufficient and Advisory techniques (Fig. 1). At the top are four principles that provide the foundation for Web accessibility: Perceivable, Operable, Understandable, and Robust. Under the principles are guidelines, and there are 12 guidelines, for each of which, testable success criteria are provided. Three levels of conformance are defined: A (lowest), AA, AAA (highest).
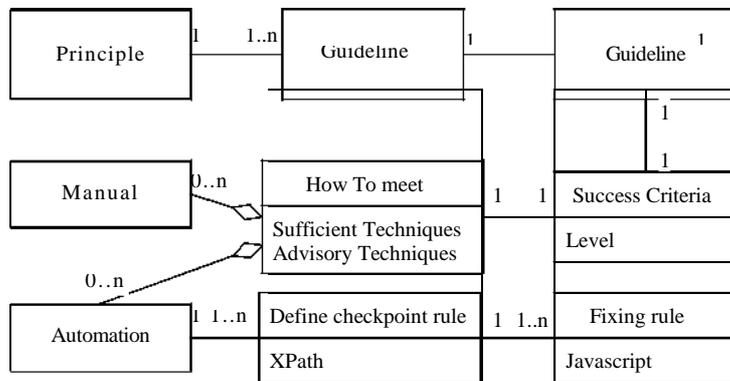

Fig. 1. WCAG 2.0 layers of guidance augmented with rules defined in this research.

2.2 Web Accessibility Initiative - Accessible Rich Internet Application (WAI-ARIA) [5]

WAI-ARIA is published by W3C. It is an API between HTML and assistive tools as illustrated in Fig. 2. By adding role, state, and property information to dynamic web

applications, it will increase more web accessibility. As a result, the assistive tool will be triggered once the monitored tags have been updated. Assistive technology accessibility includes (but is not limited to): Appropriate alternative text; Form labels; Table headers; Logical heading structure; Links that make sense out of context; A logical, intuitive reading and navigation order; Full keyboard accessibility; Captions and transcripts.
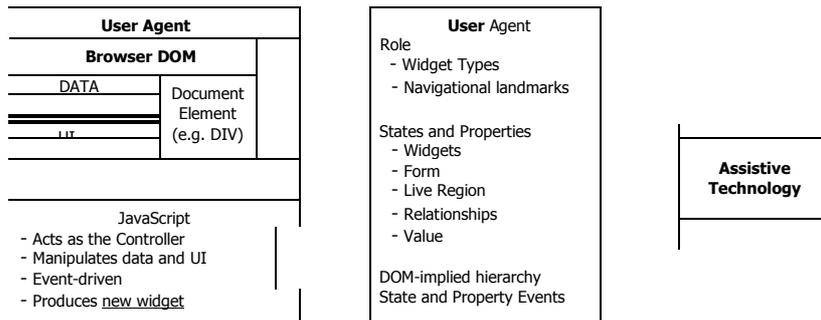
Fig. 2. WAI-ARIA as accessibility API between web browser and assistive tool [5].

2.3 WCAG Formalization with W3C Standards [6]

Web accessibility consists of a set of checkpoints which are rather expensive to spot or to evaluate the conformance to WCAG. This paper thus presents a W3C formalized rule-set version for automatable checkpoints according to WCAG 1.0. In this work, the WCAG checkpoints were formalized as XPath 1.0 rules. However, no fixing is performed on the webpages for more accessibility.

3 Research Methodology

Referring to WCAG 2.0 layers of guidance, the checkpoints are formalized as XPath 2.0 rules and a set of fixing rules is defined by JavaScript in this work. The rules can be majorly classified into 2 groups: 1) objectively automatable rules, and 2) manual rules which require human judgment for the adjustment. The rules defined in the web browser extension developed in this work are the type of objectively automatable as illustrated in Fig. 3.
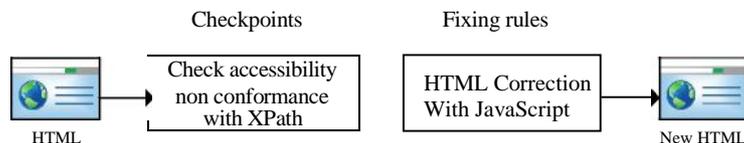
Fig. 3. Steps of HTML adjustment.

The web browser extension developed in this work is designed to enhance the web accessibility on Mozilla Firefox. Once it has been installed onto the web browser, the process of HTML adjustment is executed as the following 5 steps:

Step 1: Web browser requests data from the server by means of XMLHttpRequest (XHR).

Step 2: HTTP Interception resulting in sending the HTML via XHR to the web browser extension for working in step 3.

Step 3: Web browser extension performs the HTML adjustment using JavaScript based on the checkpoint validation with XPath 2.0 (Fig. 3).

Step 4: Firefox web browser receives the adjusted HTML DOM structure [7] from step 3.

Step 5: Web browser loads and displays the HTML displaying data such as CSS, images, media etc.

XPath is used to navigate through elements and attributes in an XML document. In this work, XPath 2.0 is used for the evaluation of HTML tags against the checkpoints defined as XPath rules. In case the HTML element is nonconformance to WCAG2.0, its location will be returned to JavaScript for adjustment using the fixing rule satisfying the success criteria.

Example of the XPath rule specifying the checkpoint based on the success criteria 1.4.7 "Low or No Background Audio" in Table 1 is shown as follow. This guideline recommends that the website should not contain background audio since this feature will interfere with the screen reader.

```
//audio[@autoplay] || //video[@autoplay]
```

Another example of the XPath rule based on the success criteria 2.4.5 "Multiple Ways" from Table 1 is shown as follow. This guideline recommends that the website should provide alternative means of accessing the web content. For example, the website should create the widget of table of content to inform the sequence of web headings so that the user would not scroll all over the webpage when looking for the desired content.

```
//h1//following-sibling::h2|//h2//following-sibling::h3
```

Example of JavaScript containing XPath and fixing rules according to the success criteria 1.4.7 is illustrated in Fig. 4.

```
var audioautoRun = document.evaluate(
        "//audio[@autoplay]", document, null,
        XPathResult.UNORDERED_NODE_ITERATOR_TYPE,null);
var thisNode = audioautoRun.iterateNext();
    while(thisnode) {
        $(thisNode).removeAttr("autoplay");
    };
var createTOC = document.evaluate(
        "//h1//following-sibling::h2|//h2//following-sibling::h3",
        document, null, XPathResult.UNORDERED_NODE_ITERATOR_TYPE, null);
```

Fig. 4. Locate HTML tags using XPath defined in JavaScript.

4 A Prototype

The browser extension is implemented in .xpi file as the result from Firefox builder. The creation of XPath rules to evaluate the checkpoints and the fixing rules for increasing web accessibility is essential for the implementation of the browser extension. The results of testing the created XPath rules and the fixing rules to satisfy the success criteria 1.4.7 and 2.4.5 are illustrated in the following figures.

Fig. 5 shows the initial HTML structure, of which the right hand side is the display corresponding to the left hand side HTML code. The initial HTML page has automatically play background sound function and it does not provide alternative means of web content access. The console dialogue in Fig. 6 displays the evaluation result from executing the XPath rule that discovers the unconformity HTML tags.
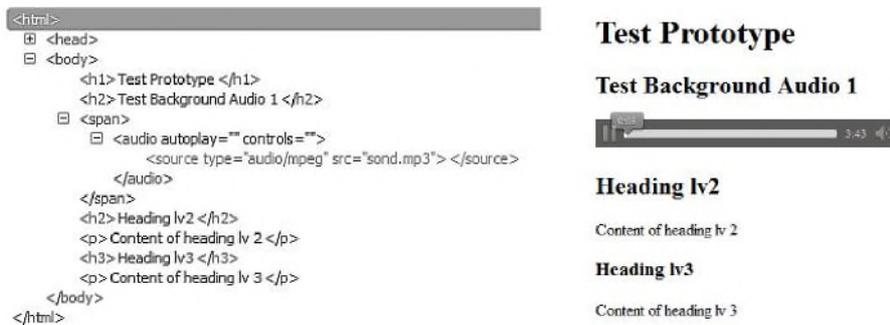

Fig. 5. Initial HTML structure before adjustment.

Fig. 6. Evaluation result of unconformity HTML tags.

The adjustment of the HTML tag quality to conform to success criteria 1.4.7 is performed by breaking the automatically play background audio function. To meet the success criteria 2.4.5, the table of content widget is created from the heading tag. The HTML structure and display after adjustment is shown in Fig. 7.
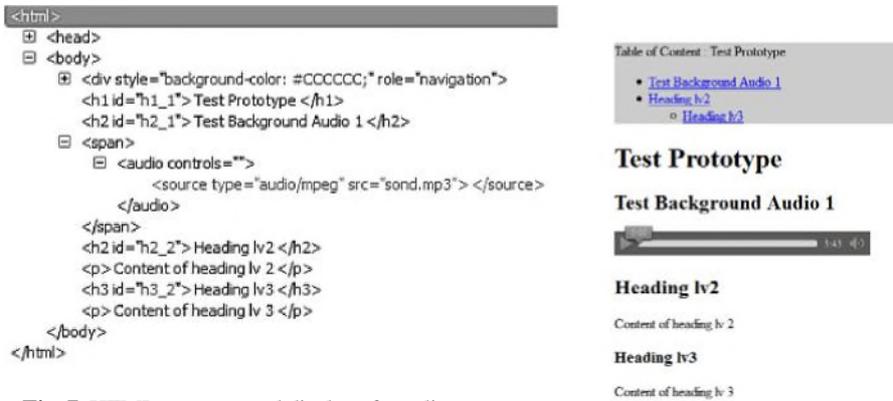
Fig. 7. HTML structure and display after adjustment.

5 Conclusion

The web offers so many opportunities to people with disabilities that are unavailable through any other media. However, if a web site is not created with web accessibility principle, the web's potential is falling short. In literature, the economical advantages of developing accessible websites have been reported. Users with disabilities often use screen readers or other assistive technologies to access content through various senses or to modify content to be best perceivable to them. In this work, the browser extension to enhance web accessibility for visually impaired is developed based on WCAG 2.0. It is designed for Firefox web browser.

References

1. World Health Organization: Visual impairment and blindness (2012) , http://www.who.int
2. Lopes, R., Gomes, D., Carriço, L.: Web not for all a large scale study of web accessibility. In: Proceedings of the 2010 International Cross Disciplinary Conference on Web Accessibility (W4A), pp. 10 (2010)
3. Carter, J., Markel, M.: Web Accessibility for people with disabilities an introduction for Web developer. In: IEEE Transactions on Professional Communication, PP. 225-233 (2001)
4. The World Wide Web Consortium: WCAG 2.0 (2008), http://www.w3.org/TR/WCAG
5. The World Wide Web Consortium: WAI-ARIA (2011), http://www.w3.org/TR/wai-aria
6. Centeno, V., Kloos, C., Gaedke, M., Nussbaumer, M.: WCAG formalization with W3C standards. In: Special interest tracks and posters of the 14th international conference on World Wide Web, New York, NY, USA, pp. 1146–1147 (2005)
7. w3schools: HTML DOM , http://www.w3schools.com/htmldom/dom_intro.asp.