Social Accessibility: Achieving Accessibility through Collaborative Metadata Authoring

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ABSTRACT

Web content is under the control of site owners, and therefore the site owners have the responsibility to make their content accessible. This is a basic assumption of Web accessibility. Users who want access to inaccessible content must ask the site owners for help. However, the process is slow and too often the need is mooted before the content becomes accessible. *Social Accessibility* is an approach to drastically reduce the burden on site owners and to shorten the time to provide accessible Web content by allowing volunteers worldwide to 'renovate' any webpage on the Internet. Users encountering Web access problems anywhere at any time will be able to immediately report the problems to a social computing service. Volunteers can be quickly notified, and they can easily respond by creating and publishing the requested accessibility metadata—also helping any other users who encounter the same problems. Site owners can learn about the methods for future accessibility renovations based on the volunteers' external metadata. There are two key technologies to enable this process, the external metadata that allows volunteers to annotate existing Web content, and the social computing service that supports the collaborative renovations. In this paper, we will first review previous approaches, and then propose the Social Accessibility approach. The scenario, implementation, and results of a pilot service are introduced, followed by discussion of future directions.

Categories and Subject Descriptors

K.4.2 [**Social Issues**]: Assistive technologies for persons with disabilities; H.3.5 [**Information Storage and retrieval**]: Online Information Services

General Terms: Human Factors, Standardization

Keywords: Web accessibility, social computing, transcoding, collaborative authoring, metadata.

1. INTRODUCTION

The Web has already become an important infrastructure for our society. That is why it is important to make all of the content and all Web-based services accessible for everyone in our society.

Web content is under the control of the site owners, and therefore site owners bear the responsibility for making their content accessible. This is one of the basic assumptions for current Web accessibility approaches.

From the compliance perspective, Web designers and developers have to embed sufficient **accessibility metadata** into their content. For example, alternative texts are required for nonvisual users, and structural metadata (such as for headings and lists) is a key to making content navigable for both nonvisual users and many kinds of limited bandwidth users. Unfortunately, the accessibility metadata is usually inadequate in both quality and quantity. Site owners are not able to give higher priority to accessibility enablement than to changing business models and to evolving Web technology trends, and the visual attractiveness of each website remains paramount.

Even when site owners are willing to renovate their sites to seek compliance, it remains hard to make websites fully usable for people with disabilities. In general, and not just for accessibility, only end users can assess the real usability. However in current accessibility frameworks **user participation** is severely limited. The general consensus of users is that reporting problems to site owners via the various channels (such as feedback forms) is of limited utility. Many users regard an autoconfirmation as a relatively favorable response. Users feel that no effective feedback loop exists to correct accessibility problems.

Our *Social Accessibility* proposal will address these problems by applying **social computing** strategies to accessibility metadata authoring. This will drastically reduce the burden on site owners, while shortening the creation time for accessible Web content. Not only Web designers and developers, but any Web user will be able to volunteer to renovate any webpage on the Internet based on user requests. Whenever a user faces a problem with Web access, the problem can be reported to the community service. Volunteers can quickly be notified so they can discuss the problems and create and publish the needed accessibility metadata—which is thereby disseminated worldwide to all users who face the same problems.

There are two key technologies to enable this process. Transcoding for Web accessibility is a category of technologies to make existing webpages accessible on the fly. It was invented to help users with disabilities access inaccessible webpages without asking the site owners to modify their pages. The technology is still not widely used by end users in spite of its huge potential to change their access environment. One of the major reasons is the workload of metadata authoring. In order to complement the missing internal (embedded) metadata, **external metadata** must be used to generate usably accessible content. That is why we

came up with the idea of building metadata through collaborative authoring.

In this paper, we will first review related work and discuss previous approaches and limitations of external metadata. Then we will propose the concept of Social Accessibility approach, and introduce our pilot system, which focuses on screen reader users. Finally, the results of the pilot service and the future directions are discussed.

2. RELATED WORK

This approach is a union of two categories of technologies, one for collaborative authoring, and the other for transcoding. In this section, we would like to introduce both technologies, and some projects in the intersection region.

Collaborative document authoring is an area with a long history (e.g. [15]). The largest success in this area is the wiki [16], and this technology has yielded such fruits of global collaboration as the Wikipedia. In spite of the successes of collaborative authoring, it has rarely been applied in the accessibility area. One of the recent projects is for collaborative "caption" authoring of multimedia content. The We-LCoME project is aimed at building accessible multimedia e-learning content through collaborative work on a wiki system [9, 10]. We-LCoME and Social Accessibility run in similar directions, using collaborative authoring for accessibility. Another example is the Google Image Labeler[11]. This is a system to build accurate textual descriptions of images through a game. The goal of the project is to improve the accuracy of Google Image search, but the generated metadata could potentially be used for accessibility.

Transcoding for webpages originally developed to adapt webpages for mobile devices[3] and to personalize pages[18]. Then, the technique was applied to transform inaccessible Web content into accessible content on the fly, forming a new category of technology, "Transcoding for Web accessibility". [1] is a survey article including history and methods. Transformation techniques can be divided into two major types, one for automatic transcoding and the other for metadata-based (or annotation-based) transcoding. Automatic methods have clear accuracy limitations, and therefore external metadata is needed for usably accessible transformation results, especially for people with severe disabilities, such as blindness. However, the external metadata approach has problems with metadata authoring. We will discuss this topic in Section 3.

A recent research challenge in the transcoding area is dynamic Web applications including AJAX techniques. The aiBrowser has a metadata mechanism to dynamically convert AJAX and Flash-based dynamic content into accessible formats [19]. AxsJAX [7] is a technology to make AJAX applications accessible by using JavaScript descriptions as a kind of metadata. Access Monkey [5] also uses JavaScript to transcode content. The current Social Accessibility pilot system (Section 5 and 6) does not cover these dynamic Web applications, but it focuses on sharing metadata for dynamic content [14].

3. ISSUES OF METADATA AUTHORING

Transcoding with external metadata has great potential as a new approach for creating a more accessible Web environment by supplementing the insufficient internal metadata. However, the workload of authoring has prevented it from providing major real-world benefits to users. We classify the approaches to reduce the authoring time and effort as follows.

1. Automatic generation

Automatic transcoding techniques can transform content without any additional information by using various inference techniques such as content analysis [20], differential analysis [21], and so on. These automatic methods have an advantage in coverage, since they can deal with any content on the Web, but the accuracy of their inferences can be problematic. Mechanisms to add supplementary manual metadata are needed for practical deployments. WebInsight[4] is an example of this approach. The system infers alternative texts for images by automatically combining the results of OCR with text-based content analysis and human-authored metadata. The system is also characterized by its use of manual metadata as a last resort after exhaustive automatic processing.

2. User-side authoring

The users' knowledge obtained from their explorations of complicated Web contents can be a source of metadata. This approach is also known as "user annotation". For example, blind users can find the starting position of the main content in a page by exploring the page, and they can record this position for other users. Some commercial screen readers have functions to register alternative texts for images (e.g. JAWS®[13]). Hearsay [6][20] has more advanced functions to allow users to add metadata (labels) in combination with an automatic analysis function. Users can easily select an appropriate label from the candidates. User-side annotation still has problems with authoring because it is still time consuming for users to create the metadata.

3. Improvement of centralized authoring (template matching)

Site-wide Annotation [22] aimed to reduce the workload by combining template matching algorithms and a metadata management tool called Site Pattern Analyzer (SPA). A snapshot of a target site would be crawled by the tool in advance, and then the tool visualizes the correspondences of each item of metadata with each page on the screen. This mechanism allowed creating the metadata for an entire newspaper site in 30 hours. In spite of the improvements, the workload for metadata maintenance was still excessive and prevented adoption by the site owners as a practical way of making their rapidly evolving content accessible.

4. Improvement of centralized authoring (styling information)

SADIe [12] is characterized by its annotation mechanism based on CSS (Cascading Style Sheet) information. One of the recent trends in Web design is CSS-based styling, since it provides flexibility in design, reduces costs to manage visual layouts, and even improves accessibility by separating the logical structure of the content from the design of the page. This system takes advantage of that trend to reduce the workload of metadata authoring by associating semantics with the styling components. The main limitation in applying the technique is that it only supports sites with well-organized styling information. Pages on the site should have logical structures and the styling units (such as headers and navigation bars) should be sufficiently logical to segment each page.

4. SOCIAL ACCESSIBILITY APPROACH

We propose a new approach, called *Social Accessibility*, to make existing content accessible by using the power of the open community. In the current framework, developers have the primary responsibility to make content accessible by embedding accessibility metadata into the content. There is no systematic feedback loop from users to developers, even though only the

users have the ability to assess the real usability. The Social Accessibility approach changes the landscape by welcoming the open community as authors of external accessibility metadata. Figure 1 shows the concept of the approach. Various users, who have various accessibility needs, can participate in the activity by reporting their evaluations of the usability of content. Any open community member (any Web user) can help make any content or service accessible through collaboration with other community members. Whenever a user reports difficulties in some content, the volunteers can discuss, create, and publish of the accessibility metadata for all users who face the same problem. For the website owners and developers, the reported issues can be regarded as the results of volunteer-based global usability testing by real users of the site. The created metadata can also be regarded as volunteer-based consulting for accessibility improvements (see Section 8.2). In other words, the goal is to make a system of collective intelligence for end users, volunteers, site owners, and everyone who has an interest in the accessibility of the Web.

The basic principle of the approach is that anyone, developers, users, or even open community members, will be able to improve the accessibility of any content on the Internet by collaboratively authoring the accessibility metadata. This approach is a combination of Web accessibility technology (external metadata) and social computing strategy (collaborative authoring). The collaborative authoring is a method to build tangible knowledge presentations among a group of people. This approach will fill the missing link of external metadata (mentioned in Section 3) by applying collaborative authoring methods.

In order to enable this collaboration process, we need to overcome various technical challenges. It is critical to invent new types of authoring tools and collaboration services. The authoring tools should be usable enough to allow non-technical and accessibility-novice volunteers to join in. Even though metadata consists of highly technical entities (Sections 6.1 and 7.1), the authoring tools should hide the complexities from the volunteers. Collaboration services should help participants to work together in the right direction and achieve appropriate sets of metadata. The service should effectively motivate volunteers to contribute to the activity, and should reduce their stress by giving them opportunities to ask questions and to get instructions. Also the design of metadata will define the flexibility of the parallel authoring. The accuracy and generality of metadata are also important technical challenges.

If the approach is established and these technical challenges are overcome, it is not difficult to imagine the impact of the approach on the Web accessibility environment. In the balance of this paper, we will introduce initial results from our pilot system and discuss issues and possibilities.

5. USAGE SCENARIO OF PILOT SYSTEM

This section gives an overview of typical collaboration scenarios in our pilot system, from problem reporting to the distribution of the created metadata. The system is characterized by its focus on screen reader users. Technical details and the implementation will be explained in the next section (Section 6).

5.1 Registration and Installation

There are two types of registration, users and supporters. A user is an end user who has accessibility needs, and a supporter is an author of metadata, and their work is voluntary. When a user registers from the front page, client-side code is installed in the user's browser. The scripts handle both problem reports and
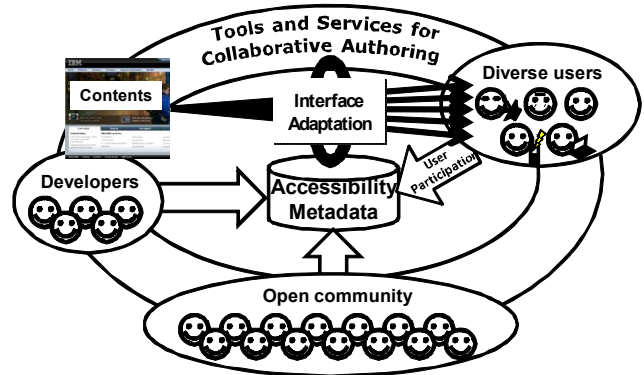

Figure 1. Concept of Social Accessibility Approach

Figure 2. Example Screen of a Portal Page in the Pilot System

transcoding (Sections 6.2 and 6.5). Each supporter installs a browser plug-in that provides various functions (Section 6.3). The system provides a portal function for every participant. Figure 2 shows an example portal screen. The page provides basic information, activity ratings, rankings among participants, pending requests, and hot sites where many problems have been reported or where metadata is actively being created.

5.2 Reporting

When a user presses a shortcut key command (CTRL + ;), a dialog with an input box to describe the problem is shown in the browser window. The user briefly describes the problem and submits it by pressing the <Enter> key. The user returns to the previous reading position and can continue browsing. These steps were designed to be as simple and unobtrusive as possible. Though it is simple, sufficient information to provide context for the supporters is sent to the server, such as a screen image of the browser window, the last reading position in the browser window, an XPath[23] notation for the reading position, and the user's comment (see Section 6.2).

Figure 3 shows a "request view" for a supporter, this shows the various data associated with a request.

5.3 Notification and Authoring

The tool for supporters is provided as a browser extension sidebar. The sidebar provides various functions for supporters to participate in the collaborative authoring process. When a user reports an issue, a small popup appears in the browser toolbar to notify the supporter of an active user request. The authoring tool is seamless with the notification pop up. When a supporter selects the "Start fixing it" link in the report view, an authoring view will automatically be shown inside of the sidebar (Figure 4). The view has a simulation area of the reading text with a screen reader. The simulation uses color coding, such as red text to show obvious accessibility problems (such as an image without alternative text), blue text to show the current heading tags, and green text to show the already existing external metadata for the page (from the repository). As an example, when a supporter clicks an image without text, a basic form to create supplemental alternative text for the image appears. When a supporter clicks on a text fragment next to an image, a different form appears, this one to make an element heading tag with some additional commentary information. When the submit button is pressed, the created metadata is automatically submitted to the server. The tool also provides a "page map" function to give a visual overview of the accessibility status of the page. In this view, all of the related information as color coded in the screen reader simulation is overlaid on the thumbnail image of the whole page.

5.4 Collaboration

The authoring process calls for various types of collaboration. For example, supporters may have questions about methods for fixing problems or may want to seek a consensus with other supporters about the rules. Therefore, our pilot system supports four types of collaboration. For real-time collaboration, supporters can use group chat function of an instant messaging system (Lotus Sametime). If the request is not clear enough, they can use a Web form to send an email query to ask the requester (end user), for clarification. The clarification will also return to the supporter as email. The rationale for email is to encourage even novice screen reader users to join the collaboration process. For asynchronous collaboration, each request and metadata item has an associated thread for discussion. These discussions can be referred to by using the toolbar or the portal page. To accumulate the knowledge, a Wiki system is integrated into the system. If a team of supporters come to a consensus, they can describe and publish the guidelines for other supporters by creating new Wiki page.

5.5 Access and Measurement

After supporters create metadata in response to a user's request, an email notification is sent to the user. When the user visits the page again, all of the metadata is automatically used with the page. In our pilot service, supporters usually tried to create general fixes beyond the problem that triggered the request, so their fix could apply to similar pages. Therefore, users may experience drastic improvements in the webpages. Some examples of repairs are discussed in Section 7.

The user interface is transparent to users. When a user access a page, the installed screen-reader script automatically connects to the server and retrieves the corresponding metadata, and applies it to the page. This means that users do not need to use any other tools or software beyond their screen readers. There is another shortcut key command to allow users to give feedback about the improvements. When the new metadata is evaluated highly, "Supporter points" are given to the author of that metadata. "User points" are also given to the reported user for all feedback (see Section 6.4). If the fix doesn't
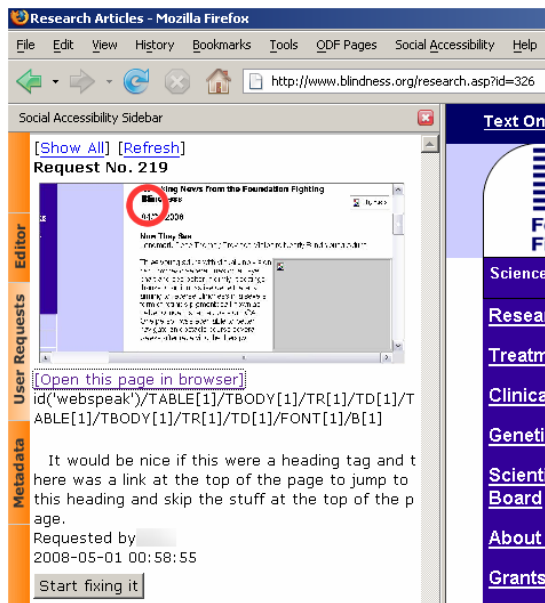

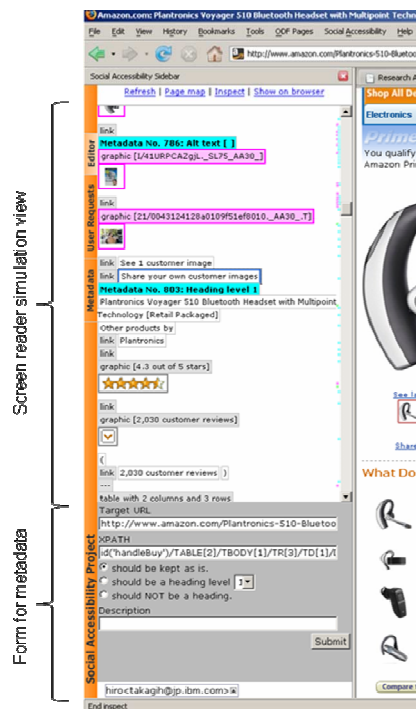Figure 3. Example Screen of a User's Request in Sidebar.

Figure 4. Example Screen of Authoring Tool in Sidebar

fully meet the expectations, the new or remaining problems can be reported. The user can also refer to the associated comments from the author of the metadata.

6. IMPLEMENTATION

Figure 5 shows the basic architecture of the pilot system. The system is divided into three major components, scripts for end users, a browser plug-in for supporters, and a server-side repository with services. The end user component is mainly written using screen

reader scripts so the user interface will be seamless with their regular Web access. Currently, JAWS® (version 8 or later) is supported and we are adding support for WindowEyes® and other screen readers. Some JavaScript code is used for the Web service handling and transcoding, and an Active X control is used to capture the browser screen image (see Section 6.2). The authoring tool for supporters is implemented as a combination of a browser extension for Firefox and portal services (see Section 6.3). The server-side services are mainly written in Ruby. At this time, the community service is independent but it is planned to connect the system to existing community services. In the following part of this section, some key functions will be introduced in detail.

6.1 Metadata Scheme

In order to enable collaborative authoring, the metadata should be designed declaratively without dependencies on other metadata. If metadata is procedural (e.g. metadata with compound JavaScript code) or uses transformation languages (e.g. XSLT), collaborative authoring will be difficult, because each author needs to cope with dependencies among transformation algorithms in the metadata instances. That is why we carefully designed the metadata to declaratively add semantics to content without dependencies on other metadata.

In addition, we are planning to make the metadata repository a common infrastructure for assistive technologies and other accessibility technologies. Toward this goal, we started an initiative called Accessibility Commons, which is aiming at sharing a metadata repository among a number of research projects [14]. As a part of the Accessibility Commons design, we have initially implemented a standard method for transcoding. A URI pattern is a URI wildcard notation to apply one piece of metadata to other pages (e.g. http://example.com/blog/*.jpg). The DATA_TYPE shows a list of the currently supported transcoding methods, such as "alttext" for adding alternative texts to non-text objects or for insert commentary annotations, and from "h1" to "h6" for adding heading tags. For pointing at a target element in a page, XPath[23] is currently supported as the addressing method (e.g. "/HTML/BODY/DIV[3]/DIV[1]/P").

6.2 Reporting Function

It is crucial to understand the reported issues coming from the users as part of the comprehensive authoring process. However, existing screen readers do not have functions to programmatically capture

context information (such as the reading position in a webpage). Therefore, we developed a method that fully utilizes the screen reader's functions with the supporting components. When the shortcut key is pressed, the installed JAWS Script programs automatically move the mouse cursor to the reading position by using the "rooting" function. Then the script gets the DOM (Document Object Model) element under the mouse cursor as the current reading position. The script also invokes an ActiveX control to capture the browser screen. On the server-side, the system overlays the reading position on the dumped screen to visualize the location of a problem (Figure 3).

6.3 Authoring Tool

The authoring tool is implemented as a sidebar extension for Firefox (Figures 3 and 4). There are two areas, an upper area showing a simulation of the screen reader verbalization, and a lower area for the input of metadata. In addition to the basic functions introduced in Section 5.3, it has a function to generate XPath with a wildcard notation. In order to add metadata to repetitive components in a page, such as headings tags for a list of search results, one piece of metadata should be able to point to multiple HTML elements in a page. When a supporter selects two text fragments while pressing the <Ctrl> key, the tool automatically generates an XPath for both fragments, and highlights all corresponding fragments in the browser view. With this wildcard function, it is possible to add metadata to dynamically changing webpages, such as online shopping and search engines. This is a key function to make the system practically usable.

6.4 Incentive Mechanism

The system gives "points" to participants, including end users and metadata authors, in order to motivate them to be active in the social computing system. As shown in Figure 2, each participant's portal page displays the current rank and points, allowing the participant to have a relative position in the community. The end users and supporters who have the highest points are listed in the participants' portals and in the community top contributors page to motivate participants to build their reputations. Incentive mechanism should be designed to let participants work toward an appropriate direction. In this case, incentive mechanism should be designed to motivate supporters to consider "usability for end users" during the authoring process. Therefore, we reward both the quantity and quality of metadata to encourage supporters to create sufficient metadata considering the usability for end users. As with many previous
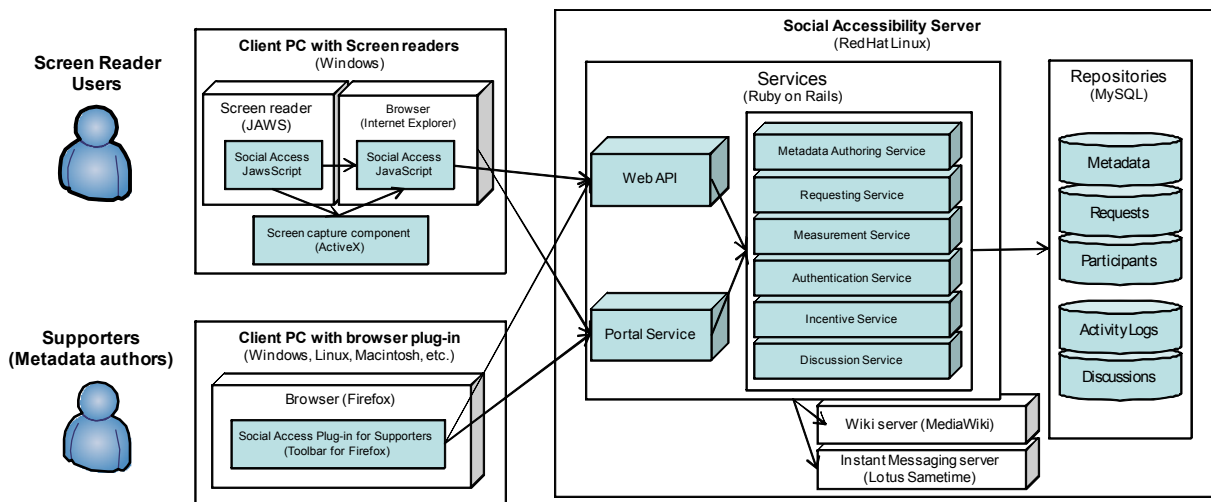

Figure 5. Architecture of the Pilot Social Accessibility System

community platforms [8][17], the system gives 1 point to metadata authors for each piece of metadata they create. To reward supporters who created valuable metadata, the system also gives bonuses for high quality metadata. Since the quality represents the usability for end users, high quality must be assessed by the end users.

6.5 Transcoding Mechanism

Transcoding is done inside the browser on the client-side by using JAWS Script and JavaScript (Figure 5). When a webpage is loaded in a browser (or a user presses a key-combination for metadata loading), our script automatically checks for the existence of any associated metadata in the repository server, and downloads the set of related metadata from the server through the Web service in the JSON format. Then our JavaScript parses the metadata (JSON format) and applies it to the loaded page. For the user, this process is transparent except for some notification sounds for the successful transcoding.

Transcoding usually requires modifying the DOM structures. This means an XPath in the metadata may not work after some of the modifications (such as a new heading tag being inserted at the top of a page). This is an issue of mutual interactions among metadata. If the modification procedure is defined by a single procedural script, it is possible to manage it to avoid mutual interaction. However, the metadata is essentially collective and should be created without considering effects by other metadata. Therefore, we developed an original XPath engine in JavaScript, which retains the original page structure even during the modification process.

7. PILOT SERVICE

The pilot system became available inside our corporate intranet in mid-April, and we gradually invited internal screen reader users and supporters to join as we continued improving the system. As of the beginning of May 2008, about 20 users including five screen reader users have joined the system. In spite of the small number of participants, various collaborations have already happened on the system. A total of 220 requests have been submitted and 810 metadata entries have been created for 50 domains. One result is that metadata for several major sites, including some major online shopping sites, has been created and continues to be improved. In this section, we would like to present some early results from the trial.

7.1 Examples of Requests and Metadata

Example 1: Anvir.com

Request: "This looks like a graphic is being used as a link to a printable document. Alt text would be nice."

In this case, the submitted screen shot clearly indicated the image location. Some image links without alt text existed around the requested image link, so a supporter created metadata for these images by using the authoring tool and submitted all of it. The operation is so simple and may be done within a few minutes. This metadata matches all appearances of the same image file. Following is the details of created metadata. The author created the metadata without knowing these technical details, but just using the user interface of the authoring tool.

```
Type: alttext
Target Path (uri):
  http://www.anvir.com/images/M_images/pdf_button.png
Description: "link to a PDF file"
```

Example 2: IBM Developer Works

Request: "A heading at the start of the blog entries would help with navigation."

The request was clear. Actually the page had two heading tags, but neither heading tag pointed at the start of the main content. Therefore a supporter created the following metadata, simply by selecting the target area. This should only take a few minutes.

```
Type: h2
Target URI:
  http://www.ibm.com/developerworks/blogs/page/aixpert
Target Path (XPath): id('v14-body-table')/TBODY[1]/TR[1]/TD[2]
Description: "Main content"
```

This metadata automatically inserts a comment "Main content" right after the start of the TD tag, which is pointed at by the XPath expression. A few days later, another supporter inspected the metadata and found other blog pages also lacked heading tags, but had similar URI. Therefore, he modified the Target URI by adding a wildcard to cover other all of the blog pages on the site. This kind of modification can only be done by more technical supporters, since it requires knowledge of regular expressions.

```
Target URI: http://www.ibm.com/developerworks/blogs/page/*
```

Example 3: Rakuten

Request: "Please add a heading at the beginning of main content."

Rakuten (http://www.rakuten.co.jp) is the largest online shopping site in Japan with more than 22 million items. The request only indicated a page for an item, but some supporters decided to try to make the shopping process accessible and create a set of metadata, and three supporters worked together on the site initially. They first discussed how to define target "keywords", since it was not feasible to exhaustively add metadata for the huge site. They discussed this using instant messaging and decided on some keywords such as "chocolate" and "ice cream", since the request was related to cakes. They defined work assignments as one person focused on the search results page, one person focused on the category top pages, and one person focused on each item page. They described their consensus results in an associated Wiki page for the domain. One of the most difficult challenges was the issue of manually created item pages. Header, footer, index list and shopping cart functions are managed and generated by the central content management system, but the main part of each item page is manually created. Therefore, it was very hard to add metadata for the beginning of the description of the item even by utilizing XPath generalization technique. Through their discussions, they noticed that each thumbnail image just above the description was located in a similar directory. Therefore they added metadata with a wildcard to mark these images as the headings.

As of the May 5, 2008, 76 metadata items for Rakuten have been created, and they cover most of the search result pages and item pages. In order to measure the coverage, we checked 330 pages linked from the search results page for "chocolate" by using a crawler. The metadata for the alternative texts covered 136 pages (41.2%), and the headings covered 211 pages (63.9%). Even they focused only a few types of pages, the metadata is applied to various pages.

Example 4: Amazon.com

Request: "Amazon has accessible version, but it does not have every feature."

Amazon.com provides a simplified accessible version (http://www.amazon.com/access), but it lacks advanced features, such as various types of recommendation functions. The pages are complicated, but the annotation authoring work is easier than Rakuten, since most of the pages are structured and many ID attributes are embedded. One of the technical issues was the complexity of the URIs. Sometimes totally different URIs indicate the same page, and sometimes similar URIs indicate pages with

different layouts. Such problems suggest developing a site-wide metadata management system based on the Site Pattern Analyzer [22]. As of the May 5, 2008, 59 metadata items have been created for Amazon, and they cover most of search result pages and item pages, especially in the electronics category. We checked 276 pages linked from the search results page for iPod, and found the alternative texts cover 264 pages (95.7%) and the headings cover 258 pages (93.5%).

8. DISCUSSION

8.1 Necessary Skills for Metadata Authoring

The current pilot system requires supporters to have minimal knowledge about accessibility, and they can learn about the tools and services. It is critical to lower the bars for new participants. There are many aspects of this aspect, including the design of the metadata as described in Section 6.1. However the most important point may be the ease-of-use of the authoring tool. We are trying to provide a simple user interface in order to avoid requiring special technical skills. As mentioned in Section 5.3 and Section 6.3, the tool has a simple user interface, which allows nontechnical authors to create simple metadata. For example, alternative text metadata for a specific image can be created by simply clicking on the target image and entering a description into a text box. A supporter used this simple user interface to fix Example 1 in Section 7.1. The current implementation is just a starting point for easy authoring and it is clear we should proceed to make the process easier in the near future.

Another aspect is the possibility of non-authoring supporters. The Social Accessibility approach ideally allows anyone to contribute the activity. For example, experts on "global warming" can give advice about appropriate metadata for content on global warming, to be used by more technical metadata authors through the collaboration mechanism. The current pilot service does not have any connection to other community services to enable this type of collaboration. We need to proceed in this direction.

8.2 Implications for Site Owners

The system will reduce the burdens on site owners through the power of the community, but it does not mean they should ignore accessibility issues. We would also like to encourage site owners to pay more attention to accessibility and hopefully renovate their sites to be more accessible. We believe collaborative authoring will also create usable information for site renovations.

Global usability testing

Site-renovation work is too often reduced to the task of reducing the number of errors reported by automatic accessibility checkers. This new system will change that by providing real users' voices as the users' requests related to a site. The request process can be regarded as volunteer-based global usability testing sessions by real users.

Consulting for renovation

The products of the collaborative authoring process—metadata, discussions, and site-specific rules for metadata—will be invaluable information for effective renovations by site owners. When they renovate their sites for greater accessibility, they can actually know exactly how the supporters fixed their pages, and know why, too. The transcoding engine does not change the visual layout, which means that user requests can still be satisfied without changing their business models that rely on the visual appearance factors such as how the screen real estate is allocated to advertisements or recommendation systems.

In order to improve the value for site owners, we plan to add functions to the system. A portal function will be added to provide aggregated information related to a site, such as frequently reported pages, summaries of created metadata, and rules for the metadata.

8.3 Appropriateness of Collaboration Methods

Four types of collaboration tools are integrated into this pilot system: instant messaging, discussion threads, a Wiki, and email (see Section 5.4). Among these tools, the most commonly used was instant messaging. One of the reasons is that the authoring process usually starts at the same time when it is triggered by a new user request. Periodically, they organized the result of discussions into Wiki pages for future reference. We believe that the importance of asynchronous collaboration will be increased as more supporters participate to the activities, especially when supporters worldwide start collaborating. We also found that metadata authoring requires a fine-grained consensus on the rules, and also various analyses should be shared among supporters. For example, heading levels for search results should be the same across a site, so supporters need to discuss which heading level will best fit with the surrounding information. According to these requirements, we are planning to integrate the collaboration methods more tightly by adding some automation functions.

8.4 Security and Privacy

When a user reports an error, a screen image of the browser and the reading position is automatically captured and sent to the server (Figure 3). This function is crucial for supporters to understand the problems faced by the user. However it creates security and privacy concerns. If a user reports an error in a page that is showing personal information, such as a personal profile or a bank account, the information would be disclosed to the supporters. To address this concern, some improvements are planned. For example, when a screen is captured, all of the input forms (text inputs, radio buttons, etc.) will be blacked out before submission to the server[2]. It is also planned to block the capture of secure pages (using https).

8.5 Effectiveness of Incentives

We interviewed the participants and all of them agreed on the importance of the incentive system. They mentioned that the ranking of supporters on the portal page motivated them to remain active on the system. They also pointed out some unfairness in the point assignment scheme. For example, metadata with well considered wildcards can cover a large number of pages, but it is harder to create such metadata. As far as the points are concerned, that broadly useful metadata still counts as "one metadata item" in the current incentive scheme. Some other supporters commented that the most effective rewards are the appreciative comments from the end users. We are considering these points and discussing with the participants how to design a better evaluation mechanism.

9. CONCLUSION

We first discussed the quality and quantity of accessibility metadata and limitations on user participation. In order to reduce the burden on site owners and shorten the time to improved accessibility, we proposed a new approach called Social Accessibility to make the Web more accessible by gathering the power of the open community. The approach is characterized by collaborative metadata authoring based on user requests. Any Web user with a disability can report their accessibility problems to the Social Accessibility service and any Web user can be a volunteer (a supporter) to fix the problems with other volunteers and users

without modifying the original content. The pilot service was focusing on issues for screen reader users, and was deployed inside our company. In spite of the brief period involved, various problems have been reported by users and fixed by volunteers. We plan to publish the service to the public later this year. At that time, we plan to invite volunteers and end users worldwide to use the service. We also plan to expand the approach to rich Internet applications (e.g. AJAX). We will keep working with our partners to invent new technologies to cope with technical challenges.

We hope that the system will impact on the current framework of Web accessibility. In a previous paper[22], we discussed the possibility of "net-wide annotation". We estimated ten full-time metadata authors can create metadata for most of the pages of 100 selected websites. Now we are in the era of social computing. Most of the Internet population is using social computing services. We hope the Social Accessibility system will grow into a worldwide collective intelligence for Web accessibility, and contribute to changing the access environments of users with disabilities worldwide.

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