

Alipi: A framework to make the web accessible and inclusive for all

Janastu Report

Acknowledgments

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Abstract

We propose Alipi, a distributed and participatory approach for re-narrating web pages for the purpose of rendering the content more accessible. This model supports alternative descriptions for a web page or parts of it via rewriting or re-narration for a given target audience by volunteers. The goal is to render the Web accessible to people across varied abilities, age, economic situation, language and geographic locations. We present the motivation, architecture and prototype implementation of Alipi.

Contents

Chapter	Page
1 Reviewing inaccessibility issues with the web	1
1.1 Introduction	1
1.2 How is the web inaccessibility tackled so far?	3
1.2.1 Building user profiles as an effort to solve web inaccessibility	5
1.3 Our approach: Solving web inaccessibility with re-narration	6
1.3.1 Revisiting web accessibility issues with re-narration approach	7
1.4 Conclusion	10
2 Alipi: A framework for making the web accessible and inclusive for all	12
2.1 Introduction	12
2.2 Alipi Architecture	13
2.3 Alipi Prototype	15
2.3.1 Steps to use Alipi prototype	16
2.4 User study of the Alipi prototype	17
2.4.1 Results of the study	18
2.5 Alipi prototype as a browser plugin	21
2.5.1 Maintaining user profile with Alipi plugin	22
2.5.2 Algorithm to recommend suitable re-narrations to the reader	23
2.6 Conclusion	24
2.7 Future Work	25
<i>Appendix A: User study feedback forms</i>	<i>26</i>
A.1 Questionnaire of study conducted for Alipi system	26
Bibliography	29

List of Figures

Figure	Page
1.1 Distribution of the web pages in different languages.	2
1.2 DOM of an HTML document presented as a tree structure where element 'a' is rewritten with some other text.	7
1.3 A web page on fire safety with text presented in English	8
1.4 Fire safety page with one paragraph narrated in Hindi	9
1.5 Fire safety page with image re-narrated to a local fire bus	10
2.1 Schematic describing the approach followed by Alipi: Several re-narrators renarrate different elements of a page, P. These re-narrations are stored at different blog spaces but are maintained as an index on Alipi server.	13
2.2 Schematic describing the generation of a renarrated web page by the browser plugin. The plugin filters some re-narrations suitable for the reader based on his preferences and then dynamically generate an accessible version of the page P.	14
2.3 Alipi browser service: a) User types the URL in the given textbox and press 'Narrate' button. b) The typed URL will be opened in another tab with a toolbar on top of the page.	15
2.4 Steps to re-narrate a page. a) After clicking on the re-narrate button, user can click on any element of the page to re-narrate. If the user clicks on the image, a window to re-narrate the image pops up. b) To publish her re-narration, the user is required to fill the necessary details about it.	16
2.5 Steps to see a re-narrated page: a) Choose the language of the re-narration from the list after clicking on 'Re-narrations' button. b) On choosing the option 'others', the image of the page is changed to the re-narrated image.	17
2.6 A snapshot of the Alipi plugin toolbar showing different options of menus and buttons for the users.	21
2.7 Maintaining user profile with Alipi plugin a) 'Settings' menu overview: The user can edit her information, disable/enable the plug-in and import her profile from Twitter or Facebook. b) User can edit her preference file by writing her interests in JSON format.	23

Chapter 1

Reviewing inaccessibility issues with the web

1.1 Introduction

Penetration of the web has crossed geographical boundaries. It has connected people from different parts of the world, thus enabling them to share their views and discuss topics of various concerns through web applications. Since the web allows freedom of speech (in the form of publishing content), there exists diversity in the presentation of the content. The web has become a wide reservoir of information covering all the possible domains, such as, medical, sports, and geography information etc. The presence of the web has witnessed a shift in performing our normal activities from accessing traditional media to accessing web applications having highly interactive and massive multimedia content. For example, online shopping services have become very popular into fulfilling our daily requirements. However, despite the phenomenal growth of Internet, major population groups of the world remain outside its influence. One of the goals of Web 3.0 is the Web penetration to our daily activities, which is still only 32%[4]. Poor accessibility of current Web resources significantly contributes to this problem. A page is considered accessible to a user (reader) if she is able to truly access and understand the conveyed information.

There are various factors which contribute to the variety in expressions on web-pages and hence lead to inaccessibility of the web [1, 15]. One of the reasons has been the social and cultural differences across regions. For example, the food habits, dressing style and way of living may differ in different culture. The other reason is the difference in the geographical conditions adding to contextual differences in expressing the information. For example, a web page, written in English, illustrating home remedies for medical diseases, mentions intake of coconut water for body weakness in summers. This information is not much useful for people belonging to the regions where coconuts are not produced. For them a possible remedy could be the intake of lemon water. Here, even if the page is written in English and the user understands English, the unlocalized information contributes to contextual difference of the data.

Another major factor causing inaccessibility of the web content is the language barrier: an individual is either illiterate and thus can not read or she finds herself illiterate with respect to another

language. Most of the web users are facing the second type of language inaccessibility which we term as “*non-literacy*”. The reason being that the overwhelming fraction of the Web content today is in those languages that are inaccessible to a large population of the world. For example, as of December 2011, no Indian or native African vernacular contributes even 0.1% of the total number of Web pages (Figure 1.1)[2]. Moreover, according to the recent consensus, only about 10% of India’s approximately 880 million literate people speak English [3, 5]. This implies that majority of the Web content is inaccessible for nearly 800 million literate people in India. In addition to this, physical disabilities such as: visual or auditory impairments, poor cognitive skills, further add to the web inaccessibility.

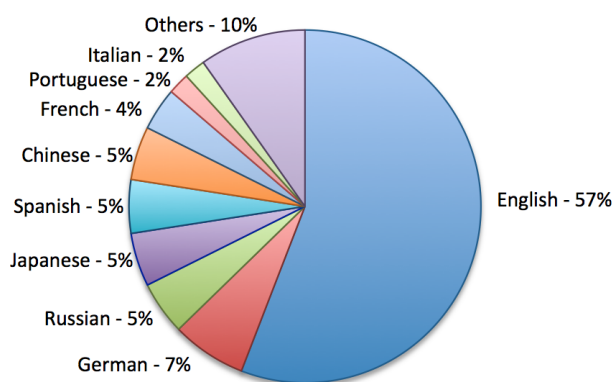


Figure 1.1 Distribution of the web pages in different languages.

Power of the web lies in its potential to provide universal access to everyone regardless of any barriers such as limited Internet connectivity, physical impairment, linguistic differences, and social, cultural and geographical factors. To realize this potential, the web should be designed to make it usable to all groups facing different accessibility limitations. Such a web design to unite excluded groups is referred to as *Designing for Social Inclusion*[6]. To achieve social inclusion, the web-page authors and developers have to follow the Web content accessibility Guidelines (WCAG). The existing approaches are either based on checking whether the W3C guidelines are followed properly by the web-pages or using certain software/browser plugins to convert the page into an accessible form. Significant work to tackle the issues related to accessibility include: video with text files (srt), text-to-speech, and speech-to-text conversion, and some elementary changes in the web page elements(e.g., font size, page color) at client end.

Most of the efforts in making the web accessible by everyone is in the direction of improving accessibility for physically impaired population. Several assistive technologies such as screen reader and voice recognition system[8, 17, 21, 32] have been developed to aid such people. Traditional approaches to solve lingual accessibility problem consist of automatic translation services for cross-lingual web resources such as online translation services using Google translator. But non-literacy has not gained much attention so far. More recently, social collaboration based approaches have emerged as an inter-

esting and popular alternative to create content on Web using humans. For example, social collaboration sites like Wikipedia, blogs etc. utilize the wisdom of crowd for generating content[27]. Under the rubric of social accessibility, these approaches rely on the power of individual users to improve web page accessibility in a decentralised manner.

However, there is another aspect of social accessibility which is concerned with the issue of the socio-cultural background and the geographical conditions of the content consumer; “social” in this context refers largely to the process in which content is created and managed by humans. Each of the approaches mentioned above are important, but the existing technologies do not adequately address the second aspect of social accessibility issue. The reason is their ignorance about the specific socio-cultural and localized aspect of the reader. This also means that the contextual differences of the readers are also ignored. In the chapter, we propose re-narration approach to solve accessibility issues. The approach allows people to rewrite different elements of a web-page to any medium such as text, video, audio or image.

In this chapter, we first explain the existing technologies developed in order to solve the problem of web inaccessibility with assistive tools (Section 1.2) and user profiles (Section 1.2.1). In Section 1.3, we propose our approach of re-narrating web using social collaboration. Then, in Section 1.3.1, we illustrate the possibility of tackling inaccessibility issues with re-narration approach. Lastly, we conclude the chapter in Section 1.4.

1.2 How is the web inaccessibility tackled so far?

The most prominent initiative towards achieving social inclusion was taken by W3C’s Web Accessibility Initiative (WAI)[20, 30]. It has a model consisting of three sets of guidelines, which are described as follows:

- Web Content Accessibility Guidelines(WCAG) for web page authors.
- User Agent Accessibility Guidelines(UAAG) for browsing and accessing technologies.
- Authoring Tools Accessibility Guidelines(ATAG) for tools to support web content creation.

However, the WAI model has certain shortcomings and therefore, does not fulfill the requirements of Web 3.0[18, 19]. One of the biggest issue is that the model requires conformance of each of the three sets of guidelines, making them dependent on each other. But this dependency is very hard to follow in real world applications. For example, web authors can control the quality of web content by following WCAG guidelines but they generally have no control over the browser technologies used by the client to access web information. Also, a web-page author may not be able to visualize the possible set of readers having different capabilities beforehand.

Earlier, the guidelines were based on the principle “one Web content for everyone”, which is not considered as much effective as “the best Web content for each one”[21]. In order to meet the new

principle, there have been efforts enabling people to access web by considering all inaccessibility issues individually. A new technology has developed for every other kind of disability. For example, a visually impaired person is powered with technologies like a screen reader for text annotation and accessing video media with flexible navigation[8, 17, 25]; a deaf person is enabled with speech-to-text assistive tools[9]. Some other work includes client-side browser settings with plugins, where the plugins restructure the web page elements(e.g., font size, page color) according to the user needs[21]. Some other attempts include facilitating low-literacy readers by providing them with simpler texts along with other relevant written material. For example, alleviating a reader by providing synonyms for difficult words and tagging named entities for clear understanding of the document[31, 32].

A few efforts are also made to solve the problem of functional illiteracy for documents with different social, cultural, and geographical contexts. Topac et al. proposed a framework to solve the issues with context specific information for medical domain. The approach empowers patients to understand medical specific terms in a lay person's language[29]. Borodin et al. designed a system to make the content accessible in different languages using Google Translator[7].

There are several examples of community sourced initiatives for subtitling and other needs creating meta-data of the page[22, 28]. Moreover, there are plenty of online services allowing people to provide annotations, reviews or comments about research papers, books or products. Some of them include Citability¹ to annotate government documents, Digress.it² and Crocodoc³ to annotate a document, iCorrect⁴ to rectify rumors and misinformation about celebrities, FinalsClub⁵ to access annotations of academic courses offered by good universities. Most of these initiatives are based on the intrinsic motivation, which we have discussed in Section ?? of Chapter ?. Some of these applications also provide monetary incentives to perform the task, for example, iCorrect pays its contributors.

The approach proposed by Takagi et al. works within the framework of WAI guidelines by using community based collaboration[27]. Given a page without appropriate accessibility tags(alt text for images, headings), the approach uses social collaboration to generate a modified page by adding metadata to its sub-sections. The notable part of this work is the use of social collaboration where a group of supporters fill in missing metadata whenever a report of inaccessibility comes in, bypassing the page author completely. The modified page is stored on a centralised server which makes it accessible to anyone visiting the original page. All these services – reporting inaccessibility, generation of metadata by supporters, as well as identifying existing re-narrations – are provided by a set of client-side tools that interact with the server via a set of APIs.

However, the above mentioned approaches require understanding of user preferences to restructure a web-page and its attributes automatically, at client side. Several approaches are proposed to capture

¹ Available at <http://citability.org>

² Founded by Eddie Tejada in 2011. Available at <http://digress.it/>

³ Founded by Ryan Damico in 2010. Available at <http://crocodoc.com/>

⁴ Founded by David Tang in 2011. Available at <https://www.icorrect.com/>

⁵ Founded by Andrew Magliozzi in 2007. Available at <http://finalsclub.org/>

the user preferences using profiles. We discuss user profile based approach to solve web inaccessibility in the next section.

1.2.1 Building user profiles as an effort to solve web inaccessibility

Recently, there have been efforts to solve the web inaccessibility issues automatically with personalized user profiles. These user profiles defines the choices and capabilities of the user. The profile helps the assistive tools and curation services to understand the user needs and accordingly provide relevant pages. The tools will search the most relevant pages from the existing set of pages according to the user profile. Therefore, to retrieve more relevant information from the web, focus is now on building a detailed user profiles describing the best possible preferences of the user.

Most of the existing approaches are based on populating the user profiles automatically or semi-automatically by gathering information about users from their communication on social network websites [11, 23, 24]. For example, tagging activity on Facebook provides information about the interests of a person. However, mining social networks to build user profiles is a challenge because social website contains huge amount of irrelevant and noisy data such as ambiguous tags and words. Some other approaches consider different user behavior at different environments[12, 26]. Since the needs and preferences of a user are highly affected by her environment, they proposed a user profile with different personae. Such a profile takes care of her different preferences at different locations and provides personalized service accordingly.

One of the notable profile management schemes is proposed by Golemati et al.[13, 14]. They proposed a context-based visualization scheme to provide the best visualization properties of a web-page to a user. The scheme maintains separate ontologies for a user, her system and the document collection. The user ontology keeps track of different abilities of a user that includes visual memory, arithmetic memory, color recognition, and her educational background. The method of identifying these abilities is based on her responses to certain queries. The hardware equipment details of her system: processor, memory, graphics, and input output devices are present in the system ontology. The document ontology contains metadata: author, title, related keywords, and document category. These ontologies communicate with each other via matching rules and provide the most appropriate visualization property to the user. This visualization property is selected from several available schemes designed by considering the experience and capabilities of the user as well as his system. However, the proposed scheme is limited to provide a page according to the cognitive abilities (visual or arithmetic) of a person and neglects other previously discussed issues influencing web accessibility.

Building user profiles automatically, semi-automatically or manually has always been a challenging task. For example, taking feedback from the users to improve their profile disturb their workflow. Moreover, building profiles automatically do not consider any changes from the users. Therefore, building user profiles automatically providing users the ability to edit their preferences seems to be an ideal solution. However, most of the existing approaches have centralized storage of the user profiles with users having little or almost no control on their profiles in terms of changing their preferences.

1.3 Our approach: Solving web inaccessibility with re-narration

The existing approaches help the curating services (such as Google) in retrieving the most relevant set of pages for the user from the existing resources. The questions still not explored completely are: How to personalize a web page to a person who is unable to access it? Can the user-profiles identify the inability of a person and provide an accessible version of the requested web-page automatically? We formulate the following research question, “*Based on the user’s preferences, can we dynamically render a page by re-constructing its elements with different narratives?*”. In the thesis, we try to answer the question by proposing a re-narration approach to the web.

Re-narration is a general activity that we have been using for centuries. A teacher re-narrate a story book to her students to invoke their interests and obtain some learning. Newspapers are very good examples of re-narration where people narrate the news to others based on their interests and capability of understanding. For example, it may be hard for people to understand a government act, therefore, people try to get its narrations through some agents or learned people. Several such services are also available on the web where people, based on their context and interests, subscribe to get more suitable narrations of different topics such as news and technical issues.

We are interested to extend this re-narration approach to solve inaccessibility issues of the web. In the web context, re-narrating a web-page is to rewrite its DOM⁶ elements based on the rewriting specification (Figure 1.2). Almost all the existing approaches to solve accessibility issues handled at browser level can be recognized as a syntactic restructuring of the DOM structure of the document with respect to particular needs. Examples of restructuring a page include: reading alternate text for images with the **alt** tag when a blind person visits the page; displaying text captions for a video when a deaf person visits the page; systematic replacement of colour in the document to make a document accessible to a person with colour blindness. Each such renarration, therefore, can range from a simple metadata completion as above, or can be a translation into another language, or an audio narration, or a simplification of text, or a description with other multimedia content. Therefore, for one page, multiple re-narrations can exist in any possible form of multimedia.

Currently, all the existing techniques follow a single point of architecture where the web curators are responsible for making the web accessible to everyone. The traditional approaches implement fixed rewriting strategies that will work for all the users visiting the page. Using restructuring as a model for accessibility frees the author of the page from implementing specific rules. We are looking towards diffusing the single point architecture of the web by allowing people to take responsibility of generating accessible content by re-narrating different elements of the page. Here, the re-narrators can be the page author, a user, a third party, or even a re-narration service. The motivation behind such an approach is the success of social networks where people share information with their friends, family members and community members. People are aware of the needs of their community members, friends and family members and thus may be willing to help them. Therefore, we believe that every individual has potential

⁶Document Object Model(DOM) is a language-independent representation of a document which shows interaction among its different objects.

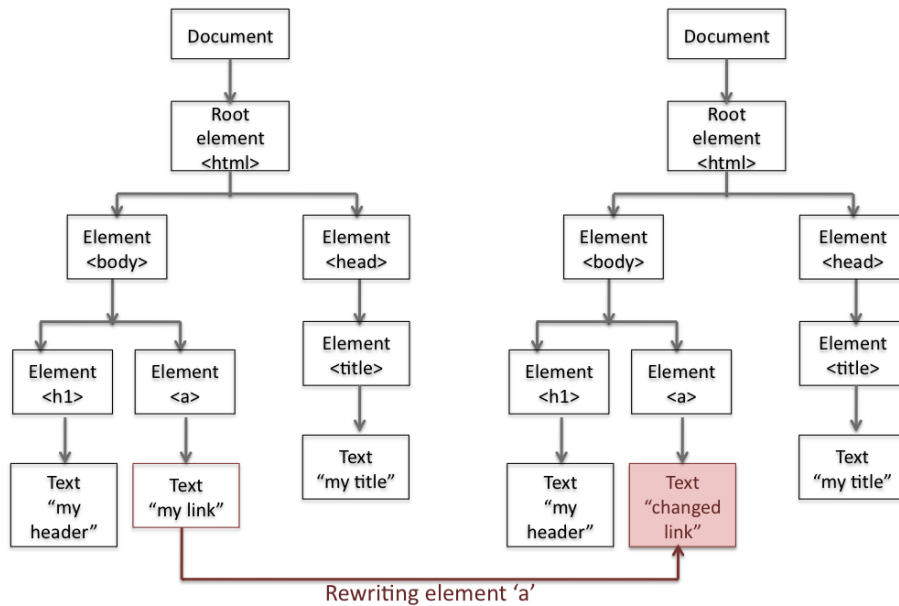


Figure 1.2 DOM of an HTML document presented as a tree structure where element 'a' is rewritten with some other text.

to make the web accessible to atleast a few small groups of acquainted people by using the re-narration approach.

1.3.1 Revisiting web accessibility issues with re-narration approach

Consider a web page of fire safety shown in Figure 1.3, authored in English, and has few images and text in it. To make this page accessible, WAI provides some guidelines as to how the page structure should be designed by the author of the page (WCAG), considering both the accessing technologies (UAAG) and rendering tools (ATAG). Let us demonstrate how to address different inaccessibility issues using this general approach of re-narrating web pages with social contributions by considering different scenarios.

Physical Disability

Let us consider a specific case of blind person, say B, visiting the page. The WAI ensures that the blind person should be able to read the page using screen-reader software and flexible navigation[8, 17, 25]. The author of the fire-safety page, say P, would have to make sure that the page has clear structural information with proper headings, image captions, alternative text for image tags, and should avoid any use of elements that are difficult to be read by screen-reader (e.g., using tables for presentation is a very common “misuse”).



Figure 1.3 A web page on fire safety with text presented in English

Now, consider a case where page author violated one or more of the WAI guidelines. In this case, B might not get an appropriate page. WAI has nothing to offer to such a user. We want to explore a re-narration approach where X might be able to provide a compatible version of the page P. Instead of reading P, B can access the re-narrated page, which is a compatible version of P for B. However, the existing approaches do not explore the community based re-narration of the web completely. The approach proposed by Takagi et al.[27] to provide accessibility tags using social collaboration is a demand-based service where person B should report for inaccessibility of P to get its accessible version. Moreover, the existing profile-based approaches would help to choose one of the visualization schemes from a set of user preferred schemes, but would not create accessible content for B.

We are willing to explore something similar to the approach of Takagi making it more flexible from request-based service. There could be many X producing different compatible versions of page P by re-narrating its different elements. For example, one person can provide an audio snippet that reads out the content of page P, making it more suitable for B. Another can provide an alternative text to the image of fire-safety bus. So, B now has the choice of picking one or many from the available multiple re-narrations. This is a more general approach where everyone is contributing to solve inaccessibility problem – in a way more in the spirit of Web 3.0.

Language barrier

Suppose page P is shared with a person L who can read Hindi but not English. In this case, page P is not accessible to L because of print illiteracy. Now, when L visits P, L would understand the page if there exists a Hindi version of P. One possible way for L is to use Google Translator service and read the page. But consider the cases when L prefers to read human translations, or if Google translator does

not cover some local dialects of Hindi like Braj⁷, Bundeli⁸. L might prefer trusting a friend in giving her a more reliable translation of page P. Figure 1.4 shows Hindi version of the page P narrated by an acquainted person to L.

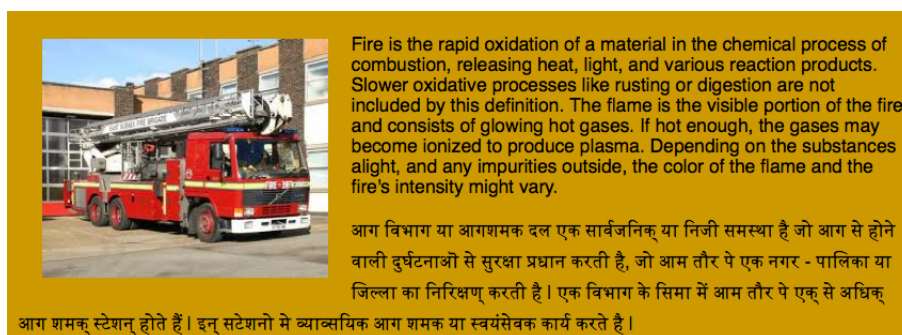


Figure 1.4 Fire safety page with one paragraph narrated in Hindi

The other ways in which the re-narration approach might address language barriers are when (a) an audio narration in Hindi is available for the English text on the page, or (b) a Hindi audio track is available for an English video, or (c) a Hindi textual commentary is available for an English video.

Social and geographical barriers

The image of fire-safety bus available on page P might not be something that person L has seen around in his town. It might be a picture of a bus service used in the US. This also contributes to print illiteracy where the context is different for a user. If the re-narrated page of P can also substitute an image of fire safety bus found in India, more specifically to the one available in hometown of L, this problem is solved (Figure 1.5). This kind of cultural re-narration is harder to achieve in language translation services and other existing approaches.

Literacy Barrier

Today, major portion of the Web is dominated by text. In countries like India, literacy rate is only about 74%[3]. Yet this does not imply that an illiterate person can not comprehend the complex issues related to government, law etc. described on the web page. In order to make the page meaningful to the illiterate person, the content can be made available in a different format that is accessible to him. For example, providing oral medium in form of a video or audio might be helpful for an illiterate person. Again, considering the re-narration approach to address this issue, a Hindi-speaking but not Hindi-literate person would be able to find a suitable re-narrated version of page P.

⁷A Hindi dialect spoken in western Uttar Pradesh

⁸A Hindi dialect spoken in west-central Madhya Pradesh



Figure 1.5 Fire safety page with image re-narrated to a local fire bus

Other accessibility issues

Apart from the language, geographical and literary barriers, there are cases when a page is not accessible because of poor writing or availability of too much technical content. The existing approaches provide dictionary meanings to difficult words of the page to help the reader. An alternative approach of providing re-narrations in form of simplifying the content might be more helpful. For example, Government documents specifying laws are not directly comprehensible to everyone visiting the page. Local versions of the page to workers, and to other readers might be more appropriate. So, a re-narration service might act as a bridge connecting technical pages with simpler narrations.

1.4 Conclusion

The goal of Designing for Social Inclusion is to render the Web that is accessible to everyone across varied abilities, age, culture and geographical locations. A web-page is accessible to a user if she is able to consume the conveyed information without any hindrance. There have been efforts to solve the web inaccessibility with different guidelines, plugins and user profiles. Furthermore, physical disabilities are traditionally given higher priority and lesser attention is given to other factors affecting web accessibility. Contextualization and localization of the web-pages according to the user preferences are still unexplored issues related to web inaccessibility.

Collaborative approach of contributing to a web page either in improving its DOM structure or its content accessibility is promising. The web becomes a much more effective medium of knowledge when users and information consumers have access to interpretations or re-narrations of content. Several rudimentary forms of re-narrations already exist today on the web as blogs, annotations on pages, bookmark recommendations, tagging, etc. Little support, however, seems to exist in the meta-data frameworks of web pages that allows a re-narrator to target a specific group of readers, based for example, on language, location, etc. Likewise, the current architecture of the web do not explicitly support the user preferences for a particular set of re-narrations to be automatically retrieved.

We are looking at a general model of web which can solve all the inaccessibility issues uniformly. We believe re-narration approach to the web has potential to reach every problem. We, therefore, propose a re-narration based framework of the web in next chapter.

Chapter 2

Alipi: A framework for making the web accessible and inclusive for all

2.1 Introduction

We propose Alipi, a distributed and participatory approach for re-narrating web pages for the purpose of rendering the content with better comprehensibility and accessibility. Alipi is a framework designed with the objective of enabling one set of web users, i.e., the ‘re-narrators’ to re-narrate any web page or its element, and a second (possibly overlapping) set of users, i.e., the ‘readers’ who consume the web resource appropriately re-narrated to them. Alipi means print illiterate in Kannada and several other languages of the Indian subcontinent. Our framework tries to fulfil its literal meaning, and therefore, supports alternative descriptions for a webpage or parts of it via rewriting or re-narration for a given target audience by volunteers. The Alipi approach is in the spirit of Takagi et al. [27], but our approach is somewhat broader. Similar to the approach by Mirri et al. [21], we also rely on browser plugins, website-toolbars, and decentralized servers for generating renarrations of pages.

Alipi is a social collaboration framework for authoring, targeting and accessing re-narrations of web pages. The components of Alipi framework consist of a predefined set of web element attributes: a browser plugin for creating re-narrations at the re-narrator’s end and for generating the re-narrated page at the reader’s end. Alipi supports an architecture where semantic attributes derived from the content of page are mixed and matched with the semantic attributes of a particular reader. Additionally, re-narration is applicable to every individual element of the page. The combination of these features makes Alipi, initially designed to address print illiteracy, usable in much more general contexts. For example, using Alipi, it is possible to combine selective translation of a page with splicing of locally relevant images in order to make information accessible in a broader sense. All the issues of web inaccessibility which we discussed in Section 1.3 of Chapter 1 can be successfully solved by using our re-narration framework, Alipi.

The traditional solutions for accessibility demand that the author of webpage take responsibility for ensuring accessibility of the page. This is usually done by the author specifying a rewriting rule usually fixed as a standard across all pages, for example, providing alt tag to images. The approach used by Alipi is that these rewriting rules need not be fixed a priori. There might be multiple versions of these rewrites

for example, by a user, the page author, a third party, or even the renarration service. Fixed strategy is then a special case of the Alipi approach where only one standard re-narration is available corresponding to a page. Alipi accommodates multiple strategies for accessibility: fetching re-narrations of a page from somewhere else on the web, or restructuring a page in place based on a standard specification without fetching anything externally, or a combination of the two, where rewriting parts of a document requires fetching a re-narrated snippet from an external service.

Rest of the chapter is organized as follows: Section 2.2 defines the Alipi architecture with its three sub-systems. Alipi prototype is explained in the Section 2.3 where steps to use Alipi system are explained. In Section 2.4, we explain the procedure and the results obtained from the study conducted to test the developed prototype. Section 2.5 discusses the browser plugin developed to support Alipi approach along with an explanation of its working. Lastly, the chapter is concluded in Section 2.6 with future work mentioned in Section alipi-future.

2.2 Alipi Architecture

Alipi relies on three main subsystems: (a) a subsystem for re-narrators to create narrations, (b) a subsystem for indexing different elements of web pages to their re-narrations, and (c) a subsystem for web-page readers to display the renarrated page dynamically.

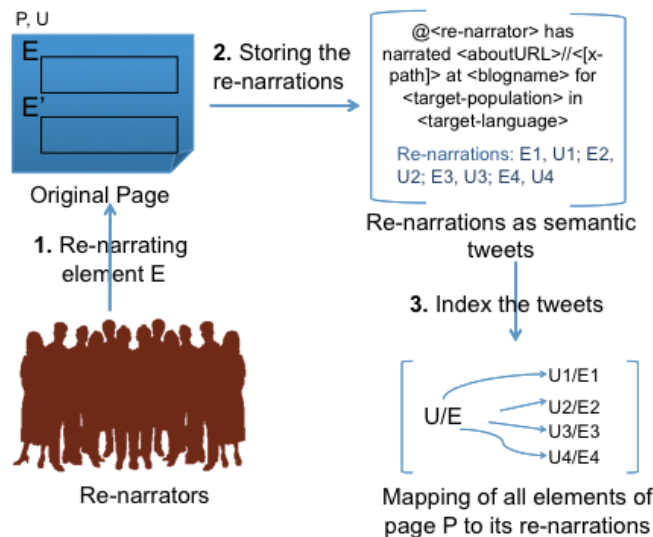


Figure 2.1 Schematic describing the approach followed by Alipi: Several re-narrators renarrate different elements of a page, P. These re-narrations are stored at different blog spaces but are maintained as an index on Alipi server.

Schematics capturing the architecture of Alipi are shown in Figures 2.1 and 2.2. In Figure 2.1, re-narrations of the web page P consisting of multiple elements (E and E') are being created and indexed. A set of re-narrators create a set of re-narrations E1, E2, ... and so on, for the element E (arrow 1). These re-narrations exist as independent entities on the web each with its own url U1, U2, ... and so on. For example, these re-narrations can be stored at personal blog spaces of the re-narrators. Alipi requires all re-narrations to be publicly accessible pages on the Web in order to ensure a decentralised re-narration model. The decentralized re-narration model of Alipi is important for allowing users to have control of their re-narrations and to decouple documents from their re-narrations so that they are treated as regular Web pages. The information about each re-narration (such as target language and population of the re-narration) is stored as a tweet in our database (arrow 2). The tweets are indexed on the Alipi server where each element of the page P is mapped to its different re-narrations (arrow 3).

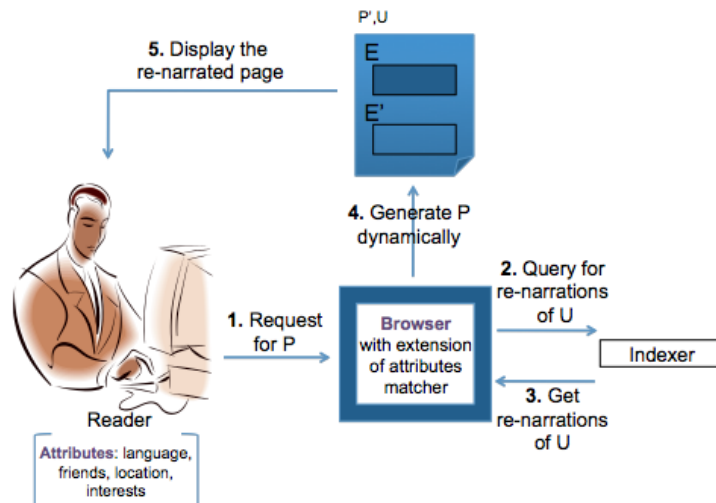


Figure 2.2 Schematic describing the generation of a renarrated web page by the browser plugin. The plugin filters some re-narrations suitable for the reader based on his preferences and then dynamically generate an accessible version of the page P.

Figure 2.2 shows how a page with possibly several re-narrations is rendered to the user consuming the page. When a user requests the page at url U (arrow 1), the user’s profile containing various semantic attributes are sent to an attribute matcher. The matcher queries the indexer for the appropriate set of re-narrations of the requested page. The appropriate re-narration, chosen on the basis of the user’s semantic attributes are then rendered in the user’s browser as a re-narration P’ of P at the same url. The architecture proposed affords flexibility in terms of implementation. The set of semantic attributes that identify a target group can belong to ontologies defined and published by the re-narrator. The indexer could leverage the semantic attributes related to the target group, e.g., language and location for efficient retrieval. The matching could be done either at the user’s end, or at the index server’s end, or even at a separate “matching server” depending on the application. The matching process could range

from simple attribute matching to a complex set of matching between ontologies combining several re-narrations. The generated page could be composed at the matching server and delivered to the user's browser.

2.3 Alipi Prototype

The Alipi prototype implements the core ideas of the Alipi architecture for re-narration. In the prototype implementation, the re-narration is implemented as a service. A screenshot of the server's entry page is shown in Figure 2.3a. A user visiting this service can choose a webpage for re-narration, specify the target groups and publish the re-narration at a url of her choice.

The re-narrator can either define alternative text such as translations or simplifications or provide alternative media such as audio or video according to the target audience. The re-narrator also provides meta information such as language, geographical region, nature of re-narration (translation, simplification etc.), and tags to identify the target audience. The re-narrator publishes the re-narration once it is completed. Alipi keeps track of the source, target, and language of each re-narration. Any number of re-narrations may exist for any given source page. Typically, a re-narrator will publish the re-narration at say, her publicly accessible blog. Alipi maintains a blog for those who do not have their own blog. Re-narrated posts using Alipi service are indexed on an alipi server.

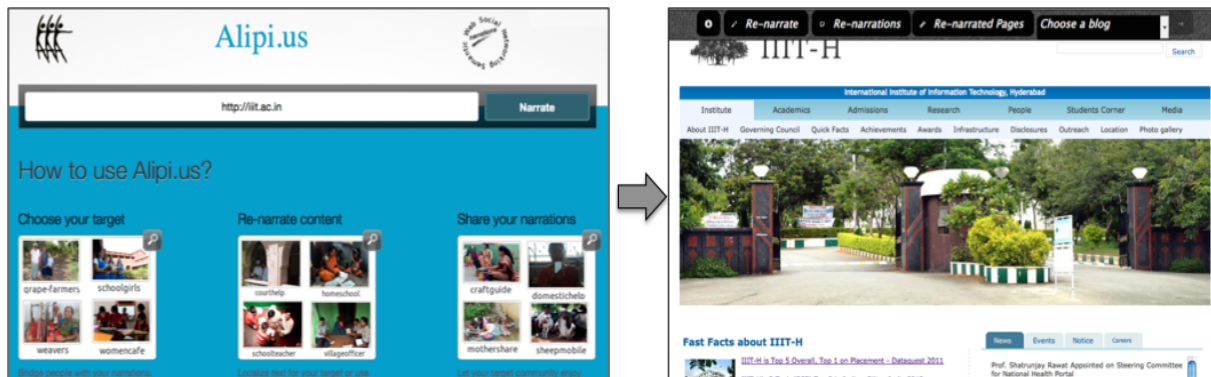


Figure 2.3 Alipi browser service: a) User types the URL in the given textbox and press 'Narrate' button. b) The typed URL will be opened in another tab with a toolbar on top of the page.

Alipi renders re-narrations by user choice. Furthermore, it can merge multiple re-narrations of a document in order to deliver the most complete re-narration. This is done by examining the xpath ids of the re-narrated elements. A user may have a locally installed browser extension for carrying out the re-narration. Prototype browser extensions for Firefox and Android has been implemented [16]. This extension also indicates the availability of re-narrations for a user requested page.

2.3.1 Steps to use Alipi prototype

Below are the steps that a user needs to follow to re-narrate a page using Alipi (refer Figure 2.3, 2.4 and 2.5).

1. Firstly, the user needs to visit the URL: <http://alipi.us>. She then types the URL of the web-page she is interested to re-narrate such as <http://iiit.ac.in>, along with <http://>, as shown in Figure 2.3a. After pressing the button ‘Narrate’, the requested page will be opened in next tab of the browser with a toolbar on top of the page (Figure 2.3b). This toolbar is provided by Alipi service which will enable the user to rewrite the page.
2. User needs to click on the ‘Re-narrate’ button to write her narration of the page. She can then select any element of the page such as an image, paragraph, hyperlinks or any other DOM element of the page. On clicking the individual element of the DOM, a window will pop up where the user can write her narration corresponding to the element (Figure 2.4a). For providing a video or image or audio re-narration to the page, the pop-up window asks for the source URL of the re-narration.

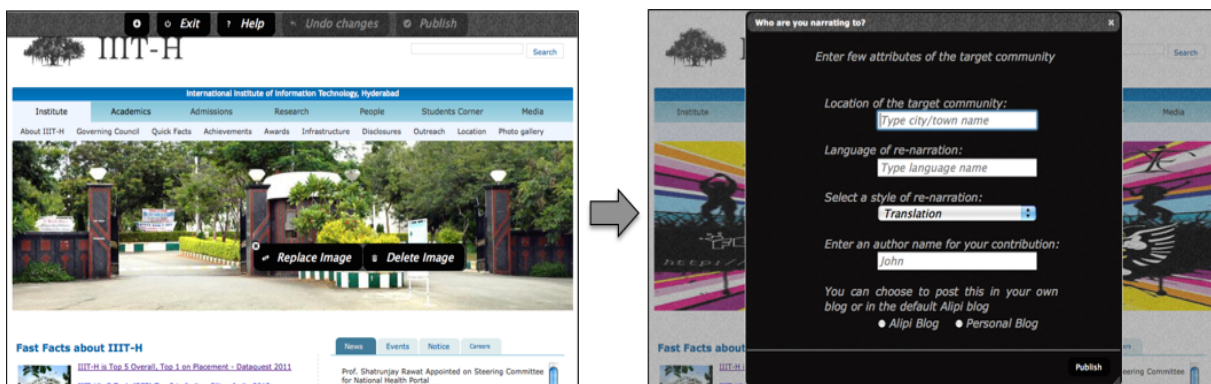


Figure 2.4 Steps to re-narrate a page. a) After clicking on the re-narrate button, user can click on any element of the page to re-narrate. If the user clicks on the image, a window to re-narrate the image pops up. b) To publish her re-narration, the user is required to fill the necessary details about it.

3. After re-narrating, the user needs to click on the ‘Save changes’ button. The re-narration is then saved and the user is re-directed to the original page to write more re-narrations for other elements of the page.
4. Finally, to publish the narration, the user needs to press the ‘Publish’ button of the Alipi toolbar. While publishing, the user is required to mention certain details about the re-narration such as the target population and location of the re-narration, re-narration language, blog-space where the re-narration should be published (Figure 2.4b).

5. Once the content is published, the user can see it along with other existing re-narrations (if available for the page) on clicking the ‘Re-narrations’ button.

To check the available re-narrations for a web-page, firstly, the reader needs to follow the above mentioned first step. Then, she needs to click on the ‘Re-narrations’ button and select one suitable language from the available list of the re-narrations (Figure 2.5a). For the chosen language, all those elements of the page will be rewritten to the re-narrated content for which the re-narrations are available. In Figure 2.5b, the image is changed to the re-narrated image.



Figure 2.5 Steps to see a re-narrated page: a) Choose the language of the re-narration from the list after clicking on ‘Re-narrations’ button. b) On choosing the option ‘others’, the image of the page is changed to the re-narrated image.

2.4 User study of the Alipi prototype

Study Objective

Since this was our first laboratory study of the project, we were interested to know the experience of people with our developed prototype based on the Alipi architecture. We were also interested to study different attributes related to both sets of people defined by Alipi, namely, readers and re-narrators of the web-pages.

Participants

We conducted a small scale study of Alipi in the R&D showcase of our university with 70 participants (male=45, female=25). These participants were Engineering students of different colleges, faculty members, and professionals from different companies. The age of the participants ranged from 18 to 45 years with average age 22 years. Thirty percent of the participants were active on blogs, forums or YouTube for technical discussions and recreation purposes (such as sharing poetries, music) while the rest were not active but were casual users of these sources. However, all of them considered such applications as

ideal platforms for open discussions allowing them to share their knowledge and thoughts.

Procedure

The study was conducted in English. We were available to help the participants throughout the study. The study was conducted in three phases: In the first phase, demographic information of the participants (name, age and profession) was taken. We asked a few questions regarding their experience with other available services like: YouTube, forums and blog (Appendix A.1). We explained our system to everyone and gave them an insight on how to use it as a re-narrator and reader. In the second phase, we asked each participant to re-narrate a page of their interest or to see a re-narrated page. To demonstrate the working of our tool, we took two web-pages: IIT-Hyderabad homepage with URL as <http://www.iit.ac.in/> and a page on Indian culture with URL as <http://www.culturalindia.net>. However, participants were free to re-narrate any page of their interest. Participants were encouraged to think aloud while performing the task. The last phase was dedicated to one-on-one interview with the participants where we informally discussed with them about their experience of our system. In the interviews, we asked the participants some questions covering different aspects of our system (Appendix A.1).

2.4.1 Results of the study

Most of the participants tried the tool with their college and company websites. Our selected two websites (IIT-Hyderabad homepage and Indian culture page) were used for the cases where college websites were not working or where the user was open to any web-page. The re-narrations were generated in text, video and image. No participant chose audio as a medium of re-narration. Participants appreciated the idea of re-narrating pages to enhance the accessibility of the web pages and were very much interested in using our system frequently. We present our findings of the study as follows:

1. *Participants were interested in playing both the roles of a re-narrator as well as a reader.*

We obtained mixed views for the role people would like to play: the role of a re-narrator or a reader. Participants were excited to re-narrate a page for the reasons of sharing their thoughts and feeling of control over the web-page content. However, the choice of role for them was dependent upon the information present on the web-page. According to the participants, if the domain of the web-page was known to them, they would re-narrate the page and share their knowledge with others and if it was unknown to them, they would prefer to see the re-narrations of others. However, for topics like politics, cricket match updates and news headlines, every participant wanted to re-narrate as well as read the available re-narrations: “I surely would want to see the comments of my friends about Dhoni’s performance in last match.”

2. *As a re-narrator, people preferred generating text based re-narrations to video and audio re-narrations.*

Sixty percent of the participants preferred to generate text based re-narrations because they found writing text is easy and less time taking. Twenty percent of them were willing to generate video

narrations also, if provided with the required set-up in a user friendly way. To describe this, one participant said, “I would love to post a video explaining a topic, but I don’t want me to be involved in getting a camera, setting it up and talking to myself about the stuff. Maybe I will appreciate an online canvas or a realtime board for the same!” For forty percent of the participants, the choice of medium was dependent upon the web-page topic and they were willing to use any medium which could convey their intention in a most easy to understand and concise manner.

3. *As a reader, people preferred re-narrations in mixed media.*

Eighty percent of the participants preferred to check a combination of multiple forms (text/ video/ audio/ image) of re-narrations for a page. The reason is that a mixture of different media would express the perceptions of people in the best possible way. Sixty percent of the participants were interested in checking the video re-narrations first, followed by text and audio because participants considered video as more descriptive and interesting medium of communication: “Whenever I want to learn a new tool, I watch a YouTube video to learn its basics.” They mentioned that for situations like low bandwidth and other degrading factors, they will prefer text based re-narrations. Only two participants mentioned to choose audio re-narrations for the page while others found audio re-narrations inappropriate: “It is very irritating to listen to someone about a topic without watching him.” Image based re-narratives were welcomed by everyone but with a combination of some other re-narrations available in text or video.

4. *Majority of the participants were willing to generate re-narrations for their friends.*

Ninety percent of the participants showed their interest in re-narrating pages for their friends such as their college and school friends group. Sixty percent of them found our system useful in helping their family members by increasing their browsing experience and making the page more comprehensible: “My mother is very much interested in cooking recipes but she is not much proficient in English. If I translate my favorite dishes to her, she can cook more for me.” Ten percent of the participants mentioned farmers and illiterate people as their target groups for their re-narrations and were interested to narrate pages specifically in videos for them.

5. *Most of the participants wanted to see re-narrations from known people.*

Eighty four percent of the participants were interested in seeing re-narrations from their friends and relatives and were less inclined towards considering re-narrations of unknown people: “My friends know me better. Therefore, they will re-narrate the pages in the best possible way for me.” Only 22% of the participants mentioned their interest in seeing re-narrations from unknown re-narrators and wanted to search the best re-narrators themselves depending upon the topic: “I usually follow several experts on technical discussion forums for coding in different languages. Similarly, I would like to identify experts for the page of my interest by reading their available narrations.”

6. *Participants were interested in generating as well as checking the re-narrations in their local languages.*

While re-narrating pages, majority of the participants were inclined towards developing webpages in their local languages because they found language as the biggest barrier to the web accessibility. Seventy eight percent of the participants showed their interest in generating and referring re-narrations in their local language whereas the rest twenty two percent were neutral to the language preferences but were more focussed at the content of re-narrations.

7. *Participants found our system very useful to share information.*

Participants found our system useful to discuss and share information about various topics ranging from sharing class notes with colleagues, to sharing comments on discussion forums and news updates, to helping specific crowd like parents and farmers, to helping physically disabled people. One college student stated, “I guess it will be really useful when notes made by our class topper can be used by us!” and another participant said, “I can mark stuffs as cool while surfing online hacking stuff helping new hacker to filter out things faster!”

On asking whether our system would lure them to create some noisy data for fun and enjoyment, majority of the participants disagreed to it. They appreciated the system for learning and sharing purposes. One participant said “If I were to write garbage then I already have Facebook and Orkut, I will not use this.”

8. *Participants found the interface design of our system non-intuitive and uneasy to follow.*

The design of our system demotivated some users to re-narrate pages. Since our system requires a sequence of steps to re-narrate a page, most of the people found it very complex and preferred being a reader rather than a re-narrator: “The tool should be as simple as liking a facebook page, writing recommendations on LinkedIn, pressing thumbs up on youtube videos.” Another participant said, “Role of the reader is more lucrative at this point, first because I am lazy and second because I don’t know an easy way to do re-narration.” Participants found the re-narration steps non-intuitive to follow. For example, the ‘Save’ button to save a re-narration gave participants an impression that their narrations were published and therefore, the next intuitive step for them was to click ‘Exit’ button. However, to publish a re-narration, our system requires clicking ‘Publish’ button as the next step, which confused them tremendously.

Every participant suggested to develop a better GUI where the steps would be more intuitive and easy to accomplish. Some of the other suggestions in the direction of improving our tool were as follows: to merge ‘Save’ and ‘Publish’ button together for reducing confusion of the users; and to give proper feedbacks to the users in order to guide them the usage of system. One participant mentioned that our system should also allow people to write text on images where the re-narrations would serve as an alternate text or caption, which is not present in the current prototype. Five participants suggested to add features such as providing ‘Like’ button on each re-narrations to increase their credibility.

9. *Majority of the participants were interested in seeing an automatically transformed page with the best set of re-narrations suitable for them.*

Sixty percent of the participants mentioned their interest of seeing a re-narrated page converted automatically by considering their profiles and interests; twenty two percent mentioned to manually select the best suited re-narrations for them. The rest eighteen percent were neutral about any such automatic transformation of the page as they wanted to experience the system for a few days to decide their preference for manual or automatic selection of the re-narrations. Thirty percent of the participants wanted an editable profile to regularly update their interests and selection priorities to improve ranking of the re-narrations for their queried pages.

While conducting the study, we faced certain issues with our existing system, which we mention as follows: 1) Our prototype does not work well with Wikipedia pages, news web-pages and other dynamic pages like <http://cricinfo.com>. 2) The alipi toolbar does not appear for some college web-pages such as <http://www.iiit-bh.ac.in>. However, we did not allow these issues to affect our study. Whenever any such issues were encountered with the requested URL, we asked the participant to experience the tool with our selected web-pages which were working fine.

2.5 Alipi prototype as a browser plugin

We are currently working on a Firefox plugin to support our Alipi framework. The plugin by passes the URL <http://alipi.us> and enables every page for re-narration. The purpose of plugin development is to provide an easy solution for the readers to access the re-narrations. Figure 2.6 shows a snapshot of the Alipi plugin toolbar which appears in the browser after its installation. In the Figure, menu ‘Renaration’ shows the number of suitable renarrations available for the user; Menu ‘Author’ shows details of the current re-narration (author and re-narrated language) recommended by the plugin; button ‘Renarate’ allows the user to renarrate the current web page and the button ‘Original’ allows the user to see the original web-page; menu ‘Settings’ contains different options to maintain the user profile. Further details about the plugin development can be found in the technical report by F. Boudinet et al. [10].

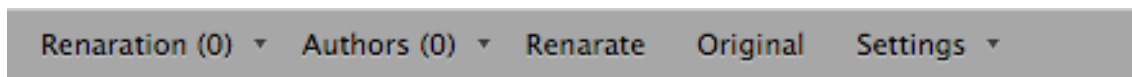


Figure 2.6 A snapshot of the Alipi plugin toolbar showing different options of menus and buttons for the users.

The plugin works in the following way for the three subsystems of Alipi:

1. At the reader end, plugin establishes a connection with the Alipi indexer server and retrieves all the available re-narrations for the queried page. The plugin filters some of the most suitable re-narrations for the reader. The selection is based on her profile along with some rules defining

how her specified preferences should be considered. We will explain the user profile and filtration algorithm of the plugin in the next section. In the current version of the plugin, all the filtered re-narrations are listed under the ‘Renaration’ menu of the toolbar and the reader needs to choose one from the list (Figure 2.6). But we are working to modify the plugin such that the original page gets re-narrated on-the-fly for the highly matched set of re-narrations available for unique sections of the page, while the remaining filtered re-narrations will be listed under the ‘Renaration’ menu of the plugin toolbar. The plugin provides necessary details of all the re-narrations available for the page such as the re-narration author, language of the re-narration, and the list of re-narrations.

2. For a re-narrator, the plugin provides a ‘Renarate’ button to re-narrate any page (Figure 2.6). The user needs to go through the same steps from step 2 onwards as explained in Section 2.3.1. Corresponding to each re-narration, following information will be stored as a semantic tweet on the Alipi server: re-narration target information (location, language, community), blog URL where the re-narration is available and re-narrator details (name, specialization).
3. Indexing of the re-narrations available for the web pages remains same as explained earlier. The available tweets are mapped for each section of the web-page, which are then fetched for every request to the page.

2.5.1 Maintaining user profile with Alipi plugin

The plugin maintains a user profile under ‘Settings’ menu of the toolbar (Figure 2.7a) and the profiles are stored as a JSON¹ file on Alipi server. The profile is editable and contains the following attributes: Language as read-and-write and listen-only; Disability as visual, hearing, none; Friends, relatives and Interests (Figure 2.7b). For example, if a person X knows three languages: English, Hindi and Telugu and he is proficient in both English and Hindi (read and write ability) but partially understands Telugu (Listen-only). Such information about language proficiency is useful to filter out the suitable re-narrations for the user. For example, a text based re-narration available in Telugu language is not useful for X. However, an audio re-narration in Telugu may be suitable for him. In addition to this, the language distinction makes a lot of sense with disabilities. For example, if X is blind, he may still be able to listen re-narrations but can not read the web-page (considering any other accessibility tools are not installed in X’s computer). Here, language type ‘listen’ should be considered by the plugin to suggest best re-narration to X.

The user needs to fill his profile in the ‘See your preference file’ manually. The plugin also allows the users to export their profile from Facebook or Twitter. If a user edits her preference file, the changes are reflected back to her JSON file maintained at the Alipi server. We are currently working on providing an easy user interface to edit profiles and on extending the attributes of user profile to include more details of the user.

¹JSON is Javascript Object Notation. It is a text based simple notation of data structures to enhance human-readability of the data.

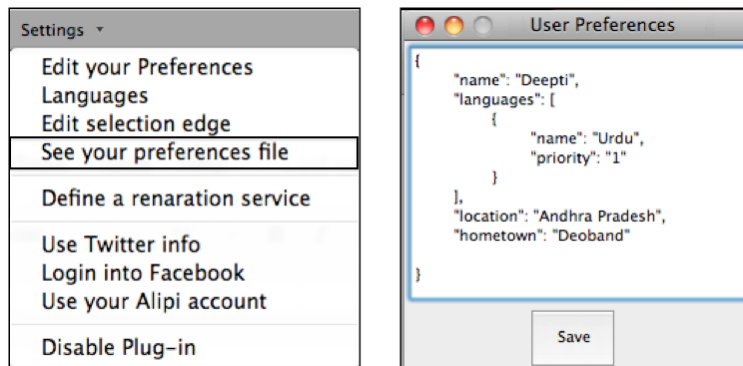


Figure 2.7 Maintaining user profile with Alipi plugin a) ‘Settings’ menu overview: The user can edit her information, disable/enable the plug-in and import her profile from Twitter or Facebook. b) User can edit her preference file by writing her interests in JSON format.

2.5.2 Algorithm to recommend suitable re-narrations to the reader

The plugin runs a selection algorithm to filter out the most suitable re-narrations for the reader by checking the available re-narrations against her profile. Below are the rules of recommending a re-narration to a reader A.

1. Target language of the re-narration should match one of the specified language in the Language list of A’s profile. Languages mentioned as ‘read-and-write’ are given higher priority than ‘listen-only’ languages. For example, if language type of the available re-narration is read-and-write, the re-narration in any medium (text, audio, video) can be recommended to A. However, if any re-narration is not available for her language preferences under read-and-write category, then plugin will recommend the available video or audio re-narrations for her preferred languages under listen-only category.
2. If a person has some disability then medium of the re-narration is chosen accordingly. For example, plugin will recommend text based re-narrations to a deaf person for the languages mentioned under read-and-write category and will not consider recommending audio or video based re-narrations.
3. Re-narrations are filtered based on the given list of friends and relatives of A. Those re-narrations are selected for which the re-narrator is either her friend or relative.
4. Those re-narrations are selected for which the target location matches with any of the locations mentioned in her profile.
5. Most recent re-narrations are then suggested to the reader. Freshness of the re-narrations is maintained by storing a timestamp corresponding to each re-narration.

In the current version of the plugin, interests of a person and disabilities (like learning & cognitive and motor related) are not considered to rank the re-narrations. Moreover, no priority is given to the location list of the person, which may contain attributes like hometown, visited places, places of education, current location and further more. In future, we will extend our algorithm to include all these factors as part of the selection algorithm. In addition to this, we will also incorporate trust level of friends to rank the re-narrations. The trust level may be helpful to decide filtering of re-narrations based on the expertise of re-narrators corresponding to her different interests. For example, if a person is interested in scientific articles then he may not consider his Facebook friends, rather he may prefer his LinkedIn connections. For recreation activities, he may prefer his Facebook friends.

2.6 Conclusion

In this chapter, we have presented Alipi, a framework that supports defining accessibility in a larger context. The Alipi framework emphasises re-narration as a general approach to address accessibility over the Web. Furthermore, the decentralisation and multiplicity of the re-narrations eliminate the top-down, normative approach of WCAG guidelines. Alipi also enables re-narration communities to grow around specific needs as experienced and articulated by the communities and its accessibility enablers without global norms of what accessible content ought to look like.

In the chapter, we have discussed how three subsystems of Alipi work to achieve the goal of re-narration. We conducted a study to test the feasibility of Alipi approach and its acceptance by people. We received encouraging response from the participants as they were thrilled by the concept of re-narrating web in their own content. We also encountered some issues while conducting the experiment, on which we are working. Dynamically generated web-pages are difficult to re-narrate because of their varying DOM structure. Alipi needs to store DOM path of each re-narrated element of a page on Alipi server and refer it to fetch the re-narrations available for the page at reader's end. We have also explained the working of a plugin developed to make the task of re-narration easier. The plugin is still in the stage of development. We look forward to incorporate different attributes in the user profile of the plugin such as dynamic re-narration of the page with most suitable set of re-narrations, considering user interests and other disability factors to recommend suitable re-narrations to the user.

Several interesting technical questions have emerged as we embark on developing Alipi from a prototype to a more robust implementation and testing it with sizeable communities over the web. To cite just a few examples, what could be a metric for matching or comparing the relatedness of two re-narrations? What optimizations are possible in the indexing and delivery of the matching pages? What are the security implications of the architecture? Finally, in the proposed Alipi architecture, we plan to build on rich ontological structures shared across social networks created in a distributed, de-centralised manner, used with browsers extensions and web services. Thus, we foresee Alipi leveraging the Semantic Web in a comprehensive way. From a social perspective, it would also be interesting to study

formally how communities share and evolve around re-narrations and what issues could emerge within these re-narrations.

2.7 Future Work

Here, we mention the future directions of this work:

1. How to check the relatedness of a re-narration (generated with Alipi tool) with the original document as well as with other available re-narrations for the same web-page? This may be achieved by using summarization techniques where the keywords of each re-narration are matched with the original document and with other available re-narrations.
2. How to check the credibility of a re-narration to filter the noisy re-narrations and to rank the useful ones higher than the others? To perform this, public voting for each re-narration may be considered by providing a simple 'Like' button as available on YouTube and other discussion forums. Moreover, to filter out the noisy re-narrations, techniques of content filtering by using external vocabularies and emotion/sarcasm detection may be useful.
3. How can we improve the re-narration selection algorithm used in Alipi plugin to make it more effective and robust? How the algorithm should be developed so that it also considers the rapidly growing online communities, every local dialect spoken in different geographical locations and the nearby areas of user preferred regions? The vicinity of user mentioned regions may be defined by considering parameters like language such as if the same language is spoken in the nearby areas of mentioned place, then re-narrations targeted for those areas can be recommended to the user. Different such factors need to be incorporated in the algorithm to generate more suitable re-narrations to the users.

Appendix A

User study feedback forms

A.1 Questionnaire of study conducted for Alipi system

Questionnaire contains two sets of questions: one asked before giving task to the user and another set was given once the user has completed the task.

Below are the questions asked before giving the task of filtering named entity relations.

Name:

Gender:

Age:

Profession:

Computer experience:

1. Do you read online documents? For what purpose? What sort of?
2. Do you face any issue(s) while accessing the web? Mention some examples.
3. If answer to question 2 is yes, then how do you think that this problem can be solved?
4. What do you think about sharing thoughts on YouTube, blogs, discussion forums or any other such medium? Have you ever participated in any such discussion? What motivates you there to write?

Below are the post-study questions.

1. Do you find the system boring/ frustrating/interesting/neutral? What do you like about this system?
2. What is more exciting: re-narrating a page (Re-narrator), or seeing a re-narrated page (consumer)? Why?
3. Which medium would you prefer to re-narrate a page: text/audio/video/image/mixed? Why?

4. Which medium would you prefer to read on a re-narrated page: text/audio/video/image/mixed?
Why?
5. Which re-narrations do you find useful: one from your friend, or from an unknown?
6. Would you like to have an algorithm of selecting a re-narration automatically?
7. What would be your target group of users for re-narration? Why?
8. How do you think this task can be made more interesting?

Related Publications

Publication List

1. T. B. Dinesh, S. Uskudrali, S. Sastry, D. Aggarwal, and V. Choppella. Alipi:A framework for re-narrating web pages. *International Cross- Disciplinary Conference on Web Accessibility (W4A)*, 22:1-4, Lyon, France, 2012.

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