Mobility Support for Visually Impaired Web Travellers

End of Second Year Interview Report

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1 Introduction

This short report presents the progress of the PhD project which aims to improve the mobility of visually impaired Web users. The thesis of this PhD project is that "Web pages could be analysed for identifying travel objects and their roles, in consequence they could be annotated with semantic metadata so that a tool could be devised to transform Web pages in a way that the objects could play their intended roles and enhance the provided mobility support". This report summarises:

- the motivation and objectives of the project,
- the work performed in the first two years,
- a work plan for the final year of the project, and
- proposes a time management scheme for the project and outlines the anticipated thesis structure.

2 Context and Motivation

Harper [6] introduced the notion of travel and mobility on the Web to improve the accessibility of Web pages for visually impaired and other travellers by drawing an analogy between virtual travel and travel in the physical world. **Travel** is defined as the confident **navigation** and **orientation** with **purpose**, ease and accuracy within an **environment**, that is to say, the notion of travel extends navigation and orientation to include environment, mobility and purpose of the journey. **Mobility** is the ease and confidence at which travel can be accomplished.

Visually impaired people have difficulties accessing the Web, either because of the inappropriately designed Web pages or the insufficiency of the currently available technologies. This lack of accessibility leads to poor travel support for visually impaired users. Visually impaired people usually access the Web, by using screen readers [8] or specialist browsers [1]. For these access technologies to work properly, Web pages must be appropriately designed and must be encoded in valid HTML that conforms to its DTD (Document Type Definition) and various accessibility guidelines. The W3C Web Accessibility Initiative and others, recognise these difficulties and provide guidelines to promote accessibility on the Web [3, 5]. Unfortunately, not many pages are so designed. Additionally, these access technologies

have focused on supporting the sensory translation of visual content to either audio or touch (through braille) rather than deeply affecting travel on the Web [7].

3 Current State of the Project

Our main goal is to improve the mobility of visually impaired Web users by providing tool support for the provision of mobility. The travel analysis framework which is the foundation for the tool is created in the first year of this project and introduced in [12]. The aim of this tool is to analyse the travel support offered within a Web page and semi-automate the process of:

1. Identifying travel objects– a Web page will be inspected for potential travel objects and these will be placed in an inventory;
2. Classifying– the role of the extracted travel objects will be identified;
3. Annotating– the extracted travel objects will be annotated by the concepts from the mobility ontology which has been created in the second year of this project;
4. Transforming– the analysed page will be transformed into another form by considering annotations so that the identified travel objects could fulfill their intended roles.

Knowledge of how visually impaired people actually travel gives a context for their travel on the Web[4]. We have devised and used an ontology to annotate pages that encapsulates this knowledge. This ontology can be considered as an assistive mechanism for applying physical travelling metaphors to movement around the Web. Our domain of interest is the mobility of visually impaired users and this ontology is used as a controlled vocabulary for the transformation part of the tool. We use the COHSE[1] annotator[2] to annotate pages with this ontology. The annotations are stored externally and accessed by the transformation part of the tool.

The mobility ontology consists of three parts. The first part encapsulates the knowledge about the travel objects from real world mobility studies– *mobility* concepts. The second part holds information about including hypermedia concepts and vocabularies used in previous work on transcoding– *authoring* concepts. The last part holds information about the context of a journey. The annotation process is encoded in an annotation pipeline. The first two parts of the ontology play important role in this annotation pipeline. Authoring concepts can capture the knowledge about how the objects are *presented* in the environment and mobility concepts can capture the knowledge about how the authoring concepts are *used* in a journey. Therefore, the combination of these two parts of the ontology, could provide extensive knowledge to perform the transformations of the Web pages to ease the travel. In the second year, the annotation pipeline is partly created and introduced in [11] along with the mobility ontology.

In the next two sections, we will summarise the work done in the first two years of this project and the work that needs to be done to complete the project.

4 Summary of the Research Undertaken

The activities in the first two years of this PhD project can be summarized as follows:

[1]The Conceptual Open Hypermedia Project (COHSE) (`http://cohse.semanticweb.org`), particularly, Mozilla plug-in version of the COHSE annotator is used.

First Year:

1. **Reviewed the published literature** related to web accessibility, travel and mobility. By conducting a literature review, it was possible to characterise the nature of visually impaired user's interaction with web pages. Additionally, it was possible to spot the problems with the style of interaction and the support offered by assistive tools.
2. **A new travel analysis framework was developed**.
   - Harper [6] provided a mobility analysis framework. We substantially revised this framework and in practice, Harper's framework proved inappropriate for the basis of the tool that we are planning to build. Therefore, we have significantly revised and extended this framework.
   - **Conducted an evaluation** to test the applicability and efficiency of the framework. The evaluation showed that it is rigorous enough for being used as the basis of a mobility support tool.

Second Year:

3. **Published a paper in WWW2003 conference**[2] for presenting the framework and the evaluation conducted [12].
4. **Devised an annotation pipeline** which provides an efficient way of annotating pages both manually and automatically. These annotations can then be used to transform pages to enhance the mobility support.
5. **Reviewed the evaluation techniques** to find an appropriate method of evaluation for the tool that we are aiming to build (see Section 5).
6. **Surveyed technological resources**, particularly annotation tools. We have investigated a number of annotation tools and decided to use COHSE annotator[2]. It has a Mozilla[3] plug-in version which we could use to annotate pages and publish the annotations by transforming pages based on the provided annotations within Mozilla. This could be important to have a single environment for authoring and delivering annotations.
7. **Created the mobility ontology**. This ontology serves two purposes: a representation of a shared conceptualisation of knowledge about the mobility of visually impaired people, and a controlled, shared vocabulary that can be communicated across applications, particularly, it could be used in the transformation part of the tool.
8. **Built a testbed manual annotation environment** by setting up the COHSE annotator and using the first draft of the mobility ontology.
9. **Devised a set of transformation heuristics** by investigating previous work on transformation of Web pages, analysing a number of Web pages and reviewing the literature on the studies of Web accessibility. This is a preliminary set of heuristics, we will continue extending these heuristics.
10. **Created a prototype sidebar** for Mozilla for performing transformations, that is to say, a technique was established for delivering the annotations and illustrating the possible usage of the annotation pipeline.

[2] See `http://www2003.org/`.
[3] See `http://www.mozilla.org/`.

11. **Published a paper in K-CAP 2003**[4] for introducing the mobility ontology, explaining the annotation pipeline and demonstrating the usage of the pipeline through a set of example transformation scenarios based on some of the devised heuristics[11].

12. **Implemented translation heuristics for annotation accumulation**. We have created a servlet that uses Jess (Java Expert System Shell)[5] which maps the authoring concepts to mobility concepts based on their properties (see Section 3). Therefore, we have started implementing some translation rules for mapping. These rules are still at the experimental stage. Using such an expert system is important to automate the process of travel analysis and transformations. In addition, it gives the flexibility to extend and add specialised rules (e.g., specific rules for specific types of pages/ sites).

As a conclusion, in the first year of this project, we have focused on completing the ground work which is the travel analysis framework and in the second year, we have focused on implementation of the process encoded in the framework. Consequently, the first half of the final year will be spent in completing the implementation and the evaluation, and the second half will be spent for writing up.

5 Work Plan

The programme of work for the remainder of this PhD is discussed below:

1. **Improving the ontology**: We will continue working on the ontology; improving the concepts and adding properties to concepts.

2. **Extending the heuristics**: The transformation heuristics will be extended and we will particularly focus on the heuristics for automating the translation of authoring concepts to mobility concepts. This is crucial for the automation of the entire travel analysis and transformation process. Since we have started using Jess, we will also focus on extending the rules for mapping authoring concepts to mobility concepts based on the properties of the authoring concepts.

3. **Completing the implementation of the annotation pipeline**: we will complete the implementation of the annotation pipeline, in particular, we will focus on the formulation of the rules for the translation.

4. **Completing the implementation of the transformation heuristics**: while we extend the transformation heuristics, we will continue implementing them.

5. **Evaluation of the prototype**: we are planning to use co-operative evaluation technique with the Task Load Index from NASA[10]. Co-operative evaluation is a method for evaluating user interfaces based on the use of verbal protocols, with users completing a set of tasks whilst being observed[9]. Mainly, we are planning to create a set of tasks, particularly demanding mobility. Half of the participants will be asked to start to perform the tasks with the original page, while other half will start to perform tasks with the transformed page, then the groups will swap. This is important to eliminate the factor of transferring lessons learnt and having preferences for the second one (positively or negatively). In co-operative evaluations, participants are encouraged to think aloud which is

[4] See `http://sern.ucalgary.ca/ksi/K-CAP/K-CAP2003/`.
[5] See `http://herzberg.ca.sandia.gov/jess/`.

Tasks	Months	1 6	7 12	13 18	19 24	25 30	31 36
preliminary study	**from 09/01 to 08/02**						
literature survey- web accessibility							
literature survey- browsing							
studying TOWEL project (the notion of travel and mobility)							
characterise travel objects							
creating travel analysis framework							
evaluating travel analysis framework							
***First year report**							
writing a paper for presenting the framework	**from 09/02 to 08/03**						
reviewing the evaluation techniques							
survey of technological resources							
creating the mobility ontology							
setting up COHSE annotator							
introducing and working on the annotation pipeline							
heuristic specifications for transformations							
implementing a prototype transformation sidebar for Mozilla							
writing a paper for introducing annotation pipeline and the mobility ontology							
implementing Jess servlet							
***Second year report**							
improving the ontology	09/03-09/03						
extending the heuristics	10/03-10/03						
completing the implementation of the annotation pipeline	11/03-12/03						
completing the implementation of the transformation heuristics	12/03-01/04						
evaluating the prototype	02/04-03/04						
****Thesis write-up**	04/04-09/04						

Figure 1: WorkPlan

important for us to get their experiences while travelling[9]. The Task Load Index(TLX) was developed by NASA as a means of measuring the workload under test conditions. Participants will be asked to give numerical ratings for different criteria such as mental demand and time pressure. By using the combination of these two evaluation techniques, we expect to demonstrate that the mobility support is enhanced in the transformed Web pages.

Planned publications based on the remaining work are expected to include:

1. A paper discussing the complete implementation of the annotation pipeline; explaining the components of the pipeline, introduce Jess servlet with translation rules and demonstrate the usage through some example transformation heuristics (can be published in WWW2004 conference);
2. A paper discussing our mobility ontology;
3. A paper presenting the entire travel analysis process including the manual and automated parts along with the evaluation results (can be published in Journal of Universal Usability, Journal of Web Semantics/Journal of Web Intelligence).

Figure 1 depicts the preliminary task decomposition above as a Gantt chart.

6 Thesis Structure

The anticipated thesis structure can be outlined and summarised as follows:

1 Introduction

2 A Survey of Related Work

3 The Travel Analysis Framework [12]

- Introduce the notion of travel and mobility;
- Criticise the framework proposed by Harper [6];
- Explain the stages of the new framework;
- Present the evaluation of the framework.

4 The Mobility Ontology (authoring concepts and mobility concepts)

- Explain why we need this ontology;
- Provide the background information that underpins this ontology;
- Provide information about the process of creating this ontology;
- Illustrate how this ontology will be used.

5 The Annotation Pipeline [11]

- Explain how the travel ontology will be deployed and used;
- Discussion of different annotation scenarios by using this pipeline;

6 The Travel Analysis Tool

6.1 Manual Travel Analysis

- Introduce the COHSE annotator [2];
- Provide some example scenarios for annotation.

6.2 Automatic Travel Analysis

- Heuristics for mapping authoring concepts to mobility concepts;
- Heuristics for extracting mobility objects;
- Provide implementation details of the annotation pipeline;
- Explain some example scenarios.

6.3 Transformation of a Page

- Heuristics for transformation;
- Explain some example scenarios.

7 Confirming the Improved Mobility (ease of travel) of the Transformed Page

- Explain the evaluation of the annotation and transformation process;
- Expect to demonstrate that the provided mobility support is enhanced.

8 Conclusions, Contributions and Future Work

References

[1] Chieko Asakawa and Takashi Itoh. User interface of a home page reader. In *Proceedings of the Third International ACM Conference on Assistive Technologies*, pages 149–156, 1998.

[2] Sean Bechhofer and Carole Goble. Towards annotation using daml+oil. In *K-CAP 2001 workshop on Knowledge Markup and Semantic Annotation*, Victoria B.C, October 2001.

[3] Kara Pernice Coyne and Jakob Nielsen. Beyond alt text: Making the web easy to use for users with disabilities. Nielson Norman Group, October 2001.

[4] Carole A. Goble, Simon Harper, and Robert Stevens. The travails of visually impaired web travellers. In *Proceedings of the Eleventh ACM on Hypertext and Hypermedia*, pages 1–10, 2000.

[5] Jon Gunderson and Ian Jacobs. User agent accessibility guidelines 1.0. World Wide Web Consortium (W3C), 1999.

[6] Simon Harper. *Web Mobility for Visually Impaired Surfers*. PhD thesis, The University of Manchester, 2001.

[7] Simon Harper, Robert Stevens, and Carole A. Goble. Towel: Real world mobility on the web. In Vanderdonckt J. and Puerta A., editors, *Computer-Aided Design of User Interfaces II*, pages 305–314. Kluwer Academic, 1999.

[8] Henter-Joyce, Inc. *Jaws*. `http://www.hj.com`.

[9] Andrew Monk, Peter Wright, Jeanne Haber, and Lora Davenport. *Improving Your Human-Computer Interface: A Practical Technique*. Prentice Hall, 1993.

[10] Robert D. Stevens and Alistair D. N. Edwards. An approach to the evaluation of assistive technology. In *Proceedings of the Second Annual ACM Conference on Assistive Technologies*, pages 64–71. ACM Press, 1996.

[11] Yeliz Yesilada, Simon Harper, Carole Goble, and Robert Stevens. Ontology based semantic annotation for enhancing mobility support for visually impaired web users. In *K-CAP 2003 Workshop on Knowledge Markup and Semantic Annotation*, 2003.

[12] Yeliz Yesilada, Robert Stevens, and Carole Goble. A foundation for tool based mobility support for visually impaired web users. In *Proceedings of the Twelfth International Conference on World Wide Web*, pages 422–430, 2003.