Accessibility Driven Design for Policy Argumentation Modelling

Dimitris Spiliotopoulos[1], Athanasios Dalianis[1], and Georgios Kouroupetroglou[2]

[1] Innovation Lab, Athens Technology Centre, Greece
{d.spiliotopoulos,t.dalianis}@atc.gr
[2] Speech and Accessibility Lab, Dept. Informatics and Telecommunications
University of Athens, Greece
koupe@di.uoa.gr

Abstract. This paper discusses the design of a web interface for policy argumentation modeling. Given the complexity of the interface the WAI-ARIA descriptions were used to ensure that the data were accessible and the visual-heavy presentation was simplified. Conclusions were drawn as to the usefulness of the WAI-ARIA guidelines to an elaborate design of user interaction with highly dynamic content.

Keywords: web interface, policy modeling, WAI-ARIA, accessibility.

1 Introduction

Recent advances in user interface design and approaches on handling complexity have led to wide adoption of data visualization techniques along the spectrum of web applications. With semantic web clearly in position to harvest, analyze and provide metadata for large-scale applications, such as opinion mining, brand monitoring, and others, data visualization is a key feature of research interest. The dynamic nature of data visualization, the dense amount of information represented and the raw number of connections between data renders such task difficult to model.

Since quite some time, graphs have been identified as a formidable tool to navigation and data exploration [1]. Recent studies verify the effect in perceived usability of graph visualization [2]. It is also argued that it is the efficient access of information through visualization that helps improve usability of traditional data exploration interfaces [3]. Usability-driven techniques are applied directly to web interfaces in order to reveal patterns and shortcomings in information accessibility [4]. Usability is also affected during the interaction with graph visualizations because the context is affected, taken out of focus [5]. That is more profound in visualization tools that exhibit high hidden dependencies [6]. On the interaction level, the semantics of the interactions can also be used to generate user interfaces [7].

Complex data semantics can be visualized using appropriate structures, like graphs, that come in several varieties. Interactive graphs aid usability since users are able to interact with the data they see, rather than triggering visualizations by clicking

C. Stephanidis and M. Antona (Eds.): UAHCI/HCII 2014, Part IV, LNCS 8516, pp. 101–108, 2014.

elsewhere on the interface. Building interactive user interfaces that heavily depend on information visualization necessitates that the design of the interaction also be focused in the visualization techniques and approaches.

WAI-ARIA is a W3C recommendation that has been recently drafted in order to describe semantic assignments that can be used in user interfaces to aid accessibility [8]. This recommendation tries to address the latest changes that semantic web has introduced to the way that information is presented and accessed. The web page centric design has been abandoned for the more distributed approach that uses multiple interaction elements and very high interactivity. The main objective of the WAI-ARIA suite is to ensure or improve web interface accessibility. Studies show that the WAI-ARIA specification can be used to adjust existing Web 2.0 interfaces to a more accessible format [9]. However, that is accomplished by defining a number of methods that essentially improve the usability, as well. That is an interesting additional value that can be used in the design as an additional set of tools for maximizing the user experience. Core design methods, such as prototyping, personas and storyboarding may use accessibility guidelines to create W3C compliant interfaces [10].

The WAI-ARIA recommendations have also been applied to the social web to improve both accessibility and usability [11, 12]. Social web is a major source of large amounts of data that are analyzed and visualized. It is, therefore, clear that semantic web and accessibility guidelines based on semantics can be part of a clean user interface design. In the cases when dynamic content that is not covered by the WAI-ARIA guidelines, other remedies may be submitted [13]. However, for the most part, the WAI-ARIA guidelines provide enough technical competence to significantly improve usability.

This work focuses on the WAI-ARIA authoring practices [14] and applies them on top of the usability-driven design and methods for designing a highly interactive information visualization web interface for policy argumentation modeling. This work identifies the intentions behind the suggested practices and includes them in the user-driven design of the NOMAD authoring interface that is entirely graphical. The paper starts by introducing the problem and then describes a pilot experiment with expert users and the resulting web interface prototype based on their feedback.

2 Requirements and Problem Specification

As part of the NOMAD[1] EU-funded project, policy makers and political scientists create domains and policies for web and social web collection of arguments of the citizens. The final policy model for a specific policy is, then, fed to the NOMAD system for collection of data, analysis and visualization. Creating an ontology domain is a meticulous task that requires specialized tools not only for testing the completeness of the data but also for evaluating the correctness of the relations between the data types.

[1] NOMAD - Policy formulation and validation through non-moderated crowdsourcing, www.nomad-project.eu

In order to study the broadness of the latter, a common initial design approach is to allow only tree-based structures to be created. That simplifies both the available space for the assignment of relations as well as the interaction required by the end users. However, there are instances where the complexity of a domain may only be fully expressed by a proper graph representation. Potentially, an unconstrained graph may be a quite complicated structure requiring high effort and cognitive load for the user to visually parse and verify the data and their relations. It is also far more complex, on the interaction level, to create such structure compared to simple tree representations.

For such rich technological basis, it was decided to study the WAI-ARIA authoring practices in order to create interactive prototype views of a graph-based authoring web interface. The requirements were simple:

1. Users need to open and edit ontology domains and policy models. In order to do that, they also need to navigate through the available domains. Domains have unique title names, spanning from one work to a long sentence.
2. To edit a domain or a policy model, insertion and deletion of nodes as well as naming and renaming are the main tasks. A different, in terms of design, is the task to apply or delete connections between the nodes.
3. Entities, norms and arguments are the three types of data that can exist on the ontology and consequently on the any visual structure.
4. Graphs may contain tens or hundreds of nodes with a relatively high amount of connections.

The challenging aspects of the task were to be able to maintain a constant level of comprehension for the users towards their data. That would minimize unnecessary looking back or zooming out on the interface in order to put the data back into perspective. One other step towards a usable interface was the need for full access to all the information at any time, unconstrained editing, yet with minimal effort by the users.

3 Tree-Based Interaction Draft Prototype

In order to be able to understand the way that experts construct a policy model, an authoring environment with tree-based representation of the ontology domains was made available (Fig. 1). Expert users created their own policy models and domains as well as revisited to check the system output. The system performs a targeted crawling process based on the policy model description and the analyzed data become an additional source of data on the policy model.

The original requirements suggested that a simple tree hierarchy of terms was sufficient for the representations of the policy models. The mind map overview (fig. 1, centre) and the hierarchy tree (fig. 1, right) could be used interchangeably for editing the models. At the early stages, the user interaction was observed in order to establish a baseline for the type of interaction needed for creating policy models. Indeed, there were several approaches that were also different, to a degree, from the traditional ontology creation process.

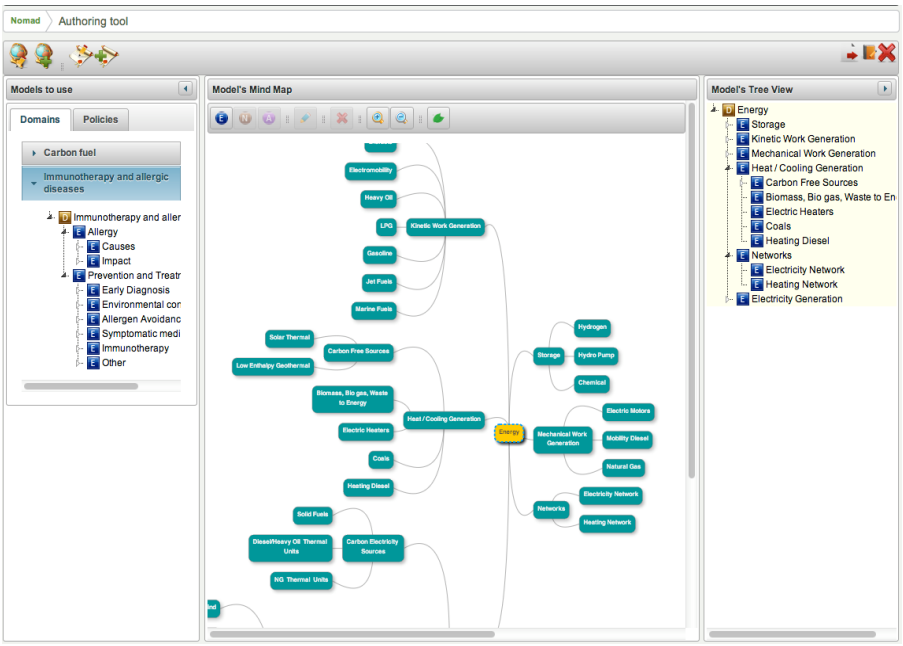

Fig. 1. Tree-based representation (initial interactive prototype for policy domain authoring)

Ten participants evaluated the interaction during the first design iteration. The purpose was twofold. The innovation of the NOMAD approach necessitated a visual modeling of policies that would be used for the data collection and the linguistic analysis. In that respect, this evaluation was designed to examine the steps that the policy experts follow and the required functionalities to achieve the goal via their interaction. Moreover, the participants copy-pasted, drag-and-dropped nodes in order to create and edit the policy models as represented by a hierarchy tree or a mindmap.

The WAI-ARIA authoring practices document includes sections on trees and drag-and-drop support. The guidelines contained in the two sections as well other general ones were used for the construction of questionnaires for the user feedback. The following is a partial list of items that were examined during the evaluation.

1. Structural navigation: clear identification of logical structure
2. Nesting: Clear role of hierarchy tree
3. Nesting: Clear role of mindmap
4. Nesting: Distinctions and differences between trees and mindmaps in interaction
5. Focus: Clear identification of items in focus
6. Labeling: Nodes labels accessibility
7. Describing: Types of data (nodes) identification
8. Dynamic changes: Live regions implementation
9. Drag-and-drop support: Purpose of drag-and-drop (duplication, editing, etc.)
10. Drag-and-drop support: Drag source and drop destination clearly marked
11. Drag-and-drop support: Cancelling drag-and-drop

12. Drag-and-drop support: Testing of functionality for between-tree-mindmap actions
13. Presentation: all data elements focusable, selectable, accessible, editable, consistent

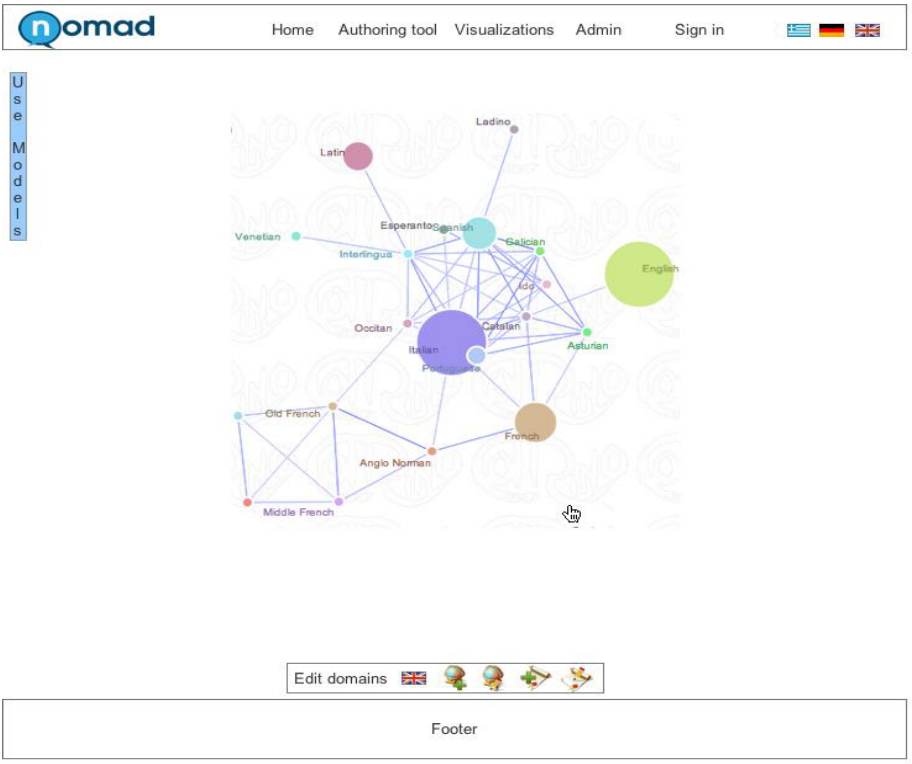

Fig. 2. Graph-based representation (mockup)

The feedback clearly favoured the more graphic of the two layouts. In the usability feedback, the tree structure was deemed more straightforward for editing, viewing the full model without having to zoom out and in clear representation of the data types (due to larger area available for the mindmap). For the above accessibility-based questions, the users identified the key points of attention:

1. Colour must be used to differentiate data types. Entities, arguments and policy components should be clearly identifiable and distinguishable from one another.
2. When a user selects an item, the linked items should be easily discoverable (mindmap).
3. Drag-and-drop between the tree and mindmap is a good approach since it allows pre-arranged actions.
4. Mindmaps and trees may be more suitable for small models, larger ones lead to unwanted need to zoom in and out, mindmaps grow too large and trees too long for larger models, making them harder to navigate.

4 Graph-Based Visual Authoring of Policy Models

As the user requirements were updated in the next iteration, the same participants evaluated the graph-based visualization approach. The core requirements for larger non-hierarchical policy models, where entities may connect to other entities instead of policy components, was the deciding factor to deploy graph-based visualization. That approach would, potentially, help resolve the accessibility issues that were raised during the previous evaluation.

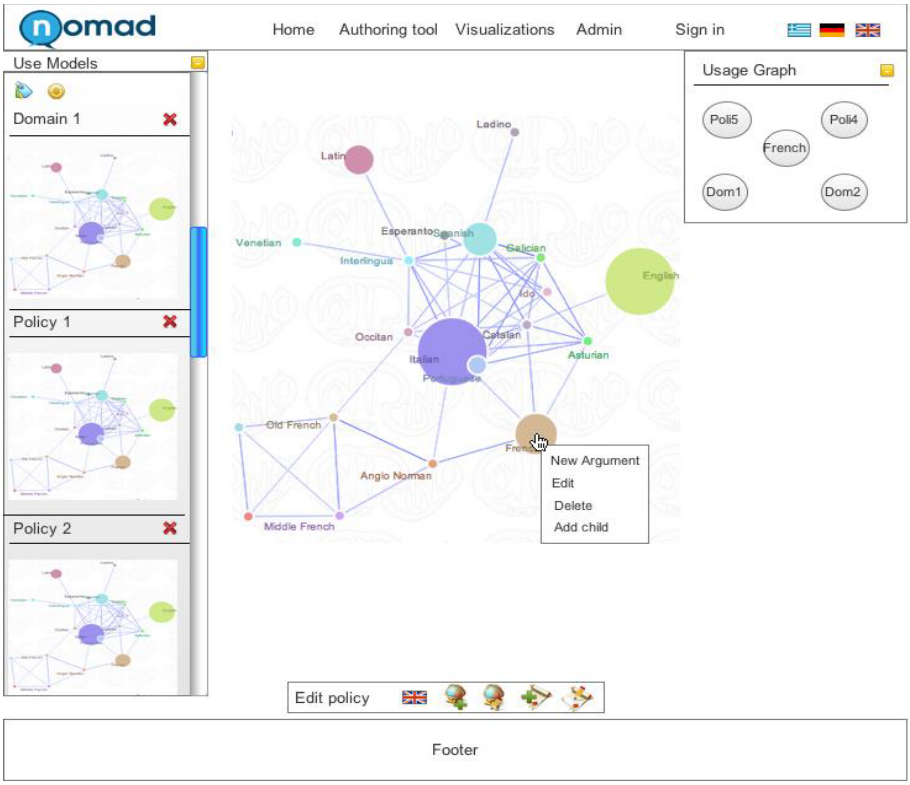

Fig. 3. Graph-based multiple representation of policy models (mockup)

At this point, the WAI-ARIA derived design specifications discussed in the previous section would serve as the guide for the interaction design. In effect, the user feedback served as hypotheses as well as additional interaction requirements for the updated design. The hypotheses were formulated automatically and were evaluated on the usability improvement over the earlier results. Figure 2 shows one of the several mockups that were designed for this approach. In order to test the parameters thoroughly, the mockups were designed to go beyond the user suggestions and also explore the WAI-ARIA derived specifications to more extensive paradigms.

The policy authors evaluated colour representation of possible actions, foci status, and data types through multiple mockups. Additionally, visual ways of ensuring that navigation information was clearly presented on the graphs were investigated. The desired result was to be able to design the same process for navigation using both mouse/trackpad and keyboard as input devices.

The feedback from the participants was very encouraging in some cases, such as the visual feedback for node selection, but also revealed that more work was needed for certain tasks that, although did not seem very complicated, were found to be quite difficult to decide on an optimal way to complete. Such task is shown in figure 3. In that example, the policy model author was trying to insert a policy component and its connected nodes to the model that was being edited. Selecting a node for drag-and-drop from an existing policy model, off a list of policy models currently showing was too complicated to do using the keyboard because of two active navigation-enabled areas at the same time.

5 Conclusion

This work investigated the recently release WAI-ARIA accessibility guidelines as a potential design specification for designing user interaction elements for accessible and usable dynamic content. The test bed was the NOMAD policy modeling authoring environment during the first two iterations of the design and testing. The traditional usability evaluation was enriched with specific accessibility-derived design considerations in order to evaluate accessibility along with usability for an accessibility-aware user driven approach.

The unavoidable complex approach, on the concept level at least, of policy modeling using a visual user interface was a serious test case for a semantically rich web application with highly dynamic content. Policy components, entities and arguments as the basic ingredients of a policy model and that was the first time that the visual modeling of a policy was experimentally investigated.

That usability evaluation session revealed that the initial hypothesis that the WAI-ARIA specific guidelines can serve as specification for the design of a complicated visual approach to a web interface was verified. It also revealed that, for highly dynamic content, the adoption of the WAI-ARIA authoring practices is not a straightforward task as was previously claimed in other works [15].

There was strong indication that additional effort is required for a fully usable and accessible web interface design for the more complex interaction functionalities. For example, spoken interaction can be used to quickly find the data in graphs, wither by title or even in tags (semantic or otherwise) that can be used for grouping and filtering. The authors believe that spoken interaction for navigation and editing tasks as well as respective visual dynamics to correspond to the input commands warrants a further investigation.

Acknowledgements. The work described here was partially supported by the EU ICT research project NOMAD, FP7-ICT-288513.

References

1. Leblanc, B., Marshall, M.S., Melancon, G.: Graph Visualization and navigation as an interface to data exploration. In: VSST 2001, Barcelona, vol. 2, pp. 279–284 (2001)
2. Mazumdar, S., Petrelli, D., Elbedweihy, K., Lanfranchi, V., Ciravegna, F.: Affective Graphs: The Visual Appeal of Linked Data. In: Semantic Web – Interoperability, Usability, Applicability. IOS Press (to appear, 2014)
3. Paulheim, H.: Improving the Usability of Integrated Applications by Using Visualizations of Linked Data. In: Proc. Int. Conf. on Web Intelligence, Mining and Semantics, WIMS 2011, Article 19. ACM, New York (2011)
4. Chi, E.H.: Improving Web Usability Through Visualization. IEEE Internet Computing 6(2), 64–71 (2002)
5. Herman, I., Melancon, G., Scott Marshall, M.: Graph Visualization and Navigation in Information Visualization: A Survey. IEEE Transactions on Visualization and Computer Graphics 6(1), 24–43 (2000)
6. Kuhail, M.A., Lauesen, S., Pantazos, K., Shangjin, X.: Usability Analysis of Custom Visualization Tools. In: Proc. SIGRAD 2012, Sweden, November 29-30, pp. 19–28 (2012)
7. Mayer, S., Tschofen, A., Dey, A.K., Mattern, F.: User Interfaces for Smart Things - A Generative Approach with Semantic Interaction Descriptions. ACM Transactions on Computer-Human Interaction (to appear, 2014)
8. Craig, J., Cooper, M.: Accessible Rich Internet Applications (WAI-ARIA) 1.0, W3C Proposed Recommendation (February 6, 2014), http://www.w3.org/TR/wai-aria/ (retrieved February 28, 2014)
9. Mori, G., Buzzi, M.C., Buzzi, M., Leporini, B., Penichet, V.M.R.: Collaborative Editing for All: The Google Docs Example. In: Stephanidis, C. (ed.) Universal Access in HCI, Part IV, HCII 2011. LNCS, vol. 6768, pp. 165–174. Springer, Heidelberg (2011)
10. Green, S., Pearson, E., Gkatzidou, V., Perrin, F.O.: A community-centred design approach for accessible rich internet applications (ARIA). In: Proc. 26th Annual BCS Interaction Spe-cialist Group Conference on People and Computers (BCS-HCI 2012), pp. 89–98. British Computer Society, Swinton (2012)
11. Buzzi, M.C., Buzzi, M., Leporini, B.: Web 2.0: Twitter and the blind. In: Proc. 9th ACM SIGCHI Italian Chapter Int. Conf. on Computer-Human Interaction: Facing Complexity, pp. 151–156. ACM
12. Buzzi, M.C., Buzzi, M., Leporini, B., Akhter, F.: Is Facebook really "open" to all? In: IEEE International Symposium on Technology and Society (ISTAS), pp. 327–336 (2010)
13. Borodin, Y., Bigham, J.P., Dausch, G., Ramakrishnan, I.V.: More than meets the eye: a survey of screen-reader browsing strategies. In: W4A 2010, p. 13 (2010)
14. Scheuhammer, J., Cooper, M.: WAI-ARIA 1.0 Authoring Practices, W3C Working Draft (March 7, 2013), http://www.w3.org/TR/wai-aria-practices/ (retrieved February 28, 2014)
15. Lele, Y., Kariya, C., Kale, N., Nandgaonkar, A., Phatak, M.: Human Computer Interaction for Visually Impaired Users in Web Based Applications. International Journal of Scientific & Engineering Research 4(8) (August 2013)