Usability Evaluation of Accessible Complex Graphs

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Abstract. This work explores the use of speech enabled complex graphs that are designed to enable non-technical users to edit and appraise visually complex semantic structures. The standard usability evaluation that was performed previously employed young, computer-literate participants that were familiar with such concepts and tools. We report on the findings of how technically-savvy and technically challenged users experience the different modalities, make choices and identify each modality advantages and shortcomings as well as the ability of each user group to optimally exploit modality combination paths.

Keywords: Speech enabled graph · Usability · Accessibility · Non-technical users

1 Introduction

Visualization of data is used abundantly to convey complex semantic meaning [9] and facilitate data exploration [14]. As part of the latest data-driven visualization approaches, storytelling is also based on the visualization using descriptive complex design [11].

Auditory feedback was used successfully for the simple math graph [2] and more complex visual chart [3] accessibility for visually impaired users, as well as combination of haptic and auditory feedback [16]. Other approaches used natural language generation for fine tuned speech rendering of complex visual objects, such as graphs [4]. Evaluating such approaches constitutes a similarly challenging task, leading to works exploring ways to enable the user-driven design and usability evaluation of technologies for accessibility [1].

This work examines a domain of high societal impact that potentially affects all citizens of the democratic world. Policy modelling utilizes moderated crowdsourcing argumentation from social media that can enable policy makers and other users to visualize the citizen opinion. Policy models are represented and visualized as relational graphs, semantically linking policy components, entities and arguments with sentiment, the latter mined from social media [12]. Related works examined design considerations for creating effectively usable tools using social media data [5] and sentiment [8].

Dedicated e-participation and e-government tools designed for modelling policies present unique advantages to the policy makers [6, 10]. However, evaluations showed that severe weaknesses hinder the citizen adaptation, such as failure to understand the

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visual structures [15]. Even policy makers find themselves not in possession of the required policy informatics-friendly competencies, skills, and attitudes to work on the policy formulation process [7]. It is, therefore, evident that, in order to include technologically marginalized citizens [17] to the new era of e-participation tools and processes, specific care should be made to facilitate the understanding of such visual representations.

2 Motivation and Experimentation

The main motivation for this work was to explore how accessibility practices may help towards using a complex interactive visual tool for policy design. A speech interface was developed as a result of the user driven design to enable improved navigation and editing of complex graphs (Fig. 1).

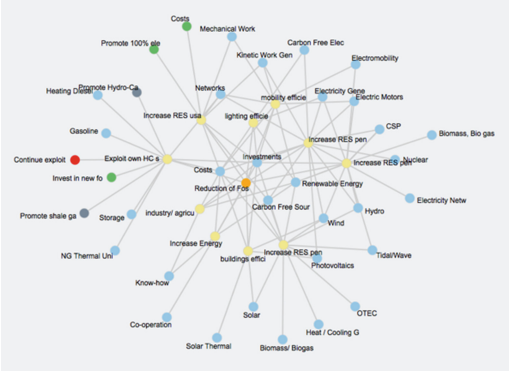

Fig. 1. A policy model

All interaction actions can be performed by either regular keyboard/mouse input or speech commands and automatic speech recognition [13]. The initial user evaluation by technically savvy users revealed that combined speech and normal (keyboard/mouse) interaction can help create and edit large complex graphs. However, it was also evident that less technology savvy users, mainly including older users, were not as successful at these tasks.

A follow up experiment was set up for exploring methods and practices to design inclusive interaction for non-tech-savvy users, essentially successfully enhancing their work output. Five participants that work in the field of policy modelling, hence familiar with the content, but do not traditionally use a computer (NTS group) and five policy formulation students that were not familiar with the interface, but considered themselves technically-savvy normal users (TSN group) were asked to explore the limits of their ability to follow the model complexity using any modality or combination they deemed optimal. The aim was to examine whether the choices of the two groups aligned and their feedback on the usability differentiated between them. Both groups

were given ample time to familiarize with the interface, functionalities, the modalities and speech commands. The interaction of each participant were logged, including timestamps, providing interactional data for validation.

3 Results and Evaluation

The NTS group needed on average roughly twice the time to familiarize with the interface. The speech modality consistently took less time to familiarize with than the visual, the former averaging a 30 % longer than the TSN group, while the latter about 80 % longer on average. For simpler tasks (e.g. adding a new node) each user group opted for different modality as their main choice. Tasks considered as less complex were treated in a uniform manner, involving both modalities for optimal interaction. However, concrete differences were observed when the complexity of the graphs increased. The TSN group explored four times more possible combinations to achieve optimal results, mainly in understanding and keeping up with the graph semantic complexity (e.g. deciding where to link a new policy component).

The NTS group insisted on making themselves more involved with selected choices, identifying themselves as the factor that hindered their progress rather than the interface. Content creation was differentiated heavily between the two groups. The TSN participants followed a path of creating very descriptive, long texts that resulted in more cluttered graphs. The NTS group, with their expertise in paper and pen approach limited by the size of the paper itself, introduced abbreviation and provided feedback as to how that abbreviation should be part of the interface, essentially partially overcoming the visual modality disadvantage.

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