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Visualizing Large-scale Linked Data with Memo Graph

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Abstract

Many studies, in the literature, have affirmed a low level of user satisfaction concerning the understandability and readability of large-scale Linked Data visualizations offered by current available tools. This issue is especially problematic for inexperienced users. To address these requirements, we have extended our previous work Memo Graph, an ontology visualization tool, to provide a user-centered interactive solution for extracting and visualizing Linked Data. It takes aim to provide comprehensible and legible visualization. To manage scalability, it is built on an incremental approach to extract descriptive summarization from a given Linked Data endpoint where it becomes possible to generate a “summary graph” from the most important data (middle-out navigation approach). It offers user interfaces that reduce task complexity for users, especially the inexperienced ones. We tested Memo Graph on a number of Linked Data datasets with encouraging results. We discuss the promising results derived from an empirical evaluation, which affirmed that Memo Graph is useful in visualizing Linked Data and usable.

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1. Introduction and Motivation

Nowadays, Linked Data is increasingly used in a variety of contexts¹. Thus, an increasing number of people in the modern knowledge society get in contact with it. It is no longer exclusively used by domain experts but also by inexperienced users.

Data verification, exploration and sensemaking are of great importance in the field of Linked Data². However, it is difficult for humans to manually analyze and explore data¹. This problem becomes worse with casual users¹.

Visualization of Linked Data helps to overcome this hurdle^{1,3,4}. It provides users an intuitive way to explore the content^{2,5}, identify more easily errors³, infer correlations and causalities² and give expert users new perspectives.

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The interweaving of the Linked Data into the Web of Data is regularly done at large-scale³. As a consequence, visualizing large-scale datasets has become a major research challenge, of which readability and understandability are vital requirements^{2,3,6}.

Several visualizations for Linked Data datasets have been proposed in the last decade^{1,5,6,7}. However, many studies indicated a low level of user satisfaction concerning (1) the readability of large-scale Linked Data visualizations^{3,5} and (2) the lack of useful mechanisms for “content-level visualization”, including support for visual descriptive summaries, overviews and selective visualization of Linked Data dataset parts^{2,3,5}. These issues are especially problematic for casual users.

This requires a new generation of user-friendly visualization tools that offer readable visualizations of Linked Data datasets for all users^{3,5} and provide visual descriptive summaries of the large-scale ones^{3,5,8}.

Attempting to address these requirements, we have extended our earlier work Memo Graph⁹, an ontology visualization tool for everyone, to be able in its new version to offer a solution for extracting and visualizing Linked Data, as a way to offer concise readable overviews of the large-scale ones, and support a “middle-out” navigation approach, starting from the most information-rich recourses i.e., “best descriptors”. It is designed to be used by everybody, including expert and non-expert users. It offers a rich set of interaction and navigation techniques; all tasks proposed by Ben Shneiderman¹⁰ as well as other functionalities.

The remainder of the present paper is structured as follows: Section 2 describes current approaches for visualizing Linked Data. Section 3 presents the extension of our previous work, Memo Graph, in offering an understandable interactive visualization of large-scale Linked Data. Section 4 gives some applications of the developed intervention. In Section 5, we present the evaluation the usability and the usefulness of Memo Graph in visualizing Linked Data that it is conducted on experienced semantic web users. Section 6 draws conclusions and future research directions.

2. State of the Art: Linked Data Visualization Approaches

Dadzie and Rowe proposed the most comprehensive survey of existing Linked Data visualization approaches³. They divided the approaches into 2 categories: browsers with visualization options and text-based. They concluded that the majority of the implemented approaches are designed to be used only by domain expert users and do not provide overviews on the dataset.

We organize Linked Data visualization approaches into 2 categories: “Approaches proposed specifically for visualizing Linked Data” and “Approaches proposed mainly for visualizing RDF ontologies supporting the specific requirements of Linked Data”. Table1 summarizes the characteristics of some Linked Data visualization approaches.

Table 1. Comparison of some Linked Data visualization approaches.

Visualization type	Interaction							Development platform	Non-expert users	
	Filter	Query (formal syntax)	Query (format or keywords)	Zoom	Overview	Detail on demand	Relate			History
“Approaches proposed specifically for visualizing Linked Data”										
RelFinder*	Graph.	*	*	*	*	*	*	*	Web application	
Explorator ¹¹	Graph.	*	*	*		*			Web application	
Fenfire ¹²	Graph.	*			*	*	*		Web application	
LODWheel ¹³	Graph and chart.	*			*	*	*	*	Web application	*
Rhizomer ¹⁴	Map, timeline and chart.	*	*	*	*	*	*	*	Web application	*

* <http://relfinder.dbpedia.org>

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