Semantic Web: Ontological Search Approach

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Abstract. This demonstrator provides a semantic search service for a business-to-business (B2B) platform. It bases on an ontology network that describes the furniture industry. Platform users typically do not know its internal structure. They cannot search through its resources quickly and unambiguously. Facet Search services often have pre-defined facets. They do not scale well with an increasing number of products. Our demonstrator provides web interfaces for an Explorative Search to address this issue. It supports platform users to explore the ontology network quickly and precisely. The demonstrator creates SPARQL queries dynamically from user interactions, such as clicking and typing keywords. It has two search modes that apply product taxonomies, filters and joins. The user does not have to use SPARQL directly. The demonstrator is available on http://hydra2.ikap.biba.uni-bremen.de:9092. It is part of a B2B platform which is available on http://bit.ly/nimble-explorative.

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1 Introduction

The demonstrator described in this article bases on a new, federated, web-based, open-source B2B platform.[1] It has a service-oriented architecture. Companies can publish digital versions of product/service catalogues on this platform. Buyers can search them to identify relevant offers and start a negotiation process about prices and delivery conditions. This paper focuses on the platform's product search. Search filters can use one or more properties (facets). **Table 1** shows important differences between the platforms facetted search (Solr service) and its explorative search (new service).

Table 1. Comparison of Facetted Search and Explorative Search

Facetted search	Explorative search
Developer creates facets (static)	User defines properties for facet creation at runtime (dynamic)

[1] NIMBLE Project: https://www.nimble-project.org

Visualization of defined facets	Visualization of relevant facets
Facet visualization does not scale	Facet visualization limited to relevant ones

The total number of products and services is large and distributed over many categories. Their conceptual structure contains multi-stage taxonomies and similar properties. It is challenging to find the needed information in this structure from the user's perspective. Similar products in a catalogue differ from each other in a few properties. This means that entering a generic keyword in the search interface would retrieve many irrelevant results. The user needs an improved search functionality to focus on property-based information. The proposed search service takes into consideration the following:

- Apply ontological structure to allow generic and specific search.
- Allow the exact formulation of the search query for specific product features.
- Support the search with consistent and stable terminology.

The common terminology is independent of a specific catalogues but rather it offers high-level and product-specific concepts. To achieve these search capabilities via an ontology, a search service is necessary that simplifies complex query languages. This demonstrator relies on catalogues which are represented as ontologies in Web Ontology Language.

We present a graph-based search and a semantic pattern search. Graph-based search visualizes the available concepts and properties in an interactive graph. The user can observe the ontological meaning for an entity making it useful for dynamic catalogues. The semantic pattern search uses list of properties within panels to enable a direct search without obtaining deeper explanations of the underlying product structure. The next section presents both search types.

2 Approach for Search Services

This section describes the approaches of the developed search service. They have different assumptions and goals as summarized in Table 2.

Table 2. Comparison of Graph Based Navigation and Semantic-Pattern-Based Approach

	Graph-Based Navigation	**Semantic-Pattern-Based Approach**
Assumptions	User has a product category in mind and searches a keyword such as a chair. The user has some product properties in mind.	User has a specific product from a B2B catalog in mind. She knows the relevant properties and wishes to reach the desired product by applying filters quickly.

Goals	• User shall have complete freedom of the product selection • The search offers all possible search direction • The user familiarizes the terminology while searching for a product	• Usage of pre-defined terminology for quick search • Reduction of search space to the point of interest • Creation of complex queries through minimal set of actions

2.1 Graph-Based Navigation Approach

The example user searches a product category through the Explorative Search. She enters the keyword "chair" and has some of its relevant properties in mind. The user wants to explore more properties for the product. The goal of the graph-based search is to provide the user complete freedom of selection. It helps her to visualize the complex Ontology through an interactive, radial net graph. Its center is the searched product and the connected nodes are direct datatypes, derived datatypes, or object properties of the product (left part of Fig.1). Interactions, such as double-clicking a node, select the property and provide a filter for numeric values. A click on a selected node removes it from the selection.

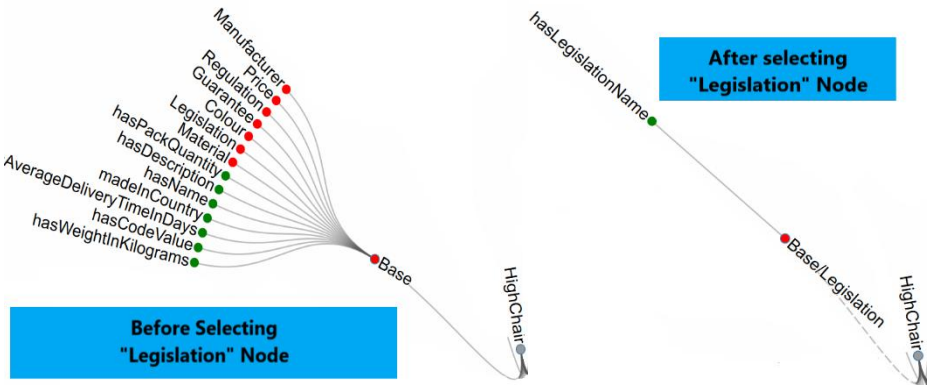

Fig. 1. Left part illustrates a part of a complete ontology for a product with related datatype (green) and object properties (red). Right side illustrates the change in the graph when selection of an object property occurs.

A double click on the object properties (red colored property) of the root concept updates the graph with new property of the already selected object property. It displays the intermediate nodes as a single node with names of these nodes separated using a forward slash.

The right part of Fig. 1 illustrates when the user wants to filter products based on properties in Legislation. Intermediate nodes collapse to support the user in keeping the focus on relevant concepts. The datatype property *hasLegislationName* appears and replaces the node *Legislation*.

2.2 Semantic-Pattern-Based Approach

We assume that the user has a specific product from the catalogue in mind. She is aware of its relevant properties and wants to apply filters quickly. This approach relies on two panels as illustrated in Fig. 2. The left panel provides the possible datatype properties and object properties. Upon clicking on a datatype property, the values for filtering become available on the right panel. If the user selects any of the filter properties, the backend selects this property for the SPARQL execution. If the user does not select a filter pertaining to a particular property then we assume that the property is not of interest and the user would only like to observe the filter values.

If the user selects an object property, the left panel updates with a new set of properties and references associated with this object property. A "breadcrumb" view on top of the panel provides an interaction history. The left panel updates with the relevant datatype properties and object properties upon clicking a breadcrumb.

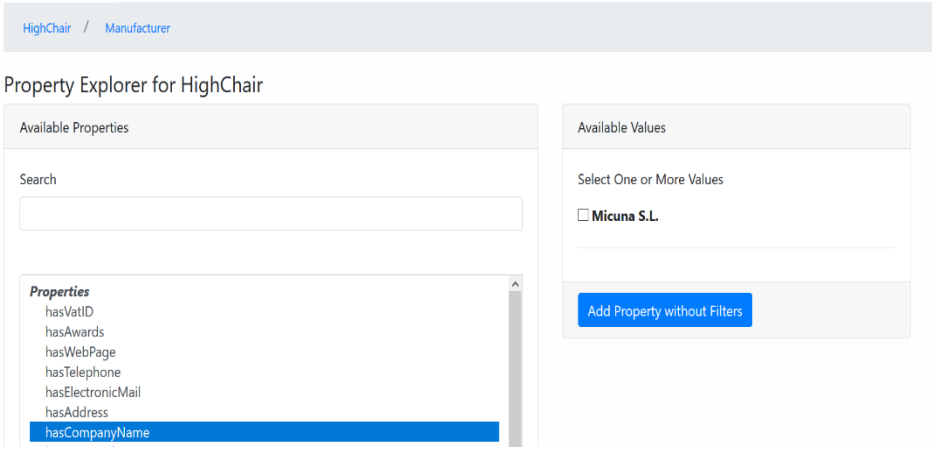

Fig. 2. Semantic Query Pattern Interface for a product

Four application scenarios provide product catalogs and domain experts for the demonstrator's evaluation. They cover the wooden furniture, wooden house, white goods and textile industries. The demonstrator can use any product catalog as long as it bases on an ontology. This makes the explorative search service applicable to many domains.

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