Onto-IKEA: A Knowledge Retrieval Framework based on IKEA Ontology

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Abstract
The evolution of Linked Open Data (LOD) has encouraged developers to create more and more context related ontologies. This advance is extremely important because Artificial Intelligence (AI) applications can access domain specific information that is in machine understandable format. In this paper, we present a knowledge retrieval framework which is based on our custom made IKEA ontology. The ontology is created with information from the IKEA dataset that we also created. The dataset contains information about household objects found in the IKEA website, relations between objects, and features such as dimensions, and material for the objects. Moreover, we provide a query interface that the user can use to address queries to the ontology.

Keywords
Knowledge Retrieval, Ontology, Object Feature

1. Introduction

The evolution of LOD in the last twenty years allowed developers to construct context related ontologies (i.e., ontologies that can be used only in specific environments, such as a household). The creation of context related ontologies seems to be the next step for allowing LOD to become the main knowledge representation mechanism for the Web. Our focus is on context related product ontologies, with features for the products (i.e., characteristics for the products). The idea of product ontologies has been given great attention recently and even generic techniques on how to create a product ontology were developed [1, 2].

This paper presents an ontology which was developed from a dataset that contains the information of the *IKEA Greece website*[1]. We present how we have collected the information from the IKEA website, how we have translated the information in a LOD format, and how we have developed a knowledge retrieval query interface to access the information in the ontology. Therefore, the issue we want to address is to provide a dataset and an ontology about real life

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[1]https://www.ikea.gr

product characteristics that were extracted from a commonly used website, which can be used as a baseline for the knowledge representation of any AI application.

The contribution of this paper is: (i) we offer the first dataset about IKEA products[2]. The dataset could benefit any computer vision mechanism that performs object recognition as it has more than 12.700 object pictures found in household environments. Moreover, we relate each product with its dimensions, and the material which are provided by the vendor's site, and (ii) we offer one of the largest ontologies about real life objects and dimension features for the objects. The ontology could be used as a tool by the vendor in order to have a presence in LOD.

The remainder of this paper is organized as follows. In Section 2 we present the related work. Next, Section 3 describes the vendor dataset, the vendor ontology, and the query interface. Finally, Section 4 concludes the paper with a discussion.

2. Related Work

The Knowledge Retrieval Framework that we present in this paper consists of three parts, the IKEA dataset, the IKEA ontology which was created from the vendor dataset, and a query interface that the user can use in order to retrieve information about the objects in the ontology. Considering that the query mechanism is a simple SPARQL query generator, we will not provide related work for this part. On the other hand, we will compare our framework with other ontologies and datasets about products and object features.

IKEA Dataset: We can compare the dataset only with parts of other object datasets, as most real life object datasets are not specialized at household environments. Object datasets with features can be found in [3] and [4]. In the former, the authors provide the weight of the objects and in the latter the material of the objects, while we provide the dimensions, and the material for the objects.

IKEA Ontology: Product ontologies can be found in the area of architecture [5], and manufacturing [6] but to the best of our knowledge we could not find an ontology about household products with features about the products, apart from *GoodRelations* [7]. GoodRelations is a generic product ontology with pricing for the products. Our difference is that we offer more object categories about household utensils than GoodRelations. Moreover, the features that we offer mainly have to do with dimensions. On the other hand GoodRelations includes pricing and other properties as well.

3. The Framework

In this section, we present the IKEA dataset, and the IKEA ontology which were created using the information from the vendor dataset. Moreover, we present the query interface with which the user can access the information in the ontology.

[2] https://github.com/valexande/IKEA-Dataset

3.1. IKEA Dataset

The *IKEA Dataset* is a custom made dataset which was created with information from the vendor website, and consists of 297 household product categories and 12.743 unique product images. The dataset contains information about the features of the products. More specifically, for each one of the 12.743 products it contains the ID which is given by the vendor, the *width*, the *length*, and the *height* in centimeters, and the *material* of the object. Figure 1 shows two product images, instances of the product category *Counter* (left) and *Coat Stand* (right), with their unique ID, as well as their features.

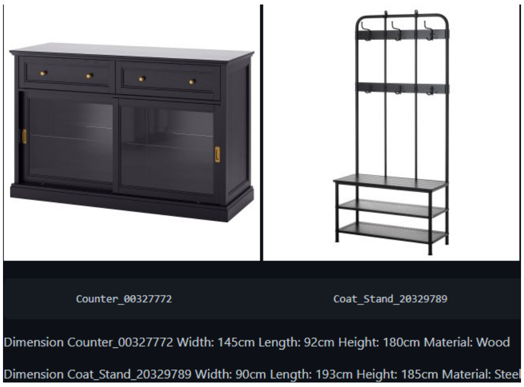

Figure 1: IKEA Object Images

Additionally, the dataset contains hierarchy relations between the product categories. For instance, the product category *Kids Chair* is a sub category of the product category *Chair*. The dataset contains the information in different files which point to the object category, each file contains the object images and a txt file with the object features. In the txt file, each line has an object ID and the features for that object. The dataset was created by scrapping the HTML code of the vendor website using the *Requests* library[3] from Python.

3.2. IKEA Ontology

The ontology was constructed based on the dataset. Therefore, the scheme of the ontology was easily created, because the hierarchy was given by the IKEA dataset. Figure 2 shows part of the ontology scheme. Each class shown in the figure represents an object category. On the other hand, in order to represent object features we created the properties *hasLength*, *hasWidth*, *hasHeight*, and *hasMaterial*. All these properties have domain the class *IKEA* and range the datatype *Decimal* (i.e., xsd:decimal), except the property *hasMaterial* which has domain the class *IKEA* and range the datatype *String* (i.e., xsd:string). Moreover, we connect the instances with their url, with the property *hasUrl*. Example 1, shows how the information for the object *"Counter_00327772"* (Figure 1), which is an instance of the class *Counter*, is represented.

[3]https://pypi.org/project/requests/

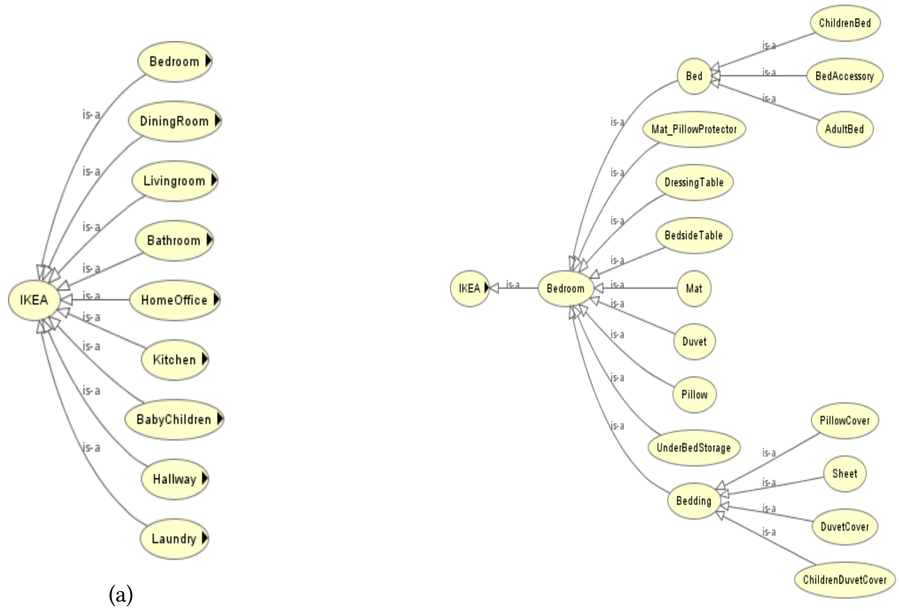

Figure 2: Part of the IKEA Ontology

Example 1.
```
:"Counter_00327772" rdf:type :Counter;
    :hasWidth 145;
    :hasLength 92;
    :hasHeight 180;
    :hasMaterial "Wood";
    :hasUrl <https://ikea.azureedge.net
    /images/680x680/1/variantimages/00327772/0.jpg>.
```

3.3. Knowledge Retrieval

The knowledge retrieval mechanism can return information about an object from the ontology, based on the object's ID. Initially, the system will ask the user for which class she desires information by displaying the names of the classes, and subsequently for which instance of the class by displaying the IDs of the objects in the class. The name of the classes as well as the instances in the class that the user selected are returned with predefined SPARQL queries. The query that returns the instances in the class needs as input the name of the class, which is given by the user. The templates of these two SPARQL queries are omitted due to lack of space, but they can be found in our source code. Similarly, after the user selected a class (<Class>) and an instance ID (<ID>), a SPARQL query as shown in the Example 2 will be generated.

Example 2.
```
SELECT ?url ?width ?length ?height ?material WHERE
        {<ID> rdf:type <Class>;
```

```
:hasUrl ?url.
OPTIONAL{<ID> :hasWidth ?width.}
OPTIONAL{<ID> :hasLength ?length.}
OPTIONAL{<ID> :hasHeight ?height.}
OPTIONAL{<ID> :hasMaterial ?material.}
}
```

The SPARQL query shown in Example 2 can return information as shown in Figure 3, where the user chose the instance *"AdultBed_40349847"* and the *AdultBed* class.

Figure 3: Results of SPARQL query

4. Discussion and Conclusion

The constant extension of LOD has showcased that we need to construct more context related ontologies. In this paper, we provide a knowledge retrieval framework which is based on our custom made ontology and dataset. More specifically, we provide an IKEA product dataset with the features of the products as given by the website of IKEA. Moreover, we constructed an ontology which is based on the dataset that we created, and a mechanism that produces automatically SPARQL queries in order for the user to access the information in the ontology. As for future work, we plan to extend our knowledge retrieval mechanism with external knowledge from semantic web knowledge bases such as ConceptNet [8] and WordNet [9]. Moreover, we plan to add more features about the products from the vendor's site, such as descriptions and reviews. Also, we will upload the knowledge graph into a public triple store and align our ontology with other commonly used ontologies, such as GoodRelations. Finally, we will construct more sophisticated SPARQL queries for the query interface, for example *"Show me all the Desk products made out of Wood"*, although a user can just use direct SPARQL queries to retrieve any information on the IKEA ontology and knowledge graph.

The information existing in various sites can help in constructing such ontologies. Our ontology aims at providing one of the largest ontologies about real life products and dimension features for the products. The information in the dataset can benefit computer vision mechanisms for object understanding through their dimension. Also, if our ontology could be extended with information from other IKEA sites (we have collected only from IKEA Greece), it could be used as a tool by the vendor in order to have a presence in LOD. The latter can work as motivation for other websites to translate their information in LOD.

The evaluation was left as a future work because we plan to construct a user interface with which the user can address queries to the ontology. Therefore, we plan to perform a user evaluation once the user interface will be ready. Moreover, the quality of the information in the dataset is actually the information that the vendor has in its site, and the quality of the information in the the vendor site is evaluated by the users through their reviews.

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