Towards a Sales Assistant using a Product Knowledge Graph

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Abstract. The phenomenal growth in the electronics industry over last decades is mainly due to the rapid advances in the integration technologies. Its market is ever evolving with new products being made available on a frequent basis. However, very often the consumers do not know features and functions of an electronic device. Although a specification of a certain product is provided by manufactures, it is hard to use for an average user to provide a common understanding. In this paper, we introduce a concept of enterprise entity hub by combining a base (general) knowledge into product knowledge. A product knowledge graph is constructed by transforming both a set of data from a product management system and external data. Then, we introduce a sales assistant called *God of Sales*[1] that aims to provide a novel approach for explaining a comprehensive manner for product features and functions with recommendation.

1 Introduction

In the last decade, we have witnessed a sharp increase in the availability and use of electronic devices such as smart phones, television, video game consoles, refrigerators, and computers [2]. According to the Consumer Electronics Association (CEA), total industry revenues would grow 2% to $211.3 billion in 2014 and another 1.2% in 2015 [3]. This means that electronic devices have become an integral part of our daily life.

However, parallel with the increased use of electronic devices, there has been a shift towards poorer understanding of device features. Recently many electronic products tend to combine the functionality into one: for example, smart phones have functionalities of digital cameras, camcorders, and GPS navigation devices. The problem arises that an average user may find it hard to understand various technical terms to describe electronic devices. Although most of manufactures provide well-defined specifications of their products, a novel approach for consumers' better understanding needs to be discussed.

[1] This is a mobile application, thus we provide a video clip. All features are implemented and can be demonstrated. Download is available at http://52.88.252.96/down/gos.mp4

In this study, we introduce an innovative sales approach using a product knowledge graph. We briefly describe a concept of hybrid enterprise entity hub with combination of a base knowledge and product knowledge. In particular, ontology model and methods for constructing a product knowledge graph are described. Then, some features of God of Sales as a sales assistant are introduced.

2 Integration Product data into Enterprise Entity Hub

The hybrid enterprise entity hub aims to become a single, up-to-date canonical source of data as a crucial infrastructure meant to structure, integrate and manage knowledge in enterprises. As illustrated in Figure 1, it aims to organise and distribute enterprise data and enable its universally accessibility for data consumers. By means of linked data technologies [1], silo'ed data in enterprises can be interlinked, and thus allow people to use data with ease and share data across heterogeneous sources.

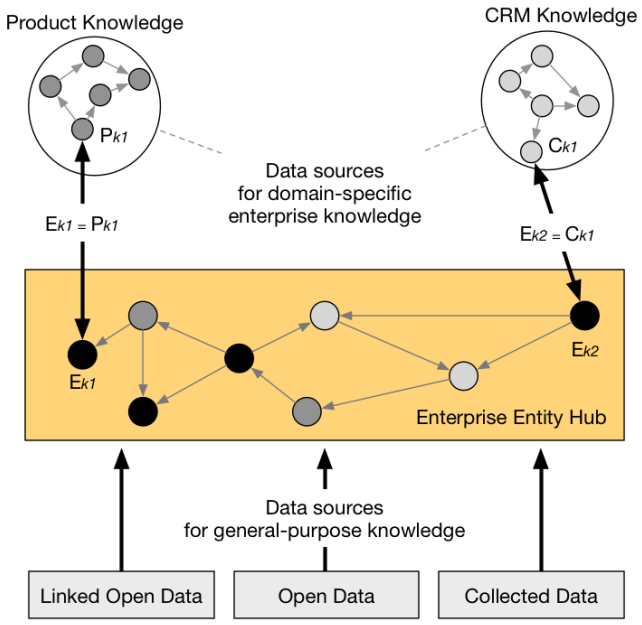

Fig. 1. A concept of hybrid enterprise entity hub

2.1 Develop Base Knowledge

To realise the enterprise entity hub, we must construct a base knowledge, one that provides a stable set of reusable concepts and entities with consistent identifiers

to enterprise systems and applications. All content and data can be interlinked to this base knowledge, and data consumers can take advantage of richer knowledge for individual entities through interlinked knowledge. It comprises of both global knowledge for describing things in the world and enterprise knowledge that provides various domain-specific business data. A domain-specific knowledge is transformed into a graph-based knowledge base by interlinking the base knowledge. When entities in a set of domain knowledge are not present in the base knowledge, this information is appended to the base knowledge.

2.2 Develop a Product Knowledge

A product knowledge graph comprises of a collection of various product categories including smart/mobile phones, tablet, computers, home appliances, television, and refrigerator. In general, most of electronics companies have their own information systems to maintain specifications of their devices and products. We also collect entire specifications as a dump from our management systems, and then update daily changes by linking between our knowledge platform and the management system. On the other hand, a set of product specifications that are made by other manufactures have collected via crawling websites, downloading relevant files on the Web, or open APIs such as BestBuy.

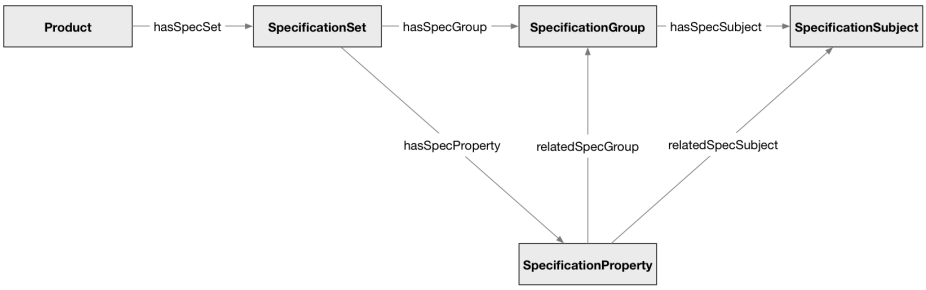

Fig. 2. A core model for describing product information

A comprehensive and sophisticated ontology is essential for representing a wide variety of product data. Figure 2 illustrates a core model for a product knowledge graph. Each product has a set of product specifications, and a specification comprises of a collection of specification groups with individual specification items. For example, power consumption of a television is a specification group of ce:Eco and ce:Power, and values of this feature are described by several formats such as integer value, unit, and display value.

Each product has its own specification that comprises a set of technical features. Some features can be applied to multiple products, and they present a shared instance. For example, specifications in UHD TV and Galaxy S6 have the same HDMI feature, and further similar cases exist throughout all products

of consumer electronics. In this case, defining this feature and its detailed descriptions as an entity in the base knowledge is more effective than describing it with respect to its individual categories (or domains). Hence, if this entity already exists, this entity is interlinked into the entity URI in the base knowledge, whereas it is added onto the base knowledge if the entity is not defined.

By using this ontology model, entire datasets are transformed into knowledge graph as a triple format. Furthermore, each entity of the product knowledge graph has connected to one of base knowledge by entity identification. Currently, the product knowledge graph has approximately 356,314 entities and five millions triples for about 10,000 products. The graph data is stored in a triple store and is published in the form of URIs with data in human readable and machine-readable form. A SPARQL endpoint to an RDF description of data sets is developed.

3 Sales Assistant - God of Sales

This application aims to allow users to have a better understanding of products using the product knowledge graph and environmental information of the users. Using this application, users are able to get more descriptive information of an individual specification item. The application provides eight usages for a television such as Exterior, Convenience, Media Activity, Smart Activity, Connectivity, Entertainment, Economy, and Screen. A usage has a set of features for describing details of methods or capabilities of a product. Connectivity has content sharing, easy to play content, Internet access, screen sharing, and wireless as a feature. Then, a relevant specification items are introduced.

An average user is hard to understand functions of a technical term without any help. In this sense, providing a usage and its related features is useful to users rather than provide a specification item directly. For example, *Twin Turner* allows to users to watch multi-channels on two different devices. As explained, this application introduces *Connectivity* as *Usage* and *Screen Sharing* as one of features. Then, *Twin Turner* is described with details including description, relevant video clips, and a list of products, which have this specification item. Furthermore, this application provides a compatibility-based recommendation. When a product is selected, compatibility among other devices is inferred. Because entities of specification items are represented at a semantic level, compatible relationships between a selected product and other devices are easily discovered.

4 Conclusion

In this study, we introduced a novel approach to generate a product knowledge graph by interlinking the base knowledge, and then demonstrate a more effective manner for delivering product information using the God of Sales. This application focuses on delivering better understanding of a product, its feature, and compatibility between different products. We consider for future research the

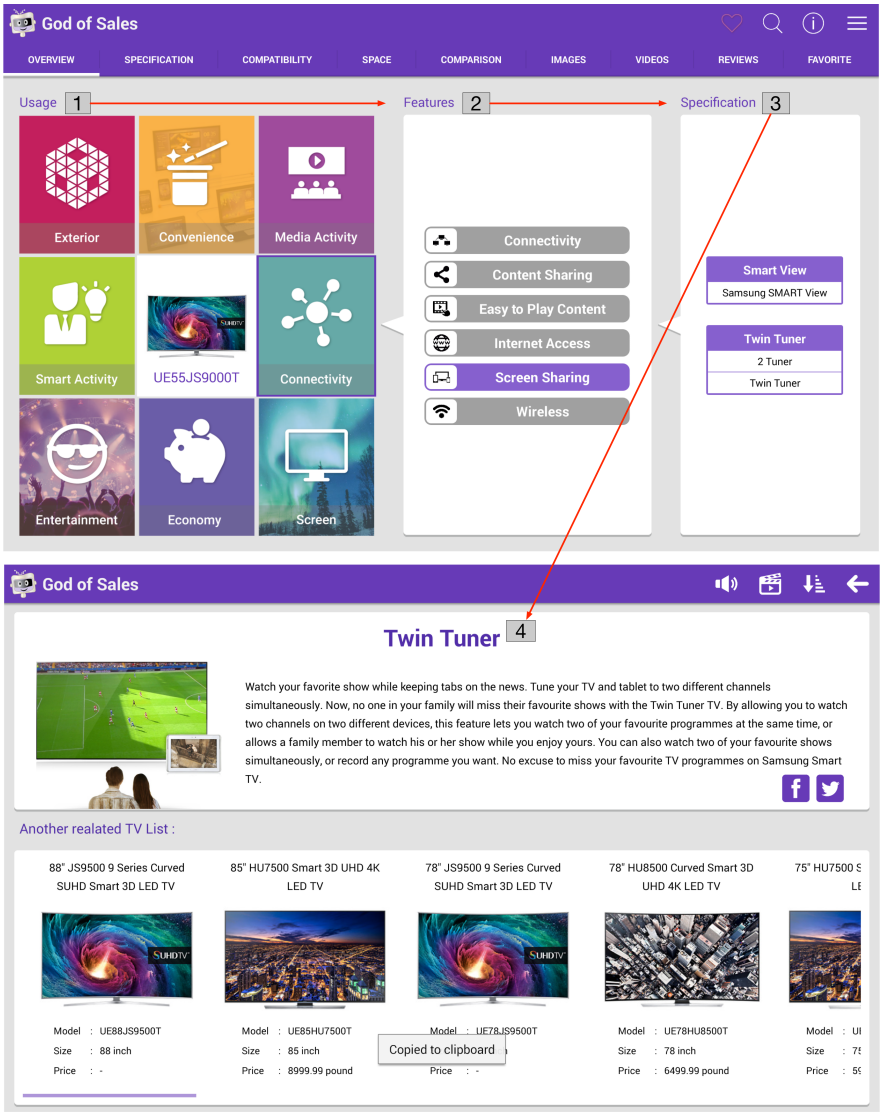

Fig. 3. An example of God of Sales - 1) Usages, 2) a set of features, 3) a set of relevant specification items, and 4) descriptive features of the selected item on 3).

investigation of ontology integration among different domains beyond consumer electronics, and automatic control and easy setup among devices.

References

1. Christian Bizer, Tom Heath, Tim Berners-Lee, Michael Hausenblas, and Sören Auer, editors. *Proceedings of the WWW2013 Workshop on Linked Data on the Web, Rio de Janeiro, Brazil, 14 May, 2013*, volume 996 of *CEUR Workshop Proceedings*. CEUR-WS.org, 2013.
2. Mari Hysing, Stle Pallesen, Kjell Morten Stormark, Reidar Jakobsen, Astri J Lundervold, and Brge Sivertsen. Sleep and use of electronic devices in adolescence: results from a large population-based study. *BMJ Open*, 5(1), 2015.
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Annex: Challenge Criteria - Open Track Submission

Minimal requirements

- The application has to be an end-user application: God of Sales provides intuitive interface for end-users to find out relation-based information.
- The information sources used should be under diverse ownership or control: The application integrates data from multiple sources of different ownerships.
- The information sources used should be heterogeneous: The data sources originally are in different formats, including CSV, HTML, JSON, or XLS, etc. The heterogeneity is resolved by transforming all data sources into RDF.
- The information sources should contain substantial quantities of real world data: All data used in the application are collected from a product management system in enterprise and some datasets are also collected from various websites.
- Meaning must be represented using Semantic Web technologies: The whole data sets are represented in RDF. In particular, product specifications are transformed into a product knowledge graph based on product ontology model.
- Data must be processed in interesting ways to derive useful information.
- This semantic information processing has to play a central role. The application uses both RDF and SPARQL to query and answer user-initiated requests.

Additional Desirable Features

- The application provides an attractive and functional Web interface. God of Sales has an intuitive interface for end-users. The end-users do not need to know semantic web technologies to get any recommendations.
- The application should be scalable. Any data sources can be added and linked into existing data sources. We continue to integrate more data sources from different data sources into our base knowledge and application.
- Functionality is different from or goes beyond pure information retrieval. The search is based on keyword-to-concept mapping, and each card is implemented by deriving from diverse sources using subgraph queries.
- The application has clear commercial potential and/or large existing user base. The broad coverage of the proposed approach allows it to be used by mobile services.
- Contextual information is used for ratings or rankings. When a feature and a specification is selected, relevant products that have the feature are automatically ranked based on ranking algorithms.
- The results should be as accurate as possible (e.g. ranking of results according to context). Not applicable.