Leverage of OWL-DL axioms in a Contact Centre for Technical Product Support

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Abstract. Real-time access to complex knowledge is a business driver in the contact centre environment. In this paper we outline for the domain of telecom technical product support a knowledge sharing paradigm in which a desktop client annotates named entities in technical documents with canonical names, class names or relevant class axioms, derived from an ontology by means of a web services framework. We described the system and its core components; OWL-DL telecom hardware ontology, ontological-natural language processing pipeline, an ontology axiom-extractor; and the semantic assistant framework.

Keywords: Semantic Assistant, Telecommunications Hardware Ontology, Natural Language Processing, OWL Axiom Extraction, Web Services

1 Introduction

To respond to customer information requests in a timely manner, contact center workers need to search through many types of knowledge resources including user manuals, training, marketing, engineering, and case resolution databases. Companies face increasing contact center costs as their products and information support services evolve. Key drivers in this business process are the reduction in number of cases escalated to more experienced workers and reducing time spent in resolving cases. Training time must also be greatly reduced and workers with less knowledge should be able to fill in for others on an ad hoc basis. A knowledge-based approach is appropriate in this context. Moreover expressive features of the OWL language [1], that permit the richer specification of relationships between Telecom hardware, their features, symptoms of hardware failure, and the suggested resolution of the technical problem are required. We report a custom solution for a telecommunications original equipment manufacturer (OEM) technical contact center involving development of

product-specific OWL-DL Ontologies that are consumed by a middleware leverageing web services to push information to client side knowledge workers.

2 Telecom Support System Architecture

The system architecture for our knowledge sharing paradigm includes the following core components: (i) Ontology; (ii) Ontological NLP pipeline; (iii) Ontology Axiom-extractor; (vi) Semantic Assistant Framework [2]. These components are integrated into an online annotation workflow shown in Figure 1.

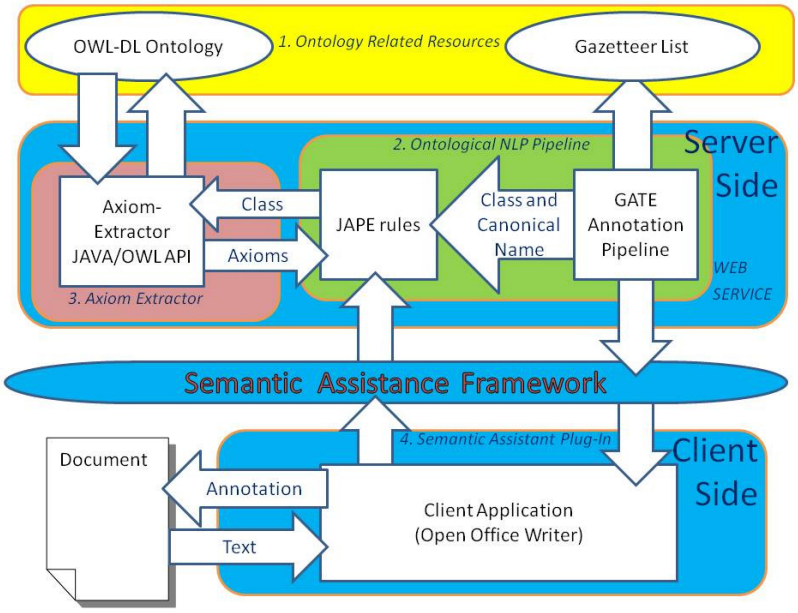

Fig. 1. Semantic Assistant Framework

3.1 Telecommunications Hardware Ontology

The scope of the ontology included hardware components that comprise the chassis of a telecommunications switch and more specifically the compatibilities of different hardware components therein [3]. Equivalent class axioms were used to conceptualize which version of each chassis component was compatible with versions of the chassis models. A total of 54 classes of hardware and 149 object and 68 data properties specific to the hardware domain were represented and a further 20 axiom constraints were applied across 13 hardware classes, namely; (i) three intersection or consolidation axioms involving 17 classes were used to describe various component

assemblies (chassis, cable management bracket kit, and dual back plane); (ii) two disjunctions (consolidation axioms) involving 33 classes were used to ensure no illogical inferences; (iii) 22 restrictions on data properties were defined describing the maximum and minimum number of power supplies or line cards (modules) that can physically be part of a chassis; (iv) two derivative axioms were established involving four power supply classes to automatically populate legacy and replacement power supply equipment from the main AC and DC power supply class categories. A total of 16 necessary conditions and 16 sufficient conditions were defined, and four cases of joint necessary and sufficient conditions. A further 15 classes were introduced in a top level literature specification for describing specific features of technical documentation so that a corpus of 3,000 pages of user manuals could be text mined using, and instantiated into, the ontology for checking the relevance manually curated axioms. The ontology has a DL expressivity of SROIQ(D**).**

3.2 Ontological NLP and Axiom Extractor

The Ontological NLP pipeline is a text mining solution based on open source GATE framework [4]. GATE included two main steps, firstly a GATE annotation pipeline for recognizing named entities in source text and connecting them with canonical names and semantic classes, and secondly JAPE rules [5] for the reformatting of ANNIE[1] annotations and calling the Ontology Axiom-extractor (JAVA / OWL-API) that enriches text annotations with relevant class axioms. The GATE pipeline was wrapped in Java and integrated with Axiom-extractor to facilitate batch processing.

3.3 Semantic Assistant

The Semantic Assistant Framework is a service-oriented architecture used to enhance existing end-user clients, such Open Office Writer, with online Telecom related text analysis capabilities provided as a set of web services. The Ontological NLP pipeline links Telecom named entities occurring in a document opened on client side with existing ontologies on server side (See Figure 1). The system annotates each named entity with canonical name, class name and related class axioms providing annotation for documents on the client side. Figure 2 demonstrates an example of client-side annotated text[2]. The proposed system is scalable and extensible allowing users to easily customize the information to be delivered as annotations depending on the availability of ontologies with defined axioms linked to canonical names for entities.

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[1] ANNIE Information Extraction system developed for GATE. http://gate.ac.uk/ie/annie.html

[2] We used Open Source Writer integrated with the Semantic Assistant plug-in as a client-side application. Our annotating web services is compatible with any other existing or proposed client-side software that has web services client functionality.

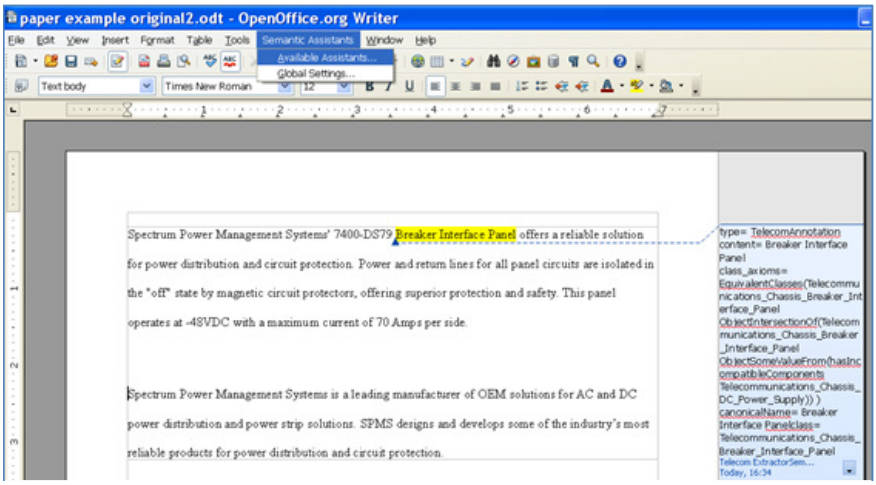

Fig. 2 Annotation of text with Equivalent Class Axioms using the Semantic Assistant

3 Discussion

When replacing unserviceable telecom hardware customers phoning a contact centre for technical product support often have questions about which components are compatible with their chassis. Older chassis models of a telecom switch may be compatible with specific models of power supplies and incompatible with later versions. By combining the Semantic Assistant with existing text mining and axiom extraction pipelines we leverage the DL-axioms in our OWL ontology to great effect, rapidly communicating hardware incompatibilities to contact centre agents through their desktop applications. Installing incorrect power supplies can result in equipment failure, injury to the installer, network downtime for tens of thousands of customers.

References

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