Software Requirements Specifications Document

From Standards to Ontologies - A Web-based tool to semantify/ontologize the knowledge of a standards with semantic technologies

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1. Introduction

This document is a Requirement Specification for *[name of this project(product)]*. This is the initial draft for the requirement specification and it will be used for the extensions.

This document is divided in four chapters. The first part introduces the document and gives an brief overview of the system. The overall description of the project and the future system is in the second chapter, where the product perspective, product function, user characteristics and constraints are presented. The detailed description of the requirements, such as functional and nonfunctional requirements, is in the third chapter. The last chapter is an appendix with figures, that are referenced in other chapters.

1.1 Purpose

This document defines the software requirements involved in the project. This document is to be used in the software development process by stakeholders, software developers, testers and project managers in order to identify, validate, design and implement the overall technical features and limitations of the system.

1.2 Scope

This document describes the an overall description and both functional and non-functional requirements for the system. It has an overall description with product perspective, product functions, user characteristics and constraints. It also contains functional and nonfunctional requirements such as performance, reliability, usability, interoperability and security.

1.3 Definitions and Abbreviations

- OPC UA: OPC Unified Architecture
- RDF : Resource Description Framework
- SPARQL: Semantic query language for databases
- OWL : Web Ontology Language
- RDFS: Schema provides a data-modelling vocabulary for RDF data

1.4 System Overview

The dynamic of today's world imposes new challenges to the enterprises. The globalization, the ubiquitous presence of the internet and the development of hardware systems are some of the technological improvements that provoke changes everywhere. In the engineering and manufacturing domain, there is currently an atmosphere of departure to a new era of digitized production. In different regions, initiatives in these directions are known under different names, such as industrie du futur in France, industrial internet in the US or Industrie 4.0 in Germany. [1]

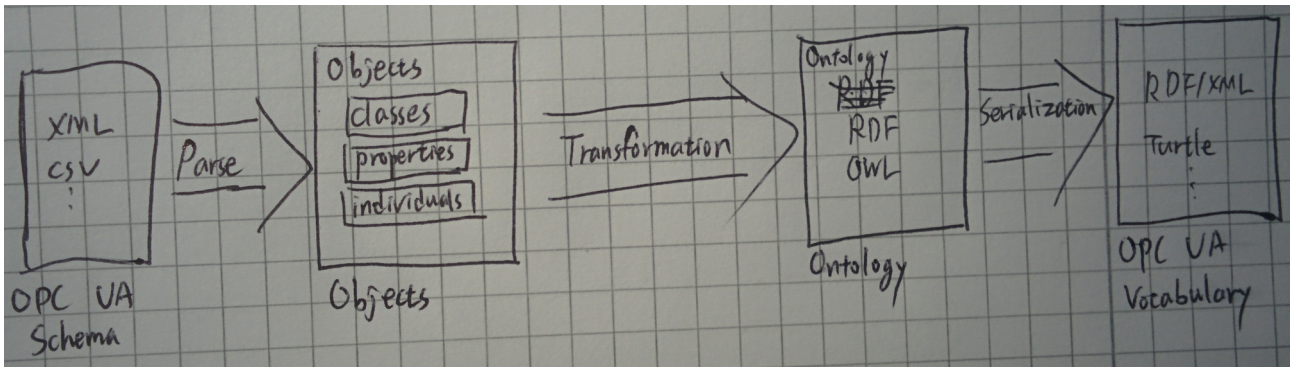
Industry 4.0 (I4.0) is a term coined in Germany to refer to the fourth industrial revolution. This is understood as the application of concepts such as Internet of Things (IoS), Cyber-physical Systems (CPS), the Internet of Services (IoS) and data-driven architectures in the real industry. [2] Under this concept we can find the term Machine to Machine (M2M) which refers to the communication between devices using a specific communication channel. One of the protocols created to implement M2M interoperability is OPC Unified Architecture (OPC UA)

The proposed system should visualize and analyze OPC UA standard specification documents and provides the functionality of parsing to create a vocabulary and allowing the user to edit vocabularies. This process should be supported with existing fundamental ontologies to simplify the integration into existing conceptual models.
The development is intended to be done using modern web technologies such as Node.js, Express, React.js, Bootstrap etc.

2. Overall Description

2.1 Product perspective

The conceptual process with respect to the handled data is explained as below:



- Parser load categories, features, and values of OPC UA schema into an internal model, which specifies ontology classes, properties, and individuals.
- In the transformation step, the internal model, consisting of entities for classes, properties, and individuals, is turned into an RDF model that describes the final ontology
- Ontology model is serialized as RDF/XML, and all other files that can present ontology.

2.2 Product functions

The use case diagram is presented in follows.

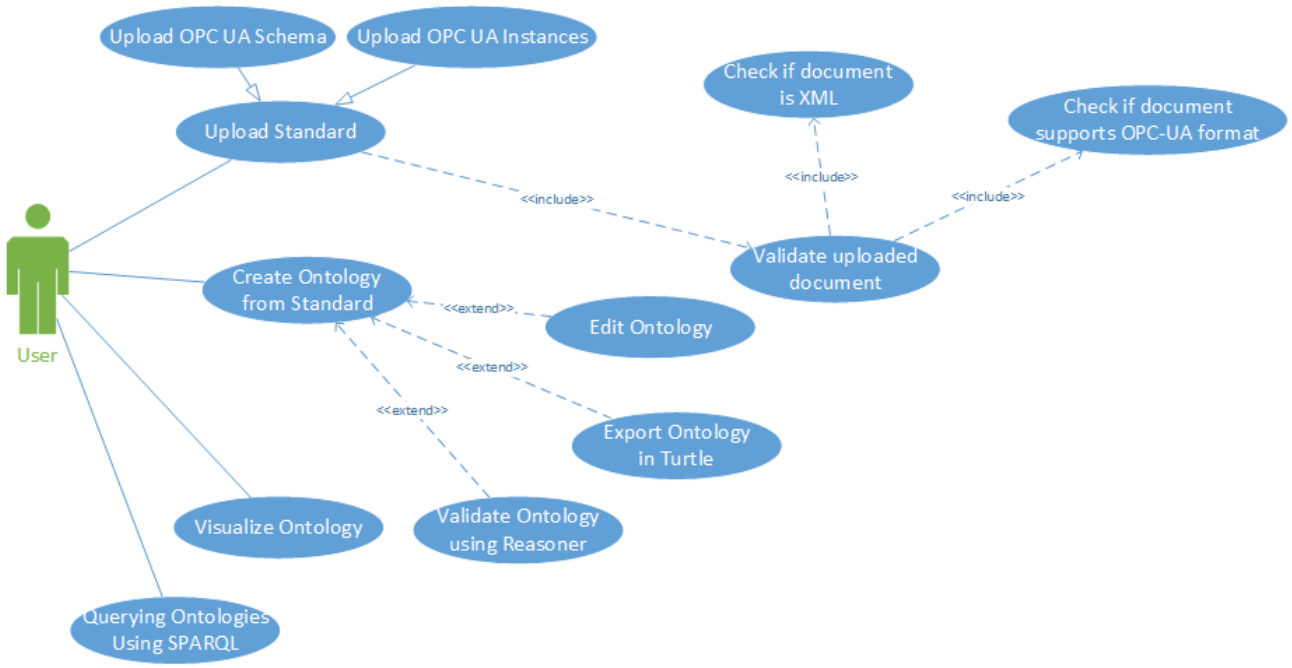


Fig 2. Use case diagram

2.2.1 OPC Unified Architecture

OPC Unified Architecture (shortly, OPC UA) is a platform-independent standard through which various kinds of systems and devices can communicate by sending Messages between Clients and Servers over various types of networks. OPC UA defines a common infrastructure model to facilitate this information exchange.

OPC UA is applicable to manufacturing software in application areas such as Field Devices, Control

Systems, Manufacturing Execution Systems and Enterprise Resource Planning Systems. These systems are intended to exchange information and to use command and control for industrial processes. [3]

The OPC UA specifications are layered to isolate the core design from the underlying computing technology and network transport. This allows OPC UA to be mapped to future technologies as necessary, without negating the basic design. Two data encodings are defined:

- XML/text
- UA Binary

```
<UAObject NodeId="i=3063" BrowseName="Default XML" SymbolicName="DefaultXml">
  <DisplayName>Default XML</DisplayName>
  <Description>The default XML encoding for a data type.</Description>
  <References>
    <Reference ReferenceType="HasTypeDefinition">i=58</Reference>
  </References>
</UAObject>
<UADataType NodeId="i=24" BrowseName="BaseDataType" IsAbstract="true">
  <DisplayName>BaseDataType</DisplayName>
  <Description>
    Describes a value that can have any valid DataType.
  </Description>
  <References/>
</UADataType>
```

Fig. Sample OPC UA Schema (XML)

2.3 User Characteristics

The user shall be an ontology engineer with extensive knowledge on Semantic Web, ontologies, meaning and usage. The user's knowledge may be backed up by theoretical experience or by practical experience.

3. Specific Requirements

3.1. Functional and Non-functional Requirements

Requirements	Description	Priority
Functional		
Translation of OPC UA Schema files into OWL vocabularies/ontologies	Load and read OPC UA Schema files and translate it into OWL vocabularies/ontologies. The load of the file could be done specifying the URL of the file or directly uploading the file.	Very high
Visualization of ontologies	The translated file will be visualized graphically in a form of graph/tree	High
Edition of vocabularies/ontologies	Once it has been obtained the ontology the user will be able to modify and update it using a visual editor	High
Management and storage of vocabularies	The user will be able to store and handle the vocabularies, having functionalities such as save, delete, save as, etc.	High
Identify Malformed XML files	The system will be able to detect XML files that not comply with the OPC UA Schema and alert the user about it	Low
SPARQL queries support	The system will be able to execute SPARQL queries on the vocabularies/ontologies.	Very low
Non-functional		
Handle different format files	Manage different format files: • RDF/XML (.xml) • Turtle (.ttl) • JSON-LD (.jsonld) • RDF-JSON (.rj) • OWL (.owl, .owx, .rdf) • N-Triples (.nt) • N-Quads (.nq) • Notation3 (.n3)	Medium
Handle files with a large number of triples	The system will be able to load large OPC UA Schema files, that is, those files with large number of triples and efficiently handle and visualize them keeping a constant time performance.	Medium
Responsive interface	The system will be able to be visualized in different devices such as smart-phones, tablets and computers	Low

3.2 Use-case specifications

Title	**Create Ontology**
ID	UC1
Description	Create an ontology file. There are sub-tasks as editing and exporting.
Precondition	The user is logged into the system
Postcondition	A personalized ontology is obtained
Main course	1. The system shows an interface with the graph of the ontology. 2. The user modify the ontology with help of an editor. 3. The user press the button “Save” to store the ontology. 4. The system validates the ontology. 5. The ontology is saved.
Alternate course (a)	1. The system shows an interface with the graph of the ontology. 2. The user modify the ontology with help of an editor. 3. The user press the button “Save” to store the ontology. 4. The system validates the ontology. 5. The system shows the next error message to the user: “The ontology is not valid”.
Alternate course (b)	1. The system shows an interface with the graph of the ontology. 2. The user chooses a format. 3. The user press the button “Export”. 4. The system exports the ontology to the format that the user chose.

Title	**Upload Standard**
ID	UC2
Description	Upload OPC UA Schema or OPC UA instance files to the system.
Precondition	The user is logged into the system
Postcondition	A graph visualizing the ontology is obtained
Main course	1. User selects the option “Upload OPC UA Schema” or “Upload OPC UA Instance” from the interface. 2. The system validates the uploaded document and create an ontology from the Standard file 3. The system shows an interface with the graph of the correspondent ontology
Alternate course	1. User selects the option “Upload OPC UA Schema” or “Upload OPC UA Instance” from the interface. 2. The system validates the uploaded file and shows an error message to the user stating that the file is not a valid schema file.

Title	**Query Ontology**
ID	UC3
Description	Execute SPARQL queries on the vocabularies stored in the system.
Precondition	The user is logged into the system
Postcondition	The system returns the result in form of queries
Main course	1. The system shows an interface with a text box giving the user the possibility to introduce SPARQL queries 2. The user writes the SPARQL query and press the button “Execute” 3. The system executes the query 4. The system returns the result in form of triples
Alternate course	1. The system shows an interface with a text box giving the user the possibility to introduce SPARQL queries 2. The user writes the SPARQL query and press the button “Execute” 3. The system executes the query 4. The system shows the next error “the query is not valid”

4. Appendix

4.1 References

[1] Grangel-González, Irlán, et al. "Towards a Semantic Administrative Shell for Industry 4.0 Components." arXiv preprint arXiv:1601.01556 (2016).
[2] Drath, Rainer, and Alexander Horch. "Industrie 4.0: Hit or hype?[industry forum]." Industrial Electronics Magazine, IEEE 8.2 (2014): 56-58.
[3] OPC UA Specifications: Part 1: Overview and Concepts(online) http://www.opcfoundation.org/UA/Part1/