Proposal of a Standard Vocabulary for Services Discovery on the Internet of Things

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Keywords: Internet of Things, Web of Things, Vocabulary, Semantic, Mark-up, IoT, Ontology.

Abstract: Internet of Things (IoT) is the paradigm that will dominate the computing world in the coming years. Thus, studies should be performed in order to ensure improvements in the search for technologies that can create new standardized semantic vocabularies to find services provided by IoT. The aim of this work is to understand the concepts of vocabularies of ontology as well as technologies that use such semantic vocabularies. Thus, it was concluded that the proposed vocabulary increase the chances of finding the IoT services, integrated with applications that work with many wireless sensor devices.

1 INTRODUCTION

With the exponential growth of web business investment, the internet has become one of the main existing business channels nowadays. Soon the development of technologies to create internet access platforms, faster and faster, efficient and cheap generated an unprecedented technological and social transformation.

Connect virtually any device to the Internet facilitates not only the design of intelligent buildings, but also makes possible remote monitoring of other devices from water energy and meters, environmental sensors, to medical implants. This interaction with other devices raises a paradigm that by 2025, according to forecast NIC (US National Intelligence Council) will dominate the computing world, called Internet of Things (IoT).

In short, the IoT is the diffuse presence of a variety of things or objects around us, for example, RFID tags - Radio Frequency Identification, smart mobile phones, wireless sensor networks - WSN, between others, that communicate by exchanging many messages, even by simple sensors (Atzori, 2010).

Some projects are directed to metadata architectures production, but are made to take into account three aspects of interoperability: semantic, enabling the understanding of the meaning of each element of the described feature, along with the associations found in it, making sure the use of specific vocabularies, ontologies and metadata standards that are essential; syntactic, determining how metadata should be coded to the information transfer, using technology employed as the XML (eXtensible Markup Language) language; and structural, that specifies how resources are organized, along with the types involved and the possible values for each type (Perera, 2013).

Therefore, a document or a file where they are formally defined the relationships between concepts in the semantic Web, is called ontology. A taxonomy formed classes and subclasses of objects related to each other more a set of inference rules that can use language like DAML (DARPA mark-up language agent) developed as an inference based on RDF (Resource Description Framework).

Create or edit an ontology for semantic vocabulary can be accomplished through a tool called Protégé-2000. Widespread for the semantic Web, this tool allows to define vocabularies in different microformats as, for example RDF and RDF Schema. Highly customizable, allows the conceptual modeling of these languages, making it possible to create a standard vocabulary to discover services used by the IoT.

This work aims to propose a standard vocabulary, creating a necessary ontology for services used by the IoT, demonstrating its functioning and interaction with the human life reality.

The remainder of this paper is organized as follows. In section 2, will be shown on existing requirements nowadays and contribute to the

de Souza Lima M., de Ribamar L. Riberio A. and David Moreno E..
Proposal of a Standard Vocabulary for Services Discovery on the Internet of Things.
DOI: 10.5220/0005493001290134
In *Proceedings of the 11th International Conference on Web Information Systems and Technologies* (WEBIST-2015), pages 129-134
ISBN: 978-989-758-106-9
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creation of a semantic vocabulary. Section 3 describes the proposed semantic vocabulary that will be explained and possible tool that can be used in creating it. Finally, in section 4, the work related to the subject covered in this paper and its relation to the ontology and semantic. Conclusion and references are given in section 5.

2 INTERNET OF THINGS VOCABULARY REQUIREMENTS

The semantic vocabularies used by the Internet of Things, have basic requirements needed to extract the communication results with the various services or applications. These basic requirements are described in this paper, to name a few of the concepts that could be used to serve as the basis for creating a standard vocabulary, such as the language syntax, ontology and semantic markup.

2.1 Syntax

Through this feature the syntax of services provides interoperability, allowing the automation of the use of information based on their semantics. Thus, to describe things, an unique to identify them, is necessary both in the current Web and Semantic Web, which are called features and identified using URIs (Uniform Resource Identifier).

The syntax description, refers to the XML standards (Extensible Markup Language), XML namespace and XML schema (W3C, 2014). The idea is to associate a namespace URI and even if a name appears in more than one space, must be unique in its namespace. These standards describe a class of objects called XML documents and the behavior of computer applications that process these documents.

Being an open standard (non-owner) and simple to read and write by software applications, a document in XML format makes it an excellent format to exchange data between different applications.

2.2 Ontology

Ontologies are key requirements to create a semantic vocabulary. They serve as support for the description, publication, discovery and Web service composition being: OWL-S (Ontology Web Language Semantic); OWL-Time, resources ontology and domains ontology.

The ontology language OWL-S is semantic markup and proposes an ontology language for Web services for general purpose, able to describe any type of Web services regardless of the domain it belongs to the service.

OWL-Time defines a higher level of temporal concepts and contains a specification of the time theory required for semantic Web applications. Is used to describe temporal content Web pages, as well as describe properties and web services time constraints.

Ontologies resources proposes a description of Web services and their intention is to be used in conjunction with OWL-S. And the domain is used to describe of Web services in order to provide the semantics necessary to enable automatic discovery and composition (Hachem, 2011).

2.3 Semantic Markup

The patterns of semantic annotations that emerged by the W3C, were: RDF, RDFa, Microformats and Microdata. The semantic annotation is the process by which includes semantic information or metadata and add machine-readable information to existing content.

Thus, if the marking is ready to find the most relevant result, the semantic annotation will add diversity and richness to the process. With Microformats, which are not a new language but an idea to solve the simplest problems of semantic Web, by today's standards and use in semantic markup, it is easy to use, with the most used formats, hCalendar (for publication events) and hCard (for people, companies and organizations in general).

The RDFS, XML-based language, considered a comprehensive language, allowing you to define ontologies with her. But, being a complex language is not feasible to use it to mark Web pages semantically. The RDFa language (RDF - in - attributes) is the standard semantic annotation that does not have the need of using new markup elements, being performed by corporate attributes on any element (Norway, 2013).

The microdata are considered the latest markup language and competitor of current standards of the Semantic Web annotations. Heavily influenced by microformats, adopting a range of attributes such as hCard, hCalendar and other microformats.

3 PROPOSAL FOR AN IOT VOCABULARY

The initial proposal will be creating a standard semantic vocabulary to obtain a better result to discover services used by the IoT.

Then, we use a tool called Protégé, to develop new semantic vocabulary to be tested with applications or devices that work in the IoT. Correlate the Web services more robust and effective manner, and to facilitate the search of users in the use of information in the applications with the IoT is the main purpose of this proposed paper.

With this platform, developed by the Stanford Medical Informatics research group at Stanford University medical school, will allow the ontology construction, namely the vocabulary to be used in the discovery of services in the IoT.

Based on the Java language, the Protégé is extensible and deals with a strong community of developers, academics and users, who use it to knowledge solutions in various areas such as biomedicine. Chosen as the semantic creation tool due to several factors: is a publisher of open source ontologies, supports editing Web client or via desktop client, access can be made via the Web or application installed on the machine, allowing the development of ontologies in various formats such as: OWL; RDF and XML Schema.

It also allows the use of existing vocabularies when creating the ontology itself and the export of ontology to the desired format, in addition to having a graphical interface easier to handle, according (Horridge, 2014).

The graphical interface provides access to the menu and toolbar bar, and presently five viewing areas (views) which act as navigation modules and editing classes, attribute, forms, forums and search the database of knowledge, providing the data input and retrieval of information. The Protégé platform interface can be viewed in Figure 1. According to a pattern to be used can be constructed by the ontology vocabulary defined by this tool. Thus, describe the classes, subclasses, instance values and capable of interacting with the applications used in Web to IoT.

The vocabulary to be created should follow the standards previously defined in order to have more interaction with IoT applications and embedded devices. The whole structure to be mounted must have open-source systems, devices that are connected to the Internet of Things, and a Web interface to bring information services found by IoT. Decrease the amount of human intervention plans in search of information as faster the semantic analysis and run the commands requested by users with better understanding are the metrics needed to get an effective result in the discovery of services connected to the IoT applications in various devices.

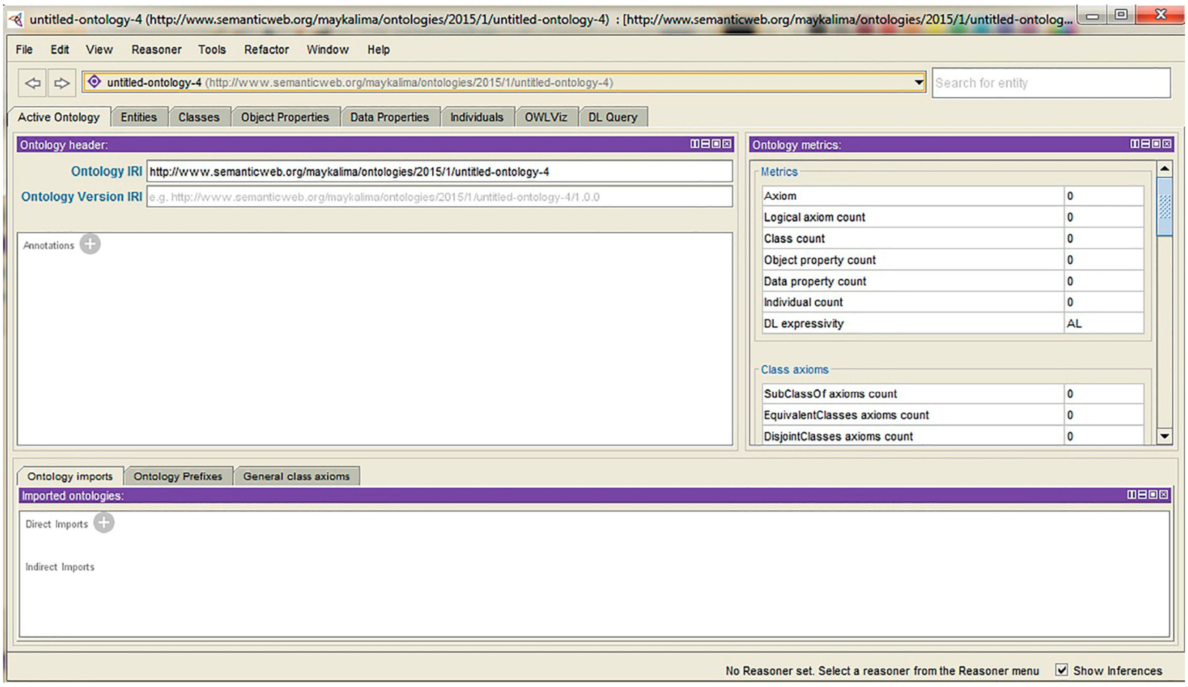

Figure 1: Protegé platform interface.

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The Web Services Description Language (WSDL) can describe a service by specifying the location and describing the operations provided for him. All documents are in XML and provide enough information to interact with the Web service. Have as elements to define the service interface: types, XML schemas; messages describing details of the methods and their parameters; type of port that defines operations. Allowing its interaction with other systems that identify the service.

A tool to be used for the discovery of services in WSDL will be the Lumina plugin. This ontology concepts associated with the input parameters, so that the search system according to see description to be made by the reference model (Menegazzo, 2009). Lumina is an eclipse plugin that allows to discover Web services based on semantic built. It has a graphical user interface and its repository services is UDDI (Universal Description, Discovery and Integration).

An example of the use of semantic vocabulary would be to use some client-side objects with a service by doing a proxy class that "mimic" the web service method calls. Working with the proxy instead of writing SOAP messages (Simple Object Access Protocol) directly. The proxy class manages the building, sending and receiving SOAP messages and OWL-S language is intended to enable the automation of discovery, invocation and Web Service composition through semantic descriptions. The axioms of OWL-S are defined in OWL and OWL-S has descriptions of classes, sub-class hierarchy and definitions of types and relationships between classes. The description of the functionality of a service is referenced by a profile of OWL-S ontology externally with the concepts defined in OWL ontology in the domain that owns the Web Service in question.

Analyzing the available work in this area, we can verify that applications involving IoT and semantic vocabularies in search of services need to get to an improvement in the syntax and semantics of communication between them, creating new vocabularies that can interact with different devices connected to things.

4 RELATED WORK

In this section will be elucidated major systems that use semantic vocabulary for their services and their characteristics. These features are related to the requirements that have been seen before.

4.1 Steer

Computer program implemented to support mechanisms for service discovery, as well as tools and semantic Web services.

STEER compound (Task execution Semantic Editor) and PIPE (Pervasive Instance Provision Environment). A Web client with a Java interface classifies services based on their input data and semantic outputs. Through a GUI manager (Graphical User Interface) PIPE services are facilitated for the users so that in this way can perform Web services for common tasks. Using as ontology language, OWL, as a powerful modeling, naturally enough to describe many areas. (Masuoka, 2003).

4.2 Middleware IoT

Middleware architecture for it consists of three modules discovery, composition and estimation, and knowledge base. This application performs a request or a service by making detection, or a composition for estimation of the manipulated object. To solve a request, this module accesses the module (discovery) and makes the knowledge base by performing the creation of a composition of services (Zhexuan, 2010). The result is obtained by running this composition within the existing network.

4.3 Ontonym

Invasive system which has the need to interpret large amounts of data from many sources. Developed to address the temporal properties of the data context as a requirement. Having as a criterion to function using a set of ontologies to represent the fundamental concepts in pervasive computing (Stevenson, 2009).

The concepts that surround it to carry out a comparison with the ontology of pervasive computing are: time, using the ontology language OWL-Time; location, generated by a GPS; people, where personal and social networking information is collected; and the ontological sensors generating data.

The works related are limited in specific services for the use an ontology as OWL and OWL-S. The profile and the process model of these services specify Web service features that can be used by agents for semantic discovery, invocation and composition services.

With an ontology class, you can define how the service will be mapped from abstract definitions of the profile and the process for specific information to be made by means of messages exchanged between the user and application. Some of these applications, using traditional architectures for Web services, such as systems for wireless devices with the set of protocols UPnP (Universal Plug and Play) (Masuoka, 2003). However, OWL-S does not require the use of service oriented architectures and several studies reported in the literature using OWL-S based on other architectures.

Map the abstract elements of OWL-S of the evidence in WSDL (Web Services Description Language), and reuse all the existing infrastructure for Web services, maintaining that the Semantic Web should be an extension of the Current Web, leads to an advantage to locate Web services in the Semantic Web layers.

4.4 CoAP Framework

The COAP protocol (Constrained Application Protocol) devices for handling resources with a REST framework and is used in generic browsers for IoT. This protocol adopts HTTP resources (Hypertext Transfer Protocol) allowing an evolution of the Web from a simple document retrieval mechanism by GET REST methods, POST, and DELETE, integrating the URIs in the browser (Kovatsch, 2013).

From this interaction arise APIs (interactive programs) easy navigation of users on the Web through links, thus discovering new devices or services.

5 CONCLUSIONS

The vocabulary to be created will primary to provide as a benefit, the most effective discovery of the various services that are used by the Internet of Things. So, returning to the applications more concise information, making it easier to use between users and the various things interconnected to the Internet.

Once created, with the defined ontology language, this vocabulary will help the semantic Web of several applications that work-related RSSP networks and the Internet of Things. Therefore, the focus is the creation of standard vocabulary for the IoT, leaving all the attention to be directed to the main goal of the research.

For future work, there is the possibility to develop applications that use this semantic vocabulary demonstrating their interaction with other devices available on the Internet of Things using different types of ontologies, syntax and semantics.

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