ourSpaces - A Semantic Virtual Research Environment

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Abstract. In this demo we present *ourSpaces*, a semantic virtual research environment designed to support inter-disciplinary research teams. The system utilizes technologies such as OWL, RDF and a rule-based reasoner to support the management of provenance information, social networks, online communication and policy enforcement within the VRE.

Keywords: provenance, virtual research environment, eResearch

1 Introduction

In recent years, scientific research has become increasingly interdisciplinary in nature and a range of information and communication technologies have been adopted by researchers to support collaboration, and to facilitate transfer of ideas, knowledge and resources. Web-based virtual research environments (VREs)[1] have been proposed as one way to help researchers in all disciplines to manage the increasingly complex range of tasks involved in carrying out research. Semantic web technologies are seen as crucial in this context in order to provide a common framework to allow intelligent applications and services to make use of information about data resources and other (research) objects held in a VRE.

The *ourSpaces* virtual research environment (described in Edwards et al. [1]) has been developed by the PolicyGrid[2] Digital Social Research project to provide a collaboration space for interdisciplinary academic research communities using state-of-the-art Semantic Web technologies. Groups using *ourSpaces* work in socio-environmental and health-related domains and there are currently around 183 registered users. A screenshot of the *ourSpaces* web interface is presented in Figure 1.

Provenance in *ourSpaces* is crucial in order to support transparency and accountability of the research process by documenting the derivation history of research artefacts. The system utilizes technologies such as OWL[3], RDF[4] and a

[1] http://www.jisc.ac.uk/publications/reports/2010/vrelandscapestudy.aspx

[2] This work is supported by the UK Economic & Social Research Council (ESRC) under the Digital Social Research programme; award RES-149-25-1075.

[3] http://www.w3.org/TR/owl-ref/

[4] http://www.w3.org/RDF/

SPIN-based[5] reasoner to support the following system functionalities: representing and tracking the provenance of digital artefacts and processes; capturing the provenance associated with a user's social network; managing policies associated with use and re-use of data, security and privacy; controlling the behaviour of services within the application using policy-based reasoning; visualising provenance information using different modalities (natural language or graphical).

Fig. 1. A screenshot of the *ourSpaces* VRE showing a user's home space, an open upload form and the graphical provenance visualiser.

During the demonstration, we will illustrate how semantic web technologies have been deployed to support key research activities within the system such as uploading and annotating research artefacts; managing project information e.g. membership, sub-projects, data, notifications; writing comments and blogs; and visualising information about research artefacts and their provenance.

[5] http://spinrdf.org/

2 A Semantic Framework for Provenance

At the heart of *ourSpaces* is an ontological framework (see Figure 2) describing different aspects of the provenance of the research process. In order to support basic provenance we use a Web Ontology Language (OWL) representation of the Open Provenance Model [2]. This ontology defines entities such as *Artefact*, *Agent* and *Process* and causal relationships between them (e.g. *wasGeneratedBy*, *used* and *wasControlledBy*). OPM is a generic solution and as a result, our framework supports additional domain-specific provenance ontologies that are created by extending the concepts defined in the OPM ontology with domain-specific classes. Using these ontologies it is possible, for example, to describe a physical research activity (e.g. an interview) as an `opm:Process`, and how such an activity causes an `opm:Artifact` to be generated (e.g. interview notes).

For research groups utilising *ourSpaces*, it is important to situate research artefacts and processes alongside people and their associated organisational structures. The current OPM specification supports limited information about a person (agent) controlling a process. Friend-of-a-Friend[6] (FOAF) is an established RDF vocabulary for describing people and their social networks and we have opted to utilise this within our framework; a `foaf:Profile` is thus a subclass of `opm:Agent`.

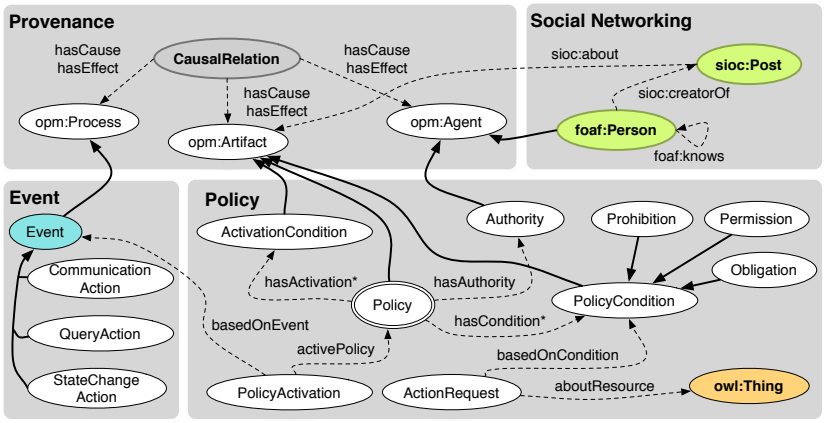

Fig. 2. *ourSpaces* ontological framework.

In an environment like *ourSpaces*, online communication is often used to comment about research artefacts or to discuss research issues. Documenting such interactions within in the VRE is a crucial requirement for achieving a full and transparent provenance representation. The SIOC[7] (Semantically-Interlinked On-

[6] http://www.foaf-project.org/
[7] http://sioc-project.org/

line Communities) ontology is designed to describe aspects of online communication by providing a model to express user-generated content such as posting a message in a blog or posting a comment. We have also integrated this vocabulary within our provenance framework, e.g. a `sioc:post` generated by a `foaf:user` can be associated with an `opm:Artifact`, `opm:Process` or `opm:Agent`.

Within the system we have developed a service enabling users to visualise short textual descriptions of the provenance of resources. This service translates RDF statements into English sentences using a Natural Language Generation algorithm based on the approach described by Bouttaz et al. [3].

Within the environment, there is also a need to manage users and their behaviours so that they comply with certain policies. For example, a user may impose certain access constraints on digital artefacts that he/she owns, e.g. an artefact may only be accessible to people within that user's social network. We have extended our ontological framework to define such policies as a combination of conditions such as obligations, prohibitions or permissions [4]. We make use of the SPIN ontology [8] to support the use of the SPARQL query language to specify rules and logical constraints necessary to reason about policies. Policies in *ourSpaces* are activated based on events taking place in the environment, e.g. download/upload artefact, add/remove metadata, etc. When an activity is detected, an event manager initiates a policy reasoning task. Using this approach in *ourSpaces* we were able to implement a number of policies for use by the project teams using the system.

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[8] http://spinrdf.org/spin