A Framework for Experience Sharing Through Contextual Tagging

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Abstract: The web is a knowledge-sharing place where many tools allow people to share their own experience about the resources they use. This shared experience informs about how resources have been perceived and involved in particular contexts. Such sharing is expected to help new users in building their own working contexts. Most of these tools involve a tagging system. Tags can help in navigating through shared knowledge, but tags also carry semantics that can help in understanding it. In this paper, we propose a literature review showing that tag semantics can only be fully understood while considering the context it comes from. Our assumption is that it is possible to better link tags to their creation context. We thus propose the EVOXEL framework, which relies on an activity-based structure and basic mechanisms that allow reaching this objective. We then discuss its capabilities, and provide first use cases we applied to test them.

1 INTRODUCTION

The web is a knowledge-sharing place where many tools allow people to share their own experience about the resources they use. This sharing can take different forms like a comment in a repository, a blog post, a Youtube video showing a set of resources involved in a particular performance, or a resources collection in a knowledge management system like PearlTrees or Elium (formerly Knowledge Plazza). Shared experience informs about how resources have been perceived and used in particular contexts. It is expected to help new users in building their own contexts for performing their own activities. Sharing one's context indeed facilitates resource appropriation, and investigating one's universe (what they have created, used, etc.) helps users to assess others, and then favors inspiration by proposing new resources and contexts of use (Singer, 2013).

Most of these tools involve a tagging system. Many researchers have indeed shown that tags help in organizing knowledge (Kersten, 2012). Moreover, they also have shown that tags themselves reflect their creator's experience (Saab, 2010). As a result, tags can help in navigating through shared knowledge, but tags also carry semantics that can help in understanding it. Some tagging systems consider tags as simple labels, but others define them as more complex structures. Different works propose ontologies designed to better represent the knowledge carried by tags (Lohmann, 2011). One can notice that most of the information added to tags is related to the context in which a tag has been created (NB: we will use the term "created" for designating the tag creation, as well as the action of associating a tag with an entity). Indeed, a tag reflects its creator's knowledge, and knowledge can only be fully understood while considering the context it comes from (Ning, 2012). If previous works altogether add interesting information about tags, our assumption is that it would be possible to better link them to their creation context.

Another point is that if the above-mentioned researches have shown that ontologies can be used to bring more contextual information into tagging systems, we can notice that tags are usually not considered themselves as ontological types. Tags carry semantics, and semantics definition is the purpose of ontologies. Some sharing tools support tags hierarchies, but they do not consider inheritance mechanisms. It is also not possible to create tags using inference. We believe that tagging systems could better benefit from the power of semantic web technologies like semantic reasoners.

To fulfill these needs, we aim at developing a new tag-oriented framework for supporting the sharing of end-user's experience about their

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resources. In the first part of this paper, we propose a literature review related to the semantic of tags. In the next part, we introduce the EVOXEL framework that is centered on the tag and activity concepts, while taking advantage of ontological mechanisms and tools. We will finally discuss this framework's capabilities by proposing selected use cases.

2 TAGGING AND CONTEXTUAL EXPERIENCE

2.1 Folksonomies Need Context

Folksonomies focus on user experience sharing through tagging. Our interest in folksonomies lies in their own definition quoted by Knerr (2006): "Folksonomy is the result of personal free tagging of information and objects (anything with a URL) for one's own retrieval. […] The act of tagging is done by the person consuming the information". As recalled by Cernae (2008), in folksonomies, metadata is not created by experts, but it is spontaneously generated by consumers. Folksonomies answer to the real need for semantic descriptions that are closer to the knowledge domain of the users (Gayo, 2010). Even if folksonomies are nowadays broadly and successfully used, research has to face several problems that inform about the semantics and knowledge carried by tags.

The most emblematic representation of folksonomies is the tags cloud that allows to navigate through the whole set of tags that have been created by the whole set of users. In parallel, a resource selection shows the whole set of tags created for it. Researchers have shown for long that this sole information is too simple for users to take best benefit from tags. Golder (2006) indicates that « information tagged by others is only useful to the extent that the users in question make sense of the content in the same way ». For being totally useful, it is necessary for the reader to be able to share the tag semantics with its creator. Due to its polysemy, the sole tag label is insufficient. Different solutions like SCOT (Kim, 2008) or MOAT (Passant, 2008) have then been proposed to link tags to definitions issued from external ontologies like DBpedia or Wordnet. This approach is interesting while allowing different users to refer to a shared definition of the same term. However, this solution is also not sufficient since, even if they share the same "formal" definition, people can use the same tag for different purpose.

Aware of the fact that tags reflect personal view of the world by individual users, researchers share the idea that knowing who provided the tag can help people in determining its relevance for their own goals (Van Setten, 2006). This finding resulted in many different works like MUTO (Lohman, 2011) proposing ontologies for creating augmented tags. In particular, tags are explicitly related to their creator. This information offers a first essential link between each tag and its creation context. However, Saab goes even further. He indicates that "a single individual can effortlessly switch their perspectives based on their identity and create tags for the same phenomenon based in different, sometimes conflicting, identities" (Saab, 2010). The author explains how a person being a hunter can tag a weapon resource as "essential", and the same person being a father can tag the same resource as "prohibited". In his analysis, Saab demonstrates that knowing a tag's creator is indeed important, but not sufficient. In order to let the experience carried by a tag be fully understood (and useful), it is necessary to let the reader know the context in which this experience has been constructed, thus letting him adopt the adequate perspective.

From another point of view, this need to better link tags to their creation context can also be found in the work of Shirky (2005). While analyzing Del.icio.us, the author relates: "You can see there's a tag *to_read*. A professional cataloguer would look at this tag in horror -- This is context-dependent and temporary". As noticed by Golder (2006), this tag can be considered as a *Task Organizing* tag in the context of one of its creator's specific task. In the same idea, Kipp (2007) suggests that users may relate tags to time or emotional reactions. Heckner (2008) and Monnin (2010) advocate for associating a tag with its creator's intention. A tag like *to_read* may be considered far from our interest in this paper. It does not seem to carry some user's knowledge, but seems exclusively dedicated to a private use. Some works like those proposed by Knerr (2006) and Lohmann (2011) have defined tagging ontologies that take care about tags visibility. We also believe that it is important to let users define private or public tags, and to let them manage this visibility. Indeed, we can notice that when the private *to_read* tag is made public, it corresponds to a semantics change. The tag goes from private organizational information to an actual transmission of its creator's experience. This same tag then represents an advice intimately related to it's creator's knowledge, and it can only be fully understood in the context in which this advice is

provided. This is for example the case when a teacher tags a particular resource for helping students in the context of a specific course. The course, its objective, the tagger's role, the other actors' identities, other resources (that may thus be considered as less important), and even linked activities (related to the university) altogether participate to the semantics carried by the tag.

2.2 Ontologies and Multi Viewpoint

The semantic web research domain also specifically focuses on tag semantics. Ontologies offers meaning to more or less formally weave the tags used to label and categorize entities. Human and computer systems can use such weaving to better understand the meaning of entities. It is also possible to infer new relations and perform complex semantic queries thanks to ontological reasoners.

The general approach developed in the semantic web tries to reach some consensus in order to propose global and shared reference ontologies in specific activity domains. Top-down approaches involve domain experts and/or knowledge engineers who develop the ontologies that will have to be accepted by all the concerned knowledge workers (Kotis, 2006). Unfortunately, literature shows that reaching such a consensus is a real difficult task.

The main difficulty comes from the fact that defining an ontology always corresponds to provide a particular viewpoint about the domain's entities. Yet, the viewpoint of knowledge engineers is usually not the same as the domain experts' one. And even experts in the same domain do not always share the same viewpoint (Zhitomirsky-Geffet, 2017). As a result, different ontologies dedicated to the same domain have been released. A large part of nowadays research tries to define means that will help to merge or to link these existing ontologies.

To palliate this problem, researchers like Dong (2015) propose to adopt the inverse approach by trying to learn structured knowledge from social tagging data. Indeed, Garcia-Silva (2014) indicates that emergent vocabularies turn folksonomies into interesting knowledge sources from which ontologies can be developed. Folksonomies are then expected to capture all the viewpoints provided by domain actors, and thus to facilitate the creation of ontologies that would be a-priori accepted by them. However, this task is also difficult since it needs to extract the semantics of the folksonomy's tags, thus leading to the numerous context-related problems we have underlined in the previous part.

Another approach tries to find equilibrium between different expertise and contributions, and different solutions have then been proposed for allowing diverse actors to co-construct their ontologies. This is for example the case in HCOME (Kotis, 2006), and DILIGENT (Pinto, 2009). For HCOME, Kotis notes that workers need to map others' conceptualizations to their own and put them in the context of their own experiences. This can result in new meanings since concepts are seen under the light of new experiences. Pinto advocates for letting people retain a part of the shared ontology and modify it locally. Indeed, these two propositions offer collaborative tools that allow users to personalize a shared ontology, to adapt it to their own experience, and then to integrate some of these adaptations into the shared global ontology.

A new trend that can be represented by the proposition made by Zhitomirsky-Geffet (2017) also nourishes our own thinking about tag semantics. The author remarks that most of the above frameworks still force the users to reach a consensus on their final ontology. She however argues that ontology users are also interested in a variety of viewpoints on the knowledge domain. Our understanding of the state of the art and the above-mentioned issues also lead us to think that there is a need for a new type of ontology that allows multiple viewpoints on the domain to co-exist. Like in HCOME and DILIGENT, the main idea is to let users develop their own personal ontologies reflecting their own contextual experiences. But in our approach, these ontologies are not intended to be finally merged in a global one. They will co-exist, and will be closely and explicitly linked to the description of the context they describe and from which they have emerged.

2.3 Tagging in Activity's Context

The above studies show that tag semantics takes great advantages in being linked to its creation context. The numerous improvement in researches about folksonomies and ontologies have all proposed new means to better take this context into account while linking created entities to their creators, or to their point of view. From our point of view, the context that should be considered is broader: it is synthesized in the concept of activity.

According to Ning (2012), the activity can be used to glue knowledge item and knowledge context such as people, resource and environment, in a semantic way, thus providing enhanced knowledge. While considering activity as a central concept for contextualizing knowledge, tags can be explicitly linked to their creators, to their creators' viewpoints,

to their role in the activity, and also to the whole set of correlated entities like the resources used, the activity's products, the other actors and roles, and even other related activities. Moreover, each tag in an activity is itself part of the knowledge context and thus becomes the background of the other tags.

Such solution implies to know in which activity a tag is created. This need is coherent to those identified in the context of research about multi-viewpoints ontologies that advocates for dealing with the way people develop their conceptualizations in the context of their day-to-day activities, in a seamless way to their working practices (Kotis, 2006). Following this direction, our approach is to let users explicitly indicate the activity related to the experience they are sharing. Explicit reference to users' activities has been successfully used in several project dedicated to information management. These propositions criticize the omnipresent hierarchical structure used to store and retrieve personal resources, and propose activity-based tagging systems to solve the identified problems (Voida, 2009). Even if the main purpose of these systems is different from ours, their results are instructive. In particular, Oleksik (2009) categorized several benefits from using the activity concept in the tagging of resources. Kersten (2012) has shown that the activity concept matches well end-users' representation of their work while fitting with real world organizations, and facilitating the management of their resources while often switching from one task to another. These findings advocate in favor of an environment emphasizing the activity concept for contextual tagging.

2.4 Main Objectives

We aim at providing a tagging system that allows users to share their experience about web resources involved in specific activities. According to the above-mentioned literature, our approach is to allow users to tag resources while keeping explicit links between these tags and the activities in which the resources were used, and where the tags fully make sense. The main purpose is to help users in sharing their viewpoints about sets of entities involved in specific contexts, and to let others discover, browse, understand and be inspired from them. Such approach can somehow be qualified as folksonomic. It allows users to browse the whole set of shared viewpoints and to create clouds in which tags are pondered by their occurrences. It is however also possible to know each specific contextual activity related to a user tagging action. And finally, one can filter and search the viewpoints according to criteria built from the system structure.

We want to take benefits from ontological tools to have access to linked data, semantic queries and inference. It however has to be noticed that even if they inspired us, our aims differ from those of Zhitomirsky-Geffet (2017) in building ontologies. The approach of the author is to guide the users to construct multiple viewpoint ontologies and then integrate them together, where multiple viewpoints are part of a central unified ontology. We do not aim at competing with engineering methods and systems for building centralized ontologies. We aim at using ontological mechanisms for supporting users in sharing their own personal experience. According to Zhitomirsky-Geffet (2008), we think that the viewpoints are not limited to different visualizations of the same information relationships: the relationships themselves may differ as well. In our approach, each viewpoint corresponds to a (potentially) different set of semantic entities and relations between them. We thus define each viewpoint as a single *contextual ontology*, a term that can be correlated to the *personal knowledge ontology* proposed by Hsieh (2008) for personal information management. A *contextual ontology* is intrinsically linked to a specific context and represents the experience developed by an actor in a specific activity. However, according to the real-world activities they represent, contextual ontologies can be interrelated. Thus, the acceptance and pooling of some contextual ontologies' concepts developed by different actors in some shared, correlated, same type, or same domain activities can be envisioned. Such acceptance by conscious integration of some others' concepts into one's contextual ontologies may help to dynamically represent the consensual viewpoint of a group of actors, and picture some shared and evolving contextual group ontologies.

3 THE EVOXEL FRAMEWORK

3.1 Using PROV to Model Context

We have chosen the Provenance data model (PROV) and especially the PROV Ontology (PROV-O) to represent the activities, the resources they use and produce, and their actors. PROV-O is an owl ontology providing a simple data model proposed by the W3C for which provenance is defined as "a record that describes the people, institutions, entities, and activities involved in producing, influencing, or delivering a piece of data or a thing" (W3C, 2013).

One of the main ideas from which PROV has emerged is that provenance of information is crucial in deciding whether information is to be trusted and how to give credit to its originators when reusing it. Such intention clearly matches our needs focusing on the provenance of the tags and the shared experience they are related to.

The PROV data model is constituted of three core concepts: Agents participate in Activities, which can use and produce Entities (such as documents, web sites, etc). We thus use prov:Agent to describe our users sharing their experience, prov:Activity to describe the contexts in which this experience emerges, and prov:Entity to describe the resources used as well as the activities' products. We also mainly use PROV's basic properties (prov:used, prov:wasAssociatedWith, etc.) to describe the relationships between these entities. PROV classes and properties are further detailed in (W3C, 2013).

3.2 Putting Tags in the Context

Using PROV thus helps us in describing activities, i.e. the contexts related our users' shared experience. As stated in the previous section, each particular context is described in a corresponding contextual ontology.

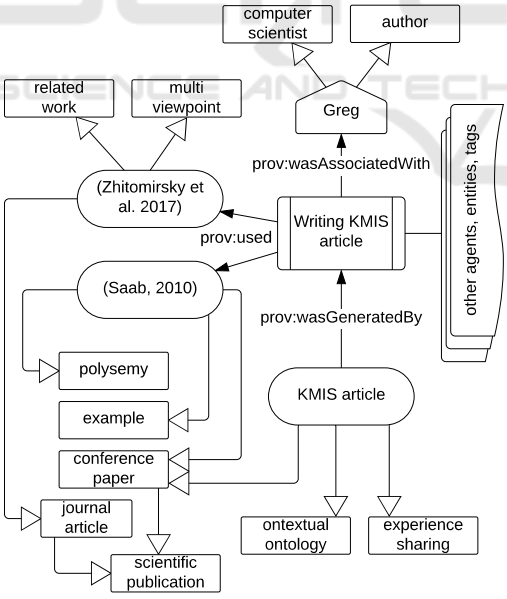

Figure 1: Fragment of Greg's contextual ontology describing his point of view on the activity.

Figure 1 describes some fragments of Greg's contextual ontology corresponding to its Writing KMIS article activity. KMIS article is a prov:Entity representing a product of this activity. Zhitomirsky et *al. 2017* and *Saab, 2010* represent two of the resources used as references in the current article. The entity *Zhitomirsky et al. 2017* is tagged *journal article*, and also *scientific publication*. In fact, Greg only applied the *journal article* tag, and *scientific publication* is inferred by the system. This is due to the fact that these tags correspond to owl classes, and that the former is defined has a subclass of the latter by Greg's in its tags hierarchy for this contextual ontology. Yet, the framework's structure allows using all classical semantic reasoners' capabilities in the context of each specific activity, thus providing contextual semantic reasoning.

Greg also tagged this resource as *related work* in the current article. It is obviously a contextual tag which sense is closely related to this specific context. Indeed, in another article, the same resource can be tagged differently (e.g. "*case study*") because it has been quoted for other reasons (e.g. basing new research on the provided study about the effect of diet on health). This tag is then applied to this entity only in this contextual ontology.

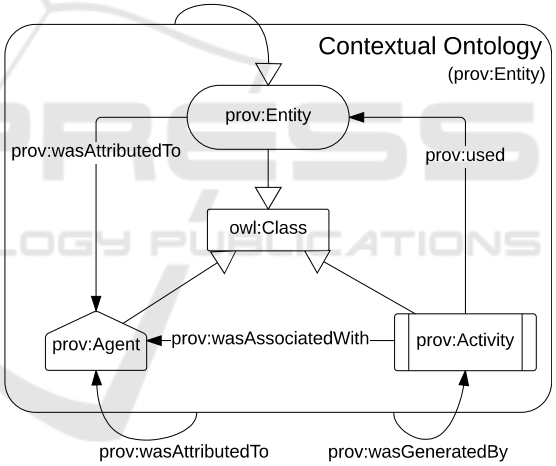

Figure 2: Contextual Ontology Structure.

Figure 2 represents the generic structure of contextual ontologies. It shows that each user's contextual ontology is also itself considered as a prov:Entity. Each user's experience in a particular activity is crystallized in a contextual ontology, which is itself considered as a product of the user's activity it describes.

3.3 Connecting Personal Ontologies

The framework generates one contextual ontology by actor and by activity, each ontology being split in two parts: a private and a public one. Some activities can however be shared by multiple actors. For

example, *Writing KMIS article* actually involves two co-authors. Such activity shared by two actors is described in two contextual ontologies, each one containing PROV data and tags associated to the elements referenced by each user in this activity.

Some entities can be involved in multiple contextual ontologies. For example, the two authors realizing the *Writing KMIS article* activity both share the same references and thus, these resources are part of their respective contextual ontologies. They also may share some tags applied to these resources, but not necessary all of them if they consider these resources from different viewpoints. Moreover, the same tags may be part of different (inheritance) hierarchies representing different meaning for their creators.

From a global viewpoint, we use the *dcterms:references* and *dcterms:isReferencedBy* relationships to keep track of the bilateral links between the many elements (identified by their IRI) like users, activities, resources, products and tags, and the contextual ontologies referencing them.

3.4 Framework Capabilities

The framework allows browsing all the contextual ontologies in which a particular entity is involved. Starting from an entity (e.g. a resource) and selecting a contextual ontology using it lets discover the other entities that participate to the realization of the targeted user's activity, and their specific relationships. This is achieved while providing the associated contextual tags, thus letting one better understand the related experience. The framework also gives the opportunity to list all the tags tied to an entity by "merging" the several users' viewpoints in a folksonomic fashion. Selecting a particular tag can lead to all the activities in which it has been used, and thus let discover its meaning in the different users' activities. It is also possible to search the environment by performing queries based on the many entities, entities types (tags) and their specific relationships in contextual ontologies.

To put these functionalities in action, we are developing a web application and Google Chrome plugins connected to a first implementation of the framework through a JEE server using the OWL API and the Openllet semantic reasoner. We tested some scenarios enhancing some existing web tools. For example, tools like Google Scholar can help in looking for specific articles, searching with keywords or author name. Given an article, it shows the list of other papers referencing it. A same paper could be cited for several reasons, depending on the context. Discovering (or remembering) why a paper references another one can help in faster understanding a researcher's viewpoint, and then evaluate the (contextual) level of interest of other's research work. Thanks to our framework, a plugin injects these new data in a references list, and proposes the contextual and potentially inferred tags associated with each reference in this context of use.

We investigated the domain of scrapbooking, where many people use *Blogger* to exhibit their creations and design methods. Each blog article gives details about a creation like the materials used and how they have been associated together. Thanks to EVOXEL, the blogger is able to contextually tag materials. Afterwards, exploring the blog lets users discover that a certain piece of paper, which has been tagged as *background* in a creation, has also interestingly been used as an *embellishment* while being associated with other specific materials (or materials types) in another one. Such discovery, letting one discover unexpected use and/or unexpected (associated) resources, becomes a source of new inspiration.

Instructional designers also used the framework to describe their pedagogical activities in an approach somehow similar to *Merlot*. They were afterwards able to use web forms applying semantic query features and for example search in others' contextual ontologies for all the *lectures* using *SCRUM* in an *active pedagogy* process.

More generally, the framework also allows the creation of tags from query results. For example, a query for retrieving all the scientific articles that cite a particular researcher's papers as *related work* can be transformed in a new (private) *to read* tag (i.e. an equivalent class). The inference will then apply the tagging on the corresponding elements, even if they are integrated well after the tag's definition.

4 CONCLUSIONS

The web nowadays offers many tools that allow people to share their own experience about the resources they use. In this context, tagging systems can help in organizing and navigating through the shared knowledge. Moreover, tags carry semantics that can help in understanding it. Building on a literature review, we have shown that tags could take great benefits from being even more closely related to their creation context. We thus have proposed the EVOXEL framework that emphasizes the concept of *activity* for contextual tagging. The framework relies on semantic web technologies and introduces the

concept of *contextual ontology* to link tags to their creation contexts, and let them benefit from ontological structures, mechanisms and tools.

We have shown that the framework yet offers the basics for supporting our needs, but EVOXEL is still under development. We are currently further developing the web applications and the Google Chrome plugins offering its functionalities at our end-users' abstraction level. The framework is also itself currently enhanced by integrating a collaborative dimension for better supporting users who share activities and/or integrate and reuse entities borrowed from other contextual ontologies. EVOXEL's model also offers new opportunities and we are already working with other researchers on new functionalities based on *contextual ontologies* similarity measurement. We expect those new features to even better support end-users' experience sharing, discovery, and inspiration.

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