An ontology for quantified self: Capturing the concepts behind the numbers

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(Article begins on next page)

An Ontology for QS: Capturing the Concepts behind the Numbers

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Abstract
This paper tackles an important issue of how to use semantic web technologies for Quantified Self (QS). Ontologies offer a great opportunity for data integration and reasoning over data in a QS environment.

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Quantified Self; Personal Informatics; Ontologies.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
Data collected by current QS applications are commonly heterogeneous w.r.t. syntax and semantics. As a result, the different information collected by such tools can be hardly integrated and they often remain enclosed in autonomous silos. This may narrow the vision on the user's "self", undermining her capabilities of finding useful insights, such as correlations and co-variations among different aspects of her life [10, 11]. Ontologies [6] can address this issue, allowing for data integration and reasoning over data. In this paper we propose to use an OWL ontology to represent different aspects that may characterize a QS scenario. A preliminary work in this direction has been described in [1].

A Quantified Self Ontology

According to [5], an ontology can be seen as a "formal, explicit specification of a shared conceptualization". With explicit specifications of domain objects and their properties, as well as the relationships between them, ontologies serve as powerful formalisms for knowledge representation. For these reasons, ontologies are often used for semantic data integration and for resolving semantic conflicts, as in [4]. Also, the associated rigorous mechanisms allow for different forms of reasoning (for example, to deduce implicit classes [3]). Nowadays, there have been several attempts to create ontologies for ambient intelligence and ubiquitous environment [2, 12, 8, 13], in order to describe the context where Internet of Things technologies operate. However, they have not been designed from a user's point of view and they have not the explicit aim of representing the QS world. Our attempt is to fill this gap. Requirements for the development of the ontology were captured by PI experts and ontology developers.

The main classes of our QS ontology aim at modelling time, space and the user. Here we present, as an example, the classes related to space and the classes connected with the user's emotional states*. Class Place* models all the different places the user is present at. It has two subclasses: Indoor and Outdoor and the properties *has_place_name, has_latitude, has_longitude, has_geofeature* (which distinguishes if the place is at the sea, in the mountain or in the city) and *has_location* (which illustrates the kind of place we are dealing with, such as cinema, restaurant etc.). Regarding the user's emotional state, we introduced the *class Emotion* used to model user's emotions according to Plutchik's emotional wheel [9]. It has two subclasses: *BasicEmotion* and *ComplexEmotion.* There are 8 *BasicEmotio*n's which all have 3 degrees of intensity. *ComplexEmotion's* are composed of *BasicEmotions*.

An ontology such as the one proposed in this paper can find many applications in QS context. First of all, such an ontology can be used to solve the possible data value and schema conflicts occurring among the data gathered from PI tools. Data value conflicts happen at the level of instances, whereas schema conflicts happen among classes of the ontology. For example, regarding schema conflicts, two different names could be used for the same concept (e.g. "biking" or "cycling"), or the same information could be modelled in different ways (e.g. "date of birth" and "age"). These conflicts may be solved by mapping the tracked data to the corresponding classes in our ontology. Next, a QS ontology can be used to make inferences. In particular, generalization in conjunction with Data Mining techniques can help discover correlations among data. For example, data mining techniques might provide a correlation between headache and running or biking activities. These two activities are both outdoor activities, hence there might exist a correlation between outdoor activities and headache in this particular user (outdoor activities are generalization of running and biking).

Another application of ontologies of this kind is the recommendation process enabled by QS data, where accuracy and diversity of recommendation can be increased. Knowing the behavior of a certain user, we can always propose similar or somehow related activities to the ones commonly practiced by the user. For example, if we know that the user often goes running, but according to our data, running is correlated with bad sleep, we might suggest some similar activities (in the same category) such as hiking or walking.

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