Persona Modeling Process
From Microdata-based Templates to Specific Web Ontologies

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Abstract: The use of Personas method for communicating user requirements in Human-Computer Interaction is well established and widely used. However, little research has been conducted regarding linking personas data with other pieces of data concerning the product development and design process or even creating a personas model. We consider that using semantic web technologies such as microdata and RDFa to annotate personas data is and adequate step towards solving these issues. This paper aims to provide a conceptual model (a HTML5 microdata schema and an OWL specification) that includes concepts and properties used to model personas. In order to exemplify our model and extract data, we made use of a semantically annotated persona template.

1 INTRODUCTION

The *Personas* method was proposed by Cooper (Cooper, 1999; Cooper et al., 2007) and has gained increasing attention in the Human-Computer Interaction (HCI) field, as it facilitates the communication of information about target users among the project team members (Pruitt and Adlin, 2010), but also provides a greater understanding of the main audience. Considering these advantages, many companies such as Microsoft, SAP, FedEx have adopted personas as a part of their design process (Blomquist and Arvola, 2002; Chapman and Milham, 2006; Drego and Dorsey, 2010; Drego et al., 2010; Browne, 2011).

A *persona* is regarded as a user archetype which can be used to "help guide decisions about product features, navigation, interactions, and even visual design" (Goodwin, 2005). Being an archetype, a persona represents a group of users who share common behavioral or physical characteristics, goals, frustrations, preferences and other similar characteristics. Even though a persona represents a group of users, a fictional individual is created, based on user interviews, to represent specific aspects of that group (Pruitt and Adlin, 2010).

Despite the popularity of this method, there are several debates (Long, 2009) regarding the implementation of this technique as many authors advocate distinct differences in the way which it can be used. Also "there have been no adequate studies addressing the reliability, validity, or utility of the method " (Chapman and Milham, 2006), and – even if methodological problems were overcome –, this technique suffers certain practical limitations: "*how personas are reconciled with other information*, and who is *responsible for interpreting them*." (Chapman and Milham, 2006). Additionally, validating the obtained information can be time consuming and troublesome, as the personas profiles are validated manually against online user profiles or through the customer service team (Caddick and Cable, 2011).

Ontologies have proven to be a very useful tool in modeling data concepts and relationships between them, by providing semantics for humans and formalism for machine processing and reasoning. Also, microformats[1], RDFa[2] and microdata[3] enable the publication and consumption of the data available on the Web – particularly, using the HTML5[4] vocabulary.

In this paper we take into consideration such semantic web technologies, as a first step towards solving the issues presented above, and opening new possibilities such as automatically validation and generation of personas based on online user profiles. We propose *PersonasOnto* ontology as a way of modeling personas related concepts and their relationships.

[1] http://microformats.org/
[2] http://www.w3.org/TR/rdfa-core/
[3] http://www.w3.org/TR/microdata/
[4] http://www.w3.org/TR/html5/

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The next section of the paper offers a review of related work. We continue with a discussion regarding several aspects of the personas method. Section 4 presents the personas knowledge modeling, and section 5 illustrates several use cases. The article ends with conclusions and future directions of research.

2 RELATED WORK

The interest on describing persons and user profiles has a wide spread as several vocabularies such as FOAF[5], SIOC[6] and Person[7] offer facile manner to publish information in a machine-readable format. Also, as the need for software system (Razmerita et al., 2003; Negru, 2010; Cheng et al., 2011) to automatically adapt to their users has increased, a number of domain specific ontologies concerning user profiles have been developed.

Such ontologies – as (Felden and Linden, 2007; Cena et al., 2011) – explore the implications of user models in the context of recommender systems. Also, (Razmerita, 2007) presents a generic ontology-based user modeling architecture applied in Knowledge Management Systems. Other related work such as (Golemati et al., 2007) provides a standard ontology for modeling user profiles with the aim of facilitating communications between applications.

A related ontology is AEGIS ontology[8] which helps the mapping between accessibility concepts, and how they can be mapped within accessibility scenarios.

As most of the existing user profiling ontologies the related work presented above emphasizes the importance of context awareness. This aspect and other relevant user modeling issues are reviewed in (Fischer, 2001).

Although seemingly overlapping concepts personas and user profiles, they are different. Personas represent a group of users who share characteristics and preferences, while user profiles (also known as user models) are a collection of personal data associated to specific users or stereotypes. Despite these differences, certain aspects regarding user modeling techniques can be transposed on the personas method.

In the next section we will consider a few aspects regarding the personas method.

[5]http://xmlns.com/foaf/spec/
[6]http://rdfs.org/sioc/spec/
[7]http://schema.org/Person
[8]http://www.aegis-project.eu/

3 PERSONAS METHOD

Unlike the target audience segmentation or user profiling, personas provide greater depth and context to generic target audience groups by focusing on one archetype which embodies the predominant qualities of the larger group. These qualities are often structured by a persona document (specification) (Long, 2009; Pruitt and Adlin, 2010; Caddick and Cable, 2011).

The data included into this document is a result of user interviews and it is distilled into one or multiple fictitious characters which corresponds to a certain persona type (Cooper et al., 2007). In this document, each character is developed in greater detail, along with scenarios which describe how that character might interact with a product. The persona and their associated scenarios form the basis for specifying how users want to experience and interact with a certain product or application.

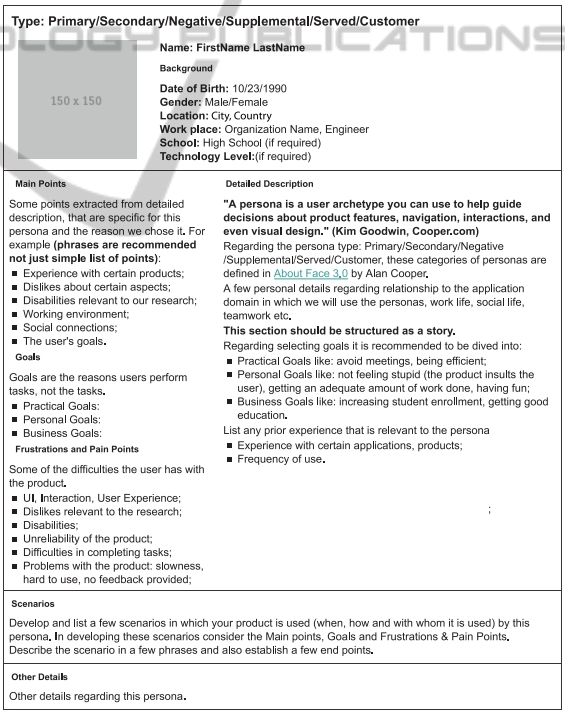

Figure 1: Overview of the personas HTML5 template.

3.1 Personas Document Template

As an important part of this method is the persona document and the information it contains, we developed our own HTML5 template[9] (Figure 1), following existing guidelines (Long, 2009; Pruitt and Adlin,

[9]publicly available at: http://blankdots.com/open/ personas/

2010; Caddick and Cable, 2011). Being a HTML document which contains information semantically annotated by using microdata/RDFa, it facilitates publication, consumption, and reuse of information.

The template is structured as follows:

1. *Type and Background Information* – contains details regarding the persona type and fictional background information such as birthday, name, gender, location and other information of interest;
2. *Main Details* – consists of a detailed description regarding this persona along with some characteristics (main points), goals and frustrations;
3. *Scenarios* – includes either a description of scenario tasks or images depicting scenarios;
4. *Other Details* – contains other relevant notes regarding the persona.

In the next section we will discuss how we can make use of this HTML template and annotate relevant data using existing vocabularies and our proposed vocabulary.

4 PERSONAS ONTOLOGY ENGINEERING

As we previously mentioned, several existing widely used vocabularies like as FOAF and `schema.org/Person` could be utilized, thus we applied such vocabularies to annotate information in our HTML template.

In a small scale experiment, we provided our template to several teams working on different projects to fill up with information. Using existing tools – such as RDFa Distiller[10] and Microdata to RDF Distiller[11] – we extracted the data presented below, from a project's personas document. This data consists of RDF triples expressed in Turtle format.

```
[ a schema:Person;
   schema:givenName "Jane"@en-us;
          schema:familyName "Doe"@en-us;
          schema:gender "Female"@en-us;
   schema:birthDate "1989-05-11"^^xsd:date;
   schema:image <student.jpg>;
   schema:location [ a schema:Place;
         schema:name "City,Country"@en-us ];
   schema:worksFor [ a schema:Organization;
         schema:jobTitle "Student"@en-us;
         schema:name
         "Univ. City,Country"@en-us ];
   schema:alumniOf
   [ a schema:EducationalOrganization
         schema:name
         "Univ. City,Country"@en-us ] ]
```

The data obtained is unsatisfactory as it omits several important pieces of data from the persona document. In order to solve this issue, we modeled our own Persona microdata schema.

4.1 Persona Schema

One advantage of the HTML5 microdata is that it is designed such that each piece of information in a document has assigned types from a single vocabulary, though each entity may have several types and properties from other vocabularies (W3C, Interest Group , 2012). Additionally, the Person schema offers properties such as *affiliation*, *interactionCount* (count of a specific user interactions with an item), *performerIn*, *spouse*, *awards* etc. which facilitates to establish certain knowledge regarding the user background and context.

Another important aspect is that `schema.org` allows the extension of existing schema, and we made use of it in this section by developing the Personas schema[12]. As represented in Table 1, we proposed a set of new properties such as *personaType*, *tagLine*, *mainPoint*, *frustrationPoint*, *endGoal*, *scenario*, *context* and other. Some properties like *myersBriggs* and *topicInterest* were inspired from the FOAF vocabulary.

Properties like *minHeigh*, *maxWeight*, *minFeetSize* refer to a persona body measurement such as height, weight, bust size, waist size, and feet size. We used min and max values instead of a range, due to the fact that they are more precise than a range.

Along with some of the new properties, we proposed several additional schemas like *Disability*, *Personality*, *Emotion*, *Scenario* and *Context*, in order to provide a more detailed vocabulary which fits our purposes. These schemas themselves come along with new properties and a range which specifies expected data types.

The *Scenario* schema has the following new properties and expected data types:

- **product**: A product (subject of a given usability test); for example, a software application or even a physical product such as mobile phone or car. Expected Type: Product or Application;
- **scenarioName**: Scenario name. Expected Type: Text;
- **userTask**: Tasks to be performed by the user. Expected Type: Text;

[10] http://www.w3.org/2012/pyRdfa/

[11] http://www.w3.org/2012/pyMicrodata/

[12] publicly available at: http://blankdots.com/open/schema/

Table 1: Persona Schema Properties and Description.

Property	Expected Type	Description
personaType	Text	The type of Persona: Primary, Secondary, Negative, Supplemental, Served or Customer.
tagline	URL or Text	A tagline specific to a persona.
mainPoint	Text	Main points specific to the persona category.
minHeight, maxHeight	Float	Minimum and maximum height of a persona.
minWeight, maxWeight	Float	Minimum and maximum body weight of a persona.
minBustSize, maxBustSize	Float	Minimum and maximum bust size of a persona.
minWaistSize, maxWaistSize	Float	Minimum and maximum waist size of a persona.
minFeetSize, maxFeetSize	Float	Minimum and maximum feet size of a persona.
experienceGoal	Text	Experience goals are simple, universal, and personal.
endGoal	Text	End goals represent the user's motivation for performing the tasks associated with using a specific product.
lifeGoal	Text	Life goals represent personal aspirations of the user that typically go beyond the context of the product being designed.
businessGoal	URL or Text	Business goals represent the goals of the organization the persons works for.
technicalGoal	Text	Technical goals reflect technical aspects regarding an application/product for example: run in a variety of browser, data privacy etc.
experienceLevel	Text	Reflects the experience level of a persona with the application or product; proposed levels: Beginner, Intermediate, Advanced.
technicalLevel	Text	Reflects the technical level of a persona.
disability	Disability or Text	A persona disability/disabilities relevant to accessibility aspects of the application/product.
myersBriggs	Personality or Text	Inspired by FOAF Myers Briggs personality classification which includes 16 4-letter textual codes (Myers et al., 1998).
topicInterest	Thing	A thing of interest for a certain persona, inspired by FOAF topic interest.
affectiveState	Emotion or Text	The affective state of the user at a certain moment, if a proper schema is not used, please provide a certain emotion using text format.
frustrationPoint	Text	Elements of a UI/UX or certain characteristics that frustrate the user or (s)he sees as pain points. These elements will help in usability evaluation.
userRole	Text	The role of the user in the application/product (if necessary - for example: admin, basic user etc.).
scenario	Scenario or URL	The scenario where the users represented by this persona will be used to test the usability.
context	Context	Description of the context that best fits a scenario recommended values: Physical/Virtual.
otherNotes	Text	Other notes and observations regarding a persona.

- **productTask**: Task performed by the product in response to the user. Expected Type: Text;
- **interactionMedium**: The medium of interaction; for example, Touch, Gestural, Mouse+keyboard etc. Expected Type: Text;
- **description**: Description of the scenario. Expected Type: URL or Text;
- **context**: Scenario context. Expected Type: Context;
- **participant**: Participants to this scenario. Expected Type: Person;

- **usabilityTest**: Usability test. Expected Type: UsabilityTest or Text;
- **evaluatedElements**: Focus/key elements in this scenario, tested later on, for example notifications element from the user interface. Expected Type: Text.

The *Context* schema has the following properties:

- **contextType**: Context type – recommended values: Physical/Virtual or Tangible/Intangible;
- **location**: Useful information about the location;
- **event**: An event has a location and a time;
- **geo**: The geographical coordinates of the context;
- **sensorData**: Sensors context data;
- **photos**: Photographs regarding the context;
- **reviews**: A set of reviews regarding the context.

Disability schema contains the following properties: *visualImpairment*, *hearingImpairment*, *gustatoryImpairment*, *somatosensoryImpairment*, *intellectualImpairment*, *mentalEmotionalDisorder*, *developmentalDisability*.

After modeling these schemas, we annotated the information in the HTML template using the above vocabularies and we extracted the data below.

```
[a <http://schema.org/Person/Persona>;
   schema:givenName "Jane"@en-us;
          schema:familyName "Doe"@en-us;
          schema:gender "Female"@en-us;
   schema:birthDate "1989-05-11"^^xsd:date;
   schema:image <student.jpg>;
   schema:location [ a schema:Place;
         schema:name "City,Country"@en-us ];
   schema:worksFor [ a schema:Organization;
         schema:jobTitle "Student"@en-us;
         schema:name
         "Univ. City,Country"@en-us ];
   schema:alumniOf
   [ a schema:EducationalOrganization
         schema:name
         "Univ. City,Country"@en-us ];
   schema:personaType "Primary"@en-us;
   schema:mainPoint [ a rdf:Bag;
         rdf:_1 "Experience with Android OS;"
         @en-us;
         rdf:_2 "connected socially to most of
         her colleagues and some teachers.
         "@en-us.];
   schema:technicalLevel "Medium"@en-us;
   schema:businessGoal
         "increase knowledge"@en-us;
   schema:experienceGoal
         "getting a proper education"
         @en-us;
   schema:frustrationPoint [ a rdf:Bag;
         rdf:_1 "hard to use"@en-us,
         rdf:_2 "no feedback provided"
         @en-us. ];
   schema:lifeGoal "be productive"@en-us;
   schema:scenario
          [ a <http://schema.org/Scenario>;
         schema:description "she will check
         grades and progress online"@en-us ] ]
```

The obtained data contains all the relevant information regarding a persona and could be processed and linked with other data in the spirit of Linked Data initiative (Bizer et al., 2009).

Although microdata is an easy way of annotating HTML document, it cannot express two aspects that RDFa supports: datatypes of literals and XML literals (Vestlandsforsking, 2012).

4.2 Personas Ontology Description

This subsection presents a description of the *PersonasOnto*[13] ontology. PersonasOnto provides a mean of annotating XHTML[14] and HTML documents with RDFa, but it can also be mapped in its RDF[15] representation to HTML5 microdata.

Table 2 presents an overview of the proposed ontology classes and subclasses and Figure 2 provides a graphical representation of the ontology classes and properties.

The *Person* class is the central one in the ontology, as it contains characteristics such as age, gender, name, date of birth, but also the *Persona* class. As a subclass of Person, the Persona class could be regarded of being a separate identity of a person, although it has the same usage. Also, as we previously mentioned, a persona represents the characteristics of a group of persons, and usually has a context associated.

Classes such as *AffectiveState*, *Personality*, *Disability*, *Organization* are used to describe several characteristics or a person like an emotion (e.g. anger), a disability (such as partial blindness), his/her personality (e.g. ESTJ – Extraversion, Sensing, Thinking, Judgment) and the organization (s)he works for, or (s)he is in.

Other classes like *Context*, *Scenario*, *Task*, *Goals*, *UsabilityTest* and subclasses *PersonaType* are connected with the *Persona* subclass. For example, a persona has a certain type (Primary, Secondary, etc.), has the characteristics of a (fictional) person, has certain life or experience *Goals*, (s)he performs certain tasks in a scenario. The scenario is placed in a certain context and can be also used in a usability test.

Many of the classes, subclasses and properties are

[13] publicly available at: http://blankdots.com/open/personasonto.owl

[14] http://www.w3.org/TR/xhtml1/

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

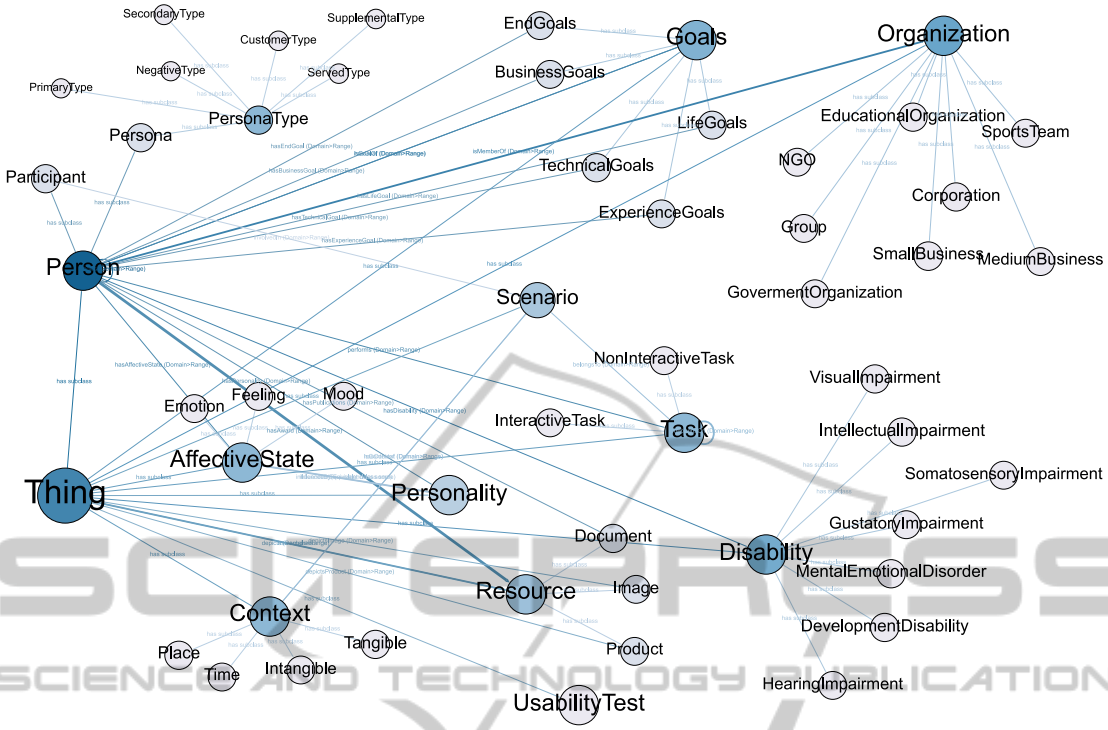

Figure 2: Overview of the PersonasOnto ontology classes and properties.

Table 2: PersonasOnto Ontology and Upper Level Classes.

Class Name	Subclasses	Class Description
AffectiveState	Emotion, Feeling, Mood	The affective state of a person at a certain point.
Context	Intangible, Tangible, Place, Time	The Context in which a scenario takes place.
Disability	VisualImpairment, HearingImpairment, GustatoryImpairment, IntellectualImpairment, MentalEmotionalDisorder, SomoatosensoryImpairment, DevelopmentDisability	A person's disabilities mental and physical.
Goals	BusinessGoals, EndGoals, ExperienceGoals, LifeGoals, Technical Goals	The goals of a Persona.
Organization	Corporation, EducationalOrganization, GovermentOrganization, Group, MediumBusiness, NGO, SmallBusiness, SportsTeam	The type of Organization a Person belongs to.
Person	Participant, Persona	Basic information about a person and more precisely about a participant or a persona.
Personality	–	The MyersBriggs personality of a person.
Resource	Document, Image, Product	Type of resources available.
Scenario	–	A series of tasks the user performs in a certain context.
Task	InteractiveTask, NonInteractiveTask	Tasks performed by a Person in a Scenario. InteractiveTask could be certain action performed by a user, NonInteractiveTask could be a machine response to that action.
UsabilityTest	–	A usability test evaluates the usability of a certain Product in a Scenario.

the same as in the *Persona* schema described in the previous subsection. On the other hand, classes like *AffectiveState* and *Personality* have certain properties which better define the relationship between them.

Such a property is expressed below in Turtle[16] format.

```
### personasOnto.owl#hasInfluence
:hasInfluence rdf:type owl:ObjectProperty ;
     rdfs:domain :Disability ;
     rdfs:range [
       rdf:type owl:Class ;
            owl:unionOf ( :AffectiveState
                          :Personality )].
```

The *Context* Class includes a tangible (physical world) or intangible (virtual world) environment, but also could specify spatial and temporal concepts. This inclusion is expressed below.

```
### personasOnto.owl##includes
:includes rdf:type owl:ObjectProperty ;
    rdfs:range [
      rdf:type owl:Class ;
           owl:unionOf ( :Place
                         :Time )] ;
    rdfs:domain [
      rdf:type owl:Class ;
           owl:unionOf ( :Intangible
                         :Tangible )].
```

Other classes like *UsabilityTest* can be extended to include domain specific concepts.

5 USE CASES

In section 2 we mentioned a small scale experiment in which we provided our template to several teams working on different projects in order to fill up with information. The purpose of such a project was to build a web-based solution along with a mobile client, for the management of the academic information (e.g. grades, schedule, courses, assignments etc.).

The team responsible for this project identified in a first phase two primary personas: professors and students – each of them having their own goals, frustrations and set of characteristics. We presented the student persona in section 2 and the professor persona is exemplified below.

```
[ a <http://schema.org/Person/Persona>;
   schema:givenName "John"@en-us;
   schema:familyName "Doe"@en-us;
   schema:gender "Male"@en-us;
   schema:birthDate "1980-10-23"^^xsd:date;
   schema:image <proffesor.jpg>;
   schema:location [ a schema:Place;
         schema:name "City, Country"@en-us ];
   schema:worksFor [ a schema:Organization;
         schema:jobTitle "Proffesor" @en-us;
         schema:name "City,Country"@en-us ];
   schema:alumniOf
   [ a schema:EducationalOrganization;
         schema:name "Univ. City,Country"
         @en-us];
   schema:personaType "Primary"@en-us;
   schema:mainPoint [ a rdf:Bag;
         rdf:_1 "dislikes applications that
         are not well structured;"@en-us,
         rdf:_2 "has programming knowledge
         "@en-us,
         rdf:_3 "uses applications to
         share courses data with students
         and manage their progress"@en-us;
         rdf:_4 "Working environment: Desktop
         Mac OS, Mobile: IOS"@en-us.];
   schema:technicalLevel "Advanced"@en-us;
   schema:businessGoal
         "increase student enrollment"
         @en-us;
   schema:endGoal "share courses"@en-us;
   schema:experienceGoal
         "organize work information and tasks"
         @en-us;
   schema:frustrationPoint [a rdf:Bag;
         rdf:_1 "dislikes weak and bad
         structured applications"@en-us,
         rdf:_2 "slowness, hard to use and
         no feedback provided"@en-us,
         rdf:_3 "Unreliability"@en-us. ] ]
```

The first challenge the team faced was to combine all the data from the interviews to obtain the personas document. But, as this team followed the method and created several personas by interviewing users, some teams created their personas by imagining possible characteristics and frustrations of their target audience. This latter method requires validation against real user data.

Both of these challenges could be solved by a software system which incorporates in its knowledge base a TBox component (Baader et al., 2007) based on the PersonasOnto and the ABox populated with data extracted from the personas document. The system would be able to generate the personas document based on a selection on online user profiles or validate the created persona against an online user profile.

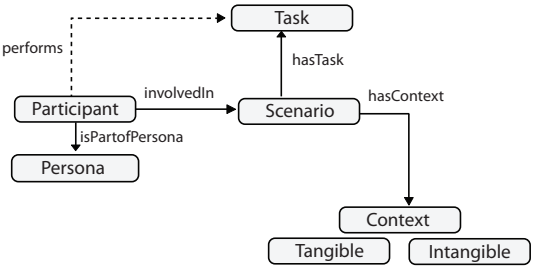

Figure 3: Components of a Scenario.

As we see in Figure 3, a scenario contains several components such as participants, tasks, and con-

[16] http://www.w3.org/TR/turtle/

text. From these components the context is the most problematic as the changes that take place in both the tangible (physical world) and intangible (e.g. virtual world, software simulation) contexts have an impact on the user, which performs a certain task.

In such a case, we need to link the data gathered in the persona document with the data obtained in the usability test, because some inconsistencies may arise. For example, certain context conditions may have an impact on the number of tasks a user has to do to, in order to reach the end point of a scenario, thus generating new frustrations.

6 CONCLUSIONS AND FUTURE WORK

This paper presented the *PersonasOnto* ontology and Persona schema which incorporate concepts and properties used to model personas. We also explored the possibility of annotating information in a personas document by using HTML5 microdata, thus making such a web page machine-readable.

Existing vocabularies and research regarding user profiling and personas have been taken into account, in order to create an accurate personas model.

These vocabularies open new possibilities regarding automatically validation and generation of personas based on online user profiles, but also linking personas data with other data (e.g. data from a usability test document or context data).

It is our future aim to study these issues, with the purpose of incorporating them in a knowledge-driven interactive system.

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