Linking the Semantics Ecosystem with Semantics Derivation Rules for Multimedia Content

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ABSTRACT

Multimedia content exhibits multiple semantics that is influenced by different factors like time, contextual use, and personal background. With the semantics ecosystem, we find an elegant and high-level description of the different factors that influence the semantics of multimedia content. On the other hand, semantics derivation rules are a concrete means to extract and to derive semantics of multimedia content while authoring it. These rules are directly applicable in concrete applications and domains. Thus, there is a gap between the high-level ecosystem and the concrete semantics derivation rules. In this position paper, we propose the use of an ontology-based description of events to combine the high-level description of the semantics ecosystem with the concrete method of semantics derivation for page-based multimedia presentations.

Keywords

Multimedia Semantics, Semantics Ecosystem, Semantics Derivation, Event Ontology

1. INTRODUCTION

Multimedia content exhibits multiple semantics that is influenced by different factors like time, contextual use, and personal background. Describing this phenomena in terms of the different factors and their influences to each other in a Semantics Ecosystem [11] provides an interesting high-level model of (multimedia) semantics. However, it is hard to apply for implementing concrete applications. On the other hand, semantics derivation rules [1] are a concrete means to extract and to derive semantics for multimedia content such as page-based multimedia presentations. Here, we can derive information such as the importance of images, the caption of media assets, and titles of the presentation's pages. It is a directly applicable technique with defined input and output. However, it is very focused and lacks of broader context.

The goal is to link the high-level description of the phenomena of multimedia semantics with the concrete method of deriving multimedia semantics and annotating multimedia content through rules. In this position statement, we investigate for an ontology-based description of events to bridge the gap between the high-level description of the phenomena with the concrete semantics derivation rules for page-based multimedia presentations.

The remainder of the paper is structured as follows: In the next section, we introduce the Semantics Ecosystem. In Section 3, the semantics derivation for page-based multimedia presentations is described. In Section 4, we introduce how an ontology-based description of events could help to combine the both, before we conclude the paper.

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2. SEMANTICS ECOSYSTEM (SES)

With the semantics ecosystem, we find a theoretical approach for understanding and modeling semantics [11]. The ecosystem bases on work from the philosopher Karl Popper [6]. We assume the existence of a Physical World and a Mental Model as depicted in Figure 1. The ecosystem defines five different types of semantics (natural, analytical, user, expressive, and emergent semantics) and their relationships. It aims at integrating existing work in the field rather than reinventing it.

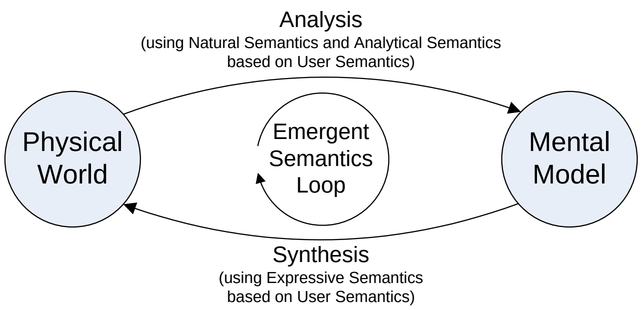

Figure 1: Overview of the Semantics Ecosystem

With natural semantics, we understand the semantics of the non-living physical objects, living things, and events of our physical world. It is the result of the long-term natural language communication between humans. Natural semantics associates basic objects and actions with symbols. Analytical semantics bases on natural semantics. It aims at understanding more complex objects, concepts, and situations. Analytical semantics is applied to dismantle these more complex objects, identify the individual parts, and interpreted

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them by applying natural semantics. User semantics is the human's perception of the physical world based on his or her personal background. It is the perception of the items, biological objects, and events of the physical world based on a multitude of very different aspects. Among them are the individual's knowledge, preferences, interests, needs, and cultural background [2, 5, 4] and the location, time, used end device, and social situation [12, 3, 13]. With expressive semantics, we consider how the products of the physical world are created. A product can be a gesture, a spoken sentence, or any kind of a non-living object like a book, CD, or multimedia presentation. Expressive semantics describes the intention of the creator when creating such a product (why is the product created in that certain way and what is the intention of the creator in creating it like this). The expressive semantics heavily depends on the individual's background and contextual situation as introduced above. Thus, it depends on the user semantics. Finally, emergent semantics considers the change of semantics over time and use. This means that the individual's semantics and observation of a physical world item, biological object, or event can and will change over time and will change through the different contexts in which it is used. Emergent semantics can be short-termed (a couple of seconds up to some minutes) or very long-termed (like a couple of years). However, the key to emergent semantics is the interaction of expressive semantics and analytical semantics. This interaction leads to a modification of user semantics, i.e., the personal ontologies and understanding of the physical world of the individual.

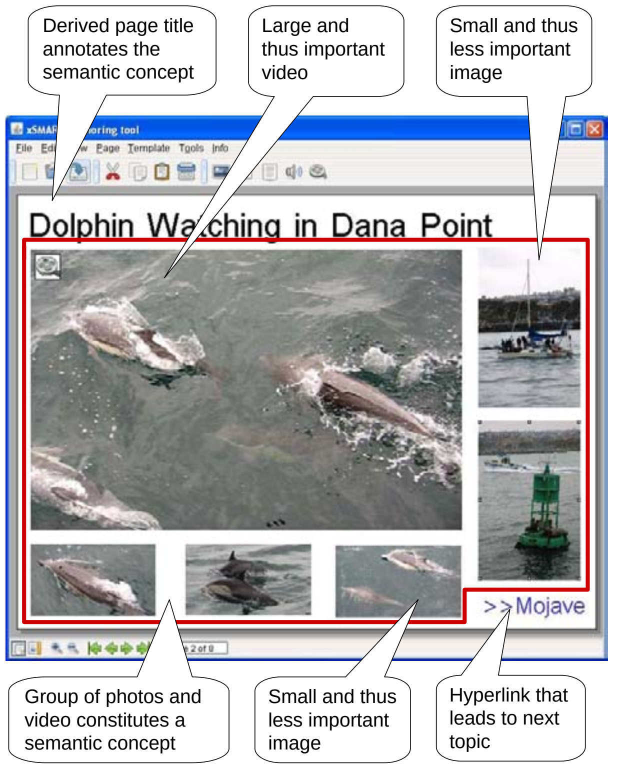

Figure 2: Example of semantics derivation for page-based multimedia presentation

3. SEMANTICS DERIVATION

For the creation of page-based multimedia presentations, we developed the context-driven multimedia authoring tool xSMART [8, 7, 9]. It bases on the component framework SemanticMM4U and allows for semantics derivation of the created multimedia presentation during the authoring process [8, 10]. The xSMART tool provides an authoring wizard that supports the users in a step-wise creation of multimedia presentations. This wizard employs different concrete metadata derivation components provided by the SemanticMM4U framework for semantically enriching the multimedia presentation. Once the wizard is finished with creating the album, the users can still manually edit the presentation. While polishing the album, the xSMART tool still allows for further semantically enriching the created multimedia presentation.

Figure 2 shows an example page of a page-based multimedia presentation demonstrating the use of such semantics derivation rules in xSMART. The page depicts photos and videos from a dolphin watching tour some friends did in Dana Point, Southern California. As the figure shows, the user expresses that the video is a more important media asset in the presentation than the smaller images. By placing the media assets together on one page, they are identified as semantic concept. This semantic concept is annotated with the text *Dolphin Watching in Dana Point*, as the user expresses this text to be the title of the page by placing it at the top in a sufficiently large font.

The semantics derivation rules have been specified using the Object Constraint Language[1] (OCL). A concrete example of a derivation rule in OCL for determining the importance of images [1] is shown in the listing below. From domain knowledge one can derive that larger images are more important than smaller ones. Thus, the rule adds and removes points of importance to images used in the presentation based on their size. In order to determine whether images are small or large, we compare their spatial extension to the total size of the presentation. An image is considered large, when it covers more than one third of the presentation page (it is assumed that for the best use of a presentation page, three images will be placed on it). If an image is smaller than one sixth of a page, it is considered small and less important. This valuation of importance is manifested by a point of importance that is added or removed to the image. For images of normal size between one sixth and one third of a page no point of importance is added or removed.

```
context Photo::imageImportanceRule()
pre: self.hasBeenApplied() -> false
body:
 if self.size > ( presentation.size / 3 ) then
    self.importance = self.importance + 1
  else if self.size < ( presentation.size / 6 ) then
    self.importance = self.importance - 1
  end if
post: self.basBeenApplied = true;
```

[1] http://www.omg.org/docs/formal/06-05-01.pdf

4. LINKING THE SES AND SEMANTICS DERIVATION

With the semantics ecosystem, we provide a high-level description of the phenomena of multimedia semantics. It is an elegant description of the different factors and their dependencies that define (multimedia) semantics. However, as being such an high-level and abstract description, it is hard to apply for the implementation of concrete applications. On the other hand, we find with the semantics derivation rules a concrete method to enrich and annotate multimedia presentations. It is a directly applicable technique with defined input and output. However, it is very very focused and lacks of broader context. Thus, there is a gap between the ecosystem and the rules. Bridging this gap, i.e., linking the high-level semantics ecosystem with the concrete semantics derivation rules is of mutually benefit.

Both, the ecosystem and the rules deal with events and objects. In the ecosystem, we model human experience gained by participating in real world events. The objects in the events are the people and the non-living things involved. When deriving semantics for the multimedia presentation, we implicitly also detect or annotate events. For example, when determining important images on a page of a multimedia presentation, we are detecting important events. When detecting captions of images, we describe events or objects and when determining semantic concepts implicitly complex events are detected.

To connect the Semantics Ecosystem with the semantics derivation rules, we propose an ontology-based description of events. Such an ontology could be used to model and define what makes a birthday party, wedding, and others. Which persons are involved in such events and what kind of non-living things are present. One can also consider what kind of sub-events happen, in which chronological order, and certain dependencies.

5. CONCLUSION

In this paper, we introduced the Semantics Ecosystem as an high-level description of the different factors that influence multimedia semantics. We presented semantics derivation rules based on OCL as a concrete means for deriving semantics for page-based multimedia presentations. In order to combine the both, we propose an ontology-based description of events. With such an ontology of events at hand, we might be able to connect events and objects described in the Semantics Ecosystem with the concrete semantics derivation rules working on such events and objects.

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