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Automatic Presentation Generation for Scholarly Hypermedia

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ABSTRACT
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Automatic Presentation Generation for Scholarly Hypermedia

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8th October 2003

Abstract

Automatic hypermedia presentation generation uses an information source semantic network first to select the content and then to compose it in the presentation so that the semantic relations between the information items are conveyed to the user. A hypermedia presentation can be considered as an example of strongly-guided navigation through a hypermedia structure. This can provide a high level interface for semantic network navigation, for example aiding the user in browsing a semantic network of scholarly claims.

1 Introduction

Many information sources, like multimedia databases, were designed to be presented in a fixed structure, e.g. a museum website. As a consequence the user is often bound to what the author deemed to be the most interesting topics and structure to express them. On the other hand there can be no single general-purpose presentation format for all users, because users differ in all aspect from interests and expertise levels to devices used to visualize the requested information.

Our goal is to present information in a flexible way to serve different users. In fact, even a single user cannot be considered as a constant unit, because (s)he undergoes changes too, sometime even in the same session, e.g. mood changes. Hypermedia access has the potential for offering this flexibility either by allowing free navigation or by supporting the generation of different user-requested presentations, where the latter approach can be considered as an example of strongly-guided navigation through a semantic network.

This paper presents some ideas from our research in automatic hypermedia presentation generation that can contribute to the scholarly hypertext field, and particularly to scholarly research as described in the Scholarly Ontologies project [4].

Our approach for presenting information contained in digital libraries or musea databases is to use the semantic network first to select the content and then to compose it in the presentation so that the semantic relations between the information items are conveyed to the user. The generation process selects information items that *contain* information about the subject of the presentation (e.g. if the presentation is about the painter Rembrandt van Rijn, a portrait of him) plus items that are *semantically related* to the subject of the presentation (e.g. a portrait of Peter Lastman, Rembrandt's teacher), as described in section 2.

This process can be viewed as a way to automate the semantic network traversal, and in section 3 we present a possible application of our research to automatic generation of scholarly discourse.

2 Traversing the Semantic Network

Our Cuypers system is described in [2]; here we will briefly focus on the concepts related to the creation of a narrative structure from a semantic graph (see also figure 1 on the following page). A semantic graph is a set of elements annotated with a domain ontology. The domain ontology represents the conceptual structure of the information source and the semantic graph is equivalent to the underlying structure of a hypertext, i.e. the semantic network.

The main idea is to generate from the fabula[1] (the complete semantic graph, containing all the possible plots) a plot (our presentation, or an instantiation of a path through the semantic graph). This process uses different knowledge sources: as shown in the upper layer of figure 1, the domain ontology describes the entities and the relations contained in the semantic graph; this knowledge is used by the generation process through the discourse ontology, which provides three main parts: the *Genre* class and its subclasses, defining the different genres a presentation can have (we explore mainly the biography genre); the *Narrative Unit* class and its subclasses, defining the building blocks for each genre, and the *Actant* class defining the characters of the presentation.

[1]The fabula is understood to be the entire structure of causal-chronological events within a given time and space, while the plot arranges and connects events according to the orderly sequence in which they are presented; the plot is usually different from the fabula, for example due to artistic reasons (i.e. flash-backs, flash-forwards).

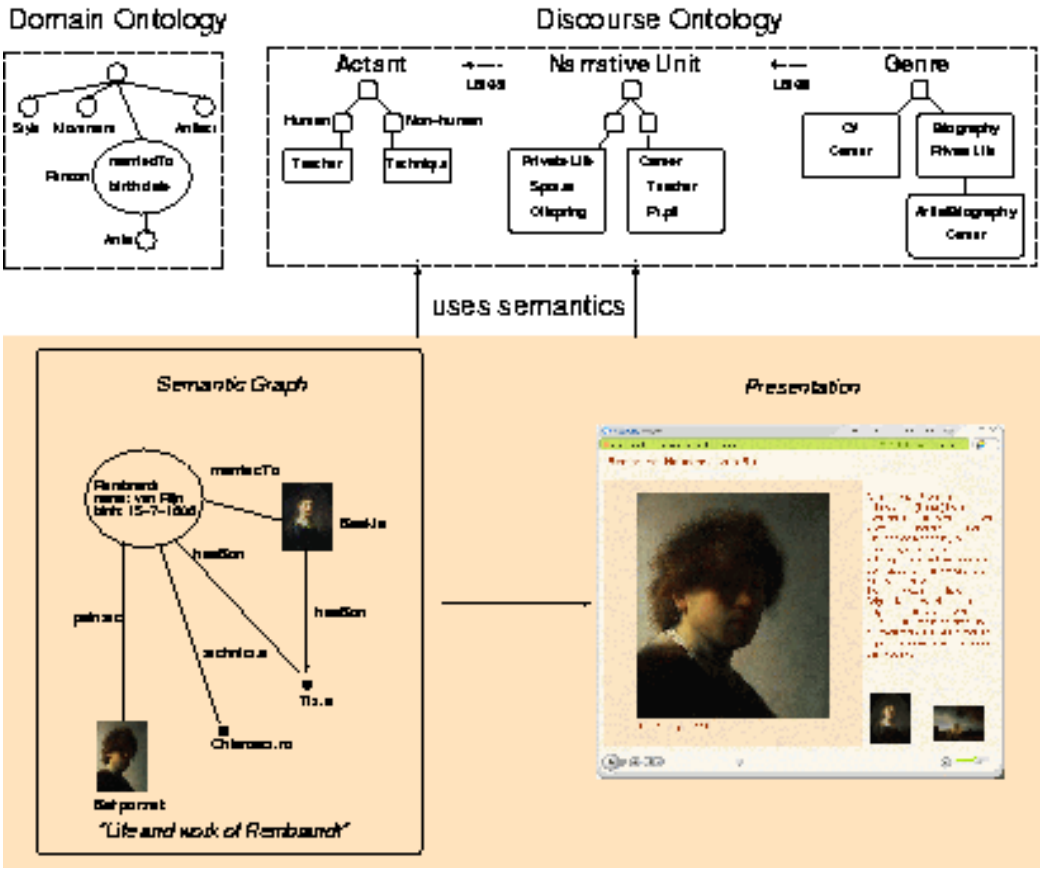

Figure 1: From semantic graph to hypermedia presentation. The bottom layer shows an example semantic graph (left) that is transformed to a hypermedia presentation (right). The upper layer shows the ontologies involved.

In our interpretation, the Genre class provides a sort of narrative pattern whose structure should be familiar enough to the user. This structure can then be decomposed in general building blocks that a user can expect to find in a particular genre; in case of an artist biography these building blocks are *Private Life*, e.g. the personal and family relations of the artist, *Career*, i.e. the professional life of the artist, etc. A particular genre and its narrative units form the structure of the presentation.

To select the content for each narrative unit from the semantic graph, we make use of the concept of *Actants* as defined in Greimas [3]. Actants are roles recurring

Figure 2: Information selected based on the Actant Main Character (mock-up).

in all stories of a particular genre. These characters are not necessarily humans even though in many genres they are; when they are not (like the forces of nature), they can be humanized.

Using the Actant concept, a presentation is created by querying the semantic graph to see if it contains data that defines a particular role; for example, when presenting the life of Rembrandt, a relation of the type *marriedTo* to another information item could determine the role *Spouse* to be created and that information item to be selected for the presentation. Spouse could have other semantic relations with other information items that could cause the creation of other roles, e.g. *Offspring*.

This approach seems well suited in order to create hypermedia presentations based on the genre biography, because there is a very intuitive way to map Actants to the characters in a biography, like the main character, his/her family members (wife, husband, sons, daughter), his/her career influential characters (master, pupils). The fact that coherent texts (like fairy tales) can be described in terms of recurring characters (i.e. Actants) make us believe that this approach can improve the general coherence of the generated presentation.

Figures 2, 3, 4 show the result of selecting information based on the Actant *Main Character*, *Mother*, *Spouse* and *Offspring*. These screen shots belong to the

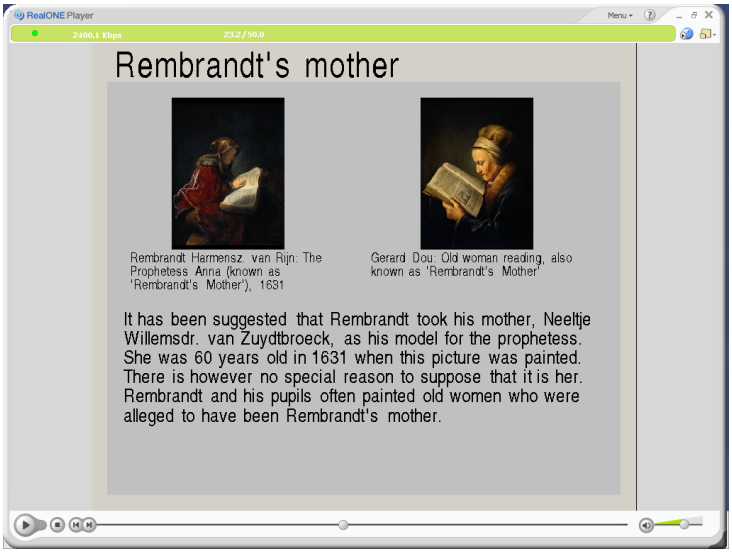

Figure 3: Information selected based on the Actant Mother (mock-up).

Private Life narrative unit of Rembrandt's artist biography[2]. Each Actant could be the starting point to generate a secondary branch of the main story, where that Actant is the main character. In figure 4 Titus (Rembrandt's son) can be seen as directly related to Rembrandt, i.e. belonging to the main stream of the story, or as a character in the secondary narrative introduced by Saskia (Rembrandt's wife).

This depends on the way the semantic relations between elements are defined in the semantic graph and on the strategy used by the presentation to select content (Cuypers is rule-based, as explained in [2]). Each Actant has normally associated a textual information and a visual information. We are currently investigating criteria to make choices on what to represent in case the same information is present in textual and visual form.

Introducing a character causes the presentation to include facts related to that character; therefore, using characters can potentially provide a way to stress a particular fact or a particular point of view, i.e. the character's point of view. A similar approach is used in Agent Stories [1]. Different strategies can be deployed when selecting the Actants that will take part in the story. These strategies could

[2]A mock-up demo can be found at `http://www.cwi.nl/~media/conferences/ISWC2003`, while a working demo but still in progress can be found at `http://media.cwi.nl:8080/demo/i2rp/`.

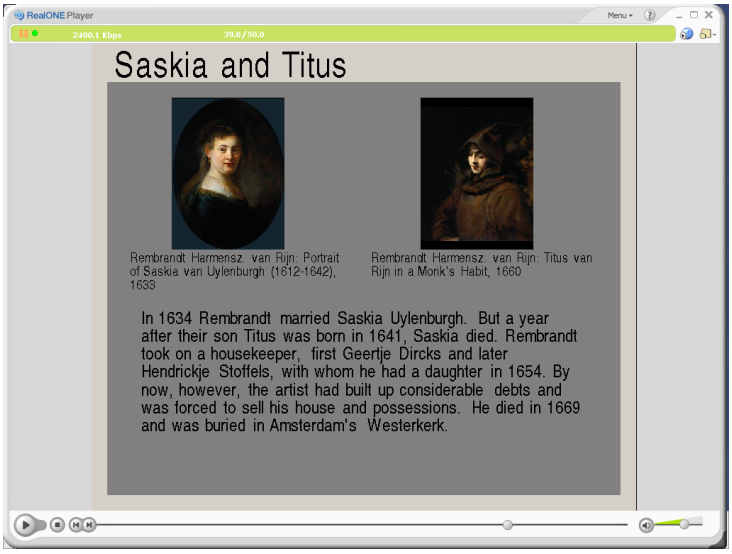

Figure 4: Information selected based on the Actants Spouse and Offspring (mock-up).

be different in their level of complexity, depending on the level of expertise of the user. For example, when presenting a theory to a domain novice, a less complex strategy would select only two characters, the main supporter or inventor and the main detractor or creator of an alternative theory, and build the “biography” of the theory based on these two characters. A more complex strategy could introduce more characters and nuances within the two main streams.

Such an improvement of the story line can also be achieved by adopting structures from other genres. For example, a biography and a monograph share a similar overall structure, where the details of substructures vary. The decision rules to establish the fact that a particular swap in the presentation strategy is useful and required are not clear yet. This also requires a better understanding which genres can be mixed and when the mix does not work.

An interesting situation is when the data changes and the environment is dynamic. In this case the presentations should be generated in a coherent way and new characters need to be consistent with those previously introduced.

3 From presentations to scholarly discourse

ScholOnto uses a semantic network to describe and debate the contributions a document makes. Such a semantic network corresponds to what we call the semantic graph and it could be used as the input domain from which presentations can be generated. This can be desirable, for example, when a student is not confident with the claim structure used by ScholOnto and wishes a somewhat higher layer interface to perform his/her scholarly research.

In this way our system could provide a front-end to a ScholOnto semantic network and aid the semantic graph traversal that a student has to perform when examining the contribution of a document.

The way we envision that is again by taking inspiration from the work of Greimas regarding Actants. As in stories, on which Greimas bases his analysis, we also find recurring roles in a Scholarly discourse, like the person supporting a claim (the supporter) and a person trying to controvert it (the skeptic). This characterization can be effective enough to provide a good understanding of a claim for a student. The scholarly activity can be transformed as a discourse between two debating parties, either in a dialog or two distinct presentations representing the two positions.

Our research is more directly related to this second method. The relation is even stronger when considering that a Scholarly topic could be to trace the history of a school of thought, i.e. a sort of biography of certain ideas.

For example, the presentation representing the role of supporter of a claim about the contribution of a particular concept could include the role of the problems solved or improved by the concept (relations *solves*, *improves on* from ScholOnto), the role of the communities that use that concept (relations *uses/applies/is enabled by*), while the skeptic could follow the *is different to* relation and define an opposite concept with its communities that use it and the problems it solves.

This approach is on the line of what ScholOnto calls “intelligent services” and fits in the envisioned use of the ScholOnto knowledge model by some agents performing reasoning on the semantic relations. Moreover, the fact that our system can also use other ontologies together with the ScholOnto one allows the use of multiple sources to produce a scholarly discourse.

4 Conclusions

Both hypermedia and automatic generation presentation use a semantic network describing individually accessible information items. Our research in presentation generation has sought to find traversal mechanisms of such a network to present the user with the information (s)he seeks. In this paper we explained one such mechanism based on the concept of Actants and present a possible use in a scholarly hypertext environment such as the ScholOnto project.

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