Semantic media application for combining and playing with user created and professional content

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Abstract

There are two important trends bringing changes and new opportunities into media consumption: the emergence of user-created content and Semantic Web technologies. In this paper we present an application that shows how these technologies can be combined to create an enjoyable media consumption experience. The application development work served also as a feasibility test of the maturity of Semantic Web technologies for media sector applications. The application contains material relating to the historical Ox road of Häme. The results indicated that users enjoyed using the application. Several ontologies were utilised, most of which were based on existing ontologies or taxonomies. With their help, it was possible to offer multiple views and exploratory routes into the available content. Further development can, among other things, be made in improving search strategies and in utilising user-created metadata for both for enriching ontologies and as an indication of user interests.

1 Introduction

Media sector is undergoing huge changes as the continuously evolving electronic media gets a stronger role in consumers' daily lives. Another important change is the more active role of media consumers. The active role does not only mean commenting and discussing the content that media companies publish but actively interacting with the content - publishing one’s own content and combining self-created content with content from other sources. Neither are users satisfied only with good usability but they expect enjoyable experiences with a considerable element of play and fun.

Semantic Web is an important trend changing the Web. The vision of the Semantic Web is to make the web more intelligent. Semantic Web technologies such as standards and tools relating to ontologies are currently being developed to reach this goal.

The work that we describe here was made in a project that wanted to research what kind of new opportunities these two trends bring to commercial media companies. In our view these trends connect to each other. Semantic Web technologies make it possible to make more enjoyable media content experiences because applications can be made more intelligent, and this way they require less effort from the users. The research approach of the project was prototyping, and a prototype application called StorySlotMachine was developed. The application helps people in choosing a travel destination by letting them explore background information relating to sights. They can also combine different media objects - both their own and others’ - into presentations. The assembled material can be taken along to enrich the actual visit. The aim was to make an application that offers interactivity opportunities for the active users, but also gives an enjoyable user experience for the less active ones. All this should be built utilising rich metadata and Semantic Web technologies to test their applicability.
2 Use scenario

Our initial use scenario was inspired by a slot machine analogy: users are presented with some content in the topic of their interest, and if they are not happy with the results, they can try their luck again. An underlying assumption was that if a person does not know so much about a topic, exploring and browsing a media object collection is more pleasant than making explicit searches. Also, the results should not be shown as a typical list of items as usual in search engines, but as a page or collection where different elements like images, videos and texts may be seen.

The presented material may then be taken as a starting point to explore the topic more, a bit like with a slot machine, where some of the items may be locked and some redrawn to improve the result. The most active users may explore the topic from many different points of view whereas the less active ones are satisfied with what is initially shown them. This way both the more and less active users are taken into consideration.

Our scenario also includes the opportunity to store the presentation and show it to other people, because an important feature that many people appreciate is the opportunity to get feedback from other users. Other opportunities for utilising presentations are either exporting it into a personal devise or printing the content. Different templates may be offered to take into consideration, which media elements are emphasised and for which device the presentation is generated for. If allowed by the original creator, other users may utilise these presentations and their components in their own ones.

We chose location related content for our pilot application with the emphasis on travelling. When preparing for a trip, people often are interested in exploring content to find out about their destination. During a trip, people take photos and videos, which can be used together with content from other sources.

The use scenario can be divided into three separate cases: before, during and after the trip. Before the trip the user can familiarise with potential destinations and their sights to find out more about them. The material can be browsed theme wise, and the user can select and combine the most relevant items into a collection that can be viewed either on the web or printed to be taken along for the trip. After the trip, the user makes his own travel story either utilising his or her own material or by combining it with the material of fellow users or the content that the media company provides. Also after the trip, the user may make theme stories like before the trip as well as also normal word based searches. The users are encouraged to add metadata in the form of keywords or tags, which are utilised to propose additional material. The users may choose any words to describe their content or choose from the ones that the system offers based on relevant ontologies.

3 User interfaces

This chapter presents screen shots of the user interfaces and describes their functionality. More detailed descriptions of the implementation and utilisation of underling ontologies are presented in chapter “Ontologies”.

The first step is to select the places of interest from the map or list. The demonstration target area is the Ox road of Häme1, a historical route between Hämeenlinna and Turku in the South of Finland. After selecting a place, the user is shown a list of the sights located there.

The user can sort the sights by history, nature and culture, read short descriptions of them, view the sights he or she find most interesting into a personal item list (see Figure 1).

The user can search background information of the selected sights as theme stories (Figure 2). A theme story is a collection of media content from some point of view (Figure 3). Our theme stories are “Life now and then”, “Life stories”, “Nature and animals”, “Historical events”, “Fairytales and stories”, “Wars”, and “Art and culture”. Some of the themes are divided into sub themes. For example, historical events are divided according to historical periods. Only the categories with some content are shown to the user. The user can play with the content: View commercial and user-created pictures and videos, and view and build theme stories. The user may include theme stories into the travel plan to be created for the trip, as well as photos and descriptions of the chosen sights. The travel plan is available as a slide show and as a web page suitable for printing.

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1 http://www.harkatie.net/english/index.html
After uploading the content, the user is asked to add some metadata. As the first step, the photos are connected to the sights by dragging and dropping them to the correct sight. After that, additional metadata can be given in the form of keywords or tags and by indicating the genre of the photo (see Figure 4). The keywords can be written freely or the user may utilise those that are suggested by the system based on relevant ontologies. The user may also add free text to his or her photos and change the visibility of the photos to other users.

Users are offered commercial and other users’ content, which they can combine with their own (see Figure 5). There are several ways to search for additional content. The user can browse through the available photos, videos and texts. Content can also be searched with the help of tags, both user’s own tags and those suggested by the application based on ontologies, or by making a traditional free text search. The travel story is created automatically out of the content selected by the user. It can be viewed as a slide show or as a web page suitable for printing.

After the trip, the user may create his or her own travel story by utilising his/her own material and the materials in the system. Photos can be uploaded after selecting the visited sights. As part of the uploading process, the user determines whether the photos can be viewed by other users, and accepts the licensing terms.
4 Content

We different types of media content, such as facts, stories and news, are needed in order to be able to create versatile travel plans, theme stories and travel stories. Media content that is directly related to the target area is preferred, but also more general information is usable. A mixture of videos, photos, sounds and texts makes the presentations more appealing and interesting.

The commercial media content of the pilot application consists of newspaper and encyclopaedia articles with images, articles from the Häme Ox road magazines, stories out of a book called “Hämeen Härkätiellä”, and photos from the Häme Ox road website. In addition to the commercial content, the application has user-created photos. The content is mostly general background information and not specific travel information like opening hours or prices.

This mixture of content and media formats meant that it was necessary to work with several metadata vocabularies. Different vocabularies are used to describe newspaper, magazine and encyclopaedia articles as well as short stories and users’ own content. Also different media formats (text, photos, and videos) have different needs and vocabularies for metadata.

The content was delivered for our prototype in different formats and the amount of metadata varied a lot. The project did not address automatic methods for creating semantic metadata, and adding metadata and converting it into RDF required manual work.

The newspaper articles and images had some metadata that had been generated in the normal newspaper production process, and some more metadata like genre, scene and IPTC subject codes were added by the media company persons for the prototype. We received the metadata in text format and it had a structure that helped us in converting it into XML even though manual work could not be avoided completely.

The encyclopaedia articles were delivered in XML and the structure of the articles could be utilised in converting their metadata into RDF. The encyclopaedia content also has the potential for populating the target ontology, for example with persons relating to the Finnish history.

The content received from the Häme Ox road did not contain any metadata so the metadata was created by hand. The articles of the Häme Ox road magazines were received in PDF format, and that caused also extra work.

5 Ontologies

5.1 The role of ontologies

The prototype utilises a number of ontologies, each of which captures knowledge of some area that is necessary to fulfil the required functionality. Ontologies are utilised when selecting content and also to produce some basic information to be shown to the users. The ontologies are also utilised when users add metadata to their own content such as suggestions to keywords.

The Target ontology describes the knowledge related to places, routes and sights, and contains information that has relevance to them such as persons, events, objects and nature.

The Media ontology describes the media content. Relevant elements were selected out of the Dublin Core (DC) and IPTC Newscode vocabularies. The Media ontology includes the typical metadata fields, such as title, creator, publisher, date, media type, genre, scene, but also relations to the Time and Target ontologies, for example relations to persons, sights, places, routes, events, objects, animals or plants. The subject of media content was described with the YSA ontology (a general-purpose thesaurus in Finnish) whenever possible, but for news articles also the IPTC and for encyclopaedia articles the Facta ontologies were used.

The Presentation ontology contains the information on themes and their subcategories and what kind of content (subject, genre, scene, time) is to be searched for presentations. There are themes like “Life now and then”, “Life stories”, “Nature and animals”, “Historical events”, “Fairytales and stories”, “Wars”, and “Art and culture”.

An ontology based on YSA (a general-purpose thesaurus in Finnish) is utilised as a kind of upper ontology for classifying the knowledge. Target, Media and Presentation ontologies are connected to
each other via the concepts of this upper YSA ontology. The YSA ontology was created only to a limited extent because the idea was to replace it with YSO (Finnish General Ontology), which was under development and not yet available during the time when the application was made.

The Time ontology defines a taxonomy of time eras and periods by time intervals, and it is based on the ontology developed in the MuseumFinland project\(^2\). We added some time periods relating to the Finnish history as well as the seasons.

The subject of the media content is determined differently for different content types: the IPTC ontology is used to determine the subject of newspaper articles. The ontology is based on the IPTC ontology\(^3\) that was developed in the Neptuno-project. The content of encyclopaedia uses its own taxonomy (Facta ontology). YSA-ontology is usable as a general subject ontology.

5.2 Searching content for theme stories

Theme stories consist of elements like a title, text, image and fact box, and they are selected on the fly based on the knowledge in the ontologies. The fact box shows information retrieved out of the ontology. It may contain knowledge about how events, like a war, are related to the sight or basic information about a person who has a connection to the sight. Sometimes the user may wonder why a certain article was shown, and the role of the fact box is to give some indication about the connection.

Media content is not linked directly to the various themes. The knowledge in the Target ontology and the search rules are utilised in searching and offering relevant media content. The search rules are determined with the Presentation ontology, Java application and SPARQL queries. The criteria for how the media content is connected to a theme, such as the subject, genre or time, are determined in the Presentation ontology. The advantage is that the search criteria are not hidden inside the Java code, but that they can be changed by modifying the instances of the ontology. Also, themes may be created, changed or deleted by modifying the ontology classes or their instances.

The Java application creates SPARQL queries for searching relevant media content based on the knowledge in the Presentation ontology. Searches use the knowledge in the Target ontology (e.g. Life stories -> persons related to the sight) and/or subjects related to themes (e.g. Every day life now and before -> food, professions, clothing etc. or Wars -> Great Northern War, World War I & II etc.). In addition to that, some restrictions may be used, like time (e.g. Historical events), genre (e.g. Stories and fairy tails), place or sight.

The subjects of the different themes are determined as relations to the YSA ontology. Also the subjects of the IPTC and Facta ontologies are connected to themes. Media content that is related to same subjects is searched for. If content that is described with some other ontology were brought into the system, the subjects of this new ontology would need to be connected to the existing themes.

5.3 Adding metadata to user generated content

Users can add metadata to their own content. Users are free to use any words they want to describe their content, but by utilising the available contextual information and the Target ontology, keywords are suggested. These suggestions relate to yearly events, objects, terms, other related sights and seasons. It was made easy to use these terms— it is enough to click a word, and no writing is needed. Users are thus encouraged to use these words that can then be utilised to suggest additional relevant content from the system.

In similar manner, users are encouraged to add keywords relating to the genre based on the knowledge in the Media ontology. Genres have been defined for all media types but only image genres are currently utilised. The genre information is useful when the user generated media objects are utilised with future users.

5.4 Searching commercial content to complement user’s own content

Offering media content to complement user’s own content is based on the user-given metadata and the knowledge of the Target ontology. First, the media content that is related directly to the sight is searched. After that, more general media content relating to events, persons and places is searched for. The relevance of the media content is determined with the help of the search order starting with from exact searches and then proceeding to more general searches.

Additional content can be searched with the help of tags. The tags suggested by the ontology may also be related persons or events in addition to tags relating to yearly events, objects, terms, other sights relating to sight and seasons. Already existing theme stories made by earlier users might be an additional way to search information also when creating one’s own travel story. Theme stories give ready-made text and image/video combinations that can easily be added to a new travel story.

6 Software and architecture

\(^2\) http://museosuomi.cs.helsinki.fi/
\(^3\) http://nets.ii.uam.es/neptuno/iptc/
The ontology editor Protégé 3.1 was used for developing ontologies. Ontologies were developed as RDFS-schema.

The application is implemented as a Java client – server solution using Struts framework and Java Server Pages (JSP). Tomcat 5.5 is used as the web server. The user interfaces were implemented with AJAX (Asynchronous JavaScript and XML) in order to offer good interactivity and usability, and to add new features, like drag-and-drop. Different views of the travel plan and travel story are generated utilising CSS style sheets.

The ontologies and RDF-based data are handled by Profium SIR (Semantic information router). A beta version with support for SPARQL-queries was used. Profium SIR saved the RDF data into a Postgres 7.4 database. Postgres 7.4 was used also for managing user information.

The Sparql4j-jdbc driver\(^4\) was used for querying RDF-data. Profium SIR created the result according to the SPARQL Protocol for RDF specification\(^5\) and forwarded it to a Sparql4j-jdbc driver, which provides the results via the Java ResultSet abstraction.

It is not easy to choose the tools for application development with Semantic Web technologies. There are several open source tools, most of which have been created for research purposes. Semantic Web related standards and recommendations are still under development, and different tools support different subsets of the standards. For example, we used one tool for developing the ontologies and another for handling the RDF-data, and this caused some extra work to overcome the incompatibilities.

Protégé 3.1 is a versatile ontology editor with many useful features. It also has features for managing and developing multiple related ontologies, but we had problems with this feature. Reopening a Protégé project file with connections to other ontologies caused error messages and sometimes even meshed up the instance data.

The development of a standard query language SPARQL for querying RDF repositories is a step to the right direction. We wanted to use such a version of Profium SIR that supported SPARQL even though it was in beta at the time. Java application development was speeded up by using the Sparql4j-jdbc driver with SIR, even though it supported only select and ask type of queries at the time of the application development.

Utilising AJAX made it possible to add impressive features into the web user interface. A downside was the lack of good development tools; debugging JavaScript code is troublesome. We also encountered the well-known problem for developing web applications for different web browsers: what works in one browser does not necessarily work in another.

As a brief summary we can conclude that there already are usable tools for developing semantic web application, but currently many tools only have a partial support for the specifications. There is room and need for further development to make the implementation and management of Semantic Web applications easier.

7 Results

7.1 User tests

The user experience of the application was tested in two phases in the context of real school excursions. The test group consisted of 33 schoolchildren (12–18 years old) and 4 teachers from four different schools. In the first phase, user needs and expectations were studied using artefact interviews, observation, collages, metadata test and prototype tests. The prototype tests were made using a co-discovery method, where two participants used the prototype together and discussed about the decisions they made. Some users tested the travel planning part of the software before an excursion, whereas others had already made a trip and created travel stories with the prototype.

At the end of the project the functional application was tested again with the same user group but with a smaller number of participants (6 schoolchildren, 12 years old). The test users had made a trip to the Häme Ox road and they used the application afterwards to store their own pictures and memories. The users were interviewed both before and after testing. After the test session they also filled out a short questionnaire.

As the result of the first interviews, observation and collages made by users, following requirements for the StorySlotMachine were found. The application should

- **arouse interest** and offer necessary facts before the trip
- **enable experiencing the stories** during the trip
- **give additional information** about the themes studied on the trip, as well as the themes about which no information was available on the trip
- **support creating a personalised travel story**
- **enable storing rich metadata about pictures, e.g. memories and feelings, as well as comments and hints for other travellers.**

A metadata test was made in order to gather information about the meanings that the users associate with their travel photos. The aim was to find out, how semantic information could be added into the pictures. The users were asked to add captions and keywords into their own travel photos,

\(^4\) [http://sourceforge.net/projects/sparql4j](http://sourceforge.net/projects/sparql4j)

\(^5\) [http://www.w3.org/TR/rdf-sparql-protocol/](http://www.w3.org/TR/rdf-sparql-protocol/)
as well as select applicable tags from a list of keywords. The written captions were generally very short, and the users did not necessarily remember anything about the objects of their photos. The intuitiveness of selecting keywords varied a lot among the users. The users must understand what the purpose of adding metadata is in order to find it easy to do. In addition, the user should see immediate advantage of adding metadata.

The keywords used to describe their photos can be divided into five groups: 1) description of an object or an action, 2) memories and atmosphere, 3) background information about the place or object, 4) questions for additional information (history and/or present), and 5) hints for other travellers.

The application functioned only partially in the first user tests. For that reason many of the test users found the user interface somewhat confusing and the idea of mixing own and media content did not become clear to everyone. In addition, media contents were not presented attractively enough to rouse the interest of users. Nonetheless, half of the users found the application engaging and useful. Schoolchildren appreciated the idea of finding the necessary information easily in one place. Images were regarded as the most interesting part of the content. The complete report of the first user tests can be read in Näkki (2006).

The prototype was developed further after the first user tests and tested again at the end of the project. In the second test, user attitudes towards the functional application were very positive. The system was found useful, quick and easy to use. Users found the StorySlotMachine more pleasant than traditional search machines, because the relevant content could be found easily as stories. The users regarded photos as the core of the application and added both their own and commercial pictures into their travel stories. The users were also eager to write short captions to the photos. Adding metadata into their own pictures was intuitive and did not burden the users. Other users’ pictures from the same excursion were found interesting, as well.

Some users wanted to create their travel story quickly, whereas others were ready to use a lot of time to finish their stories. Interestingly, the StorySlotMachine was found to be suitable for both these user groups. All participants of the last tests said that they would like to use the system again. Summary of user experiences in the both test phases can be seen in Figure 6.

From the users’ point of view, the value of semantic content is in the quickness and easiness of information retrieval. The way to find information as stories was something new for the users, but most of them found the idea easy to understand. However, the users did not necessarily want to collect, store and print stories, when planning the trip. The system should therefore better support pure browsing of the content. After a trip it was seen more understandable and useful to create a travel story, where own memories are linked to editorial material.

When users create semantic content, one challenge lies in the process of adding metadata. It was discovered that the travel images and memories include a lot of meanings that are hard to put into words as simple keywords. Users’ active participation will be needed, even though automatic semantic reasoning is used for creating presentations. It is the user who decides which content is valuable for her. However, the StorySlotMachine can substantially help the user by offering suggestions about the media content related to the theme of the user’s trip. The semantic processing makes it possible to discover interesting and surprising relations between contents that would be hard to find otherwise.

### 7.2 Ontologies and implementation

Creating, updating and managing ontologies are not easy tasks, but there are clear benefits in this type of an application:

- Ontologies make it possible to search content from multiple directions (sights, events, persons etc.).
- Also general media content can be utilised.
- It is possible to make different thematic presentations or views for people with different interests.
- For example, one user might be interested in the historical places and events of the Ox road during the 19th century and another is only in churches during the trip. They can easily be served with this kind of an application.
- Ontologies contain knowledge that makes it possible to create visualisations such as timelines, cause-effect diagrams, dialogues, trees, and maps of related resources.
- Ontologies support generating aggregations automatically.
- The benefits of being able to link the content automatically into different themes become significant as the number of content items increases and grows continuously.

There already are usable tools for developing semantic web applications, but currently many tools only have a partial support for the specifications. There is room and need for further development to make the implementation and management of Semantic Web applications easier.

Theme stories were the most central part of the application for ontology deployment. Theme stories could be easily generated for sights with a long history, but not so smaller sights. Theme stories should rather be offered at higher level like for a town or a village or as in our case, for the whole historical route, than for a single sight.

There were challenges in creating general search rules for the themes. Every theme had unique requirements and complicated the Presentation ontology. Some examples are listed below:

- “Every day life now and before” has subcategories weekday, celebration and society. Subjects like food, professions, clothing, inhabitation, celebrations, laws, and source of livelihood relate to this theme. These determine the main framework for searching, but to get more relevant content also the time periods and the type of the sight should be determined to find relevant content for a particular sight.
- “Arts and culture” is divided into the following subcategories: persons, art and buildings, and environment. When searching for content for the subcategory ‘Persons’, it is required to find persons who have a connection to the sight and have or had a profession relating to art and culture, such as composer, writer, painter, or architect.
- “Historical events” are divided into historical periods, and time restrictions are needed in searches. There are several ways to do this: search the media content that relates to the time and the sight/place, utilise terms that describe the time period or events that happened during that time.
- In the theme “Stories and fairy tails” the genre is used to restrict the content selection.

When making ontology-based searches, several search criteria can be used and their priority order must be determined. Here, it is important to find the correct balance between the number of different search criteria to use and the speed of the application. First, the most relevant content is searched and after that, the search can be expanded to more general material. The challenge is to know how deep the searches should navigate into the net of relations of the ontology and still find content that is relevant to the user. We encountered this problem both when making theme stories and searching for additional content to complement users’ own content.

When the application has more content, this will probably be less of a problem, and the challenge is the ordering or grouping of the relevant media objects in an interesting way. One of the challenges is to inform user of why certain content is offered to her/him in this context. For example, pictures of historical persons might be confusing, if user does not know who the person is and how he/she is relating to the sight. In connection to the theme stories, a fact box was used to give some indication about the connection by utilising the knowledge in the ontology, and a similar approach should be used elsewhere in the application.

The implementation uses an upper ontology that can be replaced with another one, if needed. This gives flexibility to the application development. We turned selected parts of YSA (a general-purpose thesaurus in Finnish) into ontology, and used it as our upper ontology. There is currently a project in Finland making a comprehensive ontology out of the YSA, and it should be used also here when it becomes available.

We had many different vocabularies for describing the subject of different type of media content in the StorySlotMachine application. Our first idea was to map the IPTC and Facta vocabularies to the concepts of our top YSA-ontology. Mapping different vocabularies to each other turned out to be complicated since it was not always possible to find corresponding concepts in the different ontologies. Also, there was a lack of good tools for ontology mapping.

Instead of mapping ontologies to each other, we decided to keep the different ontologies. As described earlier, the subjects of media objects were described with the concepts of the YSA-ontology when ever possible, but we also stored the original subjects described with IPTC or Facta. The subjects of the different themes were also described with the YSA, IPTC and Facta ontologies. Several searches may be done for media objects during a user session: first utilising the YSA concepts and the subjects from other ontologies. In other words, ontologies are not mapped to each other but to some extent, the mapping is done via the different themes.

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In order to better test the feasibility of this approach more media content should be added to the system.

This approach will probably work with media companies’ own media services, where they can decide which themes are available. Of course, it might be possible to offer users an interface where they can combine ontology concepts and create their own themes. One idea for the future development of the StorySlotMachine is to let users create new themes with the help of the tags they have used.

In general it is good practice to use one common upper vocabulary or ontology for describing the metadata inside the media house and also use standardised vocabularies as much as it is possible. However it is realistic to assume that a media house will have several vocabularies also in the future and one upper vocabulary or ontology cannot solve all issues and challenges. Better tools are needed to support ontology mappings and even better if mappings could be made automatically by the system.

8 Related work

The key idea in the StorySlotMachine is to aggregate content in a way that lets users explore the content in an enjoyable manner. Related work is being done in the various areas. The first distinction can be made between the aggregation level: is the aim a single story to be created out of the available content, or a collection of independent resources. Geurts et al. (2003) and the Artequakt project (Kim et al. 2002) work at the first area. Geurts et al. (2003) describe the system where the knowledge of ontologies is used to create multimedia presentations like artists’ bibliographies. Presentations vary based on the genre (e.g. Biography and CV) and output format that can be selected by the user. The basic idea of their Discourse ontology is same than our Presentation ontology. The ontologies define rules for searching content. They have different genres, whereas we have themes. Our themes use more versatile data than what is needed for artists’ bibliographies and we also have more general content which complicated the ontologies and rules. One difference is that they focus more on ready-made multimedia presentations, which contain parts (e.g. address, private life and career) that are determined in the Discourse ontology.

Our work is more related to creating a collection out of independent resources and turning them into presentations. However, we let users combine images and texts in new ways and we do not aim at producing one collection for the user to view but a starting point for further exploration with the content.

Mc Schraefel et al. (2005) have developed an open source framework called mSpace, which is available at mspace.sourceforge.net. The starting point for the mSpace development as well as for our StorySlotMachine is same: to offer an exploratory access to content. The user should be able to browse content according to their interests and associations, to leave tracks on the way by storing the most interesting items, and to get multimedia as a result rather than links to resources.

The original mSpace demonstrator was a Classical Music explorer, and it has since been utilised in other applications and domain.

mSpace is based on the idea of associative exploration of the content and user-defined and manipulated hierarchies. mSpace lets the user explore the material with the help of hierarchical columns like periods, composers, arrangements and pieces: the selection in the first column constrains the selections of the following column. Users can arrange columns according to their preferences and also add new dimensions or remove them.

mSpace provides preview cues (for example audio clips) of some representative example in the various dimensions to help in exploring and deciding whether an area is interesting. This way users may find new interesting areas without prior knowledge of them. mSpace also has info views to show related information like for example a description of a composer. Interesting items may be stored in favourites for future reference.

The preview cues in mSpace have the same aim as the themes in the StorySlotMachine: to give users ideas and hints as to what kind of content is available relating to a topic.

An interesting feature of mSpace is to let users sort and swap dimensions according to their interests. In the current StorySlotMachine version, the users are tied to pre-made themes, but one idea for future development is to let users create new themes with the help of the tags they have used.

Creation of different theme stories in StorySlotMachine is based on associations that are inferred automatically by utilising the knowledge in the ontologies. For example, a theme story may tell about a war that relates to a sight and story may include important historical persons. New theme stories are offered based on these relations and other theme story may tell more about the person. Now this is made by the system, as our guiding idea was to give the users the opportunity to try their luck and get surprised, but as an alternative, users could be given the opportunity to guide the process based on their own associations.

One difference between the StorySlotMachine and mSpace is that the StorySlotMachine offer users the possibility to make exportable packages out of the content and also utilise their own content. The mSpace user interface is more formal in style than in the StorySlotMachine, where emphasis has been put to offering a user interface with the element of play.

The Bletchley Park Text application developed for the Bletchley Park Museum (Mulholland et al.
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2005) concentrates on post-visitors of museum. During their visit, people may express their interest by sending text (SMS) messages containing suggested keywords relating to displayed objects. After the visit, they can get a collection of content relating to the selected keywords as a personalised web site. The content can be explored and a number of different views on the collection are provided.

Bletchley Park Text application is made for a specific museum and its specific content. In the StorySlotMachine application, we have several places and sights, and the material is general by nature, since one of the major goals of our project was to study how the general media content can be utilised in new ways with the help of semantic metadata. Both Bletchley Park Text application and the StorySlotMachine share the similar ideas of using the application for learning, but the Bletchley Park Text does not include utilising users’ own material like we do.

Bentley et al. (2006) have studied how consumers use photos and music to tell stories. The application is slightly different from ours, as they compare using only music and photos, but there are important similarities and lessons to be learnt. They find that different media formats, photos and music in this case, and commercial and private content should not be stored in separate silos. Instead, they should be available with the help of similar methods. Serendipitous finding utilising available information like contextual cues should be utilised to remind users of what is available and to help them in finding related resources. They also see a need for systems that allow communication by using media.

9 Discussion and future work

This chapter discusses future development opportunities of StorySlotMachine and what are the benefits, opportunities and main challenges of the media companies in creating new semantic media services, particularly in relation to StorySlotMachine type applications.

Easy access to electronic content and users’ participation opportunities into the media production cycle are bringing about huge changes in the way that media content is created, offered and consumed. The StorySlotMachine explores the possibilities of letting people explore content in a playful and theme wise way and letting them do the final touch in putting the presentation together. Semantic metadata and ontologies are utilised to offer multiple views into the available content and help the users to explore and learn in a pleasant way of topics that may not be so familiar to them. The application also lets the users import their own content and mix it with other people’s and commercial content.

The application is most suited when the content is available as relatively small units. The user tests indicated that photos and videos are important in raising interest, whereas particularly reading long texts requires more effort and is less attractive in a playful use scenario. This implies that text should be written in a way that makes it quick and easy to see what the text deals with to arouse users’ interest. In this kind of a context, the user is not looking for a specific answer to a specific question, but looking around and checking if something interesting comes up, and the content that is presented should support this approach.

The application makes it possible for people to make their own narratives about a topic. This is relevant at least in connection to learning and hobbies, like travelling and making memorabilia. The speciality here is the opportunity to combine self-created content with content from other sources. The final result must have an attractive and professional look in order to motivate the use. The electronic format also makes it possible to add live features; for example, a user-made narrative may be updated with current news and developments.

It was not possible to carry out user tests to such an extent that we would have seen how people would like to use the materials and what new ideas come up. More research is also needed to see, how purposefully prepared content users want, or do they enjoy with a mix of material and modifying it according to their own ideas.

Serendipity is a concept that seems to be popping up as a goal in search related application (Leong et al. 2005; Bentley et al. 2006; Lassila 2006) and here Semantic Web technologies come into play. Particularly in consumer applications easy, intuitive and entertaining user interfaces and applications are needed. Also our work aims at providing serendipitous finding of interesting resources. We did not directly explore how this sensation emerges, and which factors contribute to it. One assumption is that if we know what the users’ interests are, we’ll be able to suggest resources that he or she is interested in, and can offer experiences of serendipitous finding.

Many media companies have extensive archives that are not effectively utilised as end user services. The StorySlotMachine is an example of how content can be offered in a more interesting context than as mere searches and search result lists. If the content is not already modular and if there is not much metadata about the content, an investment is needed to turn the content into more usable format. The current production processes and practices should be changed so that the content is directly processed into a format that supports the reuse in this kind of applications. The best starting point for offering this kind of a new service is an area where the content is already modular and where people may have longer-term interest and personal material. These include areas like travelling, hobbies, encyclopaedia and news.
Other key questions that media companies need to agree on are descriptive metadata and terms for licensing the content for creating the narratives, and how strictly to guard their IPR. On the other hand, networking to freely available network resources such as photos that are licensed under Creative Commons licenses should be considered as a way to add resources for users to choose.

We can see at least following business opportunities with this type of an application:

- some basic features could be free, but access to more content could be available for paying customers
- related materials could be available for buying, such as books or maps, or additional services like back-up storing of images
- co-operation with operators in the application area, for example with local travel associations
- targeted advertising, particularly if people can be encouraged to longer term use, then information about their interests will accumulate and opportunities for effective advertising becomes better.

There are several opportunities for utilising and developing the StorySlotMachine application further. The StorySlotMachine application can be used as a platform to test user expectations and experiences of mixing and playing with media content, and sharing one’s own content with other users’ content more extensively. More content should be added for additional testing, and the conversion of metadata into RDF format should be made automatically.

The application could be developed into a commercial travel application or a learning application, e.g. for teaching history. For the travel application, some additional features are needed, like exact travel information (opening hours, prices), maps and mobile user interface, and collecting feedback and recommendations from users. Also new features like collaborative storytelling e.g. creating one travel story from the contents of all group members, and real time travel story that is continuously updated with topical information, could be added.

Similar applications could be built relating to other topics such as hobbies or collecting gathering personal memories from past. A new Target ontology may be needed for a new application, if it does not make sense to expand the existing one. The search criteria are not hidden inside the Java code, but they can be changed by changing the instances of the ontology, which makes it easy to develop the current application further, and to adapt it to new areas. Also, themes may be created, changed or deleted by changing the classes of ontology or its instances.

There is always room for improving the search criteria with help of the Presentation ontology, or even a general tool for automatic generation of theme stories could be created. In the future, RuleML (Rule Markup Language) or SWRL (Semantic web rule language) may be the solution to use.

At the beginning of the application development, we considered using the CIDOC CRM cultural heritage ontology that is being developed specially for describing the cultural heritage of museum collections. We decided not to, because the ontology seemed too specific and complicated for our purposes. CIDOC CRM is currently in the final stage of the ISO process as ISO/PRF 21127, and it could be reconsidered as an option in a travel-related application like StorySlotMachine to describe cultural heritage. The challenge is to decide which level of the ontology to include and what to exclude as too detailed. Additional benefits could be gained if content or information can be integrated from various museums with the help of a common ontology.

Automatic methods for creating metadata and converting it into RDF format were not addressed in this project, but they are important particularly when existing media archives are utilised in semantic applications. Once the number of concepts in our YSA ontology has been increased, or the national YSO becomes available, utilising automatic methods will be easier. Additionally, users should be utilised as metadata creators, where feasible.

One of the future needs is to increase the amount of available content. In our application, the content resources were moved to our server, but in a commercial application, content from different sources should probably be utilised. This requires that there is an agreement on what metadata to use and the content should have this metadata.

There are many opportunities to develop the searches and the ways that search results are ordered for presentation. Scene and genre information could be used for ordering images. Images from outside and inside a building, and general images and detailed close-ups could be alternated. New ways grouping media objects could be developed in addition to the current location-based presentation.

User generated metadata could be utilised more extensively. The words that people use to describe their content could be stored in case they are not found in the ontologies, and they could be offered to future users visiting the same sight. In the current system, users can add tags only to describe their content, but tags could be utilised more widely, for example, to describe media content, travel plans, and sights. If we had mechanisms to combine tags with more formal semantics and to analyse the reliability of user generated knowledge, this could be one way of adding knowledge into the ontologies.
To summarise, we can conclude that the application lets users explore and combine various types of media content, as well as virtual and real life experiences. Utilising ontologies helps in making the application more intelligent and gives opportunities to offering enjoyable user experiences.

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