Bringing New Life to Video Narratives for Exploring Cultural Heritage

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Abstract. In this paper we present a project of creating a web based interactive encyclopedia of historical knowledge related to the history of the religions, the Bible and the history in general. The main source of information in the project is a film made by the Israel Museum that accompanies the exhibition of the Dead Sea Scrolls the oldest remaining copies of the Bible and extra Biblical documents. The film is describing the life of the members of the ancient community of Qumran that was behind the creation of the Dead Sea Scrolls. In order to annotate the video we developed a data repository for creating and for linking various types of digital information to the video. Data stored in the repository is then used to develop tools for exploring the film and related annotations.

1 Introduction

Cultural heritage is an important aspect of our lives. It can be seen as a common storage of all the experiences and knowledge that is acquired over the time, and is stored in the results of various activities of human life. With the advance of digital technologies new means of experiencing our heritage emerged, resulting in many research initiatives aiming at improving the ways we are dealing with the experiences of the past. By creating digital data representation and making these representations available over the Internet and by providing various tools for interacting with data, information technologies brought important change to the way we are experiencing our heritage. Information can now be accessed anytime anywhere solving the important issue of accessibility of heritage information. Another aspect is that with digital data representation new ways of interaction with information emerged. With these new ways of interaction, we may be able to understand this information in new ways and to acquire new ideas and understanding that were difficult to obtain using traditional means of accessing and exploring cultural heritage collections. The combination of new technologies and highly informative heritage content can not only shed a new light on our culture and society but can also open up new ways for implementing this knowledge in every day life.

Video is a media format that is used in cultural heritage for a long time. It is used to present stories, ideas or knowledge about certain topics by combining visual audio and textual information. The combination of different types of information into a single medium made videos a popular choice for communicating information to the users. By presenting the information in the form of the story big amount of information can be presented in short time and with little or no effort from the user side. However there are some drawbacks of such an approach. Information presented in the video can only be accessed in linear manner. Users have no freedom to access and explore the information based on their goals and needs. This can especially be problematic when the presented information is complex. With the advance of digital technologies many new possibilities are being open for combining external information with the video and for enabling various new ways to interact with the information stored in video material. In order to present complex ideas and information users should be able to access the information in a video in many different ways. Instead of just by following the story of a video, they should be able to access any segment based on their information needs. In order to be able to do so a video should be accompanied by additional information helping users to easily navigate through the video and access information they need. Also the additional information should be used to help users understand topics presented in the video.

In this paper we present a project supported by a grant from the Dorot Foundation, aiming at creating a web based interactive encyclopedia of historical knowledge related to the religion and the Bible studies. The 20 minute long film made by the Israel Museum in Jerusalem, used as a central information point is combined with the set of annotations, to describe and explain the life of the Qumran community that is behind the creation of the Dead Sea Scrolls. The idea for the project came from the need to enrich the film and explain various historical, social and religious aspects that were in place during the time the Dead Sea Scrolls are created. Related work is presented in the section 2 that is followed in the section 3 by the explanation of the information space used as a basis for interacting with the film. In section 4 we present data repository used to annotate the film and in section 5 we present tools for interacting with the film and annotations. We conclude in the section 6 by discussing insights we got from the work on the project and discuss some ideas for future work.

2   Related Work

Cultural heritage - our shared legacy from the past - is a unique and irreplaceable source of identity and inspiration [1] Necessitated by both the quantity of information, as well as the burdens of archiving, organizing, and disseminating it, researchers and heritage managers have deployed a broad array of tools and methods to store their records. Over the time digital technologies proved to be invaluable tool in sharing the richness of cultural heritage content by using its heritage data in new ways. Recent trends, particularly in science museums, have been toward supporting visitors to actively learn rather than passively receive information. In [2] authors showed how a narrative designed with the help of digital technologies could be used to construct

explanations and make sense of the world. Digital objects have become a vehicle for inspiration and source for exploring potential new meaning of heritage objects [3]. Framework that enables composition of diverse aspect of culture into a coherent representation is presented in [4]. Authors proposed mechanisms to build rich immersive narrative, and showed the importance of user interaction and modular composition of multimedia experiences. In [5] authors proposed a unified framework that enables the integration of disparate representations of heritage elements into a holistic entity. Their approach was tailored towards a compelling and engaging narration that affords a unified user experience. The proposed solution supported both active (user controlled explorations) and passive (watching pre-orchestrated narrations) user interactions.

The advancements in user interfaces on the web have increased number of potential applications that can be served over the Internet. Many types of technology platforms (mobile, wearable, tangible, web, kiosk etc.) have been used for the design of applications for communicating contents, either to support understanding or to engage visitors in the exploration of the museum exhibition [6]. By integrating the design elements, such as graphics, color, layout and animation effect, etc, content can be presented in a concrete and determinate style, which is tightly related to end user [7]. However current web based information systems often restrict the degrees of freedom of the. In most of the cases they only support a few search activities well and other search activities have to be performed using external means for support, making the search less integrated and less pleasant for the user. The emergence of interfaces with more advanced capabilities, such as faceted browsing and result clustering, can go some way toward addressing such problems [8]. Well-designed visual representations can replace cognitive calculations with simple perceptual inferences and improve comprehension, memory and decision-making [9][10]. The design of usable user interfaces for digital libraries is a complex task that requires knowledge and guidelines on user-centered design. It requires knowledge about the users, their tasks, the context of use, and what is technically feasible [11]. User studies are necessary not only for planning and designing information systems but also for their efficient and effective operation [12].

An example of novel interactive interface for browsing of large-scale video collections is presented in [13]. It visualizes underlying structure of the dataset by the size and spatial relations of displayed images. Interaction with digital information can be seed as a channel for accessing and sensing information in virtual environments. Relation Browser [14] is a tool for understanding relationships between items in a collection and for exploring an information space. Users can explore datasets using a mixture of searching and browsing, supported by keyword search and dynamic queries using facets. In another similar example [15], authors developed two interfaces that combined search and browsing, supported dynamic exploration of conceptual structures of a thesaurus, and provided dynamic term relation features to give overview of data. They showed that browsing through thesaurus improved users understanding of the relationships between materials and catalogue resources.

Rich media is a new media concept. It is different from traditional media such as audio, video etc. It is composed of text, graphic, image, animation, audio, video and

other media objects in the time and space to provide a rich form of expression and interaction. [16]. Interactive video is a digitally enriched form of the original raw video sequence, allowing viewers attractive and powerful interactivity forms and navigational possibilities. Interactive video presentation is a form of interactive video document that is centered on enriched video but is not exclusively video. [17]. The *video collage* is an example of interface for dynamically summarizing and presenting mined multimedia information from video collections. Collages are presentations of text and images extracted from multiple video sources. They provide an interactive visualization for a set of analyzed video documents, summarizing their contents and offering a navigation aid for further exploration [18]. Another example of a tool for interacting with video collections is FreeEye [19]. It is a tool based on the efficient image clustering method and interactive hierarchical interface. It is based on an analysis of the captured video for the purpose of automatically structuring into shots or higher-level semantic units like TV news stories. A novel video browsing interface called TAV (Temporal Annotation Viewing) that provides the user with a visual overview of temporal video annotations is presented in [20]. TAV enables the user to quickly determine the general content of a video, the location of scenes of interest and the type of annotations that are displayed while watching the video. The TAV user interface consists of a traditional video player vertically adjacent to our novel-browsing interface. Below the video player multiple timelines are displayed. Each timeline refers to a specific type of video annotation, in this case goals or penalties in a hockey game. Each timeline consists of a visual identifier on the left side followed by a scrub bar with annotation icons. With all the advances in content-based analysis and proliferation of user interfaces the video is still mostly viewed in a passive way as a non-stop medium where the user's interaction with the content is somewhat limited. Hence, the viewing of the video is performed in a linear fashion where the only way to discover what is next is to follow the narration and move through the video guided by seconds and minutes. Such conventional techniques for video viewing and browsing seem to be inefficient for most users to get the crux of the video.

3   Human Sanctuary Project

In order to improve the experience and understanding of museum visitors, curators at the Shrine of the Book of the Israel Museum in Jerusalem, where the Dead Sea Scrolls [21] are exhibited decided to create a 20 minute long film (called a "Human Sanctuary" that deals with the lives of the members of the Qumran community [22] that was behind the writing and preservation of most of the Dead Sea Scrolls. creation of the scrolls. The film focuses on the life of two young members of the community, as well as of a young priest from Jerusalem Temple, covering various aspects of the communal life and everyday activities, whose understanding is important for social, historical and Second Temple Judaism studies. Writing techniques, community rules, religious rules and everyday life are just some examples of the topics covered in the film. Even though the film is short, it contains large amount of complex information that needs to be explained in more details. Over the time the curators at the museum
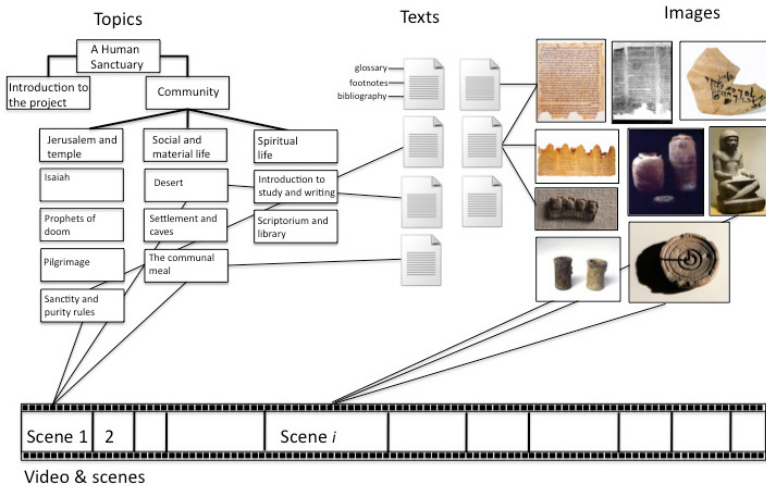
Fig. 1. Information space. The video is segmented into scenes. Each scene covers one or more topics. Each topic is described with the combination of text and images. Together with being part of the topic explanation each image is also linked to one or more scenes. All the relations between annotations are used as navigation paths through the information space, enabling users to move at their will.

realized that there is a need for explaining the film in more details to the general public. These explanation tools should help bring the content of the movie closer to the public and will help visitors better understand the importance of the Scrolls and the impact they have on our time. It was also realized from the experience in the museum, that the film could also be used as an educational tool that will provide researchers and scholars with valuable material on various topics. The idea of the Human Sanctuary project then emerged, with the main goal of annotating the film, with descriptions of various topics and developing web based tool for exploring and interacting with the movie and associated information.

The film is seen as a starting point of exploration and as a source for attaching additional information. The first step towards annotating the film was to create the hierarchical list of topics that is covered in the film. The hierarchical topic structure is meant to facilitate easier navigation through the information space constructed over the film. We use the term information space to denote the knowledge space that consists of all the available information (see Fig1). In this sense the goal of the project can be seen as creating the tools that will help users navigate through the information space and acquire new knowledge. The main source of the information, the film, is manually segmented into scenes. Each scene covers one or more topics that are fully described and explained using the combination of text and images. Together with text, explanations contain literature references for further reading, number of footnotes and glossary terms that are used to further explain various terms used in the texts. Images or real world objects related to the story of the film are used to enrich the descriptions. Also, images may be seen as a bridge between "fictional" side of the movie, where

the reconstructed scenes and objects were used to tell the story and the real world objects as they were found in the site. There are three main groups of images used in the project. Images of the objects and other archaeological remains found at the site, images related to the excavation process, and images of the scrolls. Each image is linked both to the text and directly to various scenes of the film. In the same way as each scene is linked to one or more topics, each scene is also linked to one or more images. All the available information together with links between them forms the information space that will form the basis on which users will navigate and explore the content.

4   Data Repository

Setting up of a data repository was the first stage of the project from the technical point of view. At the beginning of the project, the only content that was available was the film, the initial list of topics and a small number of images. Complexity of the content, in terms of ideas and topics presented in the film resulted in difficulties not only in the presenting phase, i.e. how to present these topics and ideas to the users, but also on how to create the appropriate annotations. This meant deciding how to describe each topic how to link different information, what images to used for each topic, and so on. All the information used to annotate the film is highly interconnected and related which means that it was important to have the complete view of the content while working on details, which was not always easy. For the purpose of collecting and generating digital records that will be used in combination with the movie we developed an interactive web based content management tool, named Metadata Collector. The Metadata Collector provides basic upload, edit, search and browsing functionalities for generating and accessing of the content.

In order to link various external information with the movie, we defined metadata structure that assigns number of properties to every data record. All these properties will be used to build the information space, and to establish connections between stored data and the movie. At this stage users can fill in necessary form fields, and assign each object a number of time stamps, a number of topics, and a number of scenes. In this way the specific descriptive object is linked to the movie. Every object can then be described with key word labels and free text description. After each object is uploaded, users can browse the set of available records and edit them if needed. As the work on data collection evolved, we identified number of possible interaction tasks that could help curators in the process of content creation. One example of such interaction tool is an interactive data table where data records are displayed in rows, with data properties displayed in columns. Content creators needed a way to quickly inspect uploaded information with respect to specific metadata fields. Instead of browsing each individual items at a time, or browsing data in a data grid, where only small number of metadata properties may be displayed, information table gave content creators a chance to compare items on a single page, while having the overview of all properties. This proved to be very useful for understanding the current stage of the project and to get fast overview of the uploaded data.
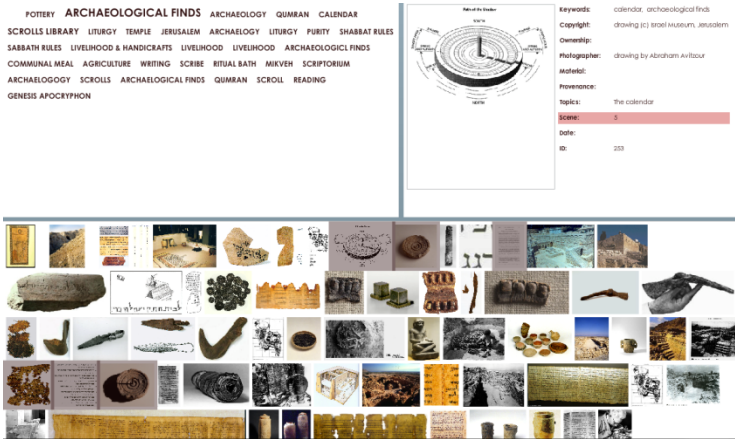
Fig. 2. Exploring relations between tags and images. Screen is divided into three parts, tag cloud, metadata panel and image panel. By clicking on any information item, set of related data is marked. For example by clicking on a tag set of images related to that tag is masked. By clicking on an image, metadata describing that image is showed and related tags are marked in the tag cloud. Users can also click on any metadata field, and set of images related to the value selected is marked in the image panel.
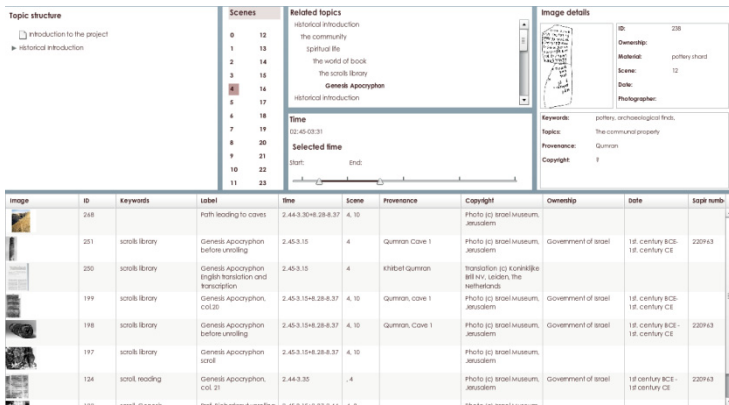
Fig. 3. Metadata exploration tool. Information panels show topic list, scene coverage, time intervals and image list and details. By clicking on any information presentation, set or related items is showed in all the other panels. For example users may select time range and set or images related to the selected time interval will be shown in the image table, set of covered topics in the topics panel and set of covered scenes in the scene panel. User can also explore each image in detail and edit the metadata values.

In order to focus on a specific data property like key word tags, we developed a data visualization tool showed in Fig. 2. This tool helps users understand relations between images and tags. The screen is divided into three parts, tag cloud, metadata panel and image panel. A tag cloud shows all available tags, and displays them based

on the appearance frequency. By clicking on a tag, images that are assigned with the selected tag are masked. Next, user can click on any image and explore its properties in details. Another way of using this tool is to select any metadata property by clicking on a specific field in the image description. This will again mask all images that are related to the selected image with respect to the selected criteria. Another tool that we have developed for interacting with content is shown in the Fig 3. This tool is used to interact with more properties at once. It uses hierarchical topic's tree, scene numbers and time intervals as queries and displays results in the image table. By selecting single criteria as a query, all other available properties are used to show relations between the query and given properties. For example if users select specific topic, set of images related to this topics is shown in the data table. Together with data table, criteria's that are not used in query such as scene number, and time intervals are used to highlight properties related to the chosen topic. Also user can investigate images in details, and edit them if needed.

5   Exploring the Content

After all the information have been carefully created, checked and stored, we moved to the next stage of the project, the creation of the tools for exploring and interacting with content. At this stage, again, the museum professionals were highly involved by testing the early prototypes, and providing the feedback to the developers on how they want to interact with the content, and what should be achieved by the interaction. This collaboration proved to be very useful since it gave both sides a chance to see the project from different perspective, and to come up with useful ideas and solutions. The goal of the users interface design was to find the balance between the amount of information presented in the screen, and the complexity of individual information units that are shown to the user. The most basic functionality gives users a chance to simply watch the movie without any additional information.

First real challenge we faced was how to notify the user that additional information is available, and how to present this information in a way that wont obstruct users natural flow of actions on one side, and enable users to explore this information at their will. Also, the way information is presented in the screen plays important role on how this information is perceived and processed by the users. On the long run it directly influences the ability of users to understand presented information and to use this information to produce new insights and knowledge. The goal of the good interface should be to help users in their journey through the information space, and also to help them to understand the places visited, help them discover new information places, and finally help them create and develop their own personal information points of interests.

The first functionality we developed was a tool that gives users a chance to explore the set of annotations dynamically while watching the film. Initially this was one of the most important tools that needed to be developed, see Fig. 4. The idea is that while watching the film users get the information about the available annotations.
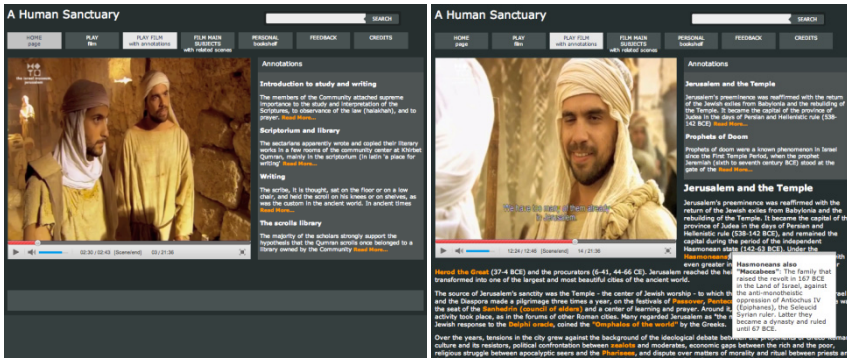
Fig. 4. Example of the user interface for watching the video and exploring the set of annotations. Annotation notifications automatically appear when specific video segment is played and are removed after the segment is finished, left image. User can then choose if they want to access the annotation (right image) or continue watching the movie.

The way users are notified about the available information while watching the video needed to be implemented in a way that will enable users to easily select next action. Whether it will be not to pay attention to the annotation and continue watching the movie or to explore the content of the annotation in more details, users actions should be smooth and not influenced by the appearance of new visual elements on the screen. This means that the way in which users are notified about the annotations should not lead users to actually access the annotation. Instead it should only open up the possibility for users to access the annotation if that is of interest to them. The main challenge for this task was the organization of visual elements on the limited screen space. There were three main groups of information that needed to be displayed. First, there is the film that should be at the center of the users attention. Second, annotation notifications should be presented to users together with the film, notifying the user when an annotation is available. The notification area should be shown in a way that enables users to continue watching the film without distractions, or enable users to explore the annotation in more details. Third group of information are complete texts of the annotations displayed after the users have responded to the notification by clicking on it. When a specific segment of the video is played, and there exist an annotation related to the specific segment, there is a short paragraph displayed on the right side of the video, with a short text of the annotation. If the user wants to explore the annotation in more details, they can click on the paragraph and get the full text with all the additional information displayed, and video stopped. After the video is played, and a segment for which the annotation exists is finished the notification for that specific annotation will be removed from the notification area.

The annotations itself are complex information units consisting of textual information and images where text is composed of the textual describing the topic, bibliography, footnotes and glossary terms. One of the finding of the early testing of the interface was that the screen that overfilled with information is not too helpful to users. On the contrary it proved to be distracting and often it resulted in users leaving the page
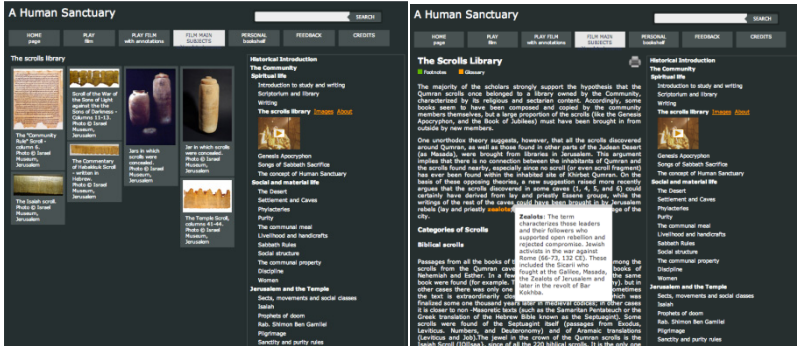
Fig. 5. Exploring the content from the list of topics. Users can choose a topic of interest and then watch all the video segments related to the selected topic, read the textual description of the topic or explore the set of related images.

without going through the content. This was an important fact to be taken into consideration, as we had to decide what information to display and how. The solution that we found to be satisfactory is to display the basic text as it is, and all the other additional textual information should be shown only upon the user action. The same solution is applied for footnotes and bibliography. Parts of text that can give additional information is shown in different color from the rest of text with the legend at the beginning of each text explaining the meaning of each color, and the type of information presented.

Another way of exploring the film is to start from the list of topics and then choose the next action. Users can watch individually all segments related to a certain topic, or may choose to read the textual description or explore set of related images see Fig. 5. In this case, users start from the annotation and come to the film, exploring the relations between data in different way. The film in this case can be seen as an annotation used to enrich the textual information. In this way we can see how the idea of information space comes to life, where all pieces of information are seen as individual information points, and the goal of the application is to enable the navigation through such a space. Instead of treating the annotation as an addition to specific information, in our approach the annotation is used at the same level of importance in the information space. Practically it means that the annotation is used to describe some information, but also the information can be used to describe the annotation. This two-way relation between the annotation and associated data is used by the interface to enable seamless navigation and exploration of the content.

6   Conclusions

We showed in this paper how the video material could be used to enrich the experience of cultural heritage. Instead of accessing a video in a traditional linear manner we proposed solutions for interacting with video material in a way that will give users

more freedom while exploring the content. We also presented a data repository used to annotate the video and store the annotations. In order to control and evaluate the content, we developed number of tools. These tools give users a chance to interact with the content in a way that can help them understand and improve the existing information. Important aspect of our work is that the cultural heritage professionals were involved in the software development process from the start of the project. This proved to be very helpful since it gave us a chance to understand the needs of end users better. Currently the project is in the phase of intense user testing. First results of the user evaluation are very positive since most of the users liked the idea of combining different information in a way that enables them easy navigation through different types of information. The ability to watch the film and at the same time explore descriptions about various topics proved to be very useful especially for scholars interested in Biblical studies. At the moment we are working on developing additional set of tools that will enable users to add comments to the film and texts. In this way the information space of the move will grow by including user's ideas and findings.

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