A Study on Structural and Semantic Analysis for Presentation Content Management

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With the advent of Web services such as MOOC (e.g., Coursera, iTunes U) and presentation sharing websites (e.g., SlideShare, Prezi), to store presentation contents that they use in speeches and lectures owing to the features for searching, browsing, reusing, and sharing. For example, famous Coursera and SlideShare provide an online presentation archive for self-learning and later review. Although these tools and Web services make it easy for creating and sharing presentation contents are widely used, criticisms have pointed out their problems from the viewpoint of understandability about relevant information, structural information, and contextual information of presentation contents. In this research, we are challenging to support for retrieval, generation, grasping overviews of presentation contents by focusing three critical issues, that is, a) determining semantic relationships, b) extracting expression styles, and c) presenting presentation context in presentation contents.

1. Introduction

Due to the advent of usable presentation tools to create attractive presentation contents, such as Microsoft PowerPoint and Apple Keynote, presentations now play a socially important role in promoting understanding in many fields, including business and education. Many people have used Web services such as presentation sharing websites (e.g., SlideShare[1], Prezi[2]) and MOOC (e.g., Coursera[3], iTunes U[4]) to store presentation contents that they use in speeches and lectures owing to the features for editing, browsing, sharing, and reusing presentation data. For example, most presentation contents with rich graphics and animations are prepared by using presentation tools, i.e., Microsoft PowerPoint, Apple keynote, and recently Prezi. In addition, presentation sharing websites such as SlideShare and Coursera provide an online presentation archive for later review with slides or video recordings of speeches.

Although useful and powerful support tools make it easy for creating presentation contents and Web services for sharing the presentation contents are widely used, criticisms have pointed out their problems from the viewpoint of understandability of the presentation contents [1, 2]. They are still a lack of support for users to (1) acquire relevant information implicit among the presentation contents; (2) utilize structural information explicit in the presentation contents; and (3) grasp overviews of contextual information existing in the presentation contents. This research addresses these problems for improving understanding of presentation contents, enhancing user interactions through the presentation contents by analyzing structural and lexical semantics in the presentation contents. In this doctoral dissertation, we are challenging to support for retrieval, generation, grasping overviews of presentation contents by focusing three critical issues, that is, a) determining semantic relationships, b) extracting expression styles, and c) presenting presentation context as shown in Fig.1.

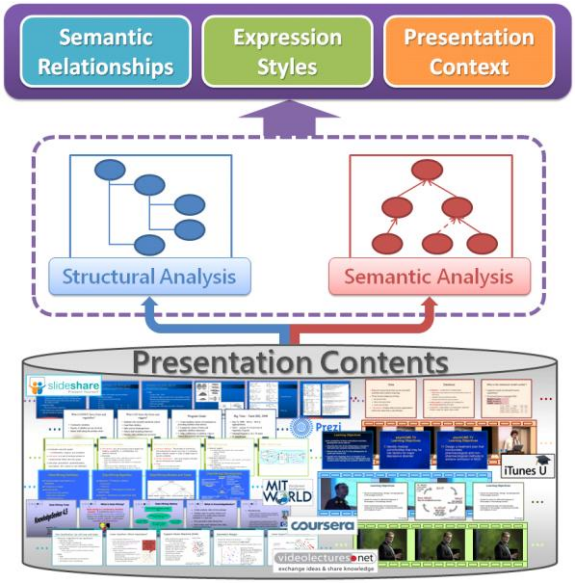

Fig.1 Concept of a structural and semantic analysis of presentation contents

This article is organized as follows. Section 2 describes our approaches and reviews related work. Section 3 explains methods to support for slide retrieval to readers or searchers by utilizing semantic relationships between slides. Section 4 describes a method to support for slide generation from textbook chapters to presenters or authors by reusing expression styles of existing slides. Section 5 presents methods to support for grasping overviews of presentation contents to readers by visualizing presentation context. Finally, Section 6 concludes this research with future direction of the research.

2. Our Approaches and Related Work

In order to provide a presentation content management for next-generation presentation contents, we have to consider the emerging issues:

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[1] SlideShare: http://www.slideshare.net/.
[2] Prezi: http://prezi.com/.
[3] Coursera: http://www.coursera.org/.
[4] iTunes U: http://www.apple.com/jp/education/itunes-u/.

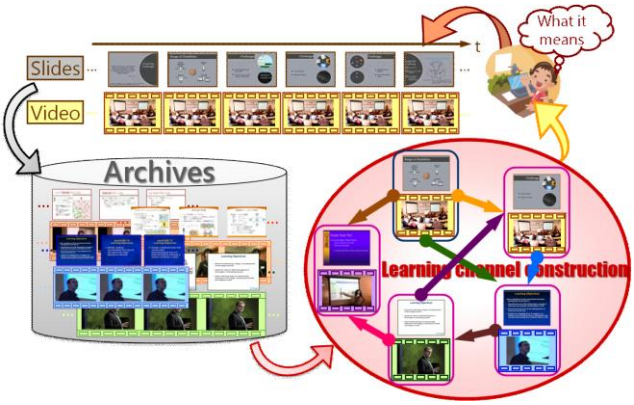

Fig.2 Concept of learning channel generation

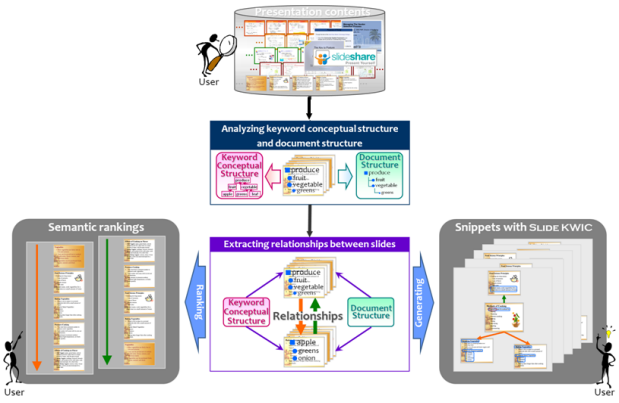

Fig.3 Concept of slide ranking and snippet generation

a) Determining semantic relationships

Support for presentation content retrieval to readers or searchers, we need to explore how to determine semantic relationships implicit among presentation contents. To difficulty of determine the semantic relationships, for instance, we develop a metadata extraction method to analyze two important features of metadata in the presentation contents: one is structural semantics that structured segments (i.e. itemized sentences of bullet points in slides), the other one is lexical semantics that semantic relations implicitly exist between keywords (i.e. an is-a, a part-of relations). In this way, it can help readers or searchers understand relevant information of presentation slides well.

b) Extracting expression styles

Support for presentation content generation to presenters or authors, we need to analyze various expression styles of existing presentation slides. To difficulty of extract the expression styles, in general, slides are made from documents of a textbook for lectures. Then, we defined expression styles of slides that levels of words are located in slides based on the slide structures from documents. Therefore, expression styles which contain words from the documents are located in which level positions of which slides. In this way, it can help presenters or authors generate presentation slides in desired expression styles of existing presentation slides.

c) Presenting presentation context

Support for grasping overviews of presentation contents to readers, we need to analyze and present presentation context of presentation contents intuitively. To difficulty of present the presentation context, for instance, in order to provide an overview of presentation slides, we adopt a word cloud visualization of presentation slides that words related to the context are important; and we also visualize presentation slides in a structural layout. In this way, it can help readers interactively and easily grasp overviews of presentation content well.

2.2 Related Work

Most of the research related to slide retrieval. Yokota et al. [3] proposed a system named UPRISE for retrieving important slides from archives containing a combination of lecture slides and recorded videos. Le et al. [4] generated digests of recorded lecture videos by using important slides. However, we considered that retrieving only the important slides decreases the relevance of the results of a query to the given context.

Several studies related to slide-making support have focused on reusing documents (i.e., academic papers, textbooks). Mathivanan et al. [5] and Miyamoto et al. [6] proposed a system for generating slides from academic papers. Their methods summarize and extract information from an academic paper by TF-IDF scores. From the viewpoint of reusing slides, Sharmin et al. [7] and Mejova et al. [8] proposed a system for composing slides from existing ones and modifying them. We share a common point in reusing expressions of words in existing slides to create new ones.

In the area of information visualization, several studies have concentrated on representing text content at the word or phrase level, including TextArc (www.textarc.org) and Phrase Net [9]. Our work focuses on visualizing presentation contents in word clouds with transitions for reflecting presentation context. In addition, NextSlidePlease [10] creates and delivers presentations in a nonlinear fashion. The Fly application addresses graph-based presentation authoring [11]. Our work is similar to these works, as we utilize a structural layout with a ZUI, to allow interactive and collaborative browsing by users for each other.

3. Presentation Content Retrieval

We propose methods to support for slide retrieval to readers or searchers by utilizing semantic relationships between slides. Concretely, we measure semantic importance and relationships with semantic relations between keywords and document structure in presentation contents; i) scene combination for slides with recorded videos and ii) semantic ranking and context summarization of slides.

As for i), we propose a method to automatically generate learning channels by using the semantic relationships among scenes, which lets users easily focus on either highly detailed scenes or introductory scenes without needing to examine all of the data (see Fig.2). As depicted in Fig.3, in the case of ii), we attempt to rank slides by using the semantics of relationships without relying on the existence of any specific structure in a slide or relevant information between slides. In addition, we consider that retrieved slides also contain irrelevant

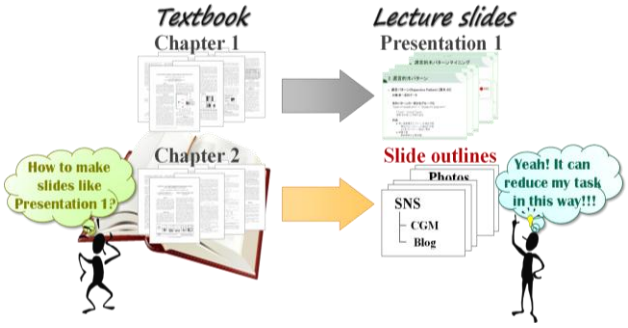

Fig.4 Concept of slide outline generation

information to a query. For this, we challenge to generate snippets that capture relevant portions of the retrieved slides as their surrounding context, which help users understand them in presentation contents easily.

3.1 Scene Combination for Slides with Videos

We developed a system of automatically generating learning channels for readers to extract scenes and combined scenes from slides with their recorded video based on semantic relationships. The system analyzed the types of semantic relationships on the basis of the metadata of structural information, such as indents and texts in slides, and the text of speech in the video. In this way, our newly generated learning channels let users easily focus on either highly detailed or introductory slides without needing to examine all of the data. In this work, we could show that there is a possibility to utilize the semantic relationships analyzed by exploiting heterogeneous media features of presentation contents.

3.2 Slide Ranking and Snippet Generation

We built a slide retrieval system for searchers involving 1) semantic ranking by considering what rank orders of the slides related to a query, and 2) snippet generation, by considering what portions of the slides are relevant to the query, on the basis of the relationships between slides. These methods are based on the keyword conceptual structure of the semantic relations that implicitly exist between keywords, and the document structure of the indent levels in the slides. With our novel 1) slide ranking method and 2) snippet-generation method, not only precise retrieve target slides but also the semantic ranking of them, thus ranking either highly detailed slides or generalized slides in an order to help users easily learn through the slides; and the relevant portions of them in the presentation by focusing on portions from either detailed or generalized slides, thus giving their surrounding context to help users easily determine which the slides to learn are useful or not. Finally, we cloud show the effectiveness of our methods that enable the users to browse slide rankings and snippets of the retrieved slides efficiently and effectively.

4. Presentation Content Generation

We propose a method to support for slide generation from textbook chapters to presenters or authors by reusing expression styles of existing slides (see Fig.4). Although most slides can be automatically generated by conventional methods follow structured document

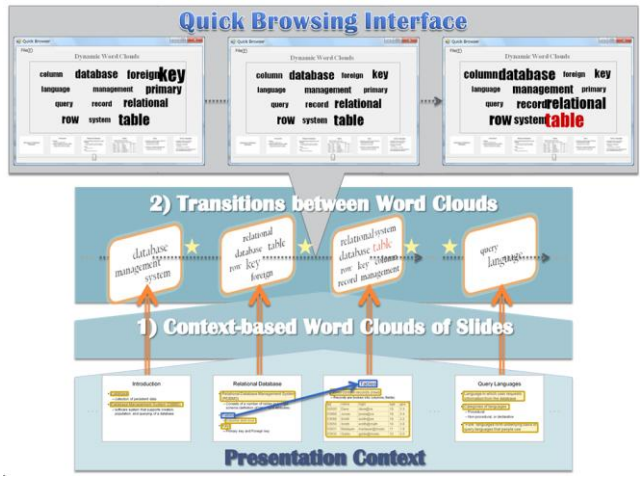

Fig.5 Concept of dynamic word cloud generation

summaries (e.g. academic papers), we aim to organize slide layouts from target chapters by reusing various styles of referred slides based on level positions of words.

Therefore, we analyze level positions of words in the referred slides and arranged the words from target chapters to generate slide outlines based on difference in document structure (i.e. text structure within a chapter, slide structure within a slide). To achieve this, we extract differences between tendency of word appearance in the chapters and their slides (referred slides). This method generated slide outlines by using the expression styles of the corresponding words from the target chapters in the same layouts as that of the referred slides. Finally, we could show the possibility to generate slide outlines by reusing the expression styles of the existing slides.

5. Grasping Overviews of Presentation Contents

We propose a method to visualize presentation contents by extracting words important to the context of presentations. Here, we focus on how to decide which files are worth learning, because most of presentation contents in search results are similar; it can be difficult to identify differences in them. Therefore, we propose a method to generate dynamic word clouds of presentation contents by presenting presentation context (see Fig.5). In addition, we propose a collaborative browsing platform that generates a meaningfully structured presentation called iPoster by using slides (see Fig.6). It promotes user interaction and communication.

5.1 Dynamic Word Clouds of Slides

We developed a quick browsing interface to help readers easily and effectively grasp overviews of presentation contents. For the purpose, we provide a word cloud visualization that summarizes information to help the users visually understand the context of each presentation. Words important to the presentation context, is first extracted based on components of the presentation content (i.e., slide structure and links between slides). In order to generate dynamic word clouds of slides, we weight extracted words from presentation context, and then present transitions that highlight the semantic

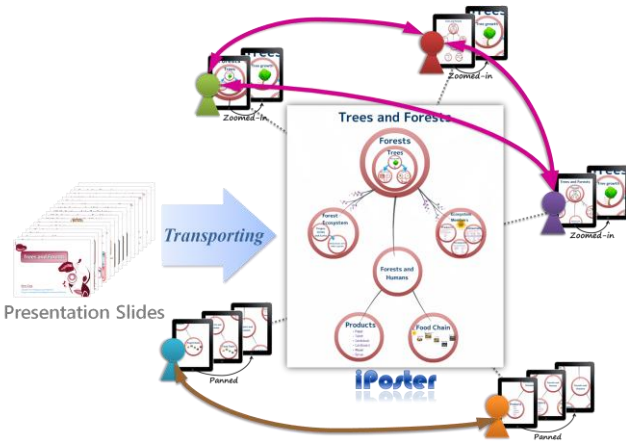

Fig.6 Concept of a collaborative browsing platform

relationships between the slides. Finally, we were able to confirm that our dynamic word clouds help readers easily and effectively understand the context of slides.

5.2 iPoster: A Collaborative Browsing Platform

Recently, zoomable presentations as a substitute to traditional presentations that allow users to zoom in and out of the presentation media. Then, we built a collaborative browsing platform for presentation slides based on interactive poster generation, called iPoster, for presenting elements (i.e., textual and graphic elements) in a meaningfully structured layout with automatic transitions, such as zooms and pans, to promote user interaction. Especially, we propose a semantic structure analysis model for extracting elements and determining the semantic relationships between the elements of the slides. In order to provide an overview of presentation slides, we initially place the elements in a tree structure combined with a stacked Venn. We then attach the zooming and panning transitions between the elements, based on the semantic relationships. Finally, we were able to confirm that iPoster helps readers to interactively and collaboratively browse, and understand educational presentations easily and efficiently using their tablets. A collaborative browsing platform based on the iPoster, which can share and navigate information, matches each user's specific requirements by analyzing the users' operations. Further, it detects other users who have similar requirements by mapping the similarity in their operations and conveys their interests to each other.

6. Conclusions

In this research, in order to management of presentation contents, we studied on a structural and semantic analysis of relevant information, structural information, and contextual information in presentation contents. For this, we proposed three approaches: a) we explored semantic relationships inside between slides or scenes; b) we analyzed expression styles of existing slides; c) we presented presentation context intuitively. As a whole, we were able to confirm that our approaches enable us to advance next-generation presentation contents and furthermore to conduct structural and semantic analysis for presentation content management that support for retrieval, generation, and grasping overviews of presentation contents.

In the future, we will further study on **Next-generation Presentation Data Analytics** and **Advanced Management**. By stepping into analyses for human-computer interaction (HCI) and collaborations through presentation contents, we plan to develop advanced applications which are efficient and useful in education area, such as self-learning navigation, social learning, and gamification.

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