

Evaluation of Interactive Information Access System using Concept Map

Masaharu Yoshioka
Hokkaido University
N14 W9, Kita-ku, Sapporo-shi,
Hokkaido, 060-0814 Japan
yoshioka@ist.hokudai.ac.jp

Noriko Kando
National Institute of
Informatics
Hitotsubashi 2-1-2,
Chiyoda-ku
Tokyo, 101-8430 Japan
kando@nii.ac.jp

Yohei Seki
1-2 Kasuga, Tsukuba,
Ibaraki, 305-8550 Japan
Tsukuba University
yohei@slis.tsukuba.ac.jp

ABSTRACT

In this study, we introduce a method to analyze the effectiveness of the interactive information access system based on the changes in users' knowledge structure. We use concept maps to compare each user's knowledge structure before and after a search. We discuss the difference between proposed evaluation method and questionnaires by using the results of user experiments for an interactive news retrieval and analysis system called NSContrast.

Categories and Subject Descriptors

H3.3 [Information Systems]: Information Search and Retrieval

General Terms

Information Retrieval

Keywords

News search, IR interface, User Experiment, Evaluation

1. INTRODUCTION

We can use many interactive information access systems for collecting information mostly from Web. In order to improve the effectiveness of such systems and provide better user experience, it is necessary to have a good framework to evaluate them. For the well established system, such as information retrieval for web, news articles, research papers, we can evaluate these system effectiveness by using standard evaluation metrics available in TREC-eval or NTCIR-eval.

On the contrary, it is not so easy to evaluate interactive information systems that supports to find interesting information from databases. Questionnaire is one of methods that are commonly used for this purpose, but this method works well when we can make an appropriate list of questionnaire. It means we need to make good questionnaires that reflects the good characteristic feature of the system to be evaluated and appropriate use cases.

Concept map [2] is a graphical representation for representing users' knowledge by showing the relationships among concepts related to the topic. Recently, there are several attempts to use concept maps for understanding the user-centered effective behavior in search process [1, 3]. This framework can extract information about what kind of new information are captured during interaction with the system and how users' knowledge structure were changed.

In this paper, we show the experimental result of using concept maps for analyzing information access system and discuss the difference between this results and ones of questionnaire survey.

2. CONCEPT MAP

Concept map is a labelled directed graph[2]. A node represents important concept related to the given topic, and a labelled directed link shows relationship between two concepts.

Node represents objects or events, such as Japan, computer, and election.

Link represents relationship between two nodes. The type of relationship is represented by label. Verbs, adjectives, and conjunctions are used for the label. By using the directed graph, we represent the order of these concepts. For example, a connection by labelled link "has a" from node "A" to node "B" means that "A has a B."

This concept map can be used for archiving expert knowledge and there are some guidelines to construct good maps [2].

Another application of concept map is analyzing change of knowledge structure in learning or searching process. Egusa et al. [1] propose a a method to compare each user's knowledge structure before and after a search using concept map to understand users' behavior in exploratory search. They confirm that concept maps greatly changed after search and it is useful to understand the knowledge obtained in the search process.

Saito et al. [3] analyze the effect of search scenario based on this method. Followings are information for analyzing change of concept maps.

1. Number of nodes, links and nodes labels
These values may related to the amount of knowledge for the topic.
2. Number of common, lost and new nodes
Common nodes represents important keywords to explain both of concept maps. Most of the cases, the user find relevant information during the task. Lost nodes are important nodes for representing prior knowledge, but are not used in the concept map after the search. It means that he/she may not find good relevant information about the keyword. New nodes represents new information during the process.

3. Number of nodes at each distance from the center node
In the concept map, the center node represents the given topic. Therefore, nodes that are directly connected to the center nodes represent aspects to explain the topic. On the contrary, nodes that are far from the center node may represent detailed information about these aspects.

They confirmed the search scenario influences type of change between two concept maps. They conduct experiments with divergent and convergent scenario. In divergent scenario, the user tend to add nodes that are close to the center node and he/she tends to add nodes with some distances in convergent scenario.

3. EVALUATION OF INTERACTIVE INFORMATION ACCESS SYSTEM

In order to evaluate interactive information access system that supports to find out interesting information from databases and serendipitous discovery. It is better to have a framework that can represent information obtained through interaction with the system. We use concept map to compare each user's knowledge structure before and after using the system.

In addition to the analysis based on the concept map, we also conduct questionnaire survey to the users and discuss the relationships among them.

Followings are procedures to evaluate interactive information access system using concept map and survey.

1. Explanation of the task
It is necessary to define a topic to draw a concept map. Topics for using the system is explained as task description.
2. Drawing a concept map that represents based on user's prior knowledge (pre concept map)
Each user draws a concept map about given topic based on their prior knowledge.
3. Using the system
He/she uses system for completing the task. If it's possible, it is better to record logs such as documents checked during this process, query for the system, and system suggested information.
4. Drawing a concept map after the task (post concept map)
He/she draws a concept map again based on the result using the system. If it's possible, he/she also make a list of corresponding nodes in two concept maps.
5. Answering questionnaire
He/she answer questionnaire survey

When there is a baseline system to compare, we conduct this procedure for the baseline system and proposed system.

Analysis for the concept map is based on [3]. This analysis may give insight to understand the type of information obtained during the process.

In addition to that, we can check the relationships among new concept nodes and information provided by the system. For example, when the system suggests a keyword for a new node, we can confirm the effectiveness of the system.

4. EVALUATION EXPERIMENT FOR NSCONTRAST

4.1 NSContrast: News Site Analysis System

In order to evaluate this evaluation framework, we conducted user experiment for interactive information access system NSContrast.

The NSContrast system is a method for accessing news articles from multiple news sites [4]. The NSContrast system has news article database populated by following news sites (Japan:Asahi newspaper, Yomiuri newspaper, Nihon keizai newspaper, Korea: Chosun newspaper, Joins newspaper, Chosun newspaper(Korean version translated by MT), China: People newspaper, Xinhua newspaper(Chinese version translated by MT), USA: CNN). NSContrast crawls articles from these sites on a daily basis and store articles for a year.

Followings are major analytic components of the system.

1. Comparative analysis among different countries
The system summarizes number of articles that satisfies given query for certain period in each country. It also shows how number of articles changes by using a graph.
2. A word collocation graph for given news articles
This graph shows the relationship among characteristic terms for a list of given articles that represents topics (e.g., set of news articles that contains topic keyword). Characteristic terms is a list of ones that are highly correlated with given articles or ones that are comparatively higher correlated with given articles in certain country.
3. Burst analysis
The system makes a list of keywords that attracts more attention than usual for each country.
4. Article retrieval system
The system retrieves news articles that satisfy structured query (such as keyword, duration, and country).
5. Topic analysis
The system shows the result of clustering for news articles for a particular day for representing topics for the day.

4.2 User Experiment of NSContrast

4.2.1 Tasks and Participants

In the experiment, we focused on the effectiveness of NSContrast for analyzing news topics comparing with other Internet based system such as Google news¹. We conducted an experiment with 14 participants. They were recruited from various departments and universities in Tokyo area.

4.2.2 Procedures

We conducted four analysis sessions with given topics after a training. In addition, we also conduct one free session where they can select the topic by themselves and can use other systems in addition to NSContrast.

¹<http://news.google.co.jp/>

In one session, we asked the user to find out new information related to the given topic. Each analysis session is conducted based on the procedure discussed in Section 3. In each task, half of them use NSContrast and others used Internet based system such as Google news.

4.2.3 Result

Followings are results of questionnaire survey about this experiment. Table 1 shows number of users who select grade (1:small-9:large) for amount of new information given by the system. Last column shows average of grade for each system. Table 2 shows amount of knowledge after the session and Table 3 shows change of knowledge before and after the session.

From these tables, it is very difficult to say which system is better for these tasks.

Table 1: Amount of New Information

	1	2	3	4	5	6	7	8	9	Avg.
NS	2	5	7	4	3	5	11	3	4	5.25
Other	0	1	2	2	4	7	10	2	1	5.97

Table 2: Amount of Knowledge after the session

	2	3	4	5	6	7	8	9	Avg.
NS	0	1	6	5	11	7	11	3	6.41
Other	1	0	3	2	8	10	5	0	6.28

Table 3: Change in amount of knowledge before and after the session

	0	1	2	3	4	5	6	Avg.
NS	2	14	15	6	5	1	0	1.97
Other	0	6	12	5	5	0	1	2.44

However, we can find characteristic type of changes between concept maps. Figure 1-4 are example of concept maps made by a user who is satisfied with NSContrast most.

Red circle nodes represents the nodes represents same concept across pre and post concept maps. By using these maps, we can characterize the type of information obtained during the session. For the North Korea case (other), the user tends to add many nodes that are far from the center node. On the contrary, we can find several new nodes are attached with the center node in the Obama's case (NSContrast). From this example, there is a possibility to say that other system is good at finding out detailed information that he/she already know. On the contrary, NSContrast may support to find out new aspect to analyze the topic.

In order to analyze this assumption, we also check the logs about the Obama session(documents checked during this process, query for the system, and system suggested information). However, there is no keyword that is directly related to the new information.

4.3 Discussion

Based on the experimental analysis discussed in previous section, we found following advantages of using concept maps for analyzing interactive information access system.

- Analyzing the nature of information obtained by the

system.

Simple questionnaire survey is useful to understand amount of information obtained by the system. However, it is not good enough to evaluate the nature of obtained information. Concept map can characterize the information by analyzing the structure.

- Analyzing the effectiveness of the functional component.

We can check the correspondence between the information in the concept map and information provided by the system. This information is helpful to understand which functional components is useful.

Since this experiment is a first trial case to use concept map for evaluating interactive information access system, it is necessary to evaluate its effectiveness by applying this evaluation method to different cases. In addition, we also plan to define quantitative measure to analyze the characteristics of different concept maps.

5. CONCLUSION

In this paper, we introduce a method to analyze the effectiveness of the information access system using concept map. Through the experimental analysis of NSContrast, we confirm that we can extract useful information to evaluate the system from comparison between concept map before and after session.

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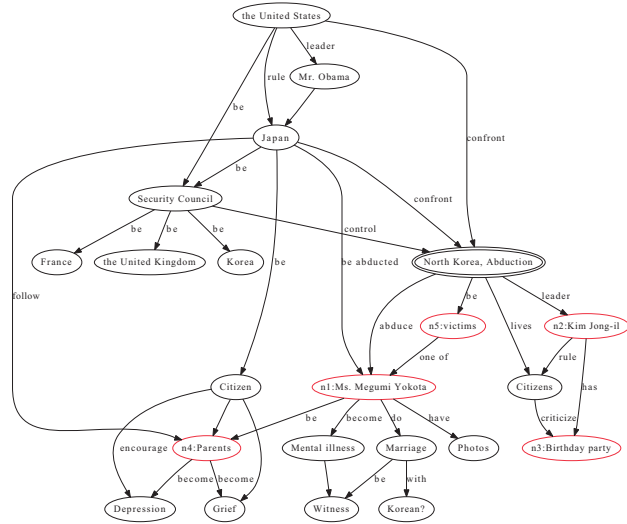


Figure 1: North Korea, Abduction(pre):Other (Manually translated from a Japanese map)

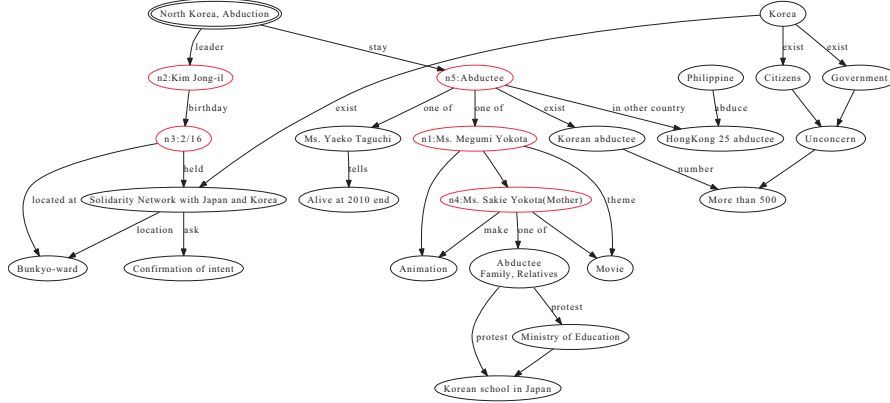


Figure 2: North Korea, Abduction(post):Other (Manually translated from a Japanese map)

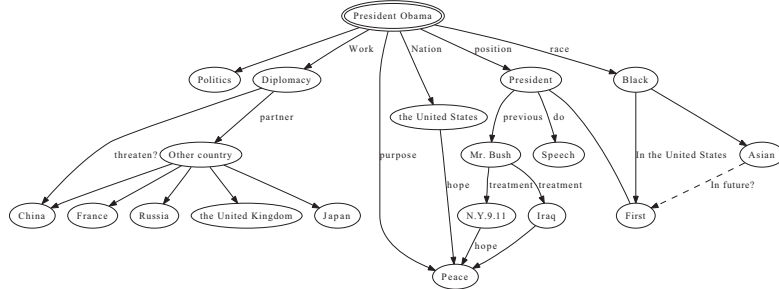


Figure 3: Obama's Diplomacy(pre):NSContrast (Manually translated from a Japanese map)

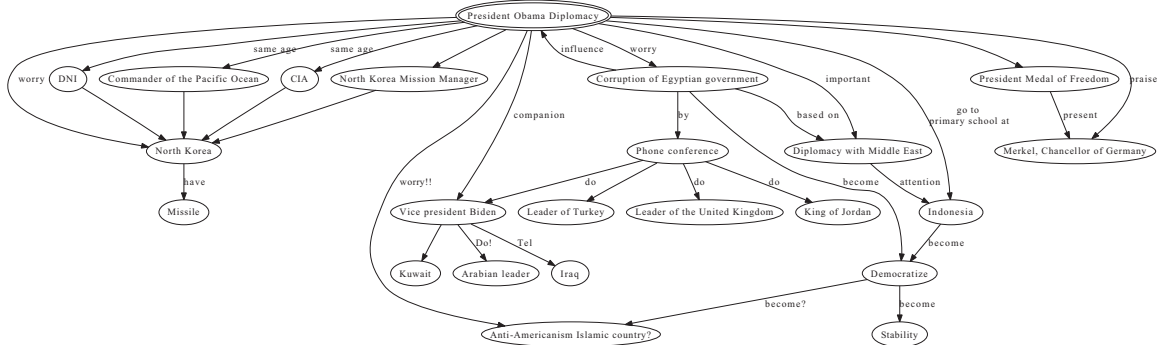


Figure 4: Obama's Diplomacy(post):NSContrast (Manually translated from a Japanese map)