

Consensus Formation Support System via Ontology Generation

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Abstract

In this paper, we propose a system called Talkabout to support nebulous communication between users who do not clearly express the concepts intended. When people have difficulty in understanding each other, using Talkabout to build an ontology of the common target world is helpful. By helping their inputting and showing some examples of concepts or ontologies from the World Wide Web, Talkabout enables users to discover the opinions of others on the use of the data. Then it facilitates discussion. This, in turn, should lead to a consensus or, at least, to a better understanding of why participants cannot come to an agreement. We describe the fundamentals of Talkabout in this paper.

Introduction

When people communicate with each other, reaching a mutual understanding is often difficult. This can be caused by the misunderstanding of words, lack of knowledge, difference of viewpoints, and so on. For the participants, however, the cause of the misunderstanding is not clear. Even worse, people do not always have an explicit conceptualization of the world which might contribute to the resolution of such a misunderstanding. Under such circumstances, rather than resolving the problem, continuing to communicate can cause more confusion. We believe a conceptual representation of the participants' topic of interest facilitates mutual understanding. That is, such information provides an understanding of the conceptual structure of the topic and the cause of the misunderstanding.

An ontology, which is "an explicit specification of conceptualization" (Gruber 1993), is the backbone of the knowledge structure of a target world. One of the problems facing researchers in this field is the difficulty of ontology development. How to design an ontology has been a key issue of ontological engineering (Mizoguchi 2001)¹. One of the promising approaches to

this problem is the use of Human-Computer Interaction (HCI) technology, which makes the interaction between the system and the developer, and the interaction between developers in collaborative development cases, more efficient.

In ontology research, unification of ontology and HCI is eagerly anticipated because of the currently limited ability of users to describe conceptual structures (Noy & Musen 1999) (Motta & Domingue 2000). Ogino et al. reported on the activities of sharing ontologies, which aims at controlling the multilingual information between the EDR dictionary and WordNet (Ogino *et al.* 1997). Aligning ontologies without tools can be an extremely tedious and time-consuming process. Noy and Musen proposed a semi-automatic approach to ontology merging and alignment (Noy & Musen 1999). Whereas these efforts used ready-made ontologies, our aim is to articulate the tacit knowledge of the nebulous mental world (Hori 1994). For example, when a person creates something new, his or her mental world contains many components of new ideas that are not yet fully articulated, especially in the early stages of creation. The articulation of this tacit knowledge is not yet established but it is a hot topic.

Building a very good ontology is not an easy task, but we applied an excellent ontology characteristic to our problem. That is, that building an ontology makes the developer aware of the conceptual structure of the target world. This is a very interesting phenomenon which can be used for resolving misunderstanding through a better and deeper understanding of the world of interest.

An aspect beneficial to our endeavor is that the use of an ontology does not require very rigorous definitions of concepts. What is mainly needed is a hierarchical structure of the key concepts and viewpoints associated with it. Using ontologies as a mediation tool has an implicit side effect, that is, we can expect a rough ontology on which the participants can agree when they come to a consensus.

Our proposed system, Talkabout, provides a discussion space for users to build ontologies of the common

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¹A Step Towards Ontological Engineering
(Translation of the paper presented at the 12th National Conference on AI of JSAL, pp. 24-31, June, 1998) [http://www.ei.sanken.osaka-u.ac.jp/english/step-](http://www.ei.sanken.osaka-u.ac.jp/english/step-onteng.html)

[onteng.html](http://www.ei.sanken.osaka-u.ac.jp/english/step-onteng.html)

target world (Sumi & Mizoguchi 2001). Talkabout helps their inputting and automatically shows some examples of concepts or ontologies from the World Wide Web (WWW). That is, by making users describe their conceptual representations of the target world, Talkabout enables users to find similarities or differences between them. By showing the opinions of others, Talkabout then facilitates discussion.

We have previously developed communication support systems which capture the user's viewpoint by observing the user's behavior using the model of the conceptual structure (Sumi 2000) and compare the differences of conceptualization between a user and an expert (Sumi & Nishida 2000). These systems estimate the domain of the topic in the background, and present information according to that. In contrast, Talkabout is independent from the domain to a certain extent because it can roughly narrow the domain by using a search engine.

Our long-term goal includes building a support environment for the resolution of misunderstanding, for facilitating creative thinking, and for building an agreed ontology by using an ontology as a mediation tool.

Cooperative consensus formation system via ontologies

We often encounter conceptual differences during communication, which are caused by 1) misunderstandings about the same objects, 2) differences of viewpoint about the same objects, 3) similar concepts for different objects, or 4) the same term for different objects. The target of the proposed system is the conceptual difference caused by viewpoint-difference among people who work in different fields or live in different cultures. See Figure 1 for an explanation of what we mean by the viewpoint-differences that are examined.

An object has a common concept, but, at the same time, it has different concepts according to individual viewpoints, and thus some conceptual differences exist. These are individual concepts. Individual concepts have different elements, structures, or weights. We treat an individual concept as an ontology, just as a common concept is treated as an ontology, because the individual concept is common within a field or generation. Recently, Semantic Web has also used this same perspective and proposed the coexistence of small individual knowledge ontologies and large common ontologies (Hendler & Feigenbaum 2001).

Talkabout supports blurred conditions caused by the differences between individual concepts. A scenario of the users' discussion proceeds as follows:

Step 1) Having difficulty understanding each other, Step 2) Discussing the conceptual differences using Talkabout, Step 3) Discovering the conceptual differences, and Step 4) Understanding each other, reaching mutual consensus, or creating a new idea.

Figure 2 is the framework of Talkabout. Talkabout

provides a discussion space where users can come to understand each other by building and showing their own ontologies of the common target world. When, in Step 1, people have difficulty in communicating with each other because of conceptual differences, Talkabout helps users to solve the difficulty by asking them to express their own concepts. Drawing and showing concepts helps our understanding and persuasive ability. Then, we finally overcome our viewpoint-difference. In Step 2, in the discussion space, Talkabout helps user to input their concepts on the display and even shows examples of the ontology by searching the WWW. Then users concentrate on discussing the topic referring to the concepts of others from the WWW. In Step 3, the users find the conceptual differences that exist between them by visualizing each concept. Through this process, they also can be expected to obtain new concepts or knowledge, and then in Step 4 they may create a new idea as a result of being stimulated by the concepts of others. Understanding others' concept stimulates our imagination, and this causes us to create new concepts.

Mining concepts from the WWW

We attempt to articulate ambiguous terms such as adjectives, which can be used and interpreted several ways by each person. If a user inputs such a term as the top concept of a conceptual tree on the display and clicks the down-arrow button, Talkabout 1) searches the WWW by the term and the topic and makes an analysis using natural language, 2) shows the user the new concepts which explain the term and which are equivalent to its low-level concepts in the conceptual tree. This process is repeated to generate an ontology automatically. The system shows the generated an ontology when a user requests it.

Talkabout analyzes the morphological and dependency structure by using natural language processing. First, the system searches for the phrase (phrase 1) which is modified by the source of the adjective phrase. Then, the system searches for another phrases (phrase 2s) which modify the same phrase (phrase 1) parallelly, and then repeatedly searches for phrases (phrase 3s) which modify the phrases (phrase 2s). It appends those phrases which modify the source phrase parallelly at each modification step (e.g., phrase 3 + phrase 2 + phrase 1, etc.). These phrases are kept as candidates. If the system does not find such parallel phrases, for gathering many candidates, It uses the phrases including the source of the adjective phrases itself (e.g., phrase 3 + the source + phrase 1), then, it appends these phrases except the source of the adjective phrase.

When we search web pages using a search engine, we can get a certain amount of information. Using the text of such information, the system mines the lower concept because we think the phrases that modify the phrase, which also modifies the source of phrases, are possible to explain the source of the adjective phrases.

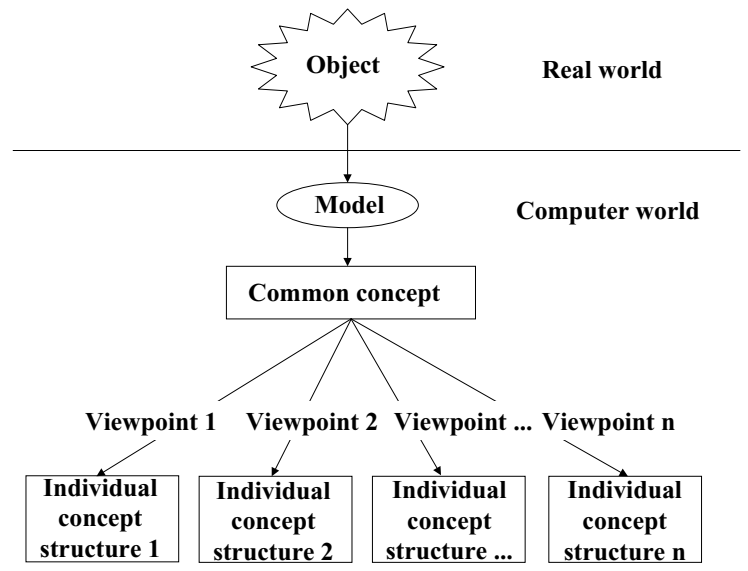


Figure 1: Ontologies and viewpoints.

Examples

In the following example, user1 and user2 are told by their boss to prepare a party for guests and employees at which some “light-hearted dishes” should be served. When they are planning the party, they find they have conflicting concrete images of the party, because they understood the term “light-hearted dishes” differently. They must take into consideration the comfort of the guests and employees. But, what are “light-hearted dishes” for guests and employees?

Talkabout is used to search for the term “light-hearted” and the topic “dish”. It then presents some relevant candidates that explain the concept. If a user inputs “light-hearted dishes” and clicks the down-arrow button, Talkabout lists inputs’ samples as low-level nodes of the term. In this case, according to Talkabout’s suggestion, light-hearted dishes means “a meal attended in informal clothes”, “dishes using chopsticks”, etc.

If a user selects “a meal attended in informal clothes” and “informal-style restaurant”, and then selects low-level nodes of the latter concept repeatedly, a conceptual tree like that in Figure ² is shown. If a user uses the automatic-generation mode of Talkabout, an example of the conceptual tree is shown automatically.

The other candidates suggested by Talkabout are as follows:

using chopsticks
 enjoying reasonable wine
 being welcomed by the owners who are husband and wife
 a meal on an open terrace

a buffet at a restaurant with bright sunshine
 sitting around a table grilling meat
 enjoying a house party
 having a French-style meal
 a bistro-style meal
 enjoying serving yourself favorite vegetables and fish
 informal-style restaurant
 enjoying a meal at a hotel
 wearing an apron
 a restaurant women can enjoy
 a room where we can chat
 a family-oriented restaurant
 enjoying a self-service-style meal
 a bar-style meal

user1 and user2 discuss each concept of “light-hearted” by describing their own conceptual tree using Talkabout, which also shows the other’s concepts concretely in order to help their inputting. Then, they finally solve the conflict as a result of articulating their opinions and the existing tacit knowledge through their discussion using Talkabout. Thus, they are able to plan a party which serves “light-hearted dishes” by referring to concrete images about it.

In this implementation, “light-hearted dishes” can be seen as a way of expressing various styles such as house party, self-service style, family-oriented style, buffet style, etc. The concept of “using chopsticks”, which western people might not have thought of, came up because Talkabout was searching only Japanese sites in Japanese at that time.

In this way, for example, if the guests are Japanese, and if Talkabout searches Japanese sites, it provides useful information. We can overcome the conceptual

²Adapted from the original snapshot (in Japanese).

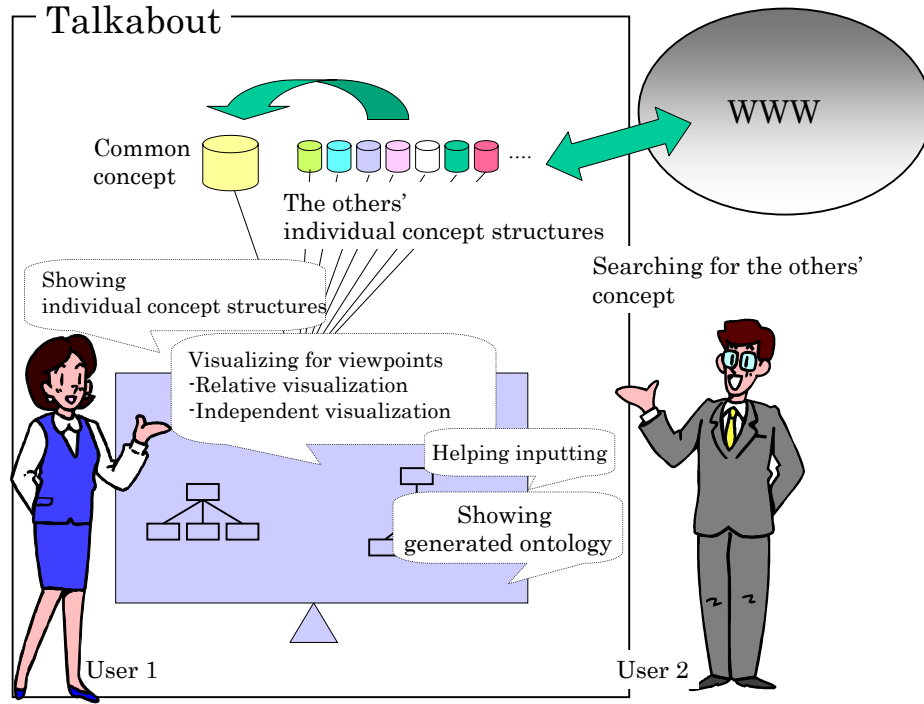


Figure 2: System framework for Talkabout.

differences which occur as a result of cultural differences by using this method. This implementation also showed concepts which were characteristic of a particular culture. Namely, the above-mentioned “sitting around a table grilling meat”, which is a popular style of eating in Japan and Korea, and “enjoying serving yourself favourite vegetables and fish”, which is also a popular style of cooking using a hot-pot to cook at the table around which everyone sits and serves themselves food from the same pot. Some additional interesting concepts such as “wearing an apron”, “women can enjoy”, and “we can chat” can also be seen.

Discussion

As communication become more global and instantaneous, we have an increasing opportunity to converse with people who have different backgrounds. The work presented in this paper is important because people will increasingly communicate with others whose background is not known.

Talkabout is an effective system for articulating concepts which users cannot express completely, but on which they have some information. Users can clarify their knowledge and recognize what they need to know by using this system. The system may also contribute to clarifying unconscious thought.

We believe that Talkabout can be widely applied to several viewpoint-differences, such as 1) one’s sense of values, 2) fixed ideological notions, and 3) new con-

cept creation. It enables communication between people who have different concepts and values.

Expression using Talkabout clarifies the concept, and visualization of the concept simplifies understanding of the different viewpoints and their expression. Talkabout helps users’ inputting and shows some examples of the ontology from the WWW when users are in a nebulous mental world. By using Talkabout, users can refer to the opinions of others and are helped to articulate their own viewpoints. There is no needs to use synonyms or legacy ontologies, only use of the WWW search engine and an easy natural language processing. In this way, users can refer to other concepts from the WWW just as if they were asking for the opinions of others.

Conclusion

In this paper, we proposed Talkabout for supporting nebulous communication between people who do not clearly express the concepts they intend. With this system, we aim to help users to be able to understand each others’ viewpoints and reach mutual consensus. The ultimate aim is that users will be able to create new ideas by understanding the viewpoints of others. We described the fundamentals of Talkabout in this paper.

The system, which uses only a WWW search engine and easy natural language processing, shows useful choices to facilitate inputting and automatically generates an ontology. We believe this system is a novel

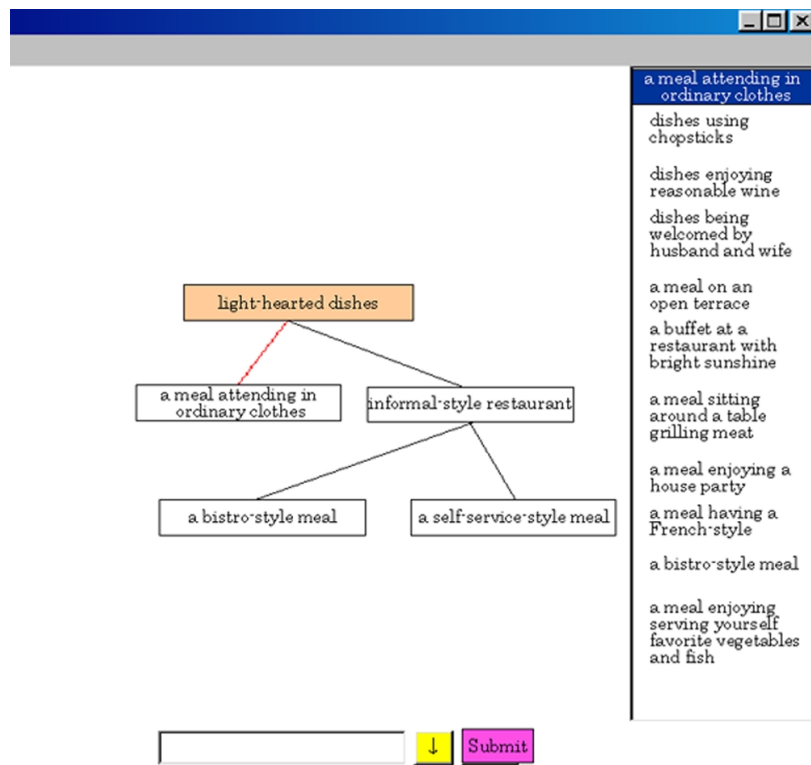


Figure 3: User interface of Talkabout (clicked and input the concept).

approach that unifies ontology and HCI for the articulation of tacit knowledge in the nebulous mental world.

In future work, we will extend the system to domains which correspond to several communication problems.

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