Augmented Support for Knowledge Sharing by Academic Conferences--- On-line Conferencing Ba

Xijin TANG Nan ZHANG Zheng WANG

***Abstract*—With the fast-growth in both scale and frequency of conferences and advances in communication and information technologies, digital revolutions are happening to conferencing affairs. Instead of only focusing on conference management, we regard conference as a platform for knowledge accumulating, organizing and sharing, which provides opportunities for idea generation and potential collaborations. Then a different attempt of developing a so-called on-line conferencing ba is made to facilitate the intensive knowledge activities by pushing augmented information acquired by a variety of linkage mining to reveal the constructive concepts of the concerned discipline, research interest groups, and correspondence between authors and ideas or topics together with basic functions in data management as general conferencing system. Such endeavors aim to exhibit different perspectives of the concerned disciplines and support emergence of a ba for knowledge creation.**

I. Introduction

Academic conferences provide opportunities to expand academic views and social networks and are vital in social processes of collaboration, communication, and consensus along scientific knowledge growing process proposed by P. Thagard [1]. With the fast-growth in both scale and frequency of conferences and advances in communication and information technologies, digital revolutions are happening to conference management. In addition to general electronic processing of paper submission, review, registration and information publishing fulfilled by web-based applications, advanced conference assistant services are also provided via ubiquitous computing technologies to facilitate participants' communications during the conferences since the late 1980s. As one of the earliest works on digital services for social events, Salomon provided CHI'89 participants with conference information by kiosk terminals located at the conference site[2]. Japanese scientists made further progress in supporting participants' communications and interactions, and awareness of interested topics and people via visualized semantic map between comments and participants provided by a more sophisticated system AgentSalon and mobile devices such as PalmGuide and applied it at JSAI'2000[3].

Manuscript received April 15, 2007. This work was supported by Natural Science Foundation of China under Grant No. 70571078 & 70221001.

X. J. Tang is with Institute of Systems Science, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing, 100080, P.R. China (phone: + 86 10 62553291; fax: + 86 10 62568364; e-mail: xjtang@iss.ac.cn).

N. Zhang and Z. Wang are graduates students of Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing, 100080, P.R. China. (e-mail: {wzheng, zhangnan}@amss.ac.cn).

As more ubiquitous computing technologies are applied, few endeavors are engaged in in-depth analysis of the semantics about collected academic ideas (papers) and participants, which may be helpful for conference organizers to make appropriate programs and for participants to find interesting topics and people and draw a rough scenario about the state-of-the-art of the concerned disciplines.

This paper describes some results of conference mining based on fundamental conference data, such as submissions and registered authors. All those in-depth exploratory analytical results are pushed to who is concerned to stimulate their further thinking, knowledge sharing, new idea emergence and friends making, before, during and after formal conference activities. Those computational functions are integrated into a so-called on-line conferencing ba, whose mechanism is addressed in next section followed by a practical application of the system. Finally some future work is indicated at last session.

II. On-line Conferencing Ba (OLCB)

Generally, an academic conference provides a place for a variety of information and knowledge intensive activities. Participants, conference rooms and auxiliary equipments are basic physical elements. Versatile organizing ways are soft elements for better communication between participants. Naturally all participants expect a nice place to share ideas and make friends. Japanese Professor Ikujiro Nonaka has once adapted a Japanese word, ba, referred as a shared space which is of physical, virtual or even mental context, to achieve the spiral SECI process of knowledge creation[4]. Simply, a ba is a platform for advancing individual and collective knowledge. Then the conference organizers engage in facilitating the emergence of a nice ba for dynamic knowledge sharing, association, dissemination and new idea emergence. Here an on-line conferencing ba is proposed to help implement such kind of human facilitation activities.

A. Framework of On-Line Conferencing Ba (OLCB)

Fig.1 shows the framework of on-line conferencing ba (OLCB). Like general conference management systems, OLCB fulfill basic functions based on roles of users,

- for authors: registration, paper submission, access to public information, review reports and BBS;
- for reviewers: access to assigned papers, review reports submission;
- for conference organizers: information publishing, paper assignment and reviewer notification, final judgment of paper acceptance, user management, etc.

Different data are stored at relevant databases. Implemented under B/S architecture, OLCB provides single entry to all users. To facilitate communication, discussions and feedback, an area of virtual conferencing to upload authors' presentation materials (slides and audios) is provided. Furthermore, a discussion board with exploratory analysis of topics, submissions and participants is provided for active interactions.

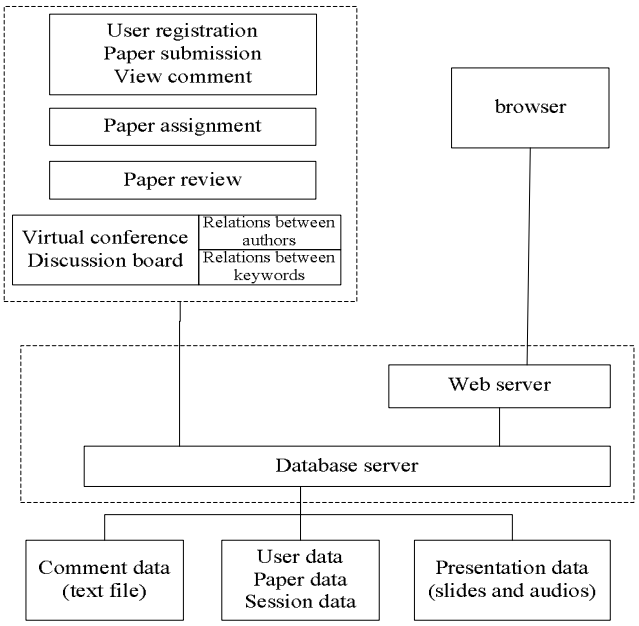

Fig. 1. Framework of on-line conferencing ba

B. Exploratory Analysis of Participants and their Ideas

The paper database is consisted of a set of paper records with the structure as

<topic, participant, paper title, keywords set, time>

Such a record indicates a corresponding *participant* submits one *paper* with a set of *keywords* under the *topic* at the point of *time*. Sometimes, abstracts are also required. Based on such a simple structure, two frequency matrices F_p and F_u can be acquired. Each element of matrix F_p denotes the frequency of keyword i referred by author j. Each element of matrix F_u denotes the frequency of keyword i referred by paper j. The keywords are articulated as attributes of authors or papers. Given frequency matrix, exploratory analysis (correspondence analysis) is employed to explore the correspondence relations between authors (papers) and keywords, and map both authors (papers) and keywords into 2-dimensional space. Moreover, based on the spatial relations, clustering could be applied to either keywords or papers. Regarding the corresponding authors with those keyword clusters, author grouping is acquired simultaneously [5,6].

Based on visualized correspondence between authors and their ideas, people may easily find who may share close attentions to some ideas (keywords) and then hold active communication and further discussions.

C. Author Network and Idea Map

An author network $G = (V, E)$ is constructed where a vertex denotes one author. If author v_i and author v_j share one keyword, then an edge $e_{ij} = (v_i, v_j)$ between them exists. The weight of the edge is the number of keywords v_i and v_j share. Obviously, author network is a weighted undirected network. Co-authorship network is a sub-graph of an author network.

Similarly, a keyword network can be constructed. Each vertex denotes a keyword and each edge denotes to the co-occurrence of keywords among papers. Each paper then corresponds to a complete keyword graph and the aggregation of all paper keyword graphs generates a topological keyword network referred as an idea map, which reveals the collective knowledge of all authors of accepted papers toward those main topics. This map is a weighted undirected network where the weight of edge refers to the number of co-occurrence of keywords among all accepted papers.

By such modeling, various network analyses can then be undertaken based on characteristics of those networks, such as cutpoints of a network, centrality of vertex and community clustering. Then useful information, such as the important people of the conference, research interest groups, key ideas and topics of the concerned disciplines, etc. may be acquired and then pushed to the interested people to enhance the level of their communications and knowledge sharing [5,6].

III. Practical Application of On-line Conferencing Ba

During September 23-25, the 7th International Symposium on Knowledge and Systems Sciences (KSS'2006) was held in Beijing. An OLCB is developed to support organizing of KSS'2006. Here only special features of KSS'2006 OLCB are addressed.

A. Visualization of Collective Knowledge of KSS'2006 by Correspondence Analysis

Fig. 2 shows the exploratory analysis of KSS'2006, where the rectangle boxes denote authors' ID and oval boxes denote keywords. Here a correspondence between authors and keywords can be acquired directly from such a map, which helps to detect people with closer interests. Obviously given different group of authors, the visualized correspondence is different. Fig.2 shows the selected authors whose papers focus on mechanism of knowledge science, support environment and technologies for knowledge mining.

Moreover, clustering of keywords can be done by a centroid-based K-means method with the spatial relations. Taking Fig. 2 for example, if K = 5, then 5 clusters are generated as shown in Fig.3 where the author's Ids are omitted. Within each cluster, the keyword whose location is closest to the centriod is referred as the representative of the

affiliated cluster. In Fig. 2, we get 5 representatives, "semantic similarity", "feature selection", "chance discovery", “creativity” and "information retrieval".

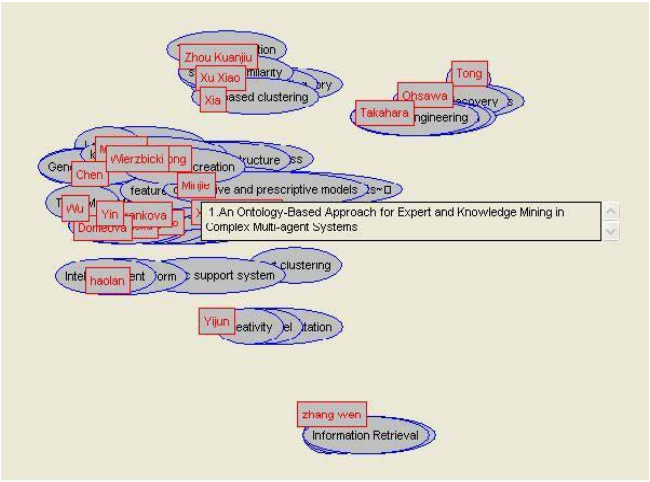

Fig. 2. Correspondence map (knowledge creation and technologies)

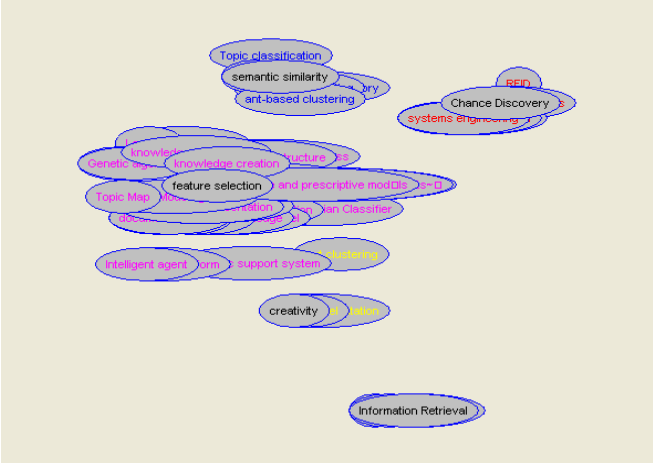

Fig. 3. Clustering of keywords

B. *Idea Map of KSS’2006*

Based on Newman-Girvan algorithm for community clustering[7], 26 subgroups are detected at the keyword network of KSS’2006. The largest component including 49 keywords is split into 3 subgroups, as shown in Fig.4. At the central part of the component, the subgroup (vertex in squares) is a group of keywords about the mechanism of knowledge creation, the downside subgroup (vertex in circles) is a cluster of keywords mainly about computerized support, and the upside subgroup (vertex is represented two triangles) is a cluster of keywords about knowledge management and its practice. The major topics of knowledge science concerned by KSS’2006 may be acquired by such way. Actually there are three parallel sessions about those three topics in KSS’2006. Such an analysis provides some hints about parallel session assignment to conference organizers.

C. *Author Network of KSS’2006*

Fig. 5 shows the biggest component of author network of KSS’2006. This component includes 44 authors who are grouped into 5 communities by Newman-Girvan algorithm.

Still tracing back those shared keywords by each community, we recognize the research foci of those 5 communities as “system thinking”, “knowledge science”, “expert mining”, “text clustering” and “data mining”. Taking subgroup on knowledge science as a central, then the upper community in Fig.5 still represents group of people on knowledge practice by systemic view, and downside communities refer to different technologies applied in knowledge science. And 4 cutpoints (*Yoshiteru Nakamori*, *Xijin Tang*, *Kuanjiu Zhou* and *Peng Liu*) connecting all those 5 communities are detected. Those people may be regarded as important people.

D. *A rough Scenario of Knowledge Science*

Above visualized analysis results are posted on virtual conference board area and somewhat helpful to FAQ, such as “What is knowledge science?”, “Who are principal explorers in this field?”, “Any major research interest groups?” and so on and then exposes a rough scenario of the new discipline - knowledge science. In addition to the keyword clusters acquired by keyword network, there are 7 cutpoints at the biggest component in Fig. 4, “knowledge creation”, “ba”, “support system”, “knowledge management”, “management learning” and “reflection”. If remove one cutpoint, the original biggest component will be decomposed into small components. Then those cutpoint keywords may be denoted as constructs in knowledge science research. Here those cutpoints actually explain the basic research topics of knowledge sciences.

As a curious person views the idea map, at least he may acquire some hints about the mainstream and major topics of knowledge science, together with the important people and interest communities detected from the author network, which construct a rough scenario of the discipline.

Such augmented information services are really appreciated by KSS’2006 participants who drop comments as shown at the bottom of Fig. 5.

IV. CONCLUDING REMARKS

Many conference assistant systems have been explored since late 1980s to enrich participants’ experiences by advanced information technologies and appliances. This paper goes further by presenting some conference mining technologies to detect more information from the submissions for a more general scenario of those concerned research themes via on-line conferencing ba (OLCB). The main goal of OLCB is to facilitate communication and information sharing and may then drive for further scientific collaboration and knowledge creation. The practical application of OLCB to KSS’2006 is addressed to show the collective ideas from all accepted papers and generate a rough vision of knowledge science studies.

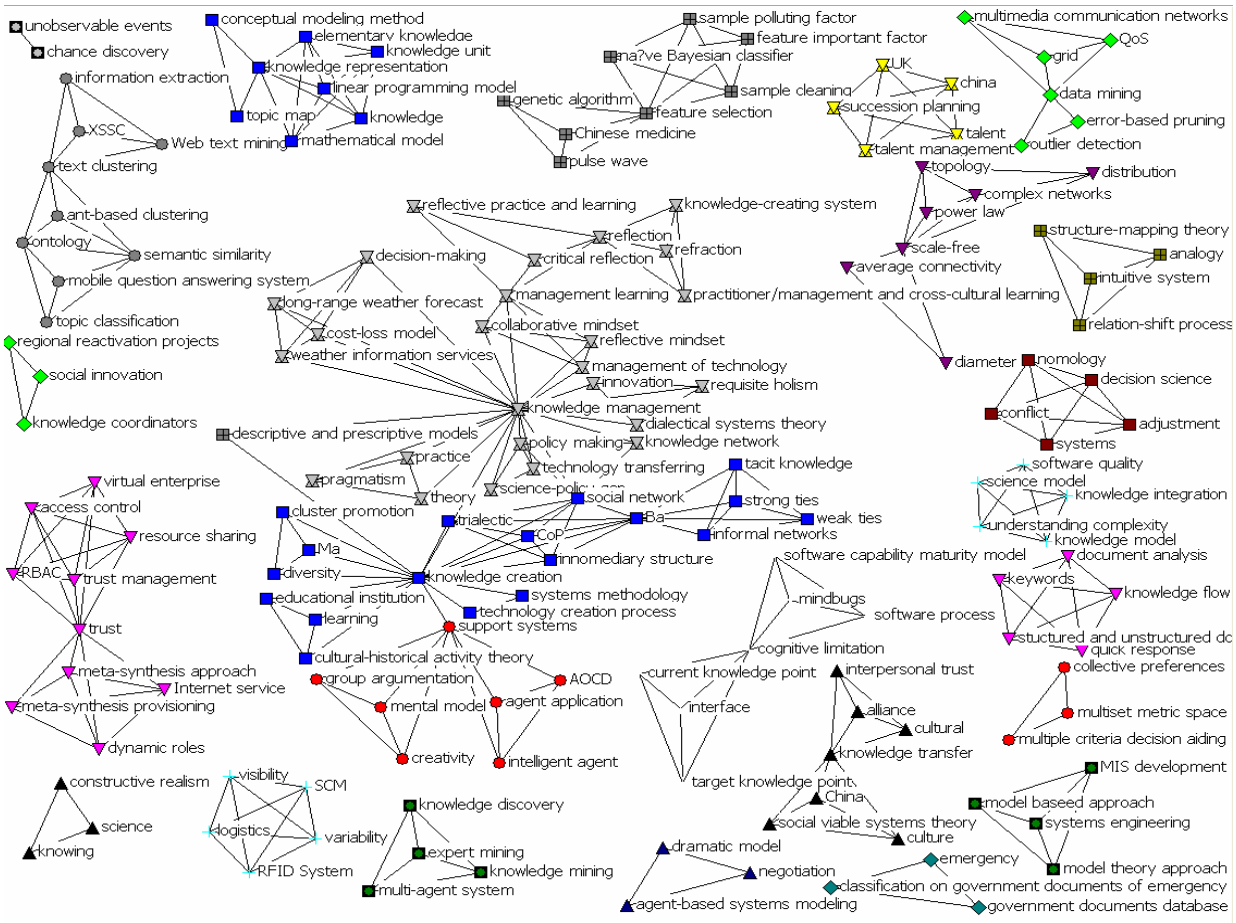

Fig. 4. A keyword network of KSS'2006

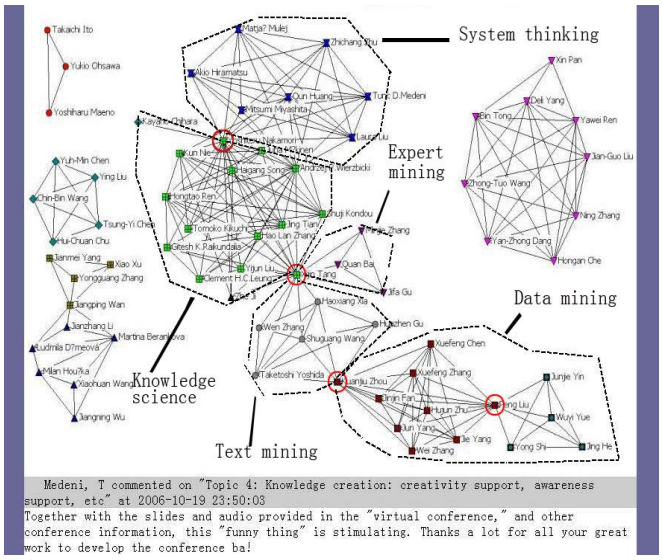

Fig. 5. Virtual conference discussion board

One-conference data is not enough for a systematic scenario of the concerned discipline. Those KSS'2006 analyses only expose partial correspondence existed in knowledge science field. It is necessary to trace all past series conferences. Lots of work remain to be done.

REFERENCES

[1] P. Thagard, *How Scientists Explain Disease*, Princeton University Press, 1999.

[2] B. S. Gitta, "Designing casual-use hypertext: The CHI'89 InfoBooth", in *Proc. the ACM CHI 90 Human Factors in Computing Systems Conference* (J. Carrasco and J.Whiteside, eds.). 1990, Seattle, USA, pp451-458.

[3] Y. Sumi and K. Mase, "Conference Assistant System for Supporting Knowledge Sharing in Academic Communities", *Interacting with Computers*, vol.14, no.6, pp713-737, 2002.

[4] I. Nonaka, N. Konno and R. Toyama, "Emergence of 'Ba'", in *Knowledge Emergence*, I. Nonaka and T. Nishiguchi eds., New York: Oxford University Press, 2001, pp13-29.

[5] X. J. Tang and Y. J. Liu, "Computerized Support for Qualitative Meta-synthesis as Perspective Development for Complex Problem Solving," in *Creativity and Innovation in Decision Making and Decision Support (proc. IFIP WG 8.3 International Conference, CIDMDS'2006*, F. Adam, et al. eds.), Vol.1. London: Decision Support Press, 2006, pp432-448.

[6] X. J. Tang, Y. J. Liu and W. Zhang, "Augmented Analytical Exploitation of a Scientific Forum", accepted paper for the 20th *International CODATA Conference*, October 23-25, 2006.

[7] M. E. J. Newman and M. Girvan, "Finding and Evaluating Community Structure in Networks", *Physical Review E*, vol.69, no.2, 026113, 2004.