INTEGRATING KNOWLEDGE ACQUISITION TECHNIQUES WITH ELECTRONIC MAIL TO PROVIDE KNOWLEDGE SUPPORT SYSTEMS FOR GROUP COLLABORATION

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Abstract: The focus of knowledge acquisition research has been on the development of knowledge-based systems through transfer of expertise from domain experts to expert system shells. However, the knowledge acquisition systems developed usually have the potential for a much wider range of applications, for example, in information retrieval, education, personal development, group decision support, and so on. *Knowledge support systems* targeted on such wider applications can take advantage of developments in knowledge acquisition methodologies and technologies, and also have the potential to advance knowledge acquisition research by providing different demands, experience, and contexts. This paper reports some experiments in the development and application of a system, RepGrid-Net, that combines repertory grid elicitation and analysis tools with electronic mail communication to support human networking through the development of special interest groups.

INTRODUCTION

Ever since Feigenbaum (1980) identified the knowledge engineering bottleneck impeding the effective application of knowledge-based systems, knowledge acquisition has been a topic attracting major research effort and resulting in the development of a wide range of methodologies, techniques and tools (Boose & Gaines, 1988, 1990; Gaines & Boose, 1988; Boose, 1989). In terms of the direct knowledge engineering process we now have a rich repertoire of approaches, support systems and experience on which to base further research and practical system development. However, it is important to note that the potential applications of the 'knowledge acquisition' systems already developed extend far beyond the development of 'expert systems'. As knowledge is made overt through various processes of elicitation and modeling it has the potential to support a wide range of human knowledge processes, only one of which is the specific decision support activities associated with expert systems. One area of obvious application is that of education and training, and there have been both anecdotal accounts of organizations deciding to use the results of knowledge acquisition studies to develop a training program rather than an expert system, as well as reported studies of the impact of knowledge engineering from an educational perspective (Dologite, 1991).

Another significant area is the support of group processes through sharing and comparison of personal knowledge. The move towards group decision support has already begun in the knowledge acquisition community. Generic toolboxes encompassing and integrating a range of methodologies such as KSSO (Shaw & Gaines, 1987; Gaines, 1988) and AQUINAS (Boose & Bradshaw, 1987), what have come to be called second-generation knowledge acquisition tools (Gaines & Linster, 1990), already make provision for users with widely varying roles, requirements and capabilities. Liou, Weber and Nunamaker (1990) have reported research on a methodology for knowledge acquisition in a group decision support system environment. Methodologies have also been developed that manage the elicitation of knowledge from groups of experts and are supported by tools that can analyze relations between the conceptual frameworks, and conflicts in the use of terminologies, for groups comprising multiple experts and clients (Gaines & Shaw, 1989; Shaw & Gaines, 1989).

The focus of research on group decision support and group knowledge acquisition has been on existing, well-defined communities with particular expertise. However, the formation processes for such communities may also be supported. How do people become aware of others with complementary interests? How can they be supported in exploring common interests, becoming aware of differences in concepts and vocabulary that may lead to misunderstanding, making connections to others with similar or opposing viewpoints? We have been studying the formation of newsgroups on Internet and the processes of knowledge exchange and debate that take place, and have become interested in providing tools to facilitate these processes.

This paper reports some preliminary experiments on the integration of repertory grid elicitation and analysis tools with an electronic mail system to support the formation of special interest groups and the structured development and exchange of knowledge within such groups.

NETWORKING

The formation of human networks is a natural social function that has been widely studied by sociologists (Boissevain & Mitchell, 1973), business commentators (Heald, 1983) and those concerned with promoting and supporting such networks (Lipnack & Stamps, 1982). Computer-mediated communication systems have been established and investigated as a means of supporting such networks (Kerr & Hiltz, 1982), and the massive growth of USENET since its inception in 1979, and the variety of special interest groups it supports, may be seen as evidence that such support is effective (Quartermain, 1990).

Current email, bulletin board, news and computer-based messaging systems provide the means for people to communicate but do not specifically support the initial stages of network formation or provide tools for focusing discussion. Network formation depends on an initial 'champion' raising topics or issues that result in others communicating until a critical mass of activity indicates that the formation of a new special-interest group is justified. On Internet such new groups tend to spawn easily from existing groups over a period of time, but it is difficult to find a suitable forum from which to attract interest and investigate the formation of radically different groups. On shorter time-scales, such as those of a conference, computer-based message systems facilitate the renewal of previous acquaintances but provide no support for the promotion of new ones.

What is missing from current email systems is the support of knowledge processes beyond those of textual discourse. There is clearly much development required at the basic level, for example, in the communication of structured documents and pictorial material. However, the communications technology already existing allows us to go way beyond this already, for example, in supporting the exchange of overt and computational knowledge structures. What is needed currently is a diversity of creative experiments to explore the potential of enhanced email systems.

RepGrid-Net is one such experiment. Its objective is to provide a system for the structured support of the formation of personal networks through the use of computer networks. It allows people to exchange views on any topic in a structured, but open-ended, fashion, and provides means to analyze the relations between views and to use this to facilitate communication. The initial implementation is part of a message system intended to be used at conferences, but the techniques and software are equally applicable through personal computer interaction with global networks.

REPGRID-NET: A NETWORKING SUPPORT SYSTEM

Repertory grid elicitation is an effective method for eliciting conceptual models in a domain (Shaw, 1980; Gaines & Shaw, 1980), and has been widely used in management,

education, clinical psychology and the development of knowledge-based systems (Shaw & Gaines, 1983, 1987; Boose, 1984, 1986). It is an extensional approach in which individuals are asked to specify a set of entities in a domain, then make distinctions among them, naming the distinctions and classifying all the specified entities in terms of them. The distinction determined in this way is an approximation to the underlying concept since critical entities may be missing. However, computer-based elicitation techniques attempt to prompt the individual for additional entities to discriminate between extensionally related distinctions (that is, making the same, or similar, classifications). Group comparisons, as discussed in this paper, have similar dynamics—an extensionally apparent correspondence may be accepted or rejected, and the rejection may be based on the specification of additional entities as counter-examples.

RepGrid-Net is a computer-based message system that integrates conventional electronic mail and bulletin board facilities with repertory grid elicitation and analysis facilities to provide both unstructured and structured communications supporting the formation and operation of special interest networks. Users see a mail system in which special-interest networks are specifically supported. The coordinators of such a network provide a basic focus for it through statements of intent, topics and issues which are handled on a bulletin board basis. They also provide one or more kernel grids listing specific topics and the concepts which they apply to them. These kernel grids can be developed by others interested in the groups, using the stated topics and concepts, and adding to them. General similarities between grids are analyzed to provide a socionet of people with common viewpoints, and this may be used to access the mail system to communicate with them. Detailed comparisons of similarities and differences between viewpoints may be made, and individual concept structures can be analyzed. The elicitation and analysis facilities are all highly graphical, designed to be fun and interesting to use.

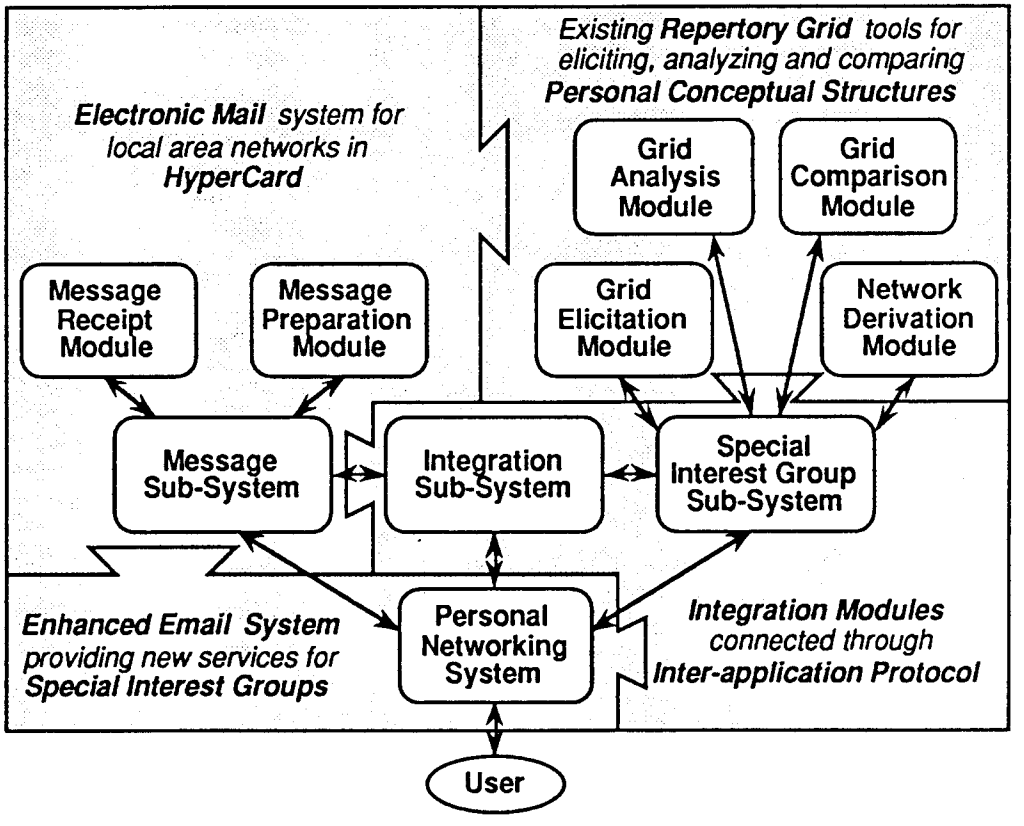

Fig.1 System architecture

Figure 1 shows the overall systems architecture. The message sub-system is written in HyperCard and is conventional in its operation. Users may register, or be pre-registered by the conference organizers, and may access lists of those with mailboxes registered on the system, lists of incoming mail and confirmations that outgoing mail has been accessed (see Figure 4). They may prepare and send mail, and receive and reply to mail. The special interest group sub-system is described in detail in the next section. It handles the group bulletin board and grid elicitation and analysis. The integration sub-system manages the interactions between the other two sub-systems, for example, that the graphic displays of networks of people with common interests may be used to send a message to one or more of them.

RepGrid-Net is implemented on a network of Macintosh computers coordinated through AppleTalk access to an AppleServe file server. Users see a conventional Macintosh program interface at all times and, even though two distinct programs are running, they communicate through inter-application protocols in such a way that there appears to be only a single application.

SYSTEM OPERATION

This section presents RepGrid-Net in operation for a special interest group based on the session themes at AAAI-90. A special interest group coordinator has already elicited a kernel grid concerned with sessions at the conference.

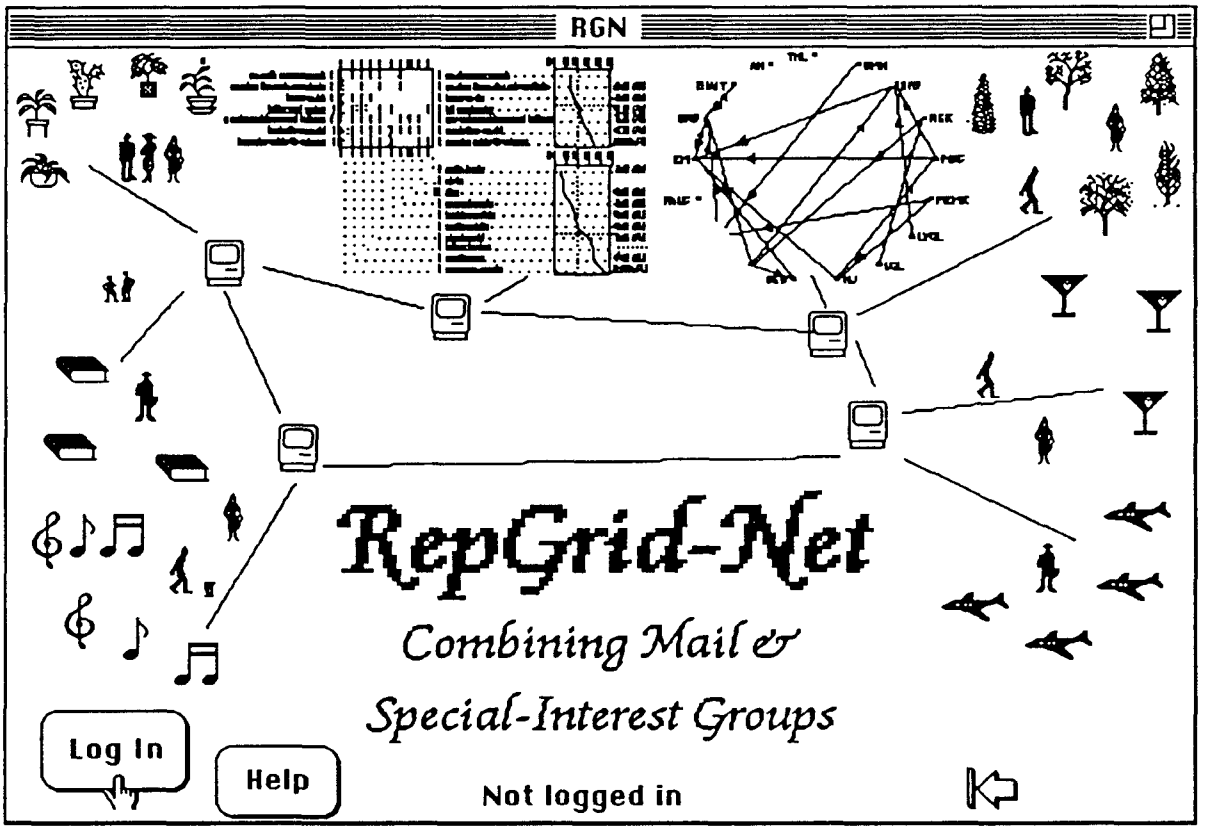

Fig.2 Initial login screen

The user selects "Reply", goes to the screen shown in Figure 7, and types a reply.

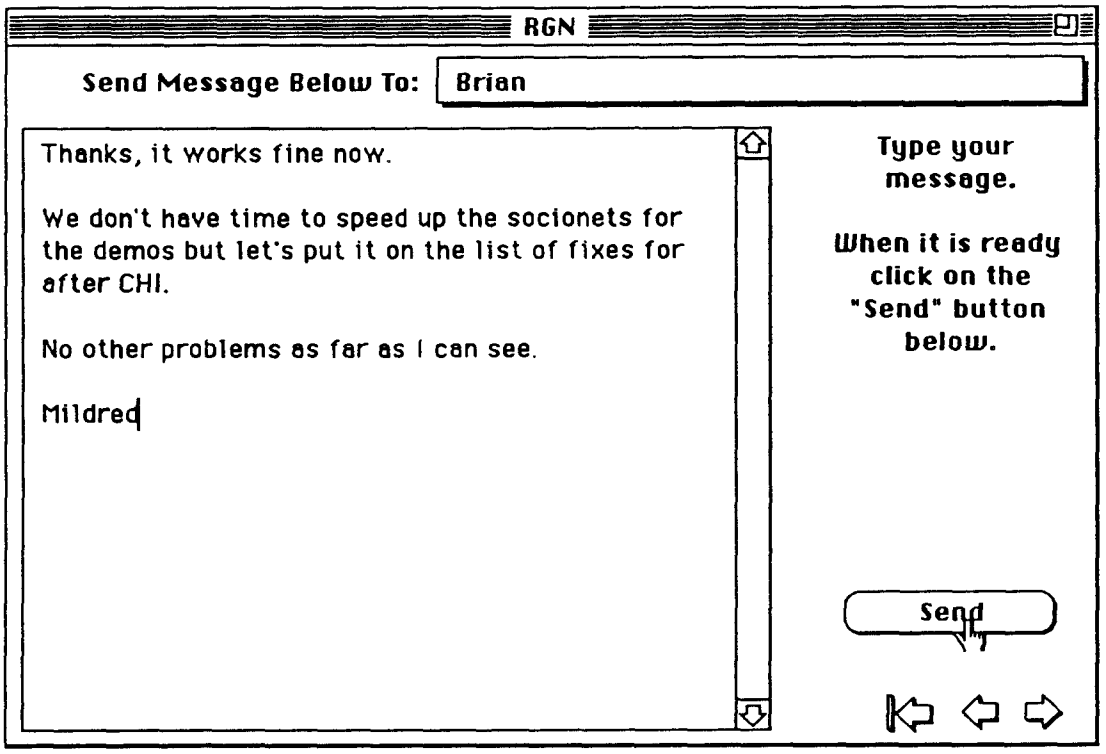

Fig.7 Outgoing mail screen

The user selects "Send", returns to the screen shown in Figure 4, selects "SIGs", and goes to the screen shown in Figure 8.

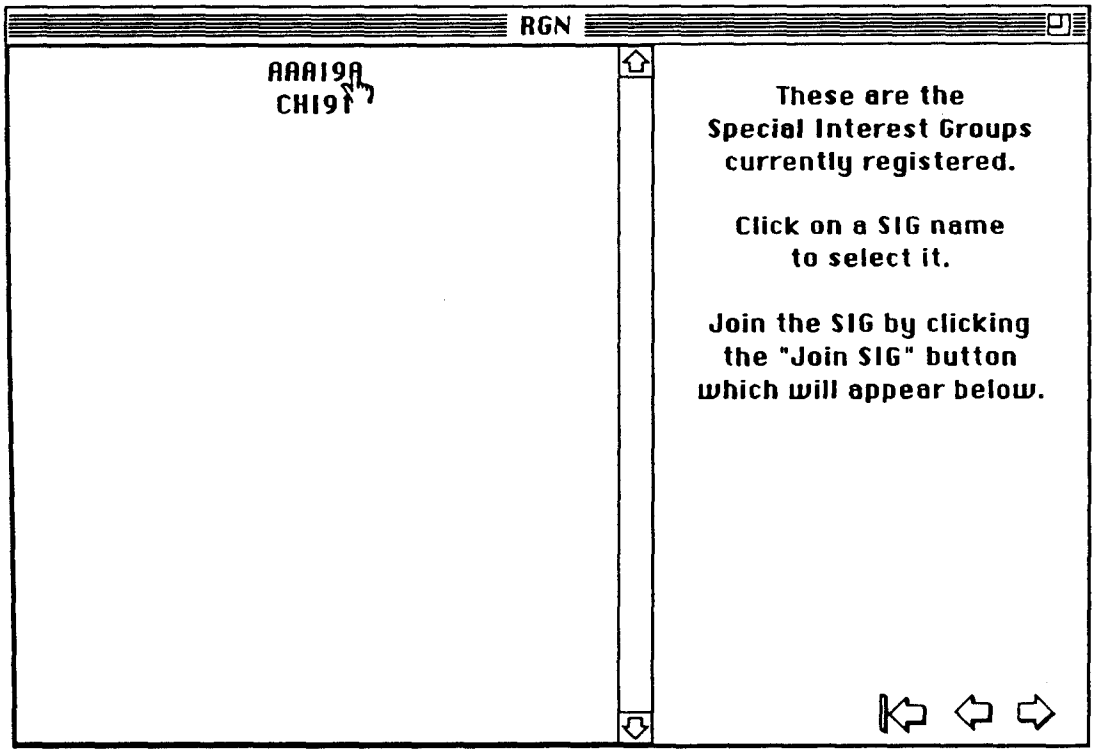

Fig.8 List of special interest groups screen

The user clicks on "AAAI90" to access the SIG and goes to the screen shown in Figure 9.

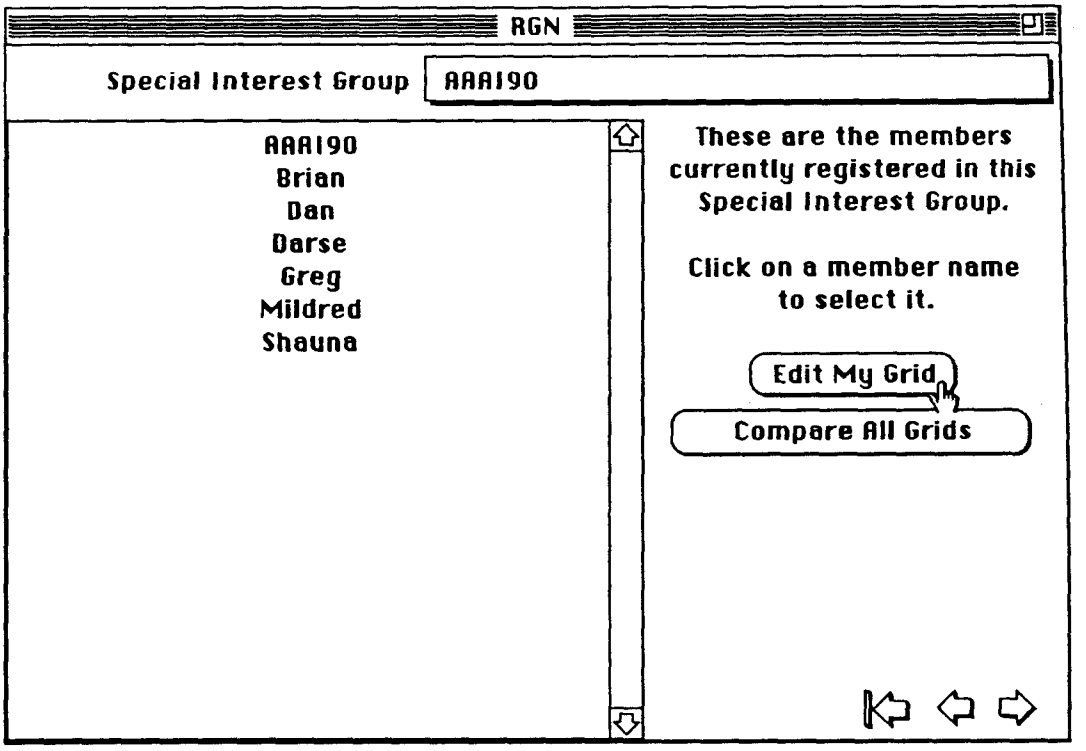

Fig.9 List of AAAI90 SIG members

The user selects "Edit My Grid" and goes to the screen shown in Figure 10, accessing a grid she has already entered using the elements and constructs of the coordinator.

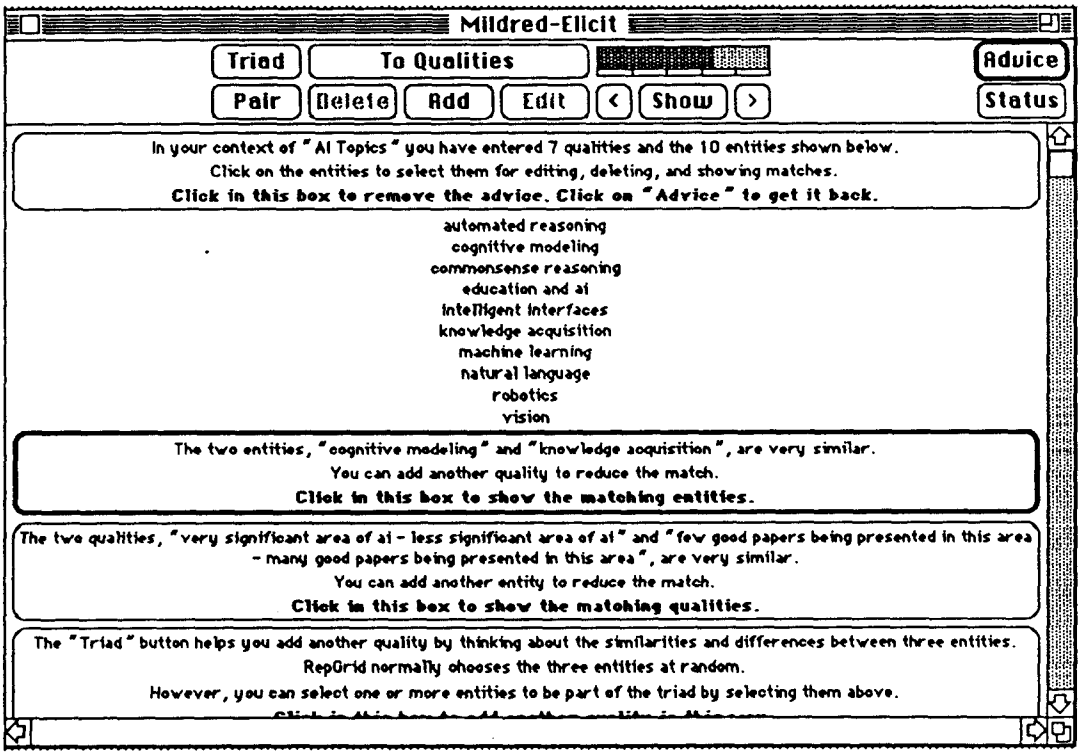

Fig.10 Repertory grid entities screen

She selects "Advice" and goes to the screen shown in Figure 11.

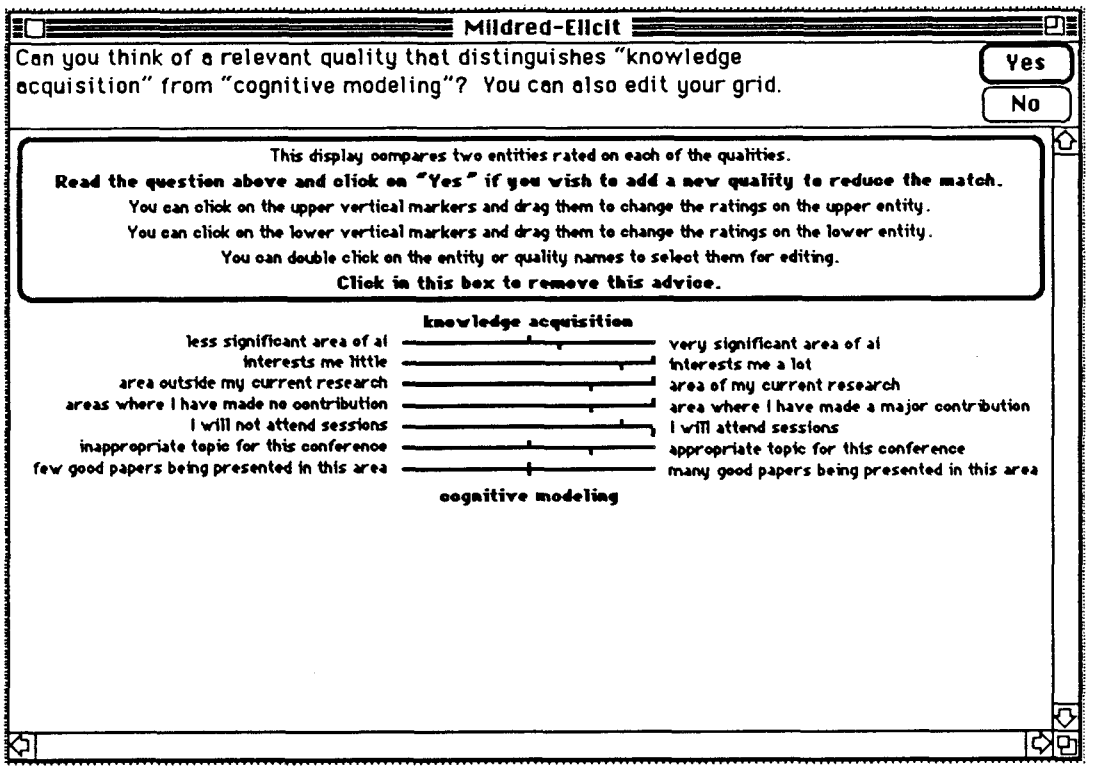

Fig.11 Element match screen

She selects "Yes" and goes to the screen shown in Figure 12.

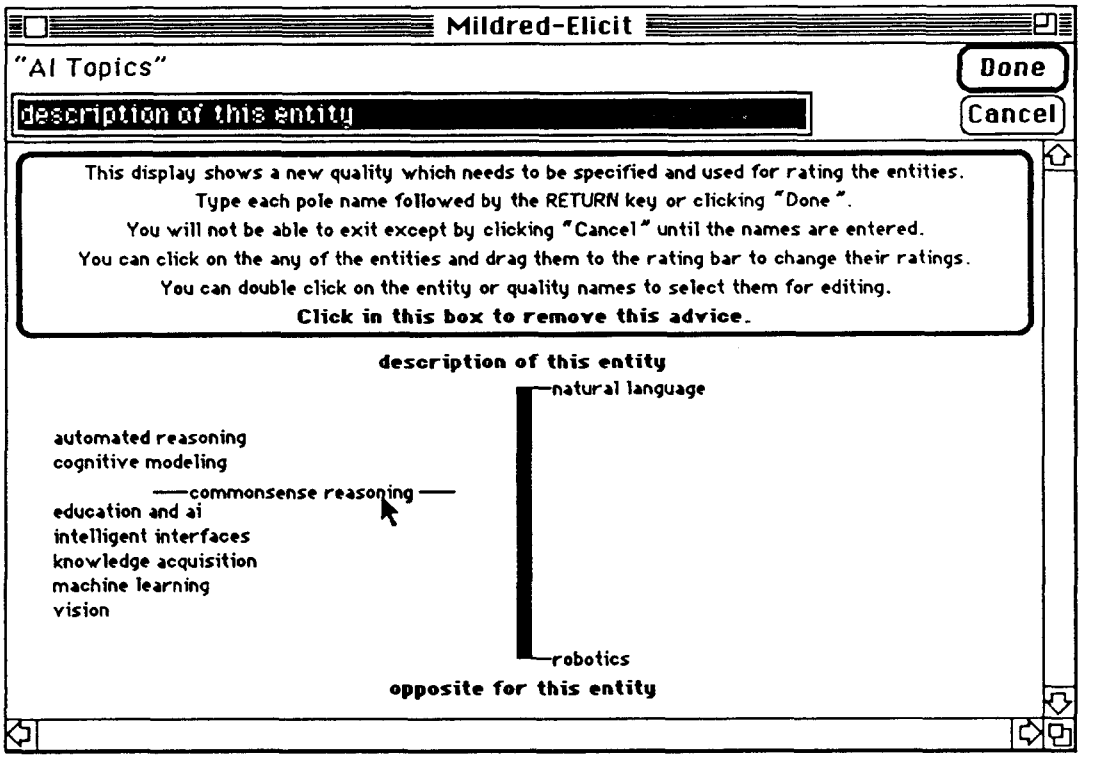

Fig.12 Element rating screen

When she has finished editing the grid, she returns to HyperCard as shown in Figure 13.

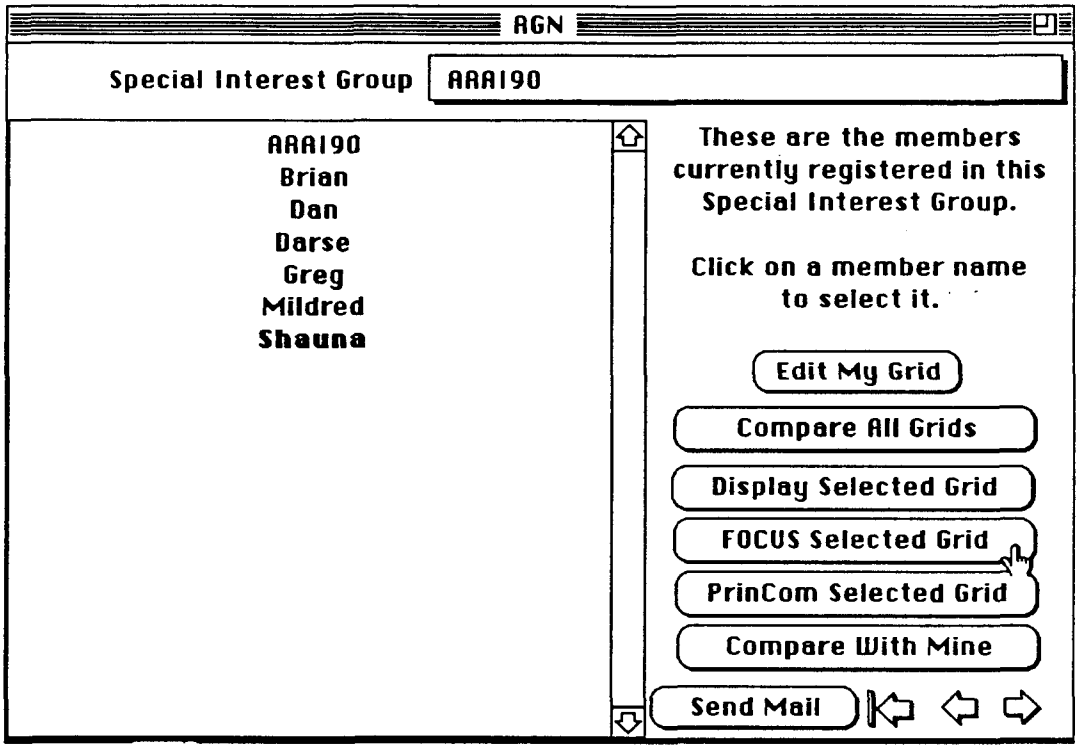

Fig.13 Grid analysis functionality screen

She clicks on "Shauna", selects "FOCUS Selected Grid", and goes to the screen shown in Figure 14.

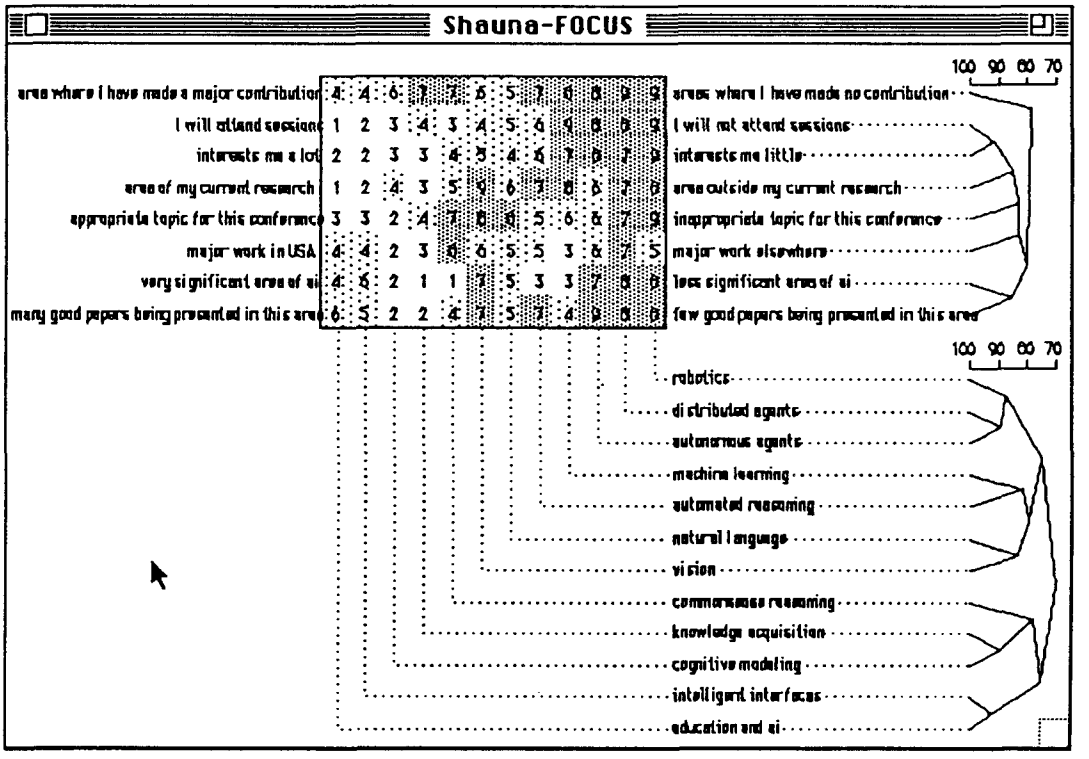

Fig.14 FOCUS cluster analysis screen

She returns to HyperCard, selects "Compare with Mine" and goes to the screen shown in Figure 15.

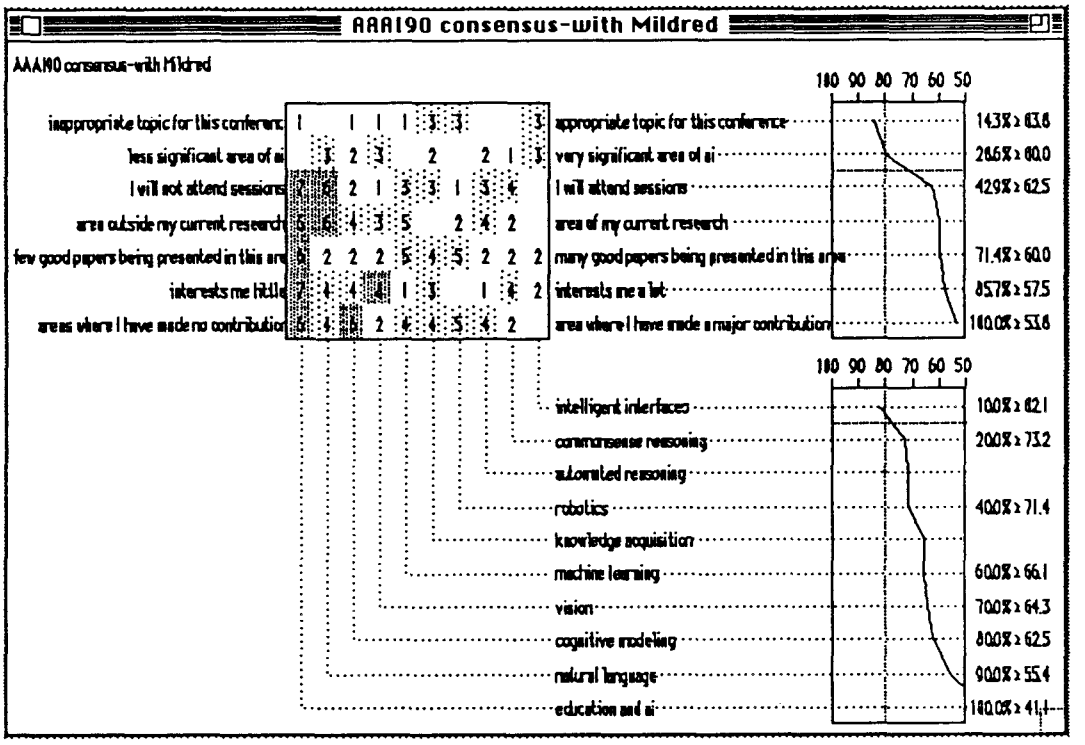

Fig.15 Grid comparison screen

She selects "Compare All Grids" and goes to the screen shown in Figure 16.

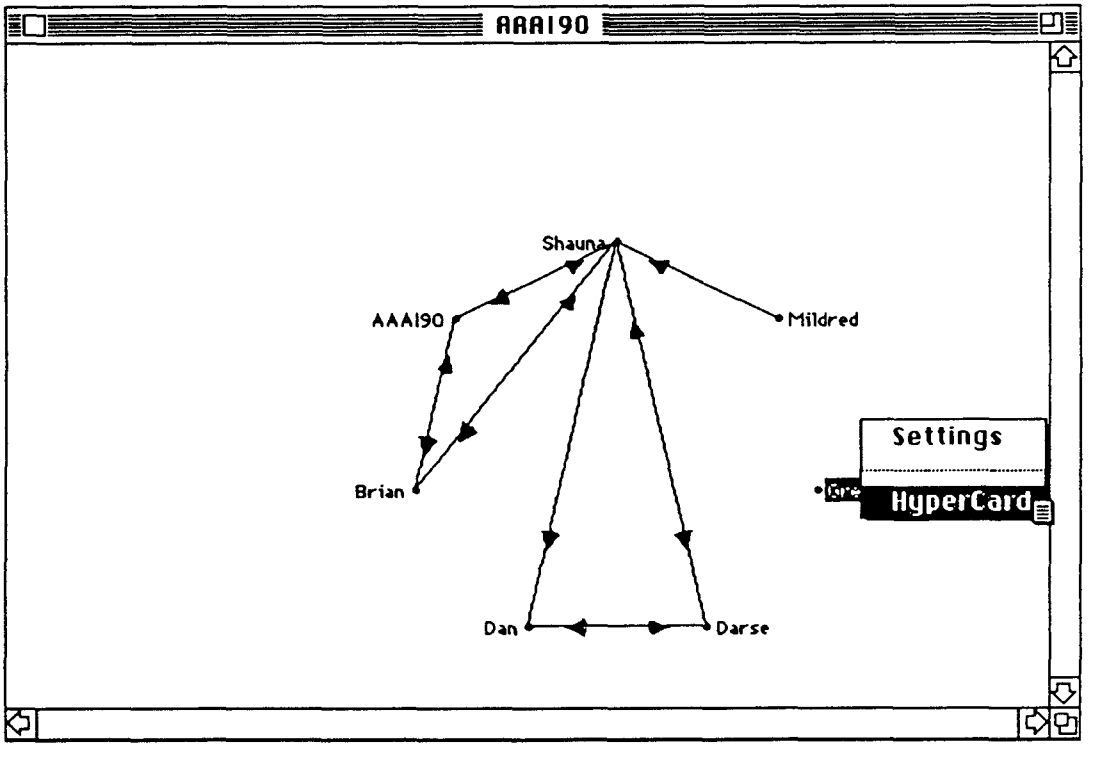

Fig.16 Socionet based on grid comparisons screen

She clicks on "Greg", uses a popup menu to return to HyperCard, and goes to the screen shown in Figure 13 with Greg now selected. The user can now explore why Greg's grid is so different from hers. She can send him mail discussing the differences, querying his use of terms, and so on. The system is highly non-modal and the user can continue using the system as demonstrated, browse between cards, use the RepGrid tools to further develop grids, use the email to communicate, and so on.

CONCLUSIONS

Potential applications of knowledge acquisition systems already developed extend far beyond the development of expert systems; a significant area is the support of group processes through sharing and comparison of personal knowledge. RepGrid-Net is a message system supporting special interest group formation and collaborative activities at many levels. It integrates techniques and programs that have already been widely used to support the elicitation and analysis of conceptual structures. However, it makes them available in a very much more informal and open setting than previously.

The current implementation is written for the Apple Macintosh and operates only on a local server network. Transferring the code to other personal computers and workstations involves the usual problems of portability of highly interactive user interfaces. Remote operation presents no major problems since the grids are compact data structures similar in size to email messages, and work is already underway to allow the system to operate over global networks.

The system described shows the potential current applications of computer-mediated communication systems to be extended simply and naturally with a range of new features supporting human knowledge processes.

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