The Knowledge Agency

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1 Introduction

The COMRIS project (Co-Inhabited Mixed Reality Information Spaces) is intended to build a conference system supporting participants by personal software agents. The agents perform several tasks like commitment reminders or negotiations with other personal agents about meetings. A hardware device "worn" by the user enables the agent to speak to him through an earphone and to perceive the current location as well as other users in the neighbourhood. For their negotiations, the agents need access to background knowledge like the conference schedule and information about users extracted from the Internet by information agents. Thus they can determine which person might be interesting to meet and which talk might be worth listening to. For this step, automatically gathered knowledge would be very helpful.

It is not suitable for a real-time system taking context information like "who is near" into account, if each agent needs to ask several information agents before being able to enter negotiation with another agent. Additionally, the information agents themselves would have to gather the corresponding information synchronously, possibly taking a long time. This encourages a decoupling of information and personal agents.

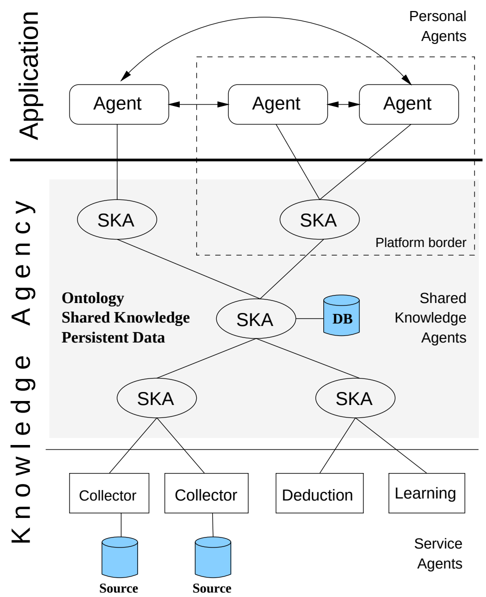

Figure 1: Knowledge Agency Overview

2 The Knowledge Agency

Our application encouraged us to build a shared Knowledge Agency that abstracts from the service and the information agents. The personal agents perform their main objective which is negotiating with other personal agents. The information agents, now part of the Knowledge Agency, are represented to the personal agents by a (possibly replicated) shared-knowledge agent

(SKA). They gather information asynchronously for the SKAs, making the personal agents more independent of the current access characteristics of the web. Thus, the information agents must be intelligent in the sense that they have to predict which information the personal agents will need. This is achieved by the SKA providing information push of changes in the knowledge base. To keep the system architecture open, XML encoded FIPA ACL was chosen for communication. Furthermore, the ontology is not hardcoded into the system but stored in the Knowledge Agency. So we were able to add ontology independent components like maintenance tools. A global view of the agency is exemplified in figure 1.

3 Applying Learning Algorithms

Having the gathered information available in the Knowledge Agency as a whole, we were able to apply a standard machine learning algorithm in order to learn indicators for a "wants-to-meet" relation between participants, based on their publication or their project profile. We achieved this by building a connection from the Knowledge Agency to the MOBAL machine learning system [3]. With only four hand-crafted training examples, which were expanded by the gathering agents to about 4000 facts, we could successfully learn the concept "wants-to-meet". Our learned rules achieved values as displayed in table 1. The moderate results from a test at the German AI Conference (KI99) are due to the fact that information about joint publications and projects are not the only factors determining a wants-to-meet relation.

Set	Coverage	Corr.	Accuracy
Train.	58 %	75 %	73 %
KI99	32.16 %	31.61 %	61.12 %

Table 1: Learning Results

4 Conclusion and Related Work

The number of communication channels in large agent populations could effectively be reduced by introducing the Knowledge Agency for indirect communication. However, the results show that the information gathering still needs enhancements. More intensive search in the home pages of the participants could possibly accomplish the information about participants. Better information gathering will immediately improve the learning results, as the enhancement of deduction capabilities implemented so far will do.

Related systems cover these topics at different levels. The centralised structure of OntoBroker [1] would be a good starting point for learning mechanisms, but the system interface human oriented only. Haynes et al. developed an agent based meeting scheduling system, which is adaptive to environmental demand and user preferences [2]. The system is restricted to the domain of meeting scheduling without an explicit ontology. Information from external sources is not taken into account.

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References

[1] Decker, S., Erdmann, M., Fensel, D., and Studer, R. Ontobroker: Ontology based access to distributed and semi-structured information. In *Semantic Issues in Multimedia Systems*, R. Meersman and other, Eds. Kluwer Academic Publisher, Boston, 1999.

[2] Haynes, T., Sen, S., Arora, N., and Nadella, R. An automated meeting scheduling system that untilizes user preferences. In *Proc. of Agents'97* (1997), ACM.

[3] Morik, K., Wrobel, S., Kietz, J.-U., and Emde, W. *Knowledge Acquisition and Machine Learning - Theory, Methods, and Applications.* Academic Press, London, 1993.