Collaborative Architecture for Distributed Autonomous Decision Makers

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SUMMARY

Operations in the domains of business, industry, life science, and military are all centered on decisions and decision-making processes. In a data-driven, decision-making environment, the efficient use of available data resources is essential to reach an inclusive and successful decision. Advances in computers and communications have made it possible for decision makers to access and share data over a network. One of the better-known sharing mechanisms is based on the concept of centralized collaboration architecture that forms an extended enterprise by linking participants together with similar aim or objective. The conventional, centralized collaboration approach is exemplified by the *collaborative decision making* (CDM) program in the airline industry domain. The intent of this program is to interconnect all participants to share data and management decision so that each participant knows what other participants are doing and planning and, thus, schedules and plans efficiently.

Similar approaches are also found in the healthcare domain. In Europe, an automated discussion forum tool for doctors at remote locations has been developed to serve as an assistant and advisor in the complex process of medical decision-making upon the appropriate treatment for a specific patient. In the US, recently, a new project, e*lectronic network of care*, has been proposed to create an electronic network that would allow participating doctors and healthcare institutions to share information that is often needed in making medical decisions.

However, the promise of the collaborate decision making in air traffic management or healthcare networking relies upon the burdens of complex communication links between participants and a central processing center. Moreover, the centralized architecture requires on-line, real-time data processing and transfer; therefore, the conventional, centralized collaborative architecture is only for dependent or inter-dependent decision makers.

For the autonomous decision makers, especially in the healthcare domain, that are seeking a loose collaboration of knowledge sharing, the centralized collaboration mechanism is too intrusive and demanding. The autonomous decision makers' main interest is to get supplementary knowledge that, combined with the present level of expertise, expands its understanding of a specific problem and minimizes any hidden deficiencies of the current decision actions, while keeping operational autonomy and data privacy.

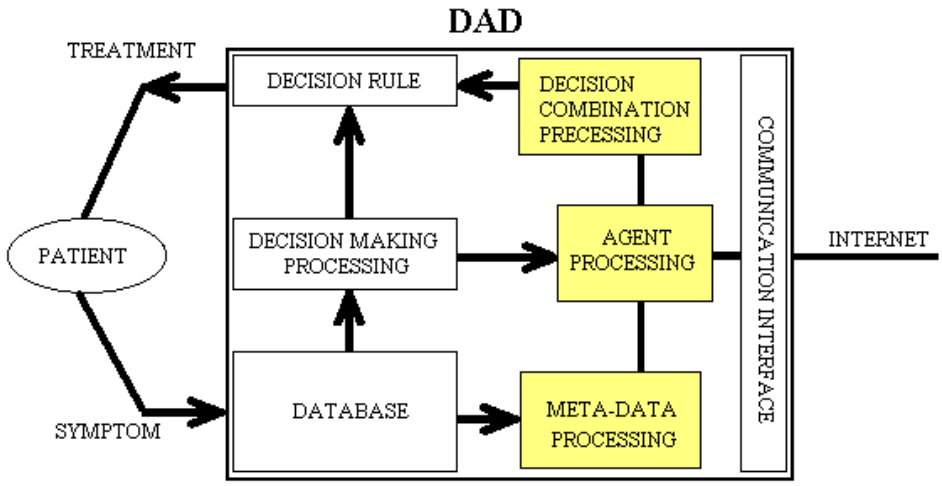
This project opens up a new collaborative architecture, on the ubiquitous Internet, characterized by non-tied-up, low bandwidth communication for distributed, autonomous decision makers to exchange knowledge. The proposed project, once completed, will become the archetype of distributed collaborative architecture that satisfies the decision makers' requirements for autonomy and privacy. The new paradigm infused in to the architecture is centered on the transport of meta-data, not data, embraced in mobile agent. The mobile agent deployment approach has two advantages. First, the Internet traffic is less demanding since the tied-up network occurs only during the agent travels from one participant's computer to another, and second, the bandwidth of the communication is further lowered by transferring the small-size meta-data code of the agent.

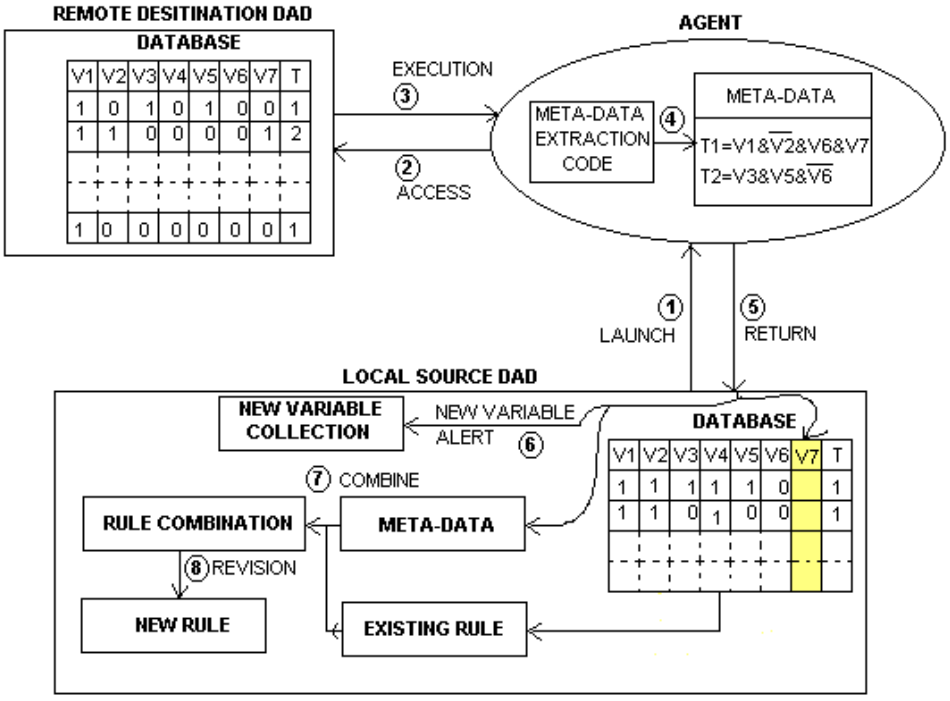
The objective of the proposal is to design, implement, and evaluate the new *collaboration architecture for distributed, autonomous decision makers* (CADAD). The scope of the project covers the following five areas: the exploration of Internet-based architectures for collaborative knowledge exchange schemes, the algorithmic development of meta-data extraction from remote database, the development of a mobile for the meta-data exchange and transport, the development of a cumulative algorithm to combine the acquired meta-data with the existing decision rules, and finally, implementation of a pilot CADAD infrastructure. Since the essential function of knowledge sharing under tight data privacy is carried out by the mobile agent, an agent framework on platform-independent virtual machine will be utilized to reduce the coding efforts and development time.

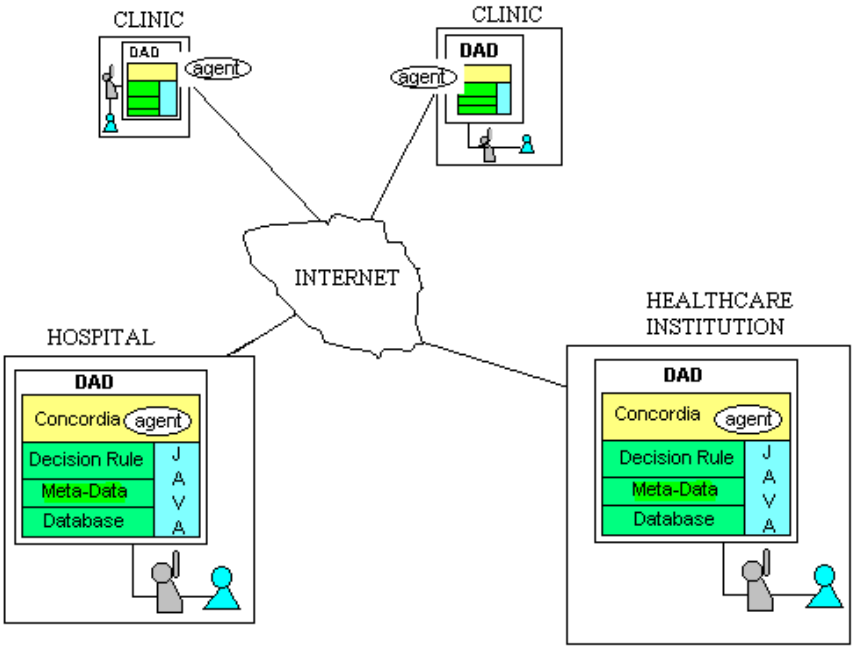
The intellectual merits of the project are that the project opens up a new distributed collaborative architecture characterized by automated decision enhancement in a non-tied-up network environment, and that it seeks the first realization of the meta-data exchange via mobile agent over the Internet for data security and reduced data transport. The most significant feature of the CADAD is the mechanism by which the data and the decision rules are shared among the autonomous decision makers without losing their highest priorities: privacy and autonomy.

The proposed project, on the one hand, brings together researches in the area of decision-making and networked computing. However, on the other hand, it commoves the researches on networked collaboration for protected resource sharing. The broader scientific and technical areas of impact and contribution of the proposed project include: learning from dynamic data sources, formulation of incremental and cumulative algorithms and

combined learning, information extraction and fusion from distributed data sources while keeping the privacy and security, architectures and systems for software agent for collaborative learning and decision-making, and decision-making in distributed environments. The domains of the broader impact and contribution of the project include: medical and clinical decision-making systems, geo-spatial information systems, and scientific discovery by wide-area knowledge accumulation.



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