AGENT-BASED OPEN CONNECTIVITY FOR DECISION SUPPORT SYSTEMS

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DECLARATION

I, Hao Lan Zhang, declare that the PhD thesis entitled *Agent-based Open Connectivity for Decision Support Systems* is no more than 100,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references and footnotes. This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.

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Signature Date

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ABSTRACT

One of the major problems that discourages the development of Decision Support Systems (DSSs) is the un-standardised DSS environment. Computers that support modern business processes are no longer stand-alone systems, but have become tightly connected both with each other and their users. Therefore, having a standardised environment that allows different DSS applications to communicate and cooperate is crucial. The integration difficulty is the most crucial problem that affects the development of DSSs. Therefore, an open and standardised environment for integrating various DSSs is required.

Despite the critical need for an open architecture in the DSS designs, the present DSS architectural designs are unable to provide a fundamental solution to enhance the flexibility, connectivity, compatibility, and intelligence of a DSS.

The emergence of intelligent agent technology fulfils the requirements of developing innovative and efficient DSS applications as intelligent agents offer various advantages, such as mobility, flexibility, intelligence, etc., to tackle the major problems in existing DSSs. Although various agent-based DSS applications have been suggested, most of these applications are unable to balance manageability with flexibility. Moreover, most existing agent-based DSSs are based on agent-coordinated design mechanisms, and often overlook the living environment for agents. This could cause the difficulties in cooperating and upgrading agents because the agent-based coordination mechanisms have limited capabilities to provide agents with relatively comprehensive information about global system objectives.

This thesis proposes a novel multi-agent-based architecture for DSS, called Agent-based Open Connectivity for Decision support systems (*AOCD*). The AOCD architecture adopts a hybrid agent network topology that makes use of a unique feature called the *Matrix-agent* connection. The novel component, i.e. Matrix, provides a living environment for agents; it allows agents to upgrade themselves through interacting with the Matrix. This architecture is able to overcome the difficulties in concurrency control and synchronous communication that plague many decentralised systems. Performance analysis has been carried out on this framework

and we find that it is able to provide a high degree of flexibility and efficiency compared with other frameworks.

The thesis explores the detailed design of the AOCD framework and the major components employed in this framework including the Matrix, agents, and the unified Matrices structure. The proposed framework is able to enhance the system reusability and maximize the system performance. By using a set of interoperable autonomous agents, more creative decision-making can be accomplished in comparison with a hard-coded programmed approach.

In this research, we systematically classified the agent network topologies, and developed an experimental program to evaluate the system performance based on three different agent network topologies. The experimental results present the evidence that the hybrid topology is efficient in the AOCD framework design. Furthermore, a novel topological description language for agent networks (TDLA) has been introduced in this research work, which provides an efficient mechanism for agents to perceive the information about their interconnected network.

A new *Agent-Rank* algorithm is introduced in the thesis in order to provide an efficient matching mechanism for agent cooperation. The computational results based on our recently developed program for agent matchmaking demonstrate the efficiency and effectiveness of the Agent-Rank algorithm in the agent-matching and re-matching processes.

PUBLICATIONS

Refereed Journal Articles:

1. **Zhang, H.L.**, Leung, C.H.C. and Raikundalia, G.K. (2008) "Topological Analysis of Agent Networks and Experimental Results based on the AOCD Architecture", *Journal of Computer and System Sciences*, Vol. 74, No. 2, pp. 255 – 278, Elsevier Publication.
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3. Raikundalia, G.K. and **Zhang, H.L.** (2006) "Document-related Awareness Elements in Synchronous Collaborative Authoring", *Australian Journal of Intelligent Information Processing Systems*, Vol. 9, No. 2, pp. 41 – 48.

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5. **Zhang, H.L.**, Leung, C.H.C., and Raikundalia, G.K. "Application of Multi-agent Technology to Information System: An Agent-based Design Architecture for Decision Support Systems", **Submitted to** *AJIS* (in December 2006).

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES