Cooperation Protocol Design Method for Repository-Based Multi-Agent Applications

Wenpeng Wei, Graduate School of Information Sciences, Tohoku University, Sendai, Japan

Hideyuki Takahashi, Graduate School of Information Sciences, Tohoku University, Sendai, Japan & Research Institute of Electrical Communication, Tohoku University, Sendai, Japan

Takahiro Uchiya, Nagoya Institute of Technology, Nagoya, Japan

Tetsuo Kinoshita, Graduate School of Information Sciences, Tohoku University, Sendai, Japan & Research Institute of Electrical Communication, Tohoku University, Sendai, Japan

ABSTRACT

This paper proposes a cooperation protocol design method for repository-based multi-agent systems. The proposal aims to improve the efficiency of multi-agent system development by introducing reusable protocol templates. To achieve the decoupling of protocol templates and application domain processes, original protocol template representations are proposed. Moreover, a graphical design tool with automatic implementation functions of proposed protocol templates is developed to reduce the development cost of multi-agent systems. To validate the functionality and feasibility of the proposal, two disparate multi-agent based applications are developed using the proposed design method. The comparison with the reference implementation shows that applying proposal in practical application development reduces approximately 50% coding work.

Keywords: Cooperation Protocol, Design Method, Multi-Agent System, Repository-Based, Reusable Protocol Templates

1. INTRODUCTION

Multi-agent systems are proved very effective for solving the problems related to distribute information processing and simulations in the past few years. Many researches make great efforts in those areas. For an instance, a multi-agent based approach for providing communication services in ubiquitous computing environment is proposed in Suganuma (2010). Pu (2010] introduces an agent-based negotiation service with the combination of ontology. An agent-based computing model and its application for care-support services are proposed in Suganuma (2009).

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However, the development of multi-agent system still remains difficult. Addressing to that restriction, this research proposes a cooperation protocol design method to improve the efficiency of multi-agent system development. Based on the repository mechanism, reusable protocol templates can be applied for disparate multi-agent applications. Furthermore, a graphical design tool with automatic code generation functions is developed to support the proposal.

The remainder of this paper is organized as follows. In Section 2, we introduce the related researches of protocol design for multi-agent systems and the repository-based agent framework. In Section 3, the proposed design method is described in details. The applications and evaluations are presented in Section 4. Finally, we conclude this paper in Section 5.

2. RELATED WORKS

2.1. Protocol Design for Multi-Agent Systems

Since communication is very important for software agent, many research focus on the protocol design for multi-agent system. Mazouzi (2002] proposes a generic approach for the protocol engineering in the case of complex interactions and open protocols. [Pena, 2003] introduces a top down approach for multi-agent system protocol descriptions. Winikoff (2004] proposes a methodology covering protocol design for multi-agent system development. Al-Hashel (2007] and Dam (2004] provide comparisons of agent-oriented software development methods taking protocol design as an important aspect. We notice that few of the researches mention the reusability of protocols for multi-agent systems. Also none of those works provides functions or mechanisms to support protocol implementation for practical usages.

2.2. Repository-Based Agent Framework

The repository-based agent framework (DASH) is proposed in Hara (2002] to supports the design and implementation of flexible distributed systems. The repository is one of unique mechanisms of DASH for supporting software reuse as shown in Figure 1. Agent developers can register their

Figure 1. The repository-based agent framework
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