Chapter 10
A Multi-Agent Question-Answering System for E-Learning and Collaborative Learning Environment

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ABSTRACT
The increasing advances of new Internet technologies in all application domains have changed life styles and interactions. E-learning and collaborative learning environment systems are originated through such changes and aim at providing facilities for people in different times and geographical locations to cooperate, collaborate, learn and work together by using various educational services. One of the most important requirements of learners in online and virtual environments is the ability to ask questions and receive appropriate answers. The nature of such environments and the lack of physical existence of teachers make such issues critical and challenging problems. This paper presents a multi-agent system for building a question-answering system in learning management systems and collaborative learning environments. In the proposed system, after validating the content of questions, all available resources including course materials, frequently asked questions and responses from other learners will be gathered and finally using a recommender system, the most appropriate answer(s) with respect to several criteria such as learner’s knowledge, research background, history of previous questions, and the candidate answers relevant to the question will be suggested. A simplified version of the system has been implemented and integrated to a well known open source collaborative learning environment system in order to simulate and evaluate the applicability and appropriateness of the proposed system. The result shows that the proposed question-answering system may be used efficiently and expanded to accommodate further advanced capabilities.

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INTRODUCTION

Much of the world has been in the midst of a great transformation fueled by continuing advances in computing and networking capabilities. The Internet provides us with the means to access vast resources of information. With this powerful communication channel comes the concept of collaborative learning (Jiaqi & Chuan, 2001). According to Wikipedia (2008), collaborative learning is an educational approach to teaching and learning that involves groups of learners working together to solve problems, complete tasks, or create products. Studying in a distance learning environment, the instructor may not be always available online to deal with questions asked by learners (Wang et al., 2006). An efficient Questions-Answering System (QAS) may assist learners to respond to questions raised by other learners.

Although the necessity of such a system is apparent, however its model may not be a straightforward task. The first problem is the variety and the large amount of information which can be useful for answer creation process. Another problem is that questions are asked in natural language that complicates their analysis and understanding. On the other hand, answer to a specific question may not be necessarily common for all learners with different knowledge level, background or research topics. Therefore, the importance of developing an effective method for supporting question-answering process in collaborative learning environments is evident.

During recent years, numerous studies have been performed in this field for which some aspects of question-answering and some parts of accessible information resources and useful available infrastructure have been considered.

This paper offers an approach for building a comprehensive question-answering system in e-learning or collaborative learning environment systems. This approach uses a multi-agent architecture that applies all available resources to find answers to questions. Initially question validation is carried out to determine the relevance of question context to the course subjects. Then the question is sent to other online learners participating in the course for which their responses are received via a developed Message Oriented Middleware (MOM) and simultaneously relevant answers are retrieved from available resources including Frequently Asked Questions (FAQ) and course materials. By gathering answers from these three types of resources, a recommender system embedded in QAS examines answers and suggests a list of the most appropriate answers, while taking into account, several criteria such as learner’s knowledge, research background, history of previous asked questions and the candidate answers relevance to the question.

In order to evaluate the functionality of the proposed system, it has been integrated into a well known open source collaborative learning environment system. By applying and tracing a simulation in the form of scenario, the applicability and appropriateness of this system is demonstrated.

The paper is organized into six sections. Following the introduction is a description of the main concepts and review of some related research studies. The proposed multi-agent framework and its structure are described next. Then we explain the system implementation and evaluations. Finally the conclusion and suggestions are given.

BACKGROUND

With the rapid developments in e-learning domain, numerous technologies and tools have been used to facilitate communication, coordination, collaboration, cooperation, and production activities.

An agent-based QAS is presented in (Ishikawa, Wongvibulsin, & Yu, 2003) which assists collaborative learning mechanisms. When a learner sends a question, an agent searches a FAQ document and also forwards the question to a selected learner(s). The agent in the system