A FRAMEWORK FOR AGENT BASED EXPERT SYSTEM FOR ONLINE ASSESSMENT IN DISTRIBUTED DATABASE ENVIRONMENT

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ABSTRACT

This paper introduces an architectural framework of an agent based Expert System for Online Assessment (EESOA) in distributed environment for the learners of ODL (Open and Distance Learning) System. This framework is an extension of ESOA (Expert System for Online Assessment). The proposed system is designed using JESS (Java Expert System Shell) and JADE (Java Agent Development Framework) with JIPMS (Java Inter-Platform Mobile Services) support. The proposed system can be deployed in J2EE (Java 2 Enterprise Edition) environment using MVC (Model View Controller) paradigm. The system is integrated with various databases, as question bank, residing in various known servers (i.e. distributed homogeneous environment), where JADE is there with JIPMS support in each and every servers. The student academic/performance records are stored in database, residing in the same server where the proposed system resides. The rule base is in the form of XML files, reside in the same server where the proposed system resides. In this system a mobile agent is used to retrieve question set for students from the known distributed environment by moving one server to another.

KEYWORDS: Agent, Expert System, JESS, Online Assessment, J2EE, MVC, JADE, JIPMS, Mobile Agent, Distributed Environment

INTRODUCTION

Our previous architectural framework was ESOA. The ESOA acts as the role of a teacher while assessing a student’s knowledge about a particular topic/subject. Here the questions will be categorized into different level of toughness; the academic history of students will be categorized depending on some defined properties/characteristics. Also there will be rules for generating the question sets for students depending on their categories and for processing assessment results. Also there was a unique technical contribution, which is dynamic knowledge management, i.e. administrative users will be able to change the facts and rules of the ESOA with the help of interactive web-interfaces. [1]

In the ESOA, the student facts, question facts and the rules reside in the same server/platform where the ESOA runs. In India, there are different universities and institutions. Most of them have their own database servers, containing a question bank, for their internal assessments/examinations. If a collaborative effort can be initiated among those universities/institutions so as to share their question databases then as a whole the question bank will be a very huge one.

The concept behind the proposed system is to use the question resources from different universities/institutions those are in collaboration. The DBMS run on the servers must be the same and so as the structure of the question databases.

A distributed database is a database in which storage devices are not all attached to a common processing unit such as the CPU, controlled by a distributed database management system (together sometimes called a distributed
database system). It may be stored in multiple computers, located in the same physical location; or may be dispersed over a network of interconnected computers. Unlike parallel systems, in which the processors are tightly coupled and constitute a single database system, a distributed database system consists of loosely coupled sites that share no physical components. [2]

In our proposed system, we use the term “Distributed Environment” because here we use the servers of different known universities with same question database structure. Also here we do not have any central Distributed Database Management System. Here the system will get question set from the various databases using agent technology.

Agent is the one that is authorized to act for another. Agents possess the characteristics of delegacy, competency, and amenability. Delegacy means discretionary authority to autonomously act on behalf of the client. Actions include making decisions, committing resources, and performing tasks. Competency means the capability to effectively manipulate the problem domain environment to accomplish the requisite tasks. Competency includes specialized communication proficiency. And Amenability is the ability to adapt behavior to optimize performance in an often non-stationary environment in responsive pursuit of the goals of the client. Amenability may be combined with accountability. [3]

DESIGN AND METHODOLOGY

In the design & development of ESOA, the software engineering approach is used. The system uses JSP and Servlet technology along with JESS. The whole system is designed in MVC Paradigm.

In ESOA, the platform is J2EE so is case with the EESOA also. J2EE specifies the logical application components within a system and defines the roles played in the development process. J2EE, introduced in 1998, defines a multi-tier architecture for enterprise information systems (EIS). [1]

Four application components are defined within the J2EE platform. They are as follows [4]: Application clients (Standalone Java clients), Applets (Java code which executes within a browser), Web components (JSPs, Servlets) and Server components (EJBs, J2EE API implementations).

JESS stands for Java Expert System Shell. It is a rule engine and scripting environment and is written in Java and supports Java APIs [1].

A program written in JESS may consist of rules, facts and objects. The inference engine decides which rules should be executed and when. JESS also provides support for the modular development and execution of knowledge bases with the defmodule construct. JESS modules allow a set of constructs to be grouped together such that explicit control can be maintained over restricting the access of the constructs by other modules. [5]

In ESOA, the rules are stored externally in XML files and can be loaded into the rule base of JESS as necessary so as with the EESOA. In EESOA, for the retrieval of questions agent technology is used. And for development of agent, we use JADE (Java Agent Development Framework) with JIPMS (JADE Inter-Platform Development Environment) support.

Agent

The growth in networked information resources requires information systems that can be distributed on a network and interoperate with other systems. Such systems cannot be easily realized with traditional software technologies because of the limits of these technologies in coping with distribution and interoperability. The agent-based technologies seem be a promising answer to facilitate the realization of such systems because they were invented to cope with distribution and interoperability. [6]
Till today, several efforts have been done towards the standardization of agent technologies and one of major standards is the FIPA (Foundation for Intelligent Physical Agents). The Foundation for Intelligent Physical Agents (FIPA) [7] is an international non-profit association of companies and organizations sharing the effort to produce specifications of generic agent technologies. FIPA is envisaged not just as a technology for one application but as generic technologies for different application areas, and not just as independent technologies but as a set of basic technologies that can be integrated by developers to make complex systems with a high degree of interoperability.

However, the use of a common communication language is not enough to easily support interoperability between different agent systems. The standardization work of FIPA is in the direction to allow an easy interoperability between agent systems, because FIPA, beyond the agent communication language, specifies also the key agents necessary for the management of an agent system, the ontology necessary for the interaction between systems, and it defines also the transport level of the protocols. [3]

Mobile Agent

Mobile agent technology [8] is a paradigm that can take advantage of current distributed environments. The mobile agent technology comes from two different disciplines: artificial intelligence, which defines agent concepts [9], and distributed systems, which deals with code mobility [10].

Mobile Agent, also known as traveling agents, these programs will shuttle their being, code and state, among resources. This often improves performance by moving the agents to where the data reside instead of moving the data to where the agents reside. The alternative typical operation involves a client-server model. In this case, the agent, in the role of the client, requests that the server transmit volumes of data back to the agent to be analyzed. Often times the data must be returned by the agent to the server in a processed form. Significant bandwidth performance improvements can be achieved by running the agents within the same chassis as the data. Mobile agent frameworks are currently rare, however, due to the high level of trust required to accept a foreign agent onto one's data server. [3]

The emerging mobile agent (MA) technology can play an important role in distributed network and systems management (NSM) [11]. With advances in technologies for accountability and immunity, mobile agent systems are expected to become more popular [3].

JADE and JIPMS

JADE (Java Agent Development Framework) is a software development framework aimed at developing multi-agent systems and applications conforming to FIPA standards for intelligent agents. It includes two main products: a FIPA-compliant agent platform and a package to develop Java agents. JADE has been fully coded in Java and an agent programmer, in order to exploit the framework [12].

JADE is written in Java language and is made of various Java packages, giving application programmers both ready-made pieces of functionality and abstract interfaces for custom, application dependent tasks. Java was the programming language of choice because of its many attractive features, particularly geared towards object-oriented programming in distributed heterogeneous environments; some of these features are Object Serialization, Reflection API and Remote Method Invocation (RMI) [12].

JIPMS (JADE Inter-platform Mobility Service) is a service which allows Inter-platform mobility support to JADE. It is an extra module, which does not come with JADE package and can be downloadable from the net.
Architecture of EESOA

As we know, our previous architecture, i.e., ESOA, includes mainly five components [1]:

- **Apache Web Server**: listens for web page request
- **Tomcat Servlet Engine**: serves dynamically generated web page using JSP and Servlet technology
- **MySql Database**: stores the student information and the question bank of various courses.
- **XML**: files for external Rule Base
- **JESS Engine**: for online assessment

In EESOA, the components (i), (ii), (iv), (v) of ESOA remain the same. The student information database part of the component (iii) resides in the same server where the EESOA resides but in case of the question bank, it is a collection of question banks from different servers of different universities/institutions. So, there are two additional components in EESOA:

- **JADE**: for agent platform
- **JIPMS**: for agents’ mobility support

![Figure 1: Architecture of Extended ESOA](image)
In case of proposed EESOA, all of the known question database servers, also the main ESOA server, are must have JVM, JADE with JIPMS support. Also in EESOA, the part up to loading of students’ fact and rules into JESS’s working memory, of working of ESOA [1] remains the same.

Initially, the JADE should also be running with JIPMS. So, after loading student fact and rules, the mobile agent, QSGMA (Question Set Generation Mobile Agent), will move in each of the question database servers, contact with a local agent, QSGLA (Question Set Generation Local Agent), and gets questions and then move to next server and so on until required numbers of questions are extracted and then return back to the EESOA main server.

Now, again the remaining steps are same as the ESOA [1].

CONCLUSIONS

This paper presents the architectural framework for the design and development of an agent based Expert System for Online Assessment (EESOA) in distributed environment for students. In this architecture, J2EE framework (with Apache Tomcat Web Server), JESS and JADE with JIPMS support, are used. The system is an extension of ESOA (primary designed for assessment of students’ knowledge online). The extension is the use of mobile agent technology for retrieval of questions for the online assessment from the servers from different universities/institutions those are in collaboration. Since the proposed system is an extension of ESOA, so the system can be used for conducting online examination and evaluation process also.

REFERENCES

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