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Designing Multi-Agent System Model for University Teaching Activities by Using UML

Mihajlo Hasanu[1], Hristina Ambaroska[1], Elena Vlahu-Gjorgievska[1] and Ilija Jolevski[1]

[1] Faculty of information and communication technologies, Partizanska bb, 7000 Bitola, Macedonia
mihajlo_hasanu@yahoo.com, a.hristina@hotmail.com, elena.vlahu@fikt.edu.mk, ilija.jolevski@fikt.edu.mk

Abstract. The area which covers the meaning of intelligent agents and their contribution is a subject of constant changes. Researchers are in a constant race to create intelligent agents that will contribute the most benefits in their life and will represent an extenuating circumstance regarding different complexity level problems, aiming to satisfy people's needs. Some of them show agent models that are going to be the starting point of future projects, and some give the whole picture of fully functioning agents. This paper gives a review of a systematic approach for designing multi agent system model for university teaching activities using UML approach.

Keywords: Intelligent agent, Multi-agent systems, UML diagrams.

1. Introduction

Nowadays, the available technology allows humanity to generate artificial intelligent agents that are capable to work according to people's need. Although there is not a universal consensus on the definition of an agent, the most acceptable definition is proposed by Wooldridge and Jennings [1]. They define the agent as a system that is situated in some environment and is capable to act in the environment in order to meet its design objectives. Also, many researchers are trying to make a distinction between the terms agent and intelligent agent. According to Wooldridge [1] [7] intelligent agent is required to be *reactive* (responds in a timely manner to the changes in its environment), *proactive* (persistently pursues goals) and *social* (interacts with other agents). Intelligent agent should perform its activities automatically by following its own agenda with a certain level of intelligence. As such, intelligent agent is advanced tool used by people for solving problems and achieving goals. The key problem that the agent faces is the decision for the actions that need to be taken in order to satisfy the goals in the best possible way. This decision can be under influence of different environment properties [2].

Any system which uses the agent abstraction and is designed and implemented within the agent technology can be seen as an agent-based system [7]. Depending of the complexity level of the given problem and the number of agents that can be included in the system, there are two types of systems: single-agent system and multi-agent system. Since the activities performed by the single-agent systems are intended for solving simple

problems, sometimes it is necessary to perform activities for solving more complex problems that occur in the real world.

The paradigm of multi agent systems is introduced due to the need of agents to solve problems with higher level of complexity that requires a joined effort by multiple agents within the working environment. The characteristics of multi-agent systems [8] are: (1) each agent has incomplete information or capabilities for problem solving, (2) there is no overall global control, (3) the data which the agents manipulate with is decentralized, and (4) the computational process is asynchronous. And their main advantages are: efficiency, robustness, scalability, simplified programming and decreased expenses. But, the key factor for the success of multi agent systems is cooperation. It is achieved through data exchange, providing a partly planned solution and enforcing restrictions between agents. Cooperation can be done by rollback of the actions, synchronization, intermediation and sharing information.

The goal of this paper is to present a systematic approach for creating a framework model for a multi agent system for university teaching activities by using UML diagrams. The main users of this multi agent system model are students and teaching staff. The designed model integrates three agents that allow entering important data and generating reports for students' evaluation.

This paper is organized as follows. In the next section the meaning of multi-agent systems is covered and overview of the multi-agent system model for university teaching activities is presented. The last section briefly describes the future work and concludes the paper.

2. Multi-Agent System Model for University Teaching Activities

Developing a multi agent system model for university teaching activities includes three agents performing different activities and work according to the user's needs. The agents that are integrated into the system are information agents because they provide useful information for the user. In the proposed multi agent system, the agents perform their activities independently without language for communication in-between agents, but they share same data.

The model has three agents: (1) Reports generating agent (*Report Agent*), that provides help to the teaching staff in the process of evaluating students; (2) *Lecture Information Agent*, providing the students with better information regarding the courses they choose, different schedules for lectures, exams, and other important events; (3) *Input Agent*, allows inputs for the activities in the database. Agents integrated in the system can be accessed through the user interface that allows different agent functionalities based on the user type (staff, student or guest).

The main users of this multi agent system are students and teaching staff. The users will gain access to the functionality of the three agents via login with validate user account through the user interface. By logging with validate account; the teaching staff will gain access to the functionality of the Report and Input Agents. They will be able to request generating reports for: seminar papers; attendance and activity; home assessments; passed exams and final grades for certain course for evaluating students' performances, as well as inputting essential data to the database as a source for the report and lecture information agents. On the other hand, the students will gain access to the functionality of the Report

Agent with permitted right only to request report for their own final grades for a certain course or grades for all courses, and Lecture information Agent for providing useful information about courses they choose.

2.1. UML Diagrams for the Multi-Agent System Model

The approach used to represent the agents, that are part of the proposed multi-agent system model, is the unified modeling language–UML. Although this approach is intended for modeling object oriented systems, many researchers dealing with the field of multi-agent systems have accepted UML approach as a way to represent the agents [3-6]. As a tool for creating the UML diagrams Microsoft Visio software solution is used.

Class Diagram. The class diagram in this paper is used for two purposes: (1) a representation of the agents separately as a classes; and (2) class diagram representation of the system as a whole so a general idea of the system can be presented. On Fig.1 are presented the agents as separate classes, with an indication of their attributes and the functions they performed.

In addition a short overview of the Report Agent's functions is given. *Report_seminars*– gives reports regarding seminar papers submitted by students and the points they get; *Report_attendance_activity*– gives reports regarding certain filtering over the attendance and activity data collected during the lectures and lab exercises for a chosen course; *Report_passed_exam* – gives reports regarding the course status (passed or failed) and the grade for it; *Report_home_assesments* – gives reports regarding the home assessments turned in and the points gained for them; *Report_final_grades_Student* – gives reports regarding student's final grade using student's ID number as an input argument of the function; and *Report_final_grade*– gives reports regarding all final grades for a certain course, using information about the desired course as an input argument.

Functions of the Lecture Information Agent are: *Info_course_description* – shows descriptive information for the searched course; *Info_notification*– shows notification to the user in case of exceptions from the originally provided information; *Info_timetable* – shows information about courses scheduling.

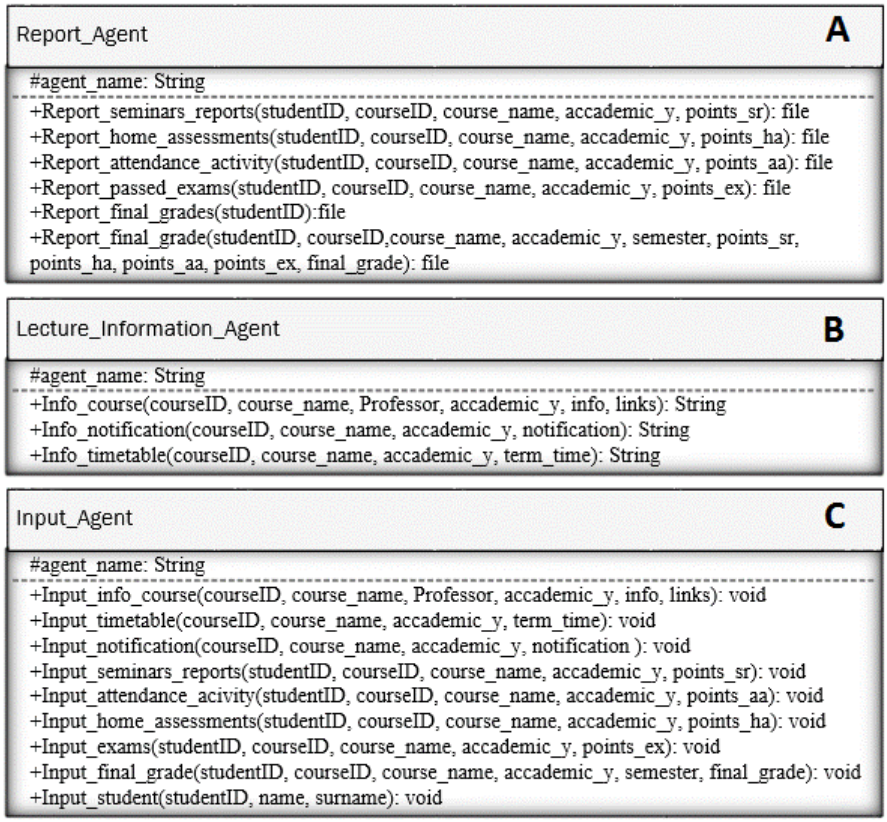

Fig. 1. Presentation of separate classes of agents: A) Report Agent class; B) Lecture Information Agent class and C) Input Agent class

Functions of the third agent, Input Agent are: *Input_attendence_activity*– input points for keeping records about students' attendance and activity during lectures and lab exercises; *Input_seminars*– input the digital version of seminar papers turned in by students, accompanied by the points they gain for the paper; *Input_home_assessments*– input points gained for home assessments turned in by the students; *Input_exams* – input information for passed exams; *Input_info_course* – input information for course description; *Input_notifications* – input notifications for certain changes and exceptions from the original information; *Input_timetable* – input the lectures and lab exercises timetable; *Input_student* – input data in the database for each student individually for a certain course; and *Input_final_grade* – input data regarding the final grade defined by previously set criteria.

Fig.2 presents general class diagram that integrates all three agents, by establishing associations between the user interface and the agents and connections with the database.

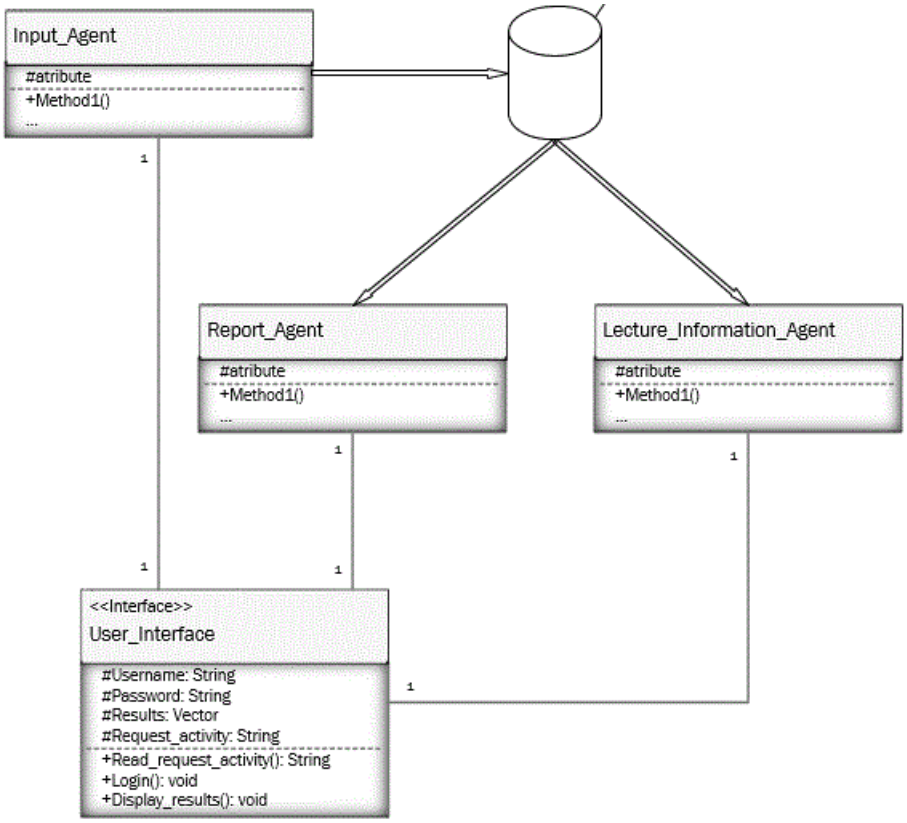

Fig. 2. General class diagram for the multi-agent system by establishing associations between the user interface with the agents and connections with the database

The general class diagram establishes one to one associations between the user interface and the agents. Additionally, the Input Agent is in one way interaction with the database (this agent inputs data into the database). While the Report Agent and Lecture information Agent are also in one way interaction with the database but these agents are getting the information from the database.

Sequence Diagram. The sequence diagram describes a single scenario, one flow of activities for a possible case. Fig.3 represents a general sequence diagram for the flow of activities for the multi-agent system model for university teaching activities.

The entire procedure covered with the general sequence diagram is as follows. First, from the user is required to make a login action through the user interface with validate account in order to use the agents (1: Request Login). Than the user interface makes an authentication account action to check the entered username and password (2: Authentication account), if they are wrong the user receives error message (3: error login), on the opposite it will continue to use the functionality of the agents. After that, depending on the users' needs, the user will request for inputting data or request for report or request for gaining information for lecture activities regarding the courses (4: Request data input/

Request report/ Request info). As mentioned earlier, depending on the users' needs, one of the three agents will start to perform their immanent functions. Then, the chosen agent will perform its main function in order to make a record in the database or to initialize an action for gathering information for generating report or information for lecture activities by establishing a connection with the database (5: Input data/ Request generating report/ Get info). After that, the appropriate agent will either make an update data in the database or will generate report and select information from the database. (6: Update data/ Generating Report/ Selecting information). The corresponding agent will acquire the necessary information of successfully done operations by feedback i.e. feedback approval for successfully updated data or massages that send the information included in the report or sending information regarding the lecture activities (7: Feedback approval/ Send report/ Send info). At the end, the corresponding agent will present the results of the required needs of the user through the user interface in a form adequate for the user (8: Display message feedback/ Display report/ Display information; 9: Report results/ Results info).

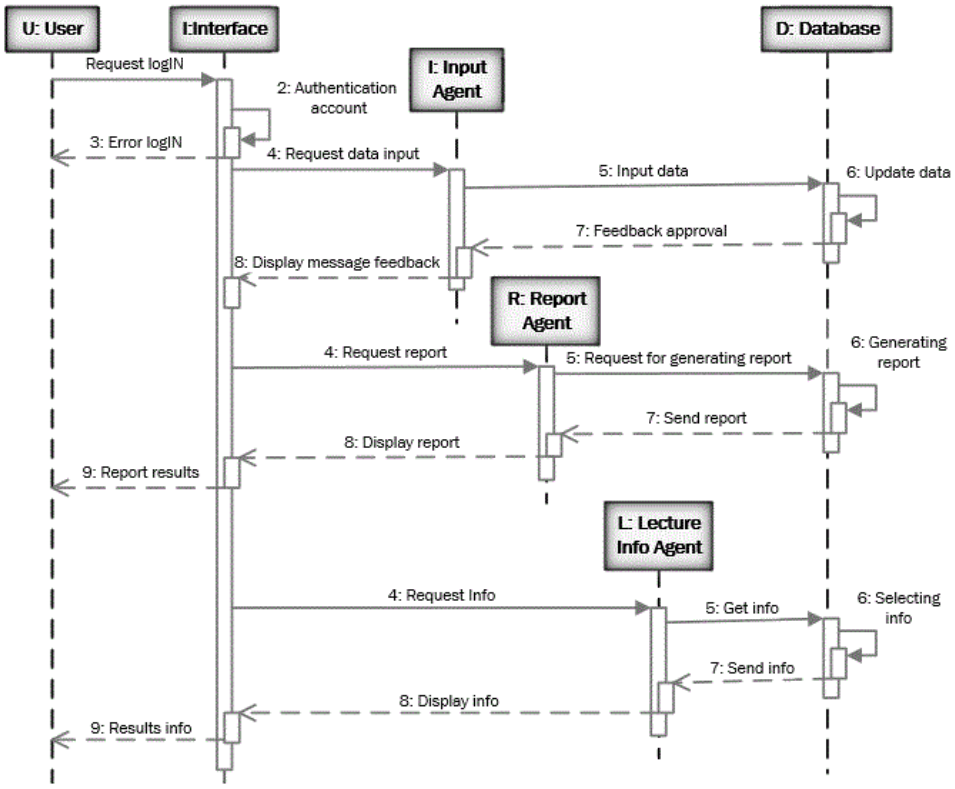

Fig.3. General sequence diagram for describing the flow of activities as whole for the multi-agent system

3. Conclusion

This paper presents a model for multi-agent system for university teaching activities. In the paper are covered intelligent agents, their technology and the meaning of agent based systems. The used approach for model representation is UML (United Modeling Language), implemented by the Microsoft Visio tool. Even though this language is meant for object oriented system, it is widely accepted by researchers from the multi agent systems area, as one of the ways to represent agents.

The presented model framework is meant for multi agent system that integrates three agents generating different reports that allow student evaluation by the teaching staff of the university; getting information regarding students' activities and input crucial data to enable agents' life cycle.

Besides the designed multi agent system model, in the future, development and implementation of a functional multi agent system is planned. The system will aim to improve the university's performances and simplify solving some student's related problems the universities have. Increasing the agent's number will be taken in consideration in order the system to be able to solve as complex problems as possible and getting optimal results to achieve its goals.

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