Scientific Journal of Riga Technical University
Computer Science. Applied Computer Systems
2011
Volume 47

Conception of the Animated Interface Agent for the Concept Map Based Intelligent Knowledge Assessment System

Alla Anohina-Naumeca[1], Romans Lukasenko[2],
Dmitrijs Skripkins[3], [1-3]*Riga Technical University*

***Abstract* – The paper presents the conception of the animated interface agent for the concept map based assessment system. The agent is being developed with an aim to solve problems related to rare use or users' unawareness of functional capabilities of the system. The conception consists of agent's goal, functions, inputs, outputs, embodiment, and properties. It is based on the interface agent characteristics and design requirements summarized in the paper, as well as analysis of system needs.**

***Keywords:* animated agent, concept map, intelligent system, interface agent**

I. Introduction

The modern society is characterized by the wide use of information and communication technologies in professional, social, and private life, young people familiar with computers from childhood, and high demand for knowledge workers. That puts new requirements on educational process as well. As a result, a lot of software for acquiring theoretical knowledge, completion of practical tasks and assessment of progress at any time, place, and pace is being developed. One of the advanced and promising solutions in this direction is intelligent educational systems capable of providing personalized instruction and learning experience. However, the majority of known systems have been developed for a special study course or even for a particular section of a course. Moreover, they typically have a specific user interface which is suitable for a chosen study domain and usually can be very complicated because developers try to offer interactive interfaces with an aim to make tutoring more interesting and motivating. As a result, users typically do not have experience related to the use of particular software and they need certain time to adapt to a system and its offered possibilities. Lieberman and Selker [1] pay attention to the fact that tutoring systems tend to deal with inexperienced computer users; therefore ease of use in the interface is a prime consideration. Moreover, they stress that growth of functionality of interactive interfaces is not sustainable. In [2] it is pointed out that learning unfamiliar software requires beginner users to read manuals and to do many trials and make errors, but very often manuals are helpless. The authors believe that users can learn the software more easily if an expert instructor assists them. The last statement makes sense because learning process is inherently social. At the same time, research by Reeves and Nass [3] has shown that people treat a computer and interpret its actions in social manner even knowing that it is not a human. Summing up, it is possible to conclude that a computerized expert-instructor integrated into software can accelerate the process of adaptation of new users to the system. This is a field of interface agents which are becoming more and more attractive due to the increasing complexity of user interfaces and tasks to which they are applied [4].

The paper presents the conception of the animated interface agent for the concept map based intelligent knowledge assessment system (IKAS) developed at the Department of Systems Theory and Design of Riga Technical University. The necessity to introduce the mentioned agent is related to the continuous growth of system's functionality, low students' awareness of possibilities offered by the system and non-transparent operation of adaptation mechanisms implemented in IKAS. The animated interface agent can solve the mentioned problems and provide adaptation of new users to the system and support to experienced ones.

The structure of the paper is as follows. Section II introduces interface agents and considers requirements for their design. Related works are discussed in Section III. Section IV presents functional overview of IKAS. Section V formulates problems which can be solved by the animated interface agent. Section VI describes the conception of the agent specifying its functions, inputs, outputs, operation schema, visual embodiment, and characteristics. Conclusions and directions of future work are given at the end of the paper.

II. Interface Agents

A. Definition of an Interface Agent

According to [5], an agent, in general, is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators. Interface agents emerged from the recent developments in the field of intelligent agents [6]. Therefore, following the general definition given above, an interface agent can be defined as a "robot" whose sensors and effectors are the input and output capabilities of the interface [4].

The last definition is too superficial. The elaborated explanation of interface agents can be acquired by summarizing available definitions [1], [4], [6], [7], [8]. As a result, an interface agent can be described on the basis of the following items:

- Essence: software entity;

- Environment: user interface of a software system;
- Purpose: performance of tasks for users of a software system or provision of advice/suggestions to them;
- Inputs: users' actions in the environment, direct commands from users, information about user emotional state received through video cameras, eye-tracking devices, etc., information from other agents (if they exist in the environment);
- Outputs: changes in objects of user interface, changes in agent appearance (emotions, gestures, speech, text-based messages, etc.);
- Functions: monitoring of the environment by reading the previously specified inputs, reacting to changes in the environment by acting and producing the previously described outputs, communication with users, and cooperation with other agents (if they exist in the environment);
- Main characteristics: autonomy (independence or ability to work without direct user control), continuity (long-liveness), reactivity (reaction to changes in the environment at reasonable speed), proactivity (anticipatory and self-initiated behaviour), social ability (communication with users and other agents), collaboration (cooperation with other agents in order to reach a common goal), ability to learn in order to assist its users better, and having some kind of presence (visual or audio presence);
- Examples of roles: a personal assistant, an internet guide, an educator, etc.

Interface agents can be implemented as embodied and non-embodied agents. In the first case an agent has some kind of graphical representation. In the second one, it has the form of an algorithm and interacts using a traditional user interface [9].

B. Animated Interface Agents

An animated interface agent (an embodied agent) appears when a visual embodiment is given to an interface agent. Animated interface agents are intended for the improvement of human-computer interaction and can be represented in the form of human-like or cartoon-like animated characters, electronic figures, graphical user interfaces, textual boxes, or any other visual components [6].

An agent implemented as a character (figure) usually exhibits various types of life-like behaviours, such as speech, emotions, gestures, and eye, head and body movements [10]. According to [11], the following types of animated interface agents can be identified:

- Contextual – the agent is consistent with the theme of the environment or task;
- Non-contextual – the agent does not have visual representational relevance to the environment or task;
- Metaphoric – the agent is easily recognizable and understood with a relationship to the environment;
- Abstract – the agent is non-representational or totally irrelevant to the environment or task.

There is no common opinion concerning merits and demerits of animated agents. Dehn and Mulken in their review [10] showed that advocates of animated agents assume that such agents make a computer system more human-like, engaging, and motivating, but their opponents argue that humanizing interface agents might hamper human-computer interaction inducing false mental models of the system and requiring cognitive resources.

At the same time, Amant and Zettlemoyer [12] pay attention to the so called "visually incompetent" interface agents which can disturb users and provide negative experience related to the use of software:

- An agent blinking and fidgeting in the corner of the screen and drawing attention away from the user's work;
- An agent raising dialog boxes that obscure important information on the screen;
- An agent offering suggestion for straightforward action that it is unable to carry out itself.

C. Design of Animated Interface Agents

There is no a common accepted framework, methodology, or guidelines concerning the design of animated interface agents. As a result, in the worst case, developers start the development from scratch, but, in the best one, after studying experience of other researchers. Only few works offer a set of requirements for animated interface agents. In [13] requirements for agent believability are presented. They include:

- Unique and specific personality;
- Presence of emotional reactions;
- Self-motivation (internal drivers and desires allowing the agent to act);
- Changing of agent's personality with time;
- Social relationships (interaction with other characters);
- Consistency of expression (facial expression, body posture, movement, voice intonation, etc. appropriate for the personality, feelings, situation, thinking, etc. of the agent);
- Illusion of life: appearance of goals, concurrent pursuit of goals and parallel action, reactivity and responsiveness, situatedness, resource (mental and physical) boundedness, existence in a social context, broad capabilities and good integration in terms of capabilities and behaviours.

Other set of characteristics related to visual appearance and personality of an agent is presented in [14]. They consider:

- Identity (personality traits, qualities of the character, and idiosyncratic behaviours);
- Backstory (experience, history, and current facts of the character's "life" outside);
- The screen appearance;
- Content of speech;
- Manner of speaking;
- Manner of gesturing;
- Emotional dynamics;
- Role and role dynamics.

Lieberman and Selker [1] mention more general requirements such as:

- Initiative or, in other words, proactive and active operation of the agent while the user is thinking or performing other actions;
- Role played by the agent: assistant or advisor. An assistant agent is one that does things for the user. An advisory agent is one which only teaches the person or suggests to the person;
- Personalization related to learning and adapting to user's characteristics, idiosyncrasies, unique needs, and preferences;
- User modelling;
- Trust in terms of appropriateness of agent's appearance and actions to agent's function in the interface;
- Feedback or, in other words, capability of the agent to explain its actions;
- Instructibility related to the improvement of agent's actions on the basis of recording user's actions;
- Anthropomorphization;
- Cognitive style in terms of user ability to adjust the degree of initiative that the agent can take.

The most detailed set of requirements is provided in [15] and includes:

- Visibility of system status (informing users about what is going on through appropriate feedback within reasonable time);
- Match between the system and the real world (consistence of agent visual appearance, personality, backstory, emotional model, speech content and manner, gestures with specific cultural conventions and norms);
- User control and freedom (direct instruction of the agent, cancelling agent's actions, stopping and starting agent's execution);
- Consistency and standards related to the platform or environment conventions and coherence in all aspects of conversation, gestures, facial expression, and body language coordinated with the attention focus of the current situation;
- Error prevention through careful design;
- Minimization of the user's cognitive load by making objects, actions, and options visible;
- Flexibility and efficiency of use in terms of support of inexperienced and experienced users;
- Aesthetic and minimalist design concerning presentation of clear, relevant, and task focused information to the user, having a variety of dialogues, visual and verbal communication corresponding to the animated agent's personality and backstory consistent with its visual style;
- Help users recognize, diagnose and recover from errors;
- Help and documentation about the use of the animated agent.

III. Related Works

During last two decades a number of interface agents have been developed for different tasks and fields. Some of them such as Adele [16], Steve [17], or Herman the Bug [18] can be treated as the best standards of agent development. However, activities in this area are still in progress. Several research works were conducted recently (in the past 5 years) in the area of embodied and non-embodied interface agents. The main goal of agents in all reviewed implementations is stated as reduction of user work and information overload. By utilizing inference engines based on artificial intelligence and learning process components, intelligent agents provide services in filtering data, searching for information, online tutoring, etc. [19], [20], [21].

Current researches in the area of interface agents could be divided in two groups. The first group pays attention to the creation of efficient processing components ("brains") of non-embodied interface agents. In turn, the second group is focused on finding efficient visual appearance of embodied interface agents to fulfil different types of tasks in different environments. The following description highlights some results achieved by both research groups.

A very recent implementation of non-embodied interface agent is an information agent that assists and guides users to reach the goal of information retrieval [19], [20]. The agent is mobile and it uses Bluetooth wireless functionality of user's mobile phone to connect to other devices and information sources, thus creating a cloud computing environment for processing users' requests. The agent is intelligent and it possesses four main functions: information searching, extracting, classifying, and representing/ranking. However, it can also really and effectively up-rise the performance of information query by optimizing and restructuring users' queries that are submitted in natural language. The agent transforms users' queries into internal canonical format and after that adds semantics to queries through the use of OntoIAS ontology, thus making responses to users' queries more relevant and efficient.

Another recent example of non-embodied interface agent is an intelligent interface agent which supports the use of the web portal in an airline company [22]. The purpose of this agent is to monitor and alert changes concerning the days off in crewmember's roster and to monitor and alert changes associated with the publication of new internal communications. Thus, from the perspective of a crewmember, the agent promotes the timely acquisition of relevant information granting the user with more independence and autonomy. In order to search for relevant information, the agent uses a crewmember profile (or user model) that consists of basic personal information and professional category (position, type of aircraft, etc.).

In the area of embodied interface agents some findings were made recently. With a help of experiments researchers concluded that [23], [24]:

- Human visual forms are more comfortable than agents with non-human visual forms;
- Agents with human-female visual forms are rated higher than agents with human-male visual forms;
- Agents that look young are more preferable;
- A friendly agent is more successful in creating an engaging environment over an unfriendly agent.

Despite general conclusions made about user perception of visual appearance of interface agents, this information cannot be utilized to build 100% effective animated interface agents. Research presented in [6] shows that the best approach in choosing visual presentation for the interface agent is to offer a variety of agent visual interfaces and leave it up to the end-users to decide which one to utilize.

An example of non-efficient interface agents could be MS Office interface agents that act as personal digital assistants [25]. The agents offer tips and real-time advice (for example, shortcut keys) when they believe users may find this information useful and applicable. They take the form of animated, graphic characters such as a paper clip or a wizard with anthropomorphic characteristics. The results of experiments show that presently computer users neither find interface agents useful nor do they enjoy utilizing them. MS Office agents provide very little extra functionality to the conventional help user interface. As a result, these interface agents actually may be intruding into user's activities and only serve to annoy and bewilder users they were designed to help.

The results reported in [26] indicate that embodied interface agents in their current implementation seem too complex, both cognitively and structurally. The author reckons that interface agents should be more "anthropocentric" meaning that agents should be more human-like in terms of visual appearance and interaction with humans. In order to achieve that, the author suggests involving end-users into the design team.

IV. Overview of IKAS

IKAS is a Web-based application which uses concept maps as a tool for knowledge assessment. The system has twofold goals in the context of integration of technology into the traditional educational process [27]: a) to promote students' knowledge self-assessment, and b) to support teachers in improvement of study courses through systematic assessment and analysis of students' knowledge. Knowledge self-assessment is supported by the evaluation of students' concept maps and provision of informative and tutoring feedback. Systematic knowledge assessment is based on possibility to extend an initially created concept map for other assessment stages. Statistics on differences between students' and teacher's concept maps allow teachers to improve their study courses.

The usage scenario of IKAS [27] assumes that a teacher divides a course into several assessment stages. A stage can be any logically completed part of the course, for example, a chapter. For each stage a concept map is created by specifying relevant concepts and relationships among them in such a way that a concept map of each stage is nothing else than an extension of the previous one. During knowledge assessment a student solves a concept map based task corresponding to the assessment stage. On submission of a solution, the system compares student's and teacher's concept maps and generates feedback.

The system can operate a) in mode of knowledge self-assessment allowing a student to assess his/her knowledge level and to learn more about a specific topic in case of incomplete knowledge, or b) in mode of knowledge control intended for the determination of students' knowledge level by a teacher [28].

At the moment six tasks of different degrees of difficulty are implemented [29]. Four of them are "fill-in-the-map" tasks in which the obligatory component is the provided structure of a concept map. Concepts can be partly inserted in it or provided to a student as a list for further insertion into the structure. Depending on the difficulty degree, linking phrases can be inserted into the structure, not used, or provided as a list. Last two tasks are "construct-the-map" tasks which assume that students must create the structure of a concept map from the list of the provided concepts and relate them by relationships using or not using linking phrases. Ten transitions between tasks are implemented: five of them increase the degree of task difficulty, other five reduce it. As a result, students can find tasks suitable for their knowledge level.

At the moment, IKAS provides rich teacher and student support considered along two dimensions [30]: help and feedback. Help assists a student in carrying out a task by finding such degree of its difficulty which corresponds to his/her knowledge level. Feedback presents information about student's progress towards the completion of a task. Help is provided during the solving of tasks, but feedback can be given both during the solving of tasks and after their completion. Help includes the previously mentioned changing of the degree of task difficulty, insertion of concepts into the right nodes of a concept map, and explanations of concepts.

Feedback consists of the labelled student's concept map, quantitative data (difficulty degree, score received, time spent, description of the score calculation process, and average results of other students who completed the same task at other degrees of difficulty), and qualitative data (concept mastering degrees and an individual study plan).

The student model is integrated into the system [29]. For each student it includes general data (such as last and first name, group, login name), initial knowledge level, concept maps, scores, incorrect relationships, concept mastering degrees, individual study plan, learning styles, priorities for types of concept explanations, language of user interface, themes and colours, statistics on the use of different types of concept explanations. The student model is used to perform four adaptation operations: to select the degree of difficulty of the first assessment stage and to change the difficulty degree of the next assessment stages in a study course, to set and to change priorities for types of concept explanations.

Moreover, the system allows teachers to offer questionnaires to students in order to get feedback on provided tasks, use of the system, and a study course.

V. Problems Under Consideration

Since 2005 new functionality is being integrated into the system on an ongoing basis. As a result, IKAS is becoming more and more complex from the point of view of its usability. Several problems are considered at the moment. Firstly, every year new students, who do not have work experience with IKAS, are registered in the system. Secondly, those, who are familiar with IKAS, use it with pauses because the system is not accepted in all study courses of the curriculum. Of course, such students forget about functional capabilities of the system with time. In order to adapt users to the system, the following actions are undertaken:

- Before starting using the system, students receive a document containing a concentrated description of knowledge approach and use of the system;
- Video files and presentations concerning knowledge assessment approach, tasks implemented, and support provided are integrated into the system and are available to students immediately after their logon;
- All elements of user interface have tooltips and meaningful titles.

Thirdly, students do not utilize all potential of the system and their work with IKAS is not quite effective. The proof can be acquired from the analysis of questionnaires offered to students after finishing assessment in a particular course. As a rule, the system is offered to students of the third study year of the bachelor programme at the Faculty of Computer Science and Information Technology in courses "Fundamentals of Artificial Intelligence" and "Methods of Systems Theory". Inquiry results of the last three years (2008-2010) allow concluding that students use very rarely or are not aware at all of system's functional capabilities, especially those concerning student support (Table I). Moreover, log files show that a third part of students do not watch system demonstration video files. The authors of the paper assume also that not all of them read the description sent to them before starting using the system.

Fourthly, adaptation algorithms implemented in the system are working at the background and sometimes customize the system in the way that can be unclear to students.

Thus, real time support is required in order to remind students about available options, to make operation of adaptation mechanisms more transparent, and to explain to students adaptation decisions made by the system. These are motivational factors for the development of the animated interface agent whose conception is presented in the next section.

TABLE I
STUDENTS' ANSWERS ON QUESTIONS CONCERNING STUDENTS' SUPPORT

Questions	Answers	Percentage of answers (number of respondents – 66)
Did you use possibility to acquire explanations of concepts?	No	41%
	I did not know about such possibility	10%
Did you use possibility to check propositions?	No	50%
	I did not know about such possibility	13,6%
Did you use possibility to insert concepts into the right nodes?	No	50%
	I did not know about such possibility	15%

TABLE II
FUNCTIONS OF THE INTERFACE AGENT

Function	Description
Adaptive	The agent might help significantly in adapting new users in the system by: • advising new users to watch video files about IKAS and knowledge assessment approach; • explaining purposes of main windows and menus of the system; • helping new users to start the first knowledge assessment stage smoothly.
Supportive	The agent might support students during the completion of concept map based tasks by: • explaining what is necessary to do in tasks; • tracking elapsed time and warning students about time left; • observing students' actions and reminding students about available support (help) if they have difficulties with the completion of tasks; • reminding to insert linking phrases in tasks where it is necessary; • explaining difference between important and less important relationships in concept maps and advising to re-think created propositions; • reminding to relate concepts by relationships in tasks where it is necessary; • instructing how to move concepts from a concept list to the working space; • reminding to perform intermediate saves of task solutions in order to prevent their loss in case of failures in a network; • reminding to examine result of the previous assessment stage before starting a new assessment stage. The agent might support students after the completion of concept map based tasks by: • instructing how to acquire detailed information about correctness of relationships in students' labelled concept maps; • reminding about possibility to see an elaborated description of results; • attracting students' attention to the individual study plan.
Explanatory	The agent might explain adaptive decisions made by the system such as why a particular difficulty degree of a task is chosen and how the system sets priorities for types of concept explanations.
Motivational	The agent might give some positive motivational/ encouraging feedback to students taking into account students' results at the end of assessment stages.
Administrative	The agent might perform the following administrative functions in the system: • ask students to fill in the questionnaire on learning styles; • ask students to fill in questionnaires prepared by teachers; • ask students to configure priorities for types of concept explanations; • ask students to change parameters in the student model.

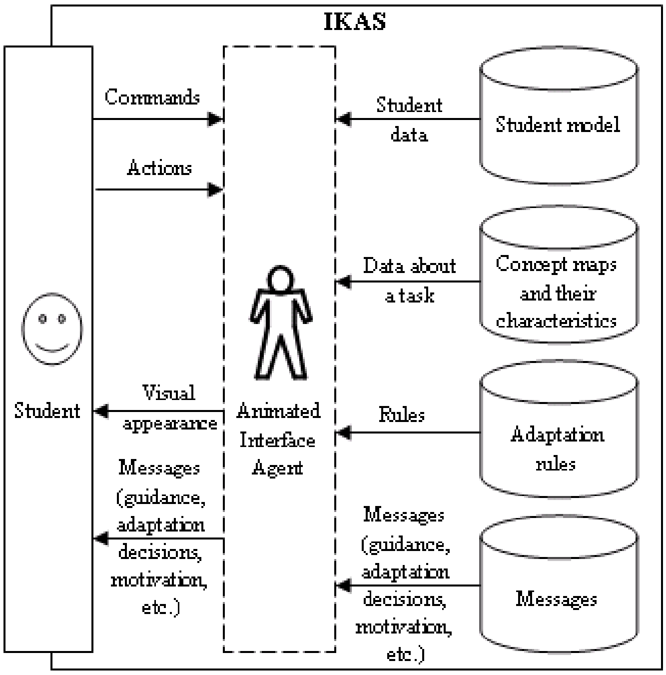

Fig. 1. The general working schema of the interface agent

VI. Conception of the Animated Interface Agent

A. Goal, Functions, Inputs, and Outputs

The goal of the interface agent intended for IKAS is to provide adaptation of new users and support to experienced ones by performing adaptive, supportive, explanatory, motivational, and administrative functions in the system. The mentioned functions are specified in Table II in detail. They clearly show that the agent will play a role of the advisory agent (Section II).

The analysis of the described functions allows identification of the main agent inputs and outputs. They are displayed in Table III. The general working schema of the interface agent is presented in Fig. 1.

The interface agent of IKAS has two types of inputs: direct inputs from a user and system data sources. User's inputs include direct commands from a user and user's observed actions. In turn, system data sources are system storages that mostly contain knowledge about tasks, student data presented in the student model, adaptation rules in the system, and agent messages concerning guidance, motivational strategies, explanation of adaptation decisions, etc. Outputs of the interface agent consist of different type of messages: simple guidance, explanation of adaptation actions, help on concepts and relationships, motivational messages. Another important type of output is agent's visual appearance. The agent is intended to be animated meaning that the agent will change its visual appearance – facial expression, pose, gestures – in correspondence with the current situation in the system.

The interface agent itself will consist of three elements: an internal knowledge base, a processing unit, and a library with different visual appearances (Fig. 2.).

TABLE III

Inputs and Outputs of the Interface Agent

Type	Item	Description
Inputs	Data about a task	Data about a task set by the teacher or corresponding to the type of a task (type, statement, time)
	Commands	Direct commands from a student to the agent to perform specific actions (to stop acting, to start acting)
	Actions	Student's actions observed during the completion of a task (inactivity for certain time, incorrect actions)
	Student data	Data in the student model (student status, whether the questionnaire on learning styles is filled in, whether the parameters of the student model are configured, whether the priorities for types of concept explanations are configured)
	Rules	Adaptation rules that are applicable to a student (selection of the degree of difficulty for the first assessment stage, changing types of concept explanations)
	Messages	Informative and motivational messages relevant to a specific situation or agent function
Outputs	Messages	Messages appearing on the screen in correspondence with the current situation
	Visual appearance	Agent facial expressions, pose, and gestures

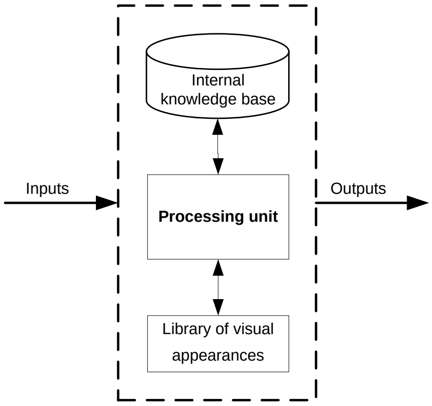

Fig. 2. Internal structure of the interface agent

The internal knowledge base will be filled mostly with knowledge on system's functionality. This will help the interface agent to provide navigation support to a student in the system. The processing unit will be used, for example, to compose motivational messages to a student or to interpret commands typed by students. The library with visual appearances will contain agent's different facial expressions, poses, and gestures that will be activated in correspondence with the current situation in the system.

Existence of the processing unit in the agent architecture means that the agent will demonstrate intelligent abilities. However, sometimes the agent will act without intelligence as a simple routing element (for example, the agent will simply transfer explanations of concepts from the system storage to a student).

TABLE IV

EVENTS TRIGGERING OPERATION OF THE INTERFACE AGENT

Category	Specific events
Before assessment events	Logon of a new user
	Logon of an experienced user and availability of results of at least one assessment stage
Events during assessment	Starting completion of a task
	Saving of the solution is not performed for certain time
	The student does not relate concepts for certain time
	The student uses only one type of relationships for certain time
	The student does not insert linking phrases for certain time
	Assessment time is going to an end
After assessment events	The student has submitted his/her solution of a task
	The student has moved to the window with results
	The student has closed the window with results
	The system determined differences in real and student's set priorities of types of concept explanations

B. Operation

Operation of the interface agent will be based on the "event-response" schema meaning that actions taken by the agent will be initiated by some events in the system. In general, all events in IKAS might be divided in three groups: "before assessment events", "events during assessment", and "after assessment events" (Table IV).

The agent will process events that occur in the system in the following manner. Firstly, it will determine the correct group of an event according to Table IV. Then, the agent will search for an appropriate action for the event from this particular group. Agent's knowledge about events and actions will be presented in a form of IF-THEN rules where IF part contains conditions that must be met before actions specified in THEN part will be performed by the agent responding to the event.

To demonstrate the event handling approach let's imagine that the following event occurred in the system "Saving of the solution is not performed for more than 20 minutes". So, while the student is executing the task, the agent constantly checks all IF-THEN rules that correspond to "events during assessment" group. When a certain event occurs, the corresponding rule is fired, for example, in our case the rule can have the following format:

```
IF (Current_time - Last_time_of_solution_saving >=
20 min) THEN (Show_Warning)
```

According to the rule, the agent will show the warning window asking to save the solution.

C. Visual Embodiment and Characteristics

It is planned to present the agent in a form of a cartoon. Only two types of agents described in Section II are considered at the moment: a contextual agent consistent with the theme of IKAS or a metaphoric agent which can be easily recognizable and understood with a relationship to the system. They are chosen because the authors believe that these types of agents can create a strong linkage between the system and its perception by students.

The agent will be composed of three sections: a section displaying the agent, a section containing text-based messages from the agent, and a section with possible commands or future course of actions. So, it is not planned to implement the agent capable of producing speech. At the same time, emotional model will be embedded into the agent providing gestures, posture, and facial expressions relevant to a specific situation.

Table V displays properties which will be incorporated into the interface agent of IKAS. They are selected on the basis of requirements considered in Section IV of the paper.

TABLE V

PROPERTIES OF THE INTERFACE AGENT

Property	Comments
Identity + Personality + Backstory + Visual appearance + Emotional model	The agent will have a name, personal traits, history, and visual embodiment. The name, history, and the agent visual presentation will be displayed to a user after his/her first logon into the system. Acting, the agent will change its appearance and emotions according to student's actions and agent function. Agent's emotions must be "moderate", because it is not an entertainment agent.
Reactivity	The agent will operate on the basis of "event-response" schema.
Proactivity	The agent will be able to perform actions without direct commands from a student by analyzing information on student's actions.
Learning and adaptivity	The agent must learn from user's action. In future, it is planned to provide possibility to recognize emotions of a student and to react to them in an appropriate manner by changing communication style accordingly.
Feedback	The agent must explain why a certain action is undertaken.

VII. CONCLUSIONS AND FUTURE WORK

Interface agents are a promising solution when it is necessary to adapt inexperienced users to unknown software or to support experienced ones in the use of functional capabilities of a system. The interface agent presented in the paper is aimed to improve usability of IKAS where such problems as continuous growth of functionality, non-transparent operation of adaptation mechanisms and use of the system with pauses from users' side cause rare use or users' unawareness of system's functional capabilities. It is planned that the agent will perform adaptive, supportive, explanatory, motivational, and administrative functions in the system and, therefore, will provide users' support related to the use of the system.

Regardless of the fact that a number of animated agents have been already developed and successfully used, no one of them has been implemented in known concept map based assessment systems. At the same time, working with concept maps has specific nuances manifesting in necessity to relate concepts in some types of tasks, to use several kinds of relationships, to insert linking phrases, to use feedback. In the offered conception these nuances are mostly incorporated in agent's functions and events that can be handled by the agent during knowledge assessment or after it.

The initial conception of the interface agent provides a good basis for future work. The nearest plans include detailed design of the agent in terms of algorithms of its operation and visual embodiment. Further, implementation of the first prototype of the agent and its integration into the system with the purpose to evaluate and to identify the needed improvements are planned.

In distant future, the development of the high-grade animated interface agent capable of recognizing student's emotions and reacting to them properly is considered. Moreover, an option for students to choose among different available characters of the agent may be introduced.

REFERENCES

[1] H. Lieberman and T. Selker, "Agents for the user interface," 2003. [Online]. Available: http://web.media.mit.edu/~lieber/Publications/Agents_for_UI.pdf [Accessed: Sept.12, 2010].

[2] K. Murata, M. Enomoto, Y. Arimoto, and Y. Nakano, "When should animated agents give additional instructions to users?-Monitoring user's understanding in multimodal dialogues," in *International Conference on Control, Automation and Systems*, 2007, pp.733-736.

[3] B. Reeves and C. Nass, *The Media Equation: How People Treat Computers, Television, and New Media Like Real People and Places*. Stanford, CA: CLSI Publications, 1996.

[4] H. Lieberman, "Autonomous interface agents," in *Conference on Human Factors in Computing Systems*, 1997, pp.67-74.

[5] S.J. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*. N.J: Prentice Hall, 2003.

[6] A. Serenko, "Importance of interface agent characteristics from end-user perspective," Int.J.Int.Inf.Tech., vol.2, no.2, pp.48-59, April-June 2006.

[7] P.Maes, "Agents that reduce work and information overload," Commun. ACM, vol.37, no.7, pp. 31-40, 1994.

[8] P. Maes, "Artificial life meets entertainment: lifelike autonomous agents," Commun. ACM, vol.38, no.11, pp.108-114, 1995.

[9] A. Geven, J. Schrammel, and M. Tscheligi, "Interacting with embodied agents that can see: how vision-enabled agents can assist in spatial tasks", in *Fourth Nordic Conference on Human-Computer Interaction*, 2006, pp.135-144.

[10] D.M. Dehn and S. van Mulken, "The impact of animated interface agents: a review of empirical research," Int. J. Human-Computer Studies, vol.52, pp.1-22, 2000.

[11] D. Wonisch and G. Cooper, "Interface agents: preferred appearance characteristics based upon context," 2002. [Online]. Available: www.vhml.org/workshops/HF2002/papers/wonisch/wonisch.pdf [Accessed: Sept.2, 2010].

[12] R.S. Amant and L.S. Zettlemoyer, "The user interface as an agent environment," in *International Conference on Autonomous Agents*, 2000, pp. 483-490.

[13] M. Mateas, "An Oz−centric review of interactive drama and believable agents", Carnegie Mellon University, Pittsburgh, USA, Tech.Rep. CMU−CS−97−156, 1997.

[14] B. Hayes-Roth, H. Maldonado, and M. Moraes, "Designing for diversity: multi-cultural characters for a multi-cultural world," in *IMAGINA Conference*, 2002, pp.207-225.

[15] M.C. Moraes and M.S. Silveira, "How am I? Guidelines for animated interface agents evaluation," in *IEEE/WIC/ACM International Conference on Intelligent Agent Technology*, 2006, pp.200-203.

[16] "Advanced Distance Education". [Online]. Available: http://www.isi.edu/isd/ADE/ade-body.html [Accessed: Feb.24, 2011].

[17] "Virtual Environments for Training". [Online]. Available: http://www.isi.edu/isd/VET/vet.html [Accessed: Feb.24, 2011].

[18] J.C. Lester, B.A. Stone, and G.D. Stelling, "Lifelike pedagogical agents for mixed-initiative problem solving in constructivist learning environments," J.User Modeling and User-Adapted Interaction, vol.9, iss.1-2, pp.1-44, 1999.

[19] S.Y. Yang, C.L. Hsu, and D.L. Lee, "An ontology-supported ubiquitous interface agent for cloud computing – example on Bluetooth wireless technique with java programming," in *Ninth International Conference on Machine Learning and Cybernetics*, 2010, pp.2971-2978.

[20] S.Y. Yang, D.L. Lee, K.Y. Chen, and C.L. Hsu, "A new ubiquitous interface agent for cloud computing – example on Bluetooth, GPS, and Zigbee techniques," in *International Computer Symposium*, 2010, pp.614-619.

[21] I. Jung, D. Thapa, and G.N. Wang, "Intelligent agent based graphic user interface (GUI) for e-Physician," in *World Academy of Science, Engineering and Technology*, vol. 26, iss.1, 2007, pp.194-197.

[22] L. Barbosa, A. Castro, and L. Reis, "An intelligent interface agent for an airline company web portal," in *Fourteenth Portuguese Conference on Artificial Intelligence (EPIA2009)*, 2009, pp.181-192.

[23] N. Perera, G. Kennedy, and J. Pearce, "Are you bored? Maybe an interface agent can help!" in *Twentieth Australasian Conference on Computer-Human Interaction: Designing for Habitus and Habitat*, 2008, pp.1-8.

[24] J. Zimmerman, E. Ayoob, J. Forlizzi, and M. McQuaid, "Putting a face on embodied interface agents," in *Conference on Designing Pleasurable Products and Interfaces*, 2005, pp.233-248.

[25] A. Serenko, N. Bontis, and B. Detlor, "End-user adoption of animated interface agents in everyday work applications," in J.Behaviour & Information Technology, vol. 26, no. 2, pp.119-132, 2007.

[26] B.E. Barbat, "Interface agents for transcultural communication: a framework," in *The good, the bad and the challenging: The user and the future of information and communication technologies*, vol.2, pp.666-674, 2009.

[27] R. Lukasenko, A. Anohina-Naumeca, M Vilkelis, and J. Grundspenkis, "Feedback in the concept map based intelligent knowledge assessment system," in *Fiftieth International Conference at Riga Technical University*, 2009, pp.17-26.

[28] A.Anohina-Naumeca, M.Strautmane, and J.Grundspenkis, "Development of the scoring mechanism for the concept map based intelligent knowledge assessment system," in *Tenth International Conference on Computer Systems and Technologies*, 2010, pp.376-381.

[29] R. Lukasenko and A. Anohina-Naumeca, "Development of the adaptation mechanism for the intelligent knowledge assessment system based on the student model," in *International Conference on Education and New Learning Technologies (EDULEARN'10)*, 2010, pp.005140-005149.

[30] A. Anohina and J. Grundspenkis, "Learner's support in the concept map based knowledge assessment system," in *Seventh European Conference on e-Learning*, 2008, pp.38-45.

Alla Anohina-Naumeca obtained the doctoral degree in the sub-field of system analysis, modelling and design in the field of information technology in 2007 from Riga Technical University, Latvia.

She is a Lecturer at the Department of Systems Theory and Design of the mentioned university. Alla Anohina-Naumeca has nine years experience of teaching in the field of computer science. Her main research fields are intelligent tutoring systems, computer-assisted assessment systems, and artificial intelligence.

Alla Anohina-Naumeca received Gebert Rüf Stiftung's Swiss Baltic Net Graduate Award for outstanding research projects and active participation in international conferences in 2008, as well as Werner von Siemens Excellence Award for the doctoral thesis in 2007 and the master thesis in 2002.

Address: Department of Systems Theory and Design, Riga Technical University, Kalku Str. 1, Riga, LV-1658, Latvia, Phone: +371 67089595, Fax: +371 67089584, E-mail: alla.anohina-naumeca@rtu.lv

Romans Lukasenko is a PhD student of the study programme "Computer Systems" at Riga Technical University, Latvia. He obtained the master degree in computer systems from the mentioned university in 2006.

Romans Lukasenko works as a Researcher at the Department of Systems Theory and Design of Riga Technical University, Latvia.

He received DATI Exigen Group award for the best bachelor work in 2004 and the "Crystal prize" award for the best paper on CompSysTech'08, Bulgaria, Gabrovo, 2008.

Address: Department of Systems Theory and Design, Riga Technical University, Kalku Str. 1, Riga, LV-1658, Latvia, Phone: +371 67089529, Fax: +371 67089584, E-mail: LREXPress@inbox.lv

Dmitrijs Skripkins is a student of the master study programme "Computer Systems" in the Institute of Applied Computer Systems of Riga Technical University, Latvia. He received the bachelor degree from the mentioned university in 2009. At the moment he is developing the master thesis related to the development of emotionally intelligent animated pedagogical agents for intelligent tutoring systems.

Address: Department of Systems Theory and Design, Riga Technical University, Kalku Str. 1, Riga, LV-1658, Latvia, Phone: +371 29335756, Fax: +371 67089584, E-mail: dmitirjskripkins@gmail.com

Alla Anohina-Naumeca, Romans Lukašenko, Dmitrijs Skripkins. Animēta saskarnes aģenta koncepcija jēdzienu tīklos sakņotai intelektuālai zināšanu vērtēšanas sistēmai

Intelektuālas mācību sistēmas, pateicoties to spējai nodrošināt personificētu mācību pieredzi, ir progresīvs un perspektīvs risinājums e-mācību jomā. Taču parasti šādas sistēmas tiek izstrādātas noteiktam mācību kursam vai kursa tēmai. Rezultātā tām ir specifiskas interaktīvas lietotāja saskarnes, kas ir piemērotas izvēlētajai mācību sfērai, sastāv no daudziem elementiem un realizē sarežģītu funkcionalitāti. Tādējādi, šādu sistēmu lietotājiem bieži vien nav vajadzīgas pieredzes, kas ļautu efektīvi izmantot sistēmu, un ir nepieciešams noteikts laiks, lai lietotāji adaptētos sistēmai un tās piedāvātajām iespējām. Saskarnes aģenti ir daudzsološs risinājums, kad ir nepieciešams adaptēt lietotājus nepazīstamai programmatūras sistēmai vai atbalstīt tos lietotājus, kuriem jau ir pieredze sistēmas lietošanā, tās funkcionālo iespēju izmantošanā. Šādi aģenti uztver lietotāju darbības lietotāja saskarnē un reaģē uz tām, mainot vizuālus elementus lietotāja saskarnē vai savu izskatu ar mērķi izpildīt uzdevumus lietotāja labā vai piedāvāt lietotājiem atbilstošu padomu/ rīcības instrukcijas. Animēti saskarnes aģenti ir vērsti uz cilvēka-datora mijiedarbības procesa pilnveidošanu un tiek atspoguļoti kā cilvēkam līdzīgi vai multiplikācijas personāži. Raksts ir veltīts animētam saskarnes aģentam, kurš tiek izstrādāts jēdzienu tīklos sakņotai intelektuālai zināšanu vērtēšanas sistēmai. Minētajā sistēmā tādas problēmas kā pastāvīga sistēmas funkcionalitātes paplašināšana, necaurspīdīga adaptācijas mehānismu darbība un sistēmas izmantošana ar pārtraukumiem no lietotāju puses noved pie tā, ka lietotāji reti izmanto vai vispār nezina par sistēmas iespējām. Lai atrisinātu šīs problēmas, ir paredzēts integrēt sistēmā animētu saskarnes aģentu. Rakstā ir piedāvāta šāda aģenta koncepcija, specificējot aģenta mērķi, funkcijas, ieejas, izejas, darbības shēmu, vizuālu iemiesojumu un īpašības. Koncepcija ir izstrādāta, balstoties uz zināmo aģentu raksturojumu un izstrādes prasību apkopošanu, kā arī sistēmas vajadzību analīzi.

Алла Анохина-Наумец, Роман Лукашенко, Дмитрий Скрипкин. Концепция анимированного интерфейсного агента для интеллектуальной системы оценивания знаний, основанной на сетях понятий

Интеллектуальные системы обучения, обеспечивающие индивидуальный опыт обучения, - это перспективное решение в области э-обучения. Однако обычно они создаются для отдельного учебного курса или темы. В результате, эти системы имеют специфический интерактивный интерфейс, который соответствует сфере обучения, состоит из множества элементов и реализует сложную функциональность. Таким образом, у пользователей таких систем зачастую нет опыта, позволяющего эффективно использовать систему, и им необходимо время для адаптации к её возможностям. Интерфейсные агенты - многообещающее решение в ситуациях, когда необходимо адаптировать неопытных пользователей к неизвестному программному обеспечению или оказать поддержку тем пользователям, которые уже имеют опыт эксплуатации системы с использованием её функциональных возможностей. Такие агенты воспринимают действия пользователей и реагируют на них, меняя визуальные элементы или свой собственный облик с целью выполнения заданий для пользователя или обеспечения советов/инструкций к действию. Анимированные интерфейсные агенты направлены на улучшение взаимодействия между человеком и машиной и отображаются в виде человекоподобных или мульт-персонажей. Данная работа посвящена одному из таких агентов, который разрабатывается для интеллектуальной системы оценивания знаний, основанной на сетях понятий. В упомянутой системе такие проблемы как непрерывное расширение функциональности, непрозрачная работа механизмов адаптации и использование системы с перерывами со стороны пользователей приводят к тому, что они редко используют или вообще не имеют представления о возможностях системы. С целью решения этих проблем предложено интегрировать в систему анимированного интерфейсного агента. В работе представлена концепция этого агента, которая включает в себя цель, функции, входы, выходы, схему работы, визуальное воплощение и свойства агента. Концепция основывается на обобщении известных характеристик агентов и требований к их разработке, а также на анализе потребностей самой системы.