

OCC FOR EMOTION GENERATION IN e-LEARNING SYSTEMS

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Abstract: This paper describes an educational authoring tool that incorporates the OCC cognitive theory of emotions in order to help instructors create and author affective courses. The authoring tool provides an important facility to instructors for the creation of their own tutoring characters for the user interface of the resulting applications. In this way, the tutoring characters that are speaking, animated personas may represent the teaching behaviour of the human instructor who is in charge of the remote lessons. Students, who are going to use the resulting educational applications, will have a user interface that is more human-like and affective. Thus they may feel less deprived of the human-human interaction between them and a human teacher that would take place in the settings of a real classroom.

1 INTRODUCTION

Web-based education is particularly good for remote teaching and learning at any time and place, away from classrooms and without necessarily the presence of a human instructor. However, this independence from real teachers and classrooms may cause emotional problems to students who may feel deprived of the benefits of human-human interaction. This may affect the educational process in a negative way because as Goleman (Goleman, 1995) points out, how people feel may play an important role on their cognitive processes as well. In this paper we address this problem by providing an authoring tool for educational applications that constructs animated tutoring personas with emotion generation capabilities, thus rendering web-based human-computer interaction more human-like. Instructors in general may use this authoring tool to create their own educational characters that will interact with their students in e-learning environments. Personas may be parameterized in many aspects, the way they speak, the pitch, speed and volume of their voice, their body-language, their facial expressions and the content of their messages. Additionally, for educational purposes, personas may express specific emotional states by the incorporation of the OCC (Ortony et. al., 1990) model. In view of the above our system incorporates an affective authoring module that relies on the OCC theory. The system uses the OCC cognitive theory of emotions for modelling possible emotional states of

users-students as well as for proposing tactics to the instructors for improving the interaction between the persona and the student while using the educational application. Through the incorporation of the OCC model, the system may suggest that the tutoring persona should express a specific emotional state to the student for the purpose of motivating her/him while s/he learns. Consequently, the persona may become a more effective teacher, reflecting the instructors' vision of teaching behaviour.

In the last decade, education has benefited a lot from the advances of Web-based technology. Indeed, there have been many research efforts to transfer the technology of ITSs and authoring tools over the Internet. A recent review (Brusilovsky, 1999) has shown that all well-known technologies from the areas of ITS have already been re-implemented for the Web. Some important assets include platform-independence and the practical facility that is offered to instructors of authoring e-learning courses at any time and any place. A remedy for these problems may lie in rendering human-computer interaction more human-like and affective in educational software. To this end, the incorporation of speaking, animated personas in the user interface of the educational application can be very important. Indeed, the presence of animated, speaking personas has been considered beneficial for educational software (Johnson et. al., 2000, Lester et. al., 1997). Hence, there have been many educational applications that incorporate animated pedagogical personas in their user interfaces (Rist et.

al., 1997).

However, as yet there are no authoring tools that provide parameterization in user interface components such as speech-driven, animated personas. The present authoring tool provides the facility to authors to develop tutoring systems that incorporate speaking, animated personas who can be parameterized by the authors-teachers in a way that reflects their own vision of teaching behaviour in the user interface of the resulting applications. In many cases it would be extremely useful to have such facilities in handheld devices, such as mobile phones rather than desktop or portable computers so that additional assets may be gained. Such assets include device independence as well as more independence with respect to time and place in comparison with web-based education using standard PCs. The proposed system deals with the problem of facilitating instructors in the educational software management. Additionally, the resulting educational software incorporates sophisticated mechanisms for accessional emotional interaction in the educational process in order to assist instructors in authoring user-friendlier, more affective, thus more effective, educational courses.

2 OVERVIEW OF THE TUTORING PERSONAS

In the educational applications that result from the authoring process described in this paper, the tutoring persona of the user interface is a cartoon-doctor. The cartoon-doctor is an animated persona who can move around the tutoring text and can show parts of the theory that a student should read (Figure 1). It has also incorporated features of human body-language. It may show patience while the student reads the theory, boredom if the student is not responding to the system, wonder if the student makes an unexpected move, etc. The cartoon-doctor's behaviour is programmatically controlled by an underlying mechanism that relies on the OCC theory, described in the next section.

Instructors may choose from 27 available speech engines that the system incorporates. These speech engines are synthesisers that produce different voices. The system also offers the facility of parameterising these voices by changing the pitch, speed and volume, as illustrated in figure 2. Thus, the resulting tutoring system may use the voices differently in different contexts to show enthusiasm, when the student is doing particularly well, to imitate whisper, when it judges that the student

needs help, or even to show anger when the student is consistently careless and does not pay any attention to the system.



Figure 1: The cartoon-doctor.

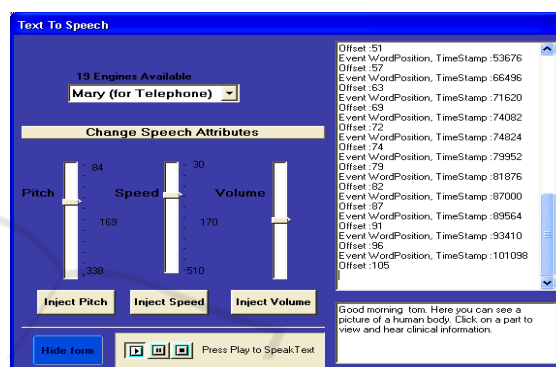


Figure 2: Setting parameters for the voice of the tutoring persona.

As an example, by increasing the pitch and also the speed and volume of the speech we have the effect of a more “angry” tone of speaking. This may also be achieved by selecting the appropriate speech engine. We may have a special speech engine that always synthesises speech with an angry tone.

The system incorporates built in tools, to which only the instructors have access. These tools help the instructors modify the behaviour of the characters further, with the personas' emotion generation facility as the final objective. Not only can the instructor command the assistant to say something under certain circumstances, but s/he can also add commands in the text that will be spoken, in a way that the persona may seem to express a specific emotional state. These commands are understood by the system and are interpreted into changing speech attributes, body movements, facial expressions, etc.

3 THE OCC COGNITIVE MODEL OF EMOTIONS

The expected contribution of our system is to affect positively the educational process in general. More

specifically, the system should motivate the students for the purpose of learning more efficiently and also more enjoyable. In (Soldato and Du Boulay, 1995) it is suggested that a tutoring system must react with the purpose of motivating distracted, less confident or discontented students, or sustaining the disposition of already motivated students. However, even if new multimodal capabilities like 3D-video and speech synthesis have made pedagogical personas more human-like, there is also a great need in determining “how” (what exactly should the pedagogical persona do) and “when” (in which situation) a pedagogical persona should act/ behave in each part of the tutoring process.

Elliott and colleagues (Elliott et. al., 1999) believe that pedagogical personas will be more effective teachers if they display and understand emotions. More specifically they point out that:

- A persona should appear to care about students and their progress
- A persona should be sensitive to the student’s emotions
- A persona should foster enthusiasm in the student for a subject matter
- A persona may make learning more fun

In view of the above our system incorporates an affective authoring module that relies on the OCC theory (Ortony et. al., 1990). The system uses the OCC cognitive theory of emotions basically for modeling possible emotional states of users-students as well as for proposing tactics to the instructors for improving the interaction between the educational persona and the student while using the educational application. Through the incorporation of the OCC, the system may suggest that the pedagogical persona should express a specific emotional state to the student for the purpose of motivating her/him while s/he learns. Accordingly, the persona becomes a more effective teacher.

In OCC theory, emotional states arise from cognitive models that measure positive and negative reactions of users to situations consisting of events, agents and objects. Correspondingly, events match user goals that are key elements in the OCC theory.

Table 1 illustrates intensity variables concerning user input actions and application events that are used by the system’s adapted OCC emotion model in order to propose an apposite for each case emotional state for the pedagogical persona. The variables illustrated in table 1 have been specified in our own implementation and adaptation of OCC in our educational application.

Table 1: Variables for calculating the intensity of events for the OCC theory.

Event Variables
<ul style="list-style-type: none"> • a mistake (the user may receive an error message by the application or navigate wrongly) • many consecutive mistakes • absence of user action for a period of time • action unrelated to the main application • correct interaction • many consecutive correct answers (related to a specific test) • many consecutive wrong answers (related to a specific test) • user aborts an exercise • user aborts reading the whole theory • user requests help from the persona • user takes a difficult test • user takes an easy test • user takes a test concerning a new part of the theory • user takes a test from a well known part of the theory

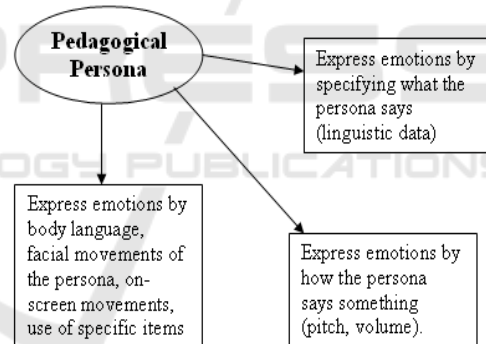


Figure 3: Events-Actions of the persona for the synthesis of an emotional state.

The application’s user interface is multi-modal, thus it is possible for the system to monitor and record user actions such as speed of typing through the keyboard as well as low voice volume through the microphone etc. The proposed authoring system integrates the OCC model by comprising a subset of five basic emotional states, namely happiness, sadness, anger, fear and surprise. Each one of the above mentioned five emotional states can be synthesized by the animated persona, as it is illustrated in figure 3.

As an example we describe a situation where a student is taking a multiple choice test after having read the corresponding theory of that lesson. The

“default” goal for each user is to succeed in answering correctly the questions of each test. In our example we assume that the difficulty level of the test is high and the student has already answered a couple of questions correctly. At this point in accordance with the system’s incorporated OCC model the student is pleased that s/he has answered correctly the previous questions and is also experiencing hope that s/he will continue answering correctly. The corresponding intensity variables for this event are illustrated in table 1 as “many consecutive correct answers (related to a specific test)” and “user takes a test concerning a new part of the theory”. The second variable indicates that succeeding in such a test is difficult, thus can invoke admiration by the pedagogical persona. The user’s hope of continuing to answer correctly may then be encouraged by the pedagogical persona by expressing admiration for the student’s success and encouraging her/him to continue answering successfully. In this case the student has a “goal” for answering correctly. If the student continues her/his successful course the pedagogical persona will express happiness, by saying something in a “happy voice” and/or by smiling or doing a positive gesture.

4 CONCLUSIONS

This paper has described an educational authoring tool that incorporates the OCC theory in order to create tutoring personas with emotion expression facilities. Based on each student’s interaction, goals, achievements and mistakes, the system proposes an emotional state for the tutoring persona as a tactic in supporting the educational process. In this way, the tutoring personas that are speaking, animated characters may represent the teaching behavior of the human instructor who is in charge of the remote lessons. Students, who are going to use the educational applications, will have a user interface that is more human-like and affective. Thus they may feel less deprived of the human-human interaction between them and a human teacher that would take place in the settings of a real classroom and get motivated for the purpose of learning more efficiently and also more enjoyable.

It is among our future plans to evaluate the system in order to examine the degree of usefulness of the authoring tool for the instructors, as well as the degree of usefulness and user-friendliness for the students who are going to use the educational system.

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REFERENCES

- Brusilovsky, P., 1999. *Adaptive and Intelligent Technologies for Web-based Education*. In C. Rollinger and C. Peylo (eds.), *Künstliche Intelligenz (4)*, Special Issue on Intelligent Systems and Teleteaching, 19-25.
- Elliott, C., Rickel, J., Lester, J., 1999. *Lifelike pedagogical agents and affective computing: An exploratory synthesis*, Lecture Notes in Computer Science, 1600, pp. 195-212.
- Goleman, D., 1995. *Emotional Intelligence*, Bantam Books: New York.
- Johnson, W. L., J. Rickel, and Lester, J., 2000. *Animated Pedagogical Agents: Face-to-Face Interaction in Interactive Learning Environments*. *International Journal of Artificial Intelligence in Education*, vol. 11, pp. 47-78.
- Lester, J., Converse, S., Kahler, S., Barlow, S., Stone, B., and Bhogal, R. 1997. *The Persona Effect: affective impact of animated pedagogical agents*. In Pemberton S. (Ed.) *Human Factors in Computing Systems, CHI’97*, Conference Proceedings, ACM Press, pp. 359-366.
- Ortony, A., Clore, G., Collins, A. 1990. *The cognitive structure of emotions*, Cambridge University Press.
- Rist, T., André, E. and Müller, J. 1997. *Adding Animated Presentation Agents to the Interface*. In Proceedings of the 1997 International Conference on Intelligent User Interfaces (eds. J. Moore, E. Edmonds & A. Puerta), 79-86. ACM Press, New York.
- Soldato, D, Boulay, D., 1995. *Implementation of motivational tactics in tutoring systems*. *Journal of Artificial Intelligence in Education* 6 (4), pp. 337-378.