Towards a platform for the education in emotion modeling based on virtual environments

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Abstract. The emotion modeling is a wide, multifaceted theme attracting many scientists. Many different projects focus on different aspects of emotions. What has not been studied in a greater depth is the education in the field of emotion modeling itself. We believe that the time has come to establish a platform that would enable learn-by-example education in this field. This position paper presents our aim at creating a software toolkit facilitating the basic education of event appraisal and emotion modeling in virtual environments. This toolkit is presently being built upon the platform Pogamut 2 used for education of undergraduate students in the field of virtual agents control.

Keywords: Emotions, virtual agents, education.

1 Introduction

Emotions play an important role in human behavior [1]. Due to their ambiguous nature, there are number of ways they can be studied. In recent years there has been a growing interest in emotion modeling in virtual environments. Emotions serve a number of purposes here – from increasing believability or performance of virtual agents to the simulation of some real world scenarios for learning purposes [2]. The role of emotions in virtual agents is not clear-cut. Emotions can affect decision making [3], expressive part of agents' behavior [4] or just serve the agent as another source of information when interacting with humans [5]. So far just a little attention has been given to the education in the field of emotion modeling itself. Especially – as far as we know – there is no platform that would facilitate the education in this field.

In our previous work we have created an educational platform Pogamut 2 [6]. This platform is fully developed and is being used as a tool for education of undergraduate computer science students at Charles University in Prague in the field of modeling behavior of virtual agents. Pogamut 2 enables simple way of prototyping virtual agents in the virtual world of 3D action game Unreal Tournament 2004 (UT04) [7]. In UT04 the player can see the 3D environment through the eyes of the avatar he or she is currently controlling. The 3D environment of UT04 can be very realistic (Fig. 1). Although UT04 is an action game, its environment can be easily exploited for "peaceful" scenarios.

The established university course that uses platform Pogamut 2 concerns also problematics of emotion modeling. So far the education in this field was just

theoretical because the Pogamut 2 does not provide any support for emotions. Consequently, the students were unable to take a grasp of the problematics. This fact and the absence of a platform facilitating education of emotion modeling in general motivated us to extend Pogamut 2 with emotion aspect.

Our general plan is to provide an interactive tool that will complement theoretical education in the field of virtual agents and emotion modeling. The target audience are students of computer science interested in artificial intelligence, virtual agents and/or artificial emotions. Educational goals are to provide examples in interactive scenarios covering the following topics: roles of emotions for virtual agents (emotions and expression, emotions as information, emotions and control) and OCC like models (general overview of the mechanisms used, event appraisal). OCC [8] is a cognitive theory of emotions proposed by Ortony, Clore and Collins that provides a popular descriptive emotion model.

We plan to evaluate the project in the already established course that is taking place on Charles University in Prague, Faculty of Mathematics and Physics.

In this position paper, we present the emotion model we have started to develop, including example scenarios intended to use for education (Section 2). We also discuss our approach and open issues of the project (Section 3).

Fig. 1. Environment of the game UT04. UT04 features various locations from open locations (forests, hills, grass fields) to closed ones (old factories, castles, space stations with low gravity, etc.). Copyright Epic Games 2008.

2 Emotions in Pogamut 2 (work in progress)

Pogamut 2 is a software platform for an easy prototyping of virtual agents living in a virtual environment. The aim of the platform was especially to provide the Integrated Development Environment (IDE) (Fig. 2). The platform facilitates the development of virtual agents by offering the IDE, which provides tools for controlling the agent, visualization of agents' inner state and debugging.

The IDE capitalizes on NetBeans. As a virtual environment, 3D action game Unreal Tournament 2004 (UT04) is used. GameBots (GB) [9], debugged and extended by additional features, are utilized to connect UT and IDE via network text protocol.

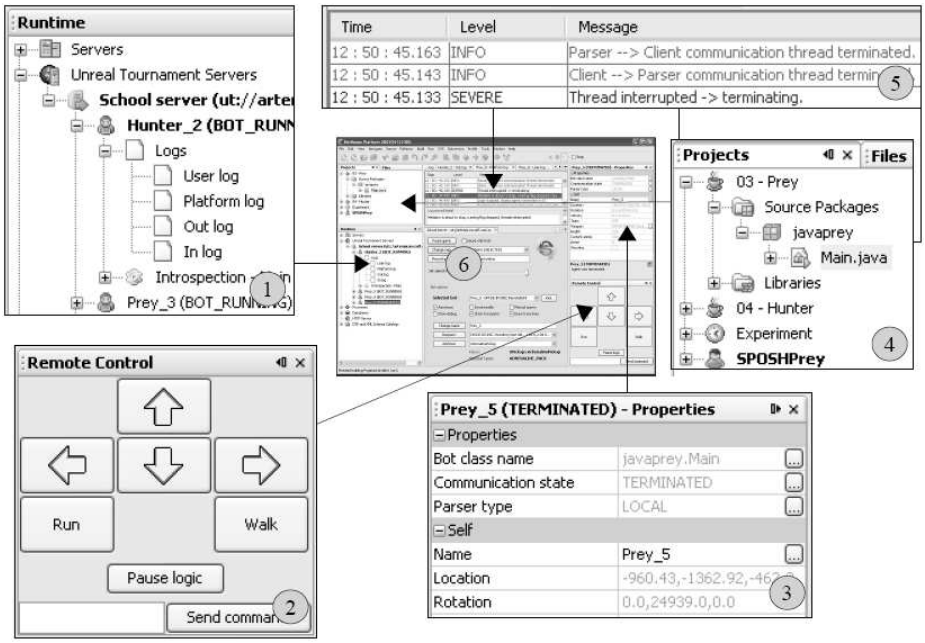

Fig. 2. Pogamut 2 IDE. Pogamut 2 features several distinct tools supporting the process of agent prototyping and debugging: The list of running servers and agents (1) helps with a management of multiple agents. The agents' properties inspector (3) gives a quick access to variables common for all agents, e.g. position, velocity, orientation, health. The logs (5) display logged messages from communication with the GameBots, the platform and the agents' logic logs. The UT04 game server can be remotely administrated from (6).

As said above, the goal of the project Emotions in Pogamut 2 is the extension of the educational potential of the platform by the emotion aspect. This should be achieved by simple (easy to understand) and extensible emotion model along with provided scenarios that will cover educational goals defined in the introduction.

Below the prototype of emotion model will be described along with the presentation of two forms of scenarios currently considered. This will be followed by a preliminary analysis of design decisions.

The emotion model. The emotion model is inspired by OCC theory [8]. Emotions in the model are represented by their intensities, which range from 0 to 1. The set of simulated emotions is limited compared to OCC theory. The set includes anger, fear, joy, sorrow and surprise. Surprise is an extension to OCC – it is modeled by variable expectedness. Other emotion affecting variables used in the model include desirability, praiseworthiness, appealingness and intensity (intensity supplements most of the intensity affecting variables of the OCC model).

Each emotion in the model has a valence. The valence is a variable with three states – positive, negative or neutral – and is used for determining the mood of the agent. The current mood is counted as the difference between averages of all emotions with positive valence and all emotions with negative valence (emotions with neutral valence are not affecting the mood).

The model is equipped with a limited memory of encountered agents and situations. The averages of changes of emotions intensities caused by the agent or situation are stored in the memory. This information then influence event appraisal. The model also features a mechanism of habituation that is used especially for lowering the intensity of changes of emotions caused by situations that occur repeatedly. Memory and habituation mechanism help the model to adapt to the environment.

The model works in three phases (Fig. 3). Firstly, the emotion-significant situations in the environment are recognized (the recognized situations can differ according to the scenario). The situations will be defined in Pogamut 2 platform. Each time a situation occurs in the environment, it will be sent to the emotion model as a data structure containing the necessary properties (who participates in the situation and what has actually happened). Secondly, the situation is appraised by a set of OCC variables. The value of these variables will depend on the properties of the situation and on the agent's current state and goals. Thirdly, these variables are processed by the set of IF-THEN rules specified by the OCC theory, resulting in potential change of emotions intensities.

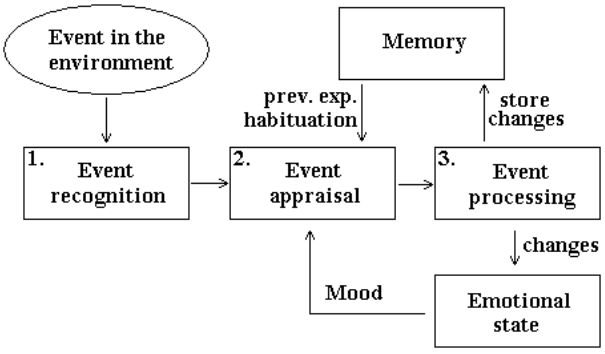

Fig. 3. The emotion model architecture. Description in the main text.

The resulting emotions intensities are influenced by the agent's current mood, his previous emotional experience with the situation, emotions attributed to other agents that participate in the situation, and the mechanism of habituation. Previous experience will influence emotions for example as follows: If some situation caused agent to be angry in the past, he will have higher tendency to get angry in the future experiencing the same situation.

The eyewitness agent scenario. This scenario will present one agent with emotions – the main character, a set of background actor-agents without emotions and one tutor without emotions. The main character will be eyewitnessing a set of predefined situations performed by actor-agents, which will be designed to trigger emotion response. Examples of such situations include other agents winning money in a lottery, a wedding, a bank robbery or even a car accident. The main character will comment these situations by a text module, telling a story about it. The changes of his emotions will affect the way he is commenting. This will be then explained by the tutor. Students will be able to interact with the scenario – they will be able to change the parameters of the emotion model and guide the main character through the environment.

In the scenario, the OCC variables of each situation will be shown along with resulting changes in the agent emotion intensities. The speech text module will be implemented using templates. Mapping of emotions to expressive behaviors in this scenario will be done one to one (one emotion for one type of expressive behavior).

This scenario can be used to explain emotional event appraisal for OCC based models. It also shows one of the roles of emotions for virtual agents – expressive behavior and emotions affecting the speech – together with associated issues (e.g. believability of expressive behavior against believability of emotion model).

The emotion agent scenario. This scenario will show that emotions can be used in agent decision making and demonstrate the advantages and pitfalls of this approach. The goal is to show properties of behaviors of agents with emotions and contrast them with behaviors without emotions. The emotions will be used as a control mechanism – agents' behaviors will be triggered exclusively by them.

The scenario will be aimed on agent survival (for this purpose the environment of UT04 is ideal as it is an action game which contains plenty of mechanisms and rules aimed on survivability). The agents will play regular game of UT04. They will try to conquer the opponent as often as possible trying to survive themselves.

Each emotion will be associated to one type of behavior (e.g. fear – avoidance behavior). The behavior with the emotion of highest intensity will be triggered. This will require a filter that will prevent rapid periodic switching of behaviors.

We remark that the aim of the scenario is not to show that the agent with emotions will score better than the agent without emotions. The scenario will show that the emotions can be used as condensed information about the environment and that they can take part in agent's decision making.

3 Analysis and Discussion

Platform Pogamut 2 and UT04 have been chosen because of two reasons. Firstly, as Pogamut 2 is our previous project, we have a good experience working with the platform and good idea how to extend it. Secondly, and more importantly, advantage of UT04 is that it can be easily extended because of its scripting language (UnrealScript), which is used for programming game mechanics. Epic Games (creator of UT) is still working on Unreal Tournament game series (UT 2007 was recently published) providing the game with better graphics engine, but still using UnrealScript language. This enables the migration of our projects to new versions of UT (taking advantages of facial expressions support and better gesture support).

The motivation to base emotion model on OCC is that the OCC model is often used as a theoretical background or it is even implemented in projects involving virtual agents, e.g. [10, 11, 12]. Its limitations are well known [13] and enhancements of the model are still being discussed [14]. Overall we believe that OCC theory is a good starting point in education of problematics concerning emotion modeling.

The removal of some emotions in the implemented model is justified by two facts. Firstly, as stated by Ortony in [14], the OCC theory by itself contains unnecessarily high number of emotion categories (concerning modeling emotions for virtual agents). Secondly, as the complexity of virtual environment is limited (comparing it to the real world), it is possible to limit the emotion model (e.g. the number of modeled emotions). Moreover the limited set of modeled emotions will enable easy mapping of emotions to expressive behavior (one to one). It will be possible to extend the model by the rest of OCC emotions – if needed (by adding the necessary variables and by extending event appraisal to support these variables).

There are several open issues. Firstly, there is the question whether we should use BDI (Belief Desire Intention) approach for controlling the agent or whether simple IF-THEN rules will be sufficient? This decision will be affected by the complexity of the emotion model. The model should be simple and easily understandable and at the same time it should show variety of emotion mechanisms. We plan to use both approaches (IF-THEN rules and BDI) and evaluate which of them will suite the problem better.

Secondly, we believe that the major advantage of interactive scenarios is that they provide feedback on ideas of students. The question is the amount of the interactivity needed for the efficient education. We will produce several scenarios with different amount of interactivity. Then we will be able to see which of them will be prefered by the students and we will have grounds for more thorough evaluation.

Thirdly, there is a question of the manifestation of the emotions. This is a complex problem by itself. For the project we need a set of clear-cut emotion manifestations. UT04 provides number of gestures and animations and can be extended by new ones. Facial expressions support is somehow limited in UT04, so we have decided not to include it in the project. For the project it may be needed to extend UT04 by the module supporting emotional expressivity (the work on this module already began). There is also the possibility of migration to Unreal Tournament 2007, which provides better gesture and facial expressions support. In future, we will also consider a possibility of defining gestures through BML [15], which is a markup language that provides standardized way of gesture specification.

4 Conclusion

The paper presented an ongoing project aimed on the education in the field of emotion modeling using virtual environments. The project will extend educational platform Pogamut 2, which uses virtual environment of the action game Unreal Tournament 2004. The goal of the project is to complement theoretical education in the field of virtual agents and emotion modeling by interactive scenarios demonstrating the problematics. An eyewitness and emotion agent scenarios were proposed to cover the following topics: roles of emotions for virtual agents (emotions and expression, emotions as information, emotions and control) and introduction to OCC like models (general overview of the mechanisms used, event appraisal).

Future work will include the implementation of the emotion model along with creating the scenarios in UT04. Then the project will be validated in the ongoing course at Charles University in Prague concerned with virtual agents.

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