Emotional Agents in Computer Games

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Abstract

Virtual simulations and environments in computer games are becoming increasingly more realistic and sophisticated. A predominant feature in many of modern games is the use of computer controlled characters (NPCs) for the purpose of more dynamic and diverse gameplay. One of the concerns regarding NPCs is that they often lack realistic behavior simulation and natural emotion-based behaviors, especially when interacting with players or other NPCs. The realism that the environment and the appearance of the character create is thereby broken to some extent.

In this paper I will present an overview of suggested solutions to the problem of simulating realistic emotion-based behaviors with emphasis on emotion models as well as discuss some of the founding theories for emotion simulation.

1. Introduction

Emotions are central components in our lives. They impact everything we do, how we see the world and what we believe. Emotion also plays a heavy role in the way we communicate with each other. Many modern computer games rely heavily on communication between players. In these games, the environment gives the impression of a realistic and dynamic virtual world. The player's avatar and computer controlled characters (NPCs or non-playable characters) within the game have the same realistic appearance but when the player wants to engage in a conversation with an NPC the realism created by the environment is often broken. The reason lies within the player's expectation of the NPC's responses and behavior towards the player's avatar. For a realistic social interaction between a player and an NPC, the NPC must be able to exhibit realistic emotion responses and behaviors regarding both the subject under discussion as well as towards the player. This is often absent in modern games. To make a believable social interaction between players and NPCs or even between NPCs themselves the interaction is generally scripted by a human author and the NPC as has a

limited number of hand-animated social and emotional responses. The results of this method are often brittle and unbelievable characters that do not engage the player sufficiently as well as the method being expensive and time-consuming to implement.

To solve this problem the use of emotional models, personality simulation and conversation trees have been suggested, among others. The aim of this paper is to present a brief overview of suggested solutions to the problem of realistic NPC emotional behavior and discuss possible future advances in the field.

2. "Emotion solutions" for NPCs

When considering the problem of emotional behavior of NPCs in games the question of simulation versus emulation will quickly surface. Are simulations and other methods that "fake" emotional responses sufficient or do the more detailed methods such as emotion models provide significantly more realistic responses? Is it necessary for NPCs to have the same emotion and behavior spectrum of a human being? The debate regarding this issue within the game-developing community is ongoing and will unavoidably differ between game-genres. This issue deserves a detailed exploration and discussion, more than is possible for this paper, and will therefore not be explored further in this paper.

This section introduces three distinct categories of solutions to this issue: emotion models, personality models and "brute force" methods, with the main focus being emotion models.

2.1 Solution overview: "the big three"

There have been many attempts made to solve the problem of realistic emotional behavior for NPCs both in academia and industry. The gaming-industry in general seems to prefer "brute force" methods but there is a growing interest in trying to find other solutions. The main reason being that the programing of realistic emotion and responses "by hand" is not only expensive and time consuming but could result in an unrealistic behavior. For the majority of solutions to this problem, I suggest the three following categories: the aforementioned "brute force" methods, emotion models and personality models.

2.1.1 Emotion models

Much effort has gone into the discussion and research of emotion models, in academia especially. To clarify how emotion models work we should consider the main role of an emotion model. That is to allow the character to argue about its own emotions the way humans

do. There is one model, the OCC model that has established itself notably as the standard model for emotion, this model as well as the main components of emotion models will be covered later.

2.1.2 Personality models

Personality models is a term for all solutions that use theories of personality, such as the Five Factor Model of personality, or are in any way based on defined personality types or traits. They often have many of the same central components as emotion models, such as categorization, goals, evaluation and mapping (see section 2.2). Since the main focus will be on emotion models there will be little more elaboration on the specifics of personality models.

2.1.3 "Brute force" methods

Methods such as hand-scripted actions and responses, conversation and behavior selection trees and other similar techniques where the characters behavior in the environment, responses to objects or other characters that it encounters are not dynamic or take situation, relationships or goals into account when generating behaviors. These techniques seem to be favored in the game-development community.

2.2 Modeling emotions: the main components of emotional models

There are several emotion models that have been developed in academia. Of those models is the OCC model that has been referred to as the standard model for emotion synthesis. (see section 2.2.1) and many emotion models are based on the same principles. There is therefore a common thread in most emotion models whereas they seem to share many of the same basic components. These are classification, calculation of intensity, interaction between categories and the characters current emotional state, mapping the resulting emotion onto categories and lastly expression of the characters new emotional state.

The core concept of many emotion models is the categorization of emotion, for to be able to express an emotion the NPC has to know what kind of an emotion it is feeling. These categories can range from 6 to 22 (Bartneck, C, 2002) depending on underlying theories. Debate on the necessity of the number of emotion categories is ongoing but there is a growing consensus that it is not a necessity to model human emotion exactly when developing believable characters for games. The range of available categories of emotion need therefore not to be as many as 22.

In emotion models categories are the basis for the evaluation, or more rightly, the classification of events, objects and other characters. When an NPC receives a piece of sensory information the evaluation results in information of possible affected categories. This evaluation is often based on the characters goals and how the information gained relates to these goals as well as standards and attitudes of the character has, as seen in the OCC model. When the possible affected categories are determined there are two possible options: pick the emotion with the highest value or calculate the intensity of the emotion. Of these the latter is a more sophisticated approach and can be based on numerous factors, such as desirability.

When the resulting emotion has been determined it has to merge or interact with the characters current emotional categories. Theoretically this could result in "mixed emotion" for the character. This interaction between emotion categories is important as the realism of the character depends on the right responses. If, for example, a character had just told a joke to the player and the player decides to tell a sad story in response, it would not be realistic if the character would go straight from laughing one minute to crying excessively the next. This is perhaps the most difficult component to implement and the most complicated one, for emotion can be gradually building as well as bursting forth with no warning. One suggested solution to this problem has been to put a personality framework on top of the emotion model to increase the behavior consistency of a character, an important factor for its believability.

When the emotional state of the character has been decided the resulting emotional state is mapped onto the characters collection of facial expressions and behaviors and the most appropriate expression found and displayed. This presents some problems, the first and foremost being that the available expressions for the character are limited and are often done-by-hand animations. This could result in unrealistic emotional responses to other characters and situations even though the characters own emotional state is appropriate. That situation is most likely to arise if the complexity of the emotion model is higher than that of the characters ability of expression.

2.2.1 The OCC Model

The purpose of the OCC model, originated by Ortony, Clore and Collins in 1988, was to model human emotion. It has 22 emotion categories that are "based on valenced reactions to situations constructed either as being goal relevant events, as acts of an accountable agent (including itself), or as attractive or unattractive objects." (Bartneck, C, 2002). The OCC model is therefore very much a model of causation. To better determine the intensity of

feelings the OCC offers a structure for other variables such as likelihood of an event and familiarity of objects and other agents. The variable for the likelihood of an event is specified beforehand and is a part of the information that the model requires, such as standards, goals and attitudes of the character. When considering the likelihood of an event it would be ideal to give the character access to this variable for the purpose of adjusting it to its situation. This is a missing component in the OCC model along with a personality designer and interaction between emotion categories. If a character does not have memory of past events it is not equipped to evaluate likelihood of an event. To address this, the use of a history function has been suggested, since memory of past events is also important for the believability of a character.

There have been discussions, as mentioned before in this paper, on the need of so many emotion categories as are available in the OCC model. This has been addressed by Ekman that proposed that the emotion categories could be reduced to 6 basic categories, as well as Ortony who agreed that the complexity of the OCC might be too great for developing realistic characters. For this he proposed a 10 category system, 5 positive emotion categories such as joy, hope and relief and 5 negative categories such as fear, anger and distress.

3. Industry Example: The Sims 3

The Sims series is composed of the world's most successful strategic life simulation computer games. In these games the player creates, controls and interacts with characters known as Sims. One of the newest additions to the series is The Sims 3. It offers players access to an even more dynamic environment than previous games as well as varied possibilities for social interaction with NPCs within the game. Each Sim in the game has a personality represented by traits as well as having both short-term and long-term desires. Examples of personality traits are: clumsy, charismatic, materialistic and kleptomaniac. The personality traits specify how the Sim can behave as well as enable new behavior and desires. The personality traits therefore directly influence the Sim's goals. When the goals are completed the Sim gets happiness points. This is in a sense a vehicle for the player to strive for a higher happiness score for his/her Sim. The goals are "derived from the personality description and input by an author" and are "meant to facilitate drama and believability". [McCoy, Mateas, Wardrip-Fruin, 2009].

Initially the game gives the impression of a complicated underlying social structure and as well as personality models for the Sims themselves. When examining the game in more detail, a certain lack of actual personality and realistic emotional behavior of the Sims becomes apparent. Personality traits have the ability to enable or inhibit behaviors as well as serve as a basis for generating short-term goals and as such fall under the category of personality models. The Sims behavior in interaction is selected using behavior selection trees that, despite the small level of uncertainty, give the impression of predetermined and scripted micro interaction between characters. For example when one Sim is telling a "funny story" he will use many of the same movements again and again.

4. Possible future advances

There are many possible advances in this field. One of them is the addition of an implementation of theory of mind based reasoning, to either emotion models or as an addition to the mental model of the NPCs. Theory of mind has been implemented in PsychSim (Pynadath, D. Marsella, S., 2005). Another interesting possibility lies in appraisal dynamics as implemented in EMA (Marsella, S. 2009) but due to the complexity of that model it is unlikely to be fully put into use in game development.

5. Discussion

There are many issues that need to be resolved when it comes to finding solutions to the problem of realistic emotional behavior of NPCs in games and of these the issue of emotion - vs. personality models and the question of whether "black box" and "brute force" solutions are all we need, will be discussed in this section.

As mentioned before the emotion and personality models have a core element in common: they both use categorization of sensory information to define the characters emotional state. It is within this categorization that the real difference lies as they are based on different theories. Personality models are, it can be argued, more limited when it comes to emotion behavior simulation. They will not be able to offer as diverse spectrum of emotion in the long run as it is not based on actual emotion but evaluated measurements of specific traits of human temperament. The concept of personality could be defined as consistency of behavior in similar situations, as we do not necessarily base our actions, consciously, on our personal definition of our own personalities. However, in the context of realistic social behavior in

games is an emotion model, with its many complexities really necessary? There is an agreement within the community that is not the case and simple personality models or pre-programmed "black box" methods are in more often than not sufficient for the simulation of realistic behavior in NPCs. The question can be broken down into two more specific questions. First, how much simulated emotional behavior is needed for the player to be able to fully immerse him-/herself in the game? The player's natural ability to interpret situations and character behavior could limit the need for diversity of both complexities of emotions and of the characters expressions. Secondly it is the computational complexity of the model and how much CPU time is required of the simulation or emulation to run: how much CPU is allowed for the model to run on?

There are more issues of similar nature that need to be discussed in more detail than is possible in this paper but those that were discussed here are two of the main issues under discussion in the community.

6. Conclusions

In the game-development community there is increasing discussion on ways to create more realistic emotional and social behaviors for characters in games. The main reason for this interest is that in most modern computer games, such behavior is lacking and is rarely able to be defined as realistic, if at al. The solutions suggested to this problem fall mainly into three categories: emotion models, personality models and "brute force" methods that are most commonly used in modern games. The main focus of this paper was on emotion models.

Emotion models offer many useful components and are a likely candidate to succeed the more "brute force" and structured methods that are used in modern games. The need for more realistic character behavior is growing and the call for more complex structures to describe them for computer games is a sound one. Realistic emotional NPC behavior is the future for computer-game development.

7. Resources and References

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