iATTAC: A System for Autonomous Agents and Dynamic Social Interactions – The Architecture

Edgar Cebolledo and Olga De Troyer

Vrije Universiteit Brussel, Department of Computer Science, WISE, Pleinlaan 2 1050 Brussels BELGIUM
{Ecebolle,Olga.DeTroyer}@vub.ac.be

Abstract. Realistic social interactions are an important aspect for games, especially in the domain of serious games. Some games like Façade or Prom Week have an impressive AI engine for this, but there is room for improvement. In this paper we present iATTAC, a system for autonomous agents and their social interactions. Our system is based on principles also used in other systems such as "StoryBricks", but also incorporates other aspects to realize realistic social interactions. It is designed to be used for educational games against cyber-bullying, but it is general enough to be used for other games. We describe the theoretical basis used as well as the architecture of the system.

Keywords: Character, Personality, Agent, Artificial Intelligence, Emotions, Mood

1 Introduction

Historically, Role Playing Games (RPG) are the ones with the biggest amount of social interactions; these games contain Non-Player Characters (NPCs or agents) that interact with the player. Usually, the NPC can fight against the player, give information, or chat with the player.

In certain situations, in particular for serious games, it is important that the NPCs show realistic behavior and in order to stimulate the player to play the game more than once, the behavior of these NPCs should not be too predictable. An example of such a serious game is being developed in the Friendly-ATTAC project [1]. The aim is to develop an educational game about cyber-bullying. In the game it must be possible to simulate interactions related to cyber-bullying. There are in general 3 types of actors in a bullying scenario: the victim, the bully, and the bystander. If we want for instance to have the player playing the role of bystander, we need to have a system that allows NPCs to bully each other, and the player (bystander) must have the option to join or not in these interactions. We also want the system to adapt to the player's decisions, meaning that the actions have repercussions, so the player can see that helping others is beneficial and bullying or supporting the bully is, in the long term, not.

To deal with such kind of games, we aim at developing an intelligent dialog system for NPCs that can support the type of advanced interactions described

above. The system should be easy to configure, and new NPCs and their behaviors should be easy to specify. The system is called iATTAC, as it is developed in the context of the Friendly-ATTAC project.

This paper is structured as follows. First we will describe the state of the art in social interactions in games, then we will explain the basic principles of our system, and finally explain the architecture of our system. The paper ends with a conclusion and further work.

2 State of the Art

We examined several games and studied their interaction systems. Some games have an advanced interaction system; we'll discuss them shortly:

- **Façade** [2]
  Façade provides a very dynamic system where the story continues with or without the player's input. The player can listen to the agents interact and can interrupt them, the agents also ask for input of the player in real time and react based on it (or lack of it). The characters are autonomous and can move based on their own personal goals. In Façade is not easy to create a new story or to modify the game.

- **Lies and Seductions** [3]
  Lies provides a less dynamic system than Façade, the story of the game also continues with or without the player's input, and the players can see the agents conversation in real time. Agents can know what the player is talking about if they are close to it and this also affects the game state. The interactions can only be one on one; if an agent is interacting with another, that interaction will be canceled if the player wants to start an interaction with any of the characters. The interactions with the player are not in real time, the player has unlimited time to pick an option for interacting, and besides the main character, you can repeat the same dialog over and over with another character.

- **Skyrim** [4]
  Skyrim has autonomous agents that pursue their own personal goals, and have their own schedules, when attacked, some can retreat and defend and some are more aggressive and try to fight back. Agents can start interactions with the player and with each other. Skyrim only has scripted conversations, some of them change based on certain actions, but in general they are not adaptive. It also has a subsystem named "Radiant" which can generate random quests, so the player always has a new quest.

There are other projects like StoryBricks [5] that also attempt to create autonomous characters with their own goals and non-scripted social interactions, but we will not discuss it since the game that uses it is still not finished so we can't yet judge it.

There are similar approaches involving personality models, emotion and mood [6] [7] [8]. However none of them satisfies the specific requirements of Friendly ATTAC, therefore we propose iATTAC, which takes features from other models and expands on them.

3 iATTAC – Basic Principles

We have two major objectives for our engine. First, the characters must be autonomous, i.e. they must act on their own, without the need to script all of their actions. Secondly, we want them to engage in social interactions, to be able to start an interaction with another agent, or to join an already existing interaction. We discuss these two aspects in the following subsections.

3.1 Autonomy (self-motivation)

To create characters that are autonomous, we decided to use personality models so our characters have their own needs and can satisfy them by doing certain actions. This approach is also used by other games, e.g., The Sims, Prom Week, and StoryBricks.

One of the most recognized personality models is "The Big Five" [9]. This model consists of five personality traits: openness, conscientiousness, extraversion, agreeableness and neuroticism. Each person has a different intensity on each of these traits and that determines his personality. Although it is widely accepted, it also has received criticism [10].

Another personality model is Reiss' "16 Basic Desires" [11]. This model consists of 16 basic desires that each person has, but with a different intensity, so a person with a high desire for "Eating" is more prone to eat or to pay for gourmet food compared to someone with a low desire for "Eating". Every person has a different value for all 16 basic desires, and even if a person's desire intensity is very low, at some point that person will do something to satisfy that desire.

We believe that Reiss's personality model is more suitable for our purpose. We can think of the 16 basic desires as bars (similar to The Sims [12] [13]) that increase over time; how fast they increase depends on the intensity of that desire, and a person with a strong desire will search for places or activities that satisfy that desire, or if another character wants to interact with it, we can predict the outcome based on his current needs.

3.2 Social Interactions

The personality model determines the needs and desires of agents; some of those needs can be satisfied by activities like eating or sleeping, but characters also have social needs that can only be satisfied by interacting with other agents. For this, we consider Eric Berne's transactional analysis [14] and the approach used in Storybricks [5].

Storybricks uses a "Universal Arbitrary Abstraction" (UAA), a list of numerical values based on the Big Five, which is used on behaviors, personality, and even objects. Every item has a UAA, so it is easy for the system to compare them and see how close they [15].

Eric Berne analyzed several social interactions and classified them in rituals, procedures, and social games. In them, the social transaction is a series of actions among several roles (each role is composed of one or more persons) with a predefined outcome and each role gets a "benefit" out of it. This benefit can be either positive or negative, and each role gets a different benefit. Using this approach we can structure a social interaction in terms of roles, dialogs, and benefits for all parties involved. He analyzes several typical social interactions explaining how is it performed and why. This is very helpful when coding social interactions since we know what does the roles expect from the interaction and why do they start it on the first place.

4 iATTAC – Architecture

The architecture of iATTAC is illustrated in Figure 1. The architecture is based on the following concepts, which are discussed in the following subsections: Personalities, Personal Agenda's, Locations, Rituals, Memories, and Actions.

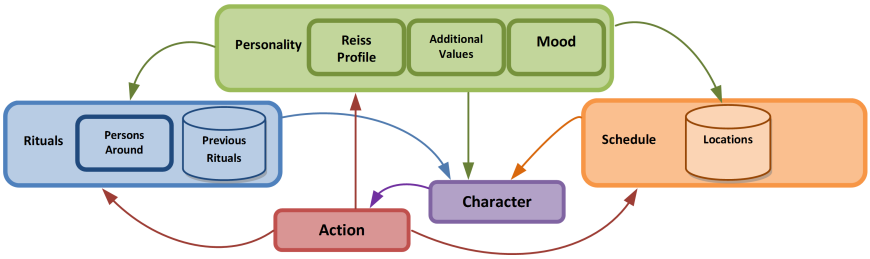

Fig. 1. Each action can modify the mood or add a new appointment or location. It is also stored for future interactions

4.1 Personality

As already indicated, iATTAC uses Reiss's personality model (see "Personality" box in Figure 1), but is not limited to it, it can also be expanded to include more elements (indicated by "Additional Values" in figure 1), which can be useful for certain scenarios or genres. Each character has its own personality profile which is not modified during the game.

We also use a mood model of 6 emotions: anger, disgust, fear, joy, sadness and surprise [16]. Characters start with no mood at all (although this may be configured differently if we want to have a scenario where a character already has a mood at the beginning) and the social interactions can increase or decrease the value of each emotion and mood. Also each character has a decay rate, so after a while all moods will be back to zero if nothing alters them.

4.2 Personal Agenda

Each character also has its own agenda (Schedule in Figure 1), which means that they have their own routines of activities and places where they regularly go. In the current implementation, each character has weekly activities, from Monday to Sunday. We plan to add support to add or delete activities during the game, so characters can have appointments or more unique agendas.

Having an appointment does not means that the character will attend it, but it will be considered when choosing an action. Characters may go to different places during the day, even if it is not in their agenda, if it satisfies a need (like going to a cafeteria if the character is hungry).

4.3 Location

A location is a place with attributes. Similar to Reiss' profile for characters, each location has a profile (called aura) and a name, which serves as an identifier for schedules. Similar to StoryBricks (UAA), each character, location and behavior has a personality profile. Each player can have a list of different locations, and even though two players could have the same location in their lists, they may have a different profile for each of them. For example, if a character is always bullied in the hallway, then he may start to associate that location with negative social interactions.

4.4 Rituals

As already indicated, we used the concept of social interactions from Eric Berne. Although we used the word ritual, we are referring to games, rituals and procedures. There are important distinctions between them, but for practical purposes in our engine, we consider them all to be the same.

Rituals are the cores of the social interactions among characters. Rituals contain all the information about social interactions; they contain a unique name, frequency, maximum and minimum amount of participants, the type of interaction, the roles and the ritual itself. Also, some rituals can be used only when a specific ritual is being used, these are called 'counter-rituals'. Rituals are shared among all characters (at least in this version).

Characters can decide if they want to participate in a ritual or not, they can just walk away or they can use a counter-ritual. For example, if character A is bullying character B, the expected outcome would be for B to feel bad because he was bullied, but if character B does not wants to be a victim, then he can play the counter-ritual 'upstanding', where he stands up to character A. At that point, character A can accept the ritual and back off, or if there are more counter-rituals, he may for instance use another stronger type of bullying.

Rituals are not nested, once a ritual is interrupted by a counter-ritual, the social interaction will never go back to it (although it will be saved in memory and can affect future interactions), the outcome of the ritual will not be added to any character.

4.5 Memory

Each ritual (successful or not) is stored in a personal database unique to each character; the stored rituals are used to consider what type of interaction is more probable to be successful.

4.6 Actions

Each action can modify the mood of a character or add a new appointment or location. It is also stored for determining future interactions.

5 Conclusion and Future Work

Our system takes the best elements from other systems, however like for any AI Engine, there is no ultimate engine that will satisfy all possible requirements, since the requirements for each game are different. Nevertheless, we believe that our engine is generic enough to be able to be used in all kind of games.

We are currently in the process of implementing the engine and the first games that will utilize it.

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