Social Interaction with Virtual Characters in a Game Environment

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Abstract. The aim of this PhD project is to propose a framework for affect-aware game design that focuses on realistic social interaction between the player and NPCs in a game environment. In games, players often have interactions with the NPCs. Furthermore, when playing a game, the player is expressing their emotions and social stances. In the real-life equivalents of these scenarios, people would be sending social signals in these situations, and we postulate that if we make the NPCs suitably socially and emotionally aware, players will equally use social signals in their in-game player-NPC interactions. In order to establish a natural and believable interaction between a player and NPCs eventually leading to relationship, NPCs must thus become socially and emotionally aware,by becoming able to capture the signals through the sensors, interpret them according to their own goals, beliefs, and desires, and ultimately response appropriately. The proposed framework should be able to be integrated to the game engines.

Keywords: Affect-aware game framework, social interaction, social relationship, social signal processing

1 Introduction

Games have been considered to be one of the most popular interactive entertainment products around the world. The key point that makes a game become popular is the player's experience when they play the game [10]. Emotion forms one of the most essential parts that craft this experience. The rapid evolution of affective computing has created new opportunities in the game area to design technology capable of creating affect-realistic games. Therefore, designing emotional experiences should be a fundamental aspect of the design of ever more engaging games. Nowadays, game technologies are rapidly being developed. The current development is mainly focused on graphics and animations which allow game production to design a realistic game environment and realistic game character animations. However, while current game technologies are prime in graphics and animations, the technology in affect realistic and complex social interactions is still in a state of infancy [7].

Virtual characters or Non-Player Characters (NPCs) can be one of the key factors to engage a player. They are a particularly interesting potential vehicle of

affect, because players are already engaged with the NPCs interacting with them directly or indirectly in a game. Over time, a pattern of interactions between player and NPCs may translate into a relationship between them. In a real world, social interaction between people involve the encoding and decoding of social signals [16]. These signals are displayed through facial expressions, body gestures, and voice (Player's SSP encoding). These signals can be captured by sensors such as a microphone and camera, subsequently analysed automatically(Player's SSP decoding) [25, 9, 20]. Furthermore, the signals can be synthesized by the NPCs (NPC's SSP encoding) [20, 3], and captured by the player through a monitor and speaker thus the player interpret the signals subconsciously (NPC's SSP decoding). This model can be implemented into a game environment in order to create a realistic interaction between a player and the NPCs (see Fig. 1). There remain several interesting questions to investigate in order to design emotionally intelligent NPCs in a game environment eventually leading to a more engaging game (as discussed in section 3).

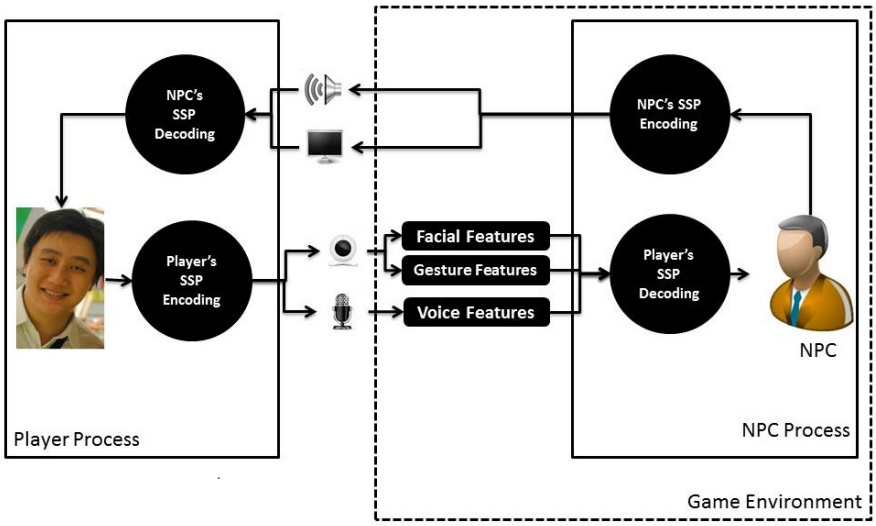

Fig. 1. Overview

The remaining sections in this paper are organized as follows: In section 2, the motivation of our research is provided, and recent works related to this research are summarized. In section 3, the methodology of our research is explained. Finally, section 4 describes research progress and the research plans for future works.

2 Motivation and Related Work

Games are increasingly being used as research tools in various disciplines. In education, games are generally used as training and assessment tools because they have the unique ability to engage with students [8, 6]. Moreover, games provide opportunities to create learning environments that actively involve students in problem solving [6]. In psychology, games can be an effective tool for psychotherapy. With games, therapists are able to present a scenario similar to the real world through a simulation; for example: FearNot! is a virtual drama game constructed for use in education against bullying [1], while Treasure Hunt is the first serious game based on principles of cognitive behaviour modification [4]. SEMAINE is a sensitive artificial listener developed to train the user's emotions by having an emotionally coloured interaction with the agents [20].

In games, a player can have an interaction with the NPCs, e.g. by talking to them by choosing several options provided. Furthermore, when playing a game, the player is expressing their emotions and social stances through facial expression, body gestures, and verbal comments[10]. They can be angry with NPCs when they lose. They can be happy when they are given items by NPCs, etc. In the real-life equivalents of these scenarios, people would be sending social signals, and we postulate that if we make the NPCs suitably socially and emotionally aware, players will equally use social signals in their in-game player-NPC interactions.

In order to establish a natural and believable interaction between a player and NPCs eventually leading to relationship, NPCs must thus become socially and emotionally aware, by becoming able to capture the signals through the sensors, interpret them according to their own goals, beliefs, and desires, and ultimately respond appropriately. Those tasks currently are difficult for the NPCs, since computers are socially ignorant [17]. There are still no comprehensive studies on which social signals are needed to analyse player affect, however, the research shows the integration of multiple signals captured from facial expression and voice produces superior results when compared to a single modality [16, 26].

NPCs design is one of the crucial parts of designing a game. The main challenges in crafting NPCs is to provide a *"believable character"* to their personality. Research shows that the expression of emotions will increase their believability [2]. The most computationally suitable model for emotion is OCC (Ortnony, Clore, and Collin's model) [15]. This model is based on the cognitive appraisal theory of emotions, in which emotions are triggered by the subjective appraisal of an event depending on the individual's goals and beliefs[11, 15, 12].

Personality is one of the aspect that influences a NPC's behaviour. Personality characterises the behavioural patterns of an individual, hence they would react differently to their environment [13]. The most renowned model in personality is the Big Five personality traits [14, 18]. The traits are: extroversion or surgency (i.e. sociable-reclusive), agreeableness (i.e. cooperative-negativistic), conscientiousness (i.e. persevering-quitting, fickle), emotional Stability (i.e. calm-anxious), and culture (i.e. imaginative-simple,direct). The model of personality

has been implemented into the virtual agents [20, 19, 13] to increased their believability and to create a colourful interaction with them.

There are many games in which players are already having social interactions with the NPCs. for example in The Sims [22], successive interactions eventually lead to a relationship status with the NPCs [22, 23]. The status is affected by the actions of the player to the NPCs. The relationship score will go up or down depending on whether interactions between them are positive or negative [23]. However, this methods of modelling relationships is based on *"click-based actions"* that either directly control interaction with the NPC or do so by changing aspects of the game world instead of capturing the social signals that the player shows when they play the game which will eventually make the interactions more natural and believable. This leads to a research question: Can we establish natural and believable interaction between a player and NPCs eventually leading to relationship that is informed by the process of encoding and decoding of social signals exchanged between the player and NPCs? Furthermore, once the relationship status between a player and NPCs has been established, the player has to be able to see what kind of relationship that they have with an NPC. They should be able to see it clearly through the encoded responses of an NPC. This leads to the question : How could we see what relationship a player has with a NPC in a game immediately?

Although the research in affect-aware games has drawn the attention of many researchers and game developers, there are still no tools for either researchers or game developer to develop them easily. While game technologies are growing fast, they still lack of support to the affect-aware game [7]. Therefore, the aims of this PhD project are to propose a framework for affect-aware game design that focuses on realistic social interaction between the player and NPCs in a game environment, and further validate the framework with several social interaction scenarios. This framework should be able to be integrated in existing game engines. Thus, researchers and game developers should be able to easily design an affect-aware game using this framework.

3 Research Methodology

3.1 Affect-Aware Game Framework

When a player plays a game and has a social interaction with NPCs, social signals from the player can be captured using sensors. From a camera, facial features(e.g. facial points, face region, eyes [25, 26]) can be acquired, while from a microphone, voice features (e.g. pitch, tempo and energy [5, 26]) can be detected and transmitted as inputs to the NPCs. Those signals can be integrated to produce a superior result for emotion recognition and social signal interpretation [16, 26]. A framework for social interaction between player-NPCs and NPCs-NPCs is shown in Fig. 2.

Based on the cognitive appraisal theory of emotions [11, 15, 12], the emotions are triggered by an appraisal of events. In this framework, events can be established from a player's social signals to the NPCs and/or from other NPCs'

actions. The NPCs response to the events depends on their personality, social relationship status, and their goals of relationship with the player or other NPCs. Moreover, the events will affect the social relationship status of player-NPCs or NPCs-NPCs. For example, if a player smiles to the NPC that is a friend of the player, NPC will think that the player is trying to be nice to them. Then, the NPC will response with welcoming responses for instance: smile back, or saying nice things to the player. Hence, the NPC will become closer to the player in their relationship. Of course, there are more complex relationship scenarios possivle, e.g. how would NPC A react when a player greets NPC B that has a negative relationship with NPC A, but who is the player's close friend?

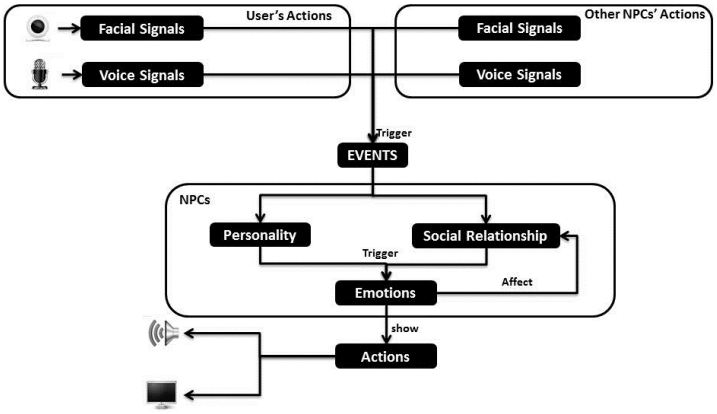

Fig. 2. Social Interaction Framework

3.2 Social Interaction

We will implement agent-based simulation particularly in the game situation to model relationship between different NPCs. The framework from Fig. 2 will be implemented into the each NPCs to building the autonomous agents. That is to say, the interactions between NPCs will be entirely through a set of social signals and signals of emotion, as it they actually interacted. With agent-based simulation we could likewise to verify the framework. To provide the interaction, a model of NPCs' detection is illustrated in Fig. 3. The areas of the detection are divided into 2 main areas: viewing area (visual), and hearing area (audio). NPCs will be able to see other's NPCs actions in the distance of v and viewing angle of θ in the both right and left side of the NPCs. In addition, NPCs will be able to hear what other's NPCs action particularly in what they say in the radius of r omni-directional. The model and variable of detection areas will be implemented to the NPCs in a game environment with several social interaction scenarios together with the affect-aware game framework. An open research question is how to obtain stable NPC-NPC relationships.

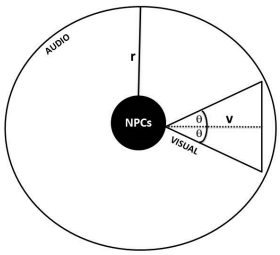

Fig. 3. Social Interaction Between NPCs

4 Research Progress and Future Works

4.1 Research Progress

Currently, I am working on a small research project in social interaction with a virtual agent in a simple game environment. The main objective of this project is to model natural and believable behaviours for the agent in game contexts. This project uses GRETA [3] as real-time 3D embodied conversational agent, as well as the SEMAINE API [20, 21] as the communication layer between components. LBP-based facial expression analysis is used as a social signal sensor [9]. The architecture of the game is illustrated in the Fig. 4

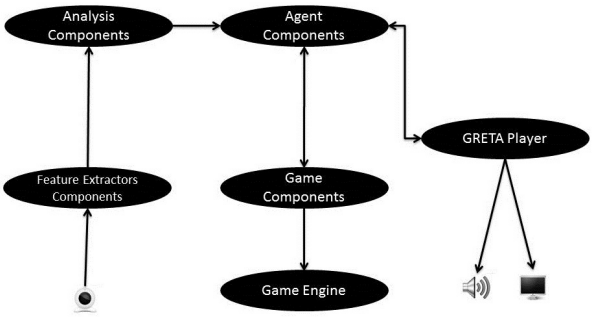

Fig. 4. Affect-Aware Game Architecture

In the game, the player will play a *Smile Game* with one of the SEMAINE characters, Poppy [20, 3]. The goal of this game is simple, which is try to make the opponent smile. During the game, social signals manifested through facial expression are captured by camera, and the features will be extracted in feature extractors components. The features extracted, thus will be analysed in analysis components. In the next step, the result of analysis will be transmitted to agent components. The agent components are the core components for the virtual character behaviours. These components will generate several behaviours based

on data sent by the analysis components, then send the behaviours to the game components that control the game play, and to the GRETA player as an agent. Optionally, the game components can be connected to the current game engines that support C++/Java and have a modular structure for instance: CryEngine, Unity, etc. Generally, game engine have a great capability to deal in graphics and physics module to design the game world easily. All data and messages are transmitted through SEMAINE communication layer [20, 21].

4.2 Future Works

The next plan of this research is to design the model of social interactions for NPCs and ultimately validate the model to the NPCs in a game environment with several social interaction scenarios.

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