Computational Models of Emotion, Personality, and Social Relationships for Interactions in Games

(Extended Abstract)

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1. INTRODUCTION

We present a novel computational model of emotion, personality and social relationships, implemented and evaluated in an existing commercial game (The Elder Scrolls V: Skyrim). We argue that Non Player Characters (NPCs) with such capabilities will accommodate a new experience in playing games and provide evidence supporting this. Applying the ERiSA Framework [1, 2] to the Skyrim Creation Kit, we designed a simple quest and 2 unique NPCs to interact with. When the ERiSA framework is used, players reported significant changes in their social relationship with the two NPCs compared to the baseline. Most importantly, the results further indicate that the models provide a new experience in playing games. In particular, players report enhanced emotional attachment to the NPCs and appear to forge relationships with the NPCs. Finally, the implemented models result in significant changes in the game engagement and the game immersion score.

2. COMPUTATIONAL MODELS

Fig 1 illustrates how in our models emotion, personality and social relationships (SR) interact with each other in influencing the NPCs' behaviour. We distinguish internal emotions that the NPCs actually "felt" from what they displayed. This is because some aspects, such as an social relationships, cultural display rules and the current situation can influence people to mask their emotions [3].

The model of personality we adopt here is based on the OCEAN model [5], represented as:

$$\mathcal{P}_{(p)} = \{O, C, E, A, N\} \in [-1, 1]^5 \quad (1)$$

Our emotion model is based on the most classic and common classification system: the six universal emotions, proposed by Paul Ekman [3]. In our models it is encoded as:

$$ve = \begin{cases} \{anger, disgust, fear, sadness, surprise\} \in [-1, 0]^4 \\ \{happiness, surprise\} \in [0, 1]^2 \end{cases} \quad (2)$$

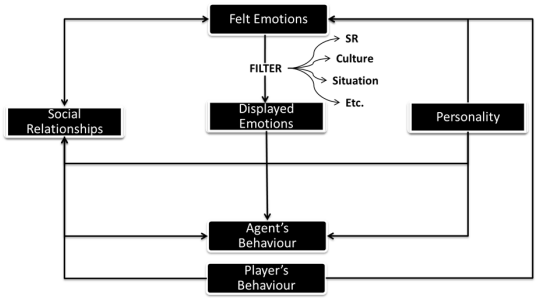

Figure 1: Models of Personality, Emotions, and SR

In our models, the NPC's personality sets the basic value of their emotion threshold ($\theta_{(v)}$). In addition, the emotions' threshold at time t is dynamically changed depending on the social relationship between i and j. Equation 3 represents the model of emotion threshold $\mathcal{T}_{(v,i,j,t)}$:

$$\mathcal{T}_{(v,i,j,t)} = \theta_{(v)} \times \mathcal{R}_{(i,j,t-1)} \quad (3)$$

A decay function is applied in our work, causing emotion to gradually return to the rest state over a period of time. The emotion intensity will depreciate below the level of the threshold, thus disappearing unless it is re-activated. We based our decay function on a sigmoid function with r as the decay rate and $\mu = ln(2)/r$. The intensity of emotion v at time t (see Equation 4 and 5) depends on the emotion triggered by the NPC as result of the event $Ev_{(v,t)}$, the importance of the event [4] ($\mathcal{M}_{(v,t)}$), the personality $\mathcal{P}_{(p)}$ of the NPC and how strong the personality influences the intensity of emotions ($\mathcal{W}_{(p)}$) at time t.

$$\mathcal{I}_{(v,i,j,t+1)} = \begin{cases} min(1, max(0, \mathcal{I}_{(v,i,j,t+1)} + \mathcal{I}_{(v,i,j,t)})) & v \geq 0 \\ max(-1, min(0, \mathcal{I}_{(v,i,j,t+1)} + \mathcal{I}_{(v,i,j,t)})) & v < 0 \end{cases} \quad (4)$$

where

$$\mathcal{I}_{(v,i,j,t)} = \begin{cases} \frac{\sum_v^n Ev_{(v,t)} \times \mathcal{M}_{(v,t)} + \left(\mathcal{P}_{(E)} \times \mathcal{W}_{(p)}\right)}{1+e^{(t-\mu)r}} - \mathcal{T}_{(v,i,j,t)} & Ev \geq 0 \\ \frac{\sum_v^n Ev_{(v,t)} \times \mathcal{M}_{(v,t)} - \left(\mathcal{P}_{(N)} \times \mathcal{W}_{(p)}\right)}{1+e^{(t-\mu)r}} - \mathcal{T}_{(v,i,j,t)} & Ev < 0 \end{cases} \quad (5)$$

We adopt the two dimensional social relationship model for NPCs in games based on [1, 2] with the familiarity in the x-axis and affinity in the y-axis. The model dynamically interacts with the game states and rules, creating a dynamic

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game play based on the social relationship as well as the NPCs' personality and emotional states. Affinity at time t denotes the degree of liking between the person i and j ($\mathcal{A}_{(i,j,t)}$), while familiarity at time t indicates how intimate the person i is to person j ($\mathcal{F}_{(i,j,t)}$), given by the number of interactions and time spent between two individuals. The models are represented as :

$$\mathcal{R}_{(i,j,t)} = \frac{\mathcal{F}_{(i,j,t)} \times \mathcal{A}_{(i,j,t)} \times \mathcal{N}_{(i,j,t)}}{1 + e^{(t-\mu)r}} \in [-1, 1] \quad (6)$$

where

$$\mathcal{F}_{(i,j,t)} = \frac{\mathcal{NI}_{(i,j,t)}}{maxFamiliarity} \in [0, 1] \quad (7)$$

and

$$\mathcal{A}_{(i,j,t)} = \mathcal{A}_{(i,j,t-1)} + (\mathcal{SF}_{(i,j)} \times I_{(v,t-1)}) \in [-1, 1] \quad (8)$$

The value of familiarity in our social relationship model is governed by the frequency of the interactions characterised by time spent together by two entities. Research shows the frequency of interactions has a strong correlation with the social relationship strength. The value of affinity is driven by the emotion intensity perceived by the NPC during event $Ev_{(v,t)}$ and the level of significance of this event to the relationship between persons i and j ($\mathcal{SF}_{(i,j)}$), aggregated to the affinity of time $t-1$. In addition, Relationships Intention from person i to person j at time t is denoted by $\mathcal{N}_{(i,j,t)}$.

3. THE SKYRIM GAME

Parts of the ERiSA Framework [1] are implemented to perceive and interpret the player's emotions, conveyed by their facial expression [6] and recorded by camera. We then integrated our models into the Agent Components of ERiSA. The Dialogue Manager proposes NPC's actions and a set of possible dialogues for the player to choose depending on the player's and NPC's internal states from the Interpreter Components, processed with our proposed models. Finally, the output is sent to the Skyrim Game Engine. A player's facial expressions also regulates their dialogue options when interacting with an NPC. For example, the option for the player to make their avatar express happiness will only be available when the Facial Expression Recognition Module interprets the real user's emotion as happy.

For evaluation, we designed two characters with opposite personality to interact with, Stella Erisa ($P_{(E,N)} = \{0.5, 0\}$, $\theta_{(v-)} = -0.3$ and $\theta_{(v)} = 0.2$) and Max Erisa($P_{(E,N)} = \{0, 0.5\}$, $\theta_{(v-)} = -0.2$ and $\theta_{(v)} = 0.3$), emotion decay rate $r = -0.5$, $maxFamiliarity = 200$, $\mathcal{W}_{(p)} = 0.2$, SR decay rate $r = -0.25$ and $\mathcal{SF}_{(i,j)} = 0.02$.

To evaluate the models, we recruited 15 participants (60% female, 73.33 % Asian, AVG age = 24.6) to play the game. All participants were familiar with the RPG Game Genre, and one-third had played Skyrim previously. A total of sixty interactions were evaluated in 18.16 hours (AVG = 1.3 hours, MAX = 51.8 mins, MIN = 1.85 mins). Each participant interacted with both NPCs, both in a baseline without the ERiSA framework and with our models implemented.

To avoid order bias, the sessions were randomized for all players. All interactions were video and audio recorded, the player, NPCs' internal states and the player's choices were also saved. The players were asked to complete a 5-point Likert scale questionnaire every time they finished a session of the game to evaluate: the NPC's personality perceived by the player, the social relationships between them, their feelings when they interacted with the NPC during the quest and their experience during the game based on the Game Engagement Questionnaire. Selected participants were invited to discuss their experience.

4. CONCLUSIONS AND FUTURE WORK

A Wilcoxon Signed-rank indicated that with the model implemented, the characteristics which constitute both NPCs personality, are evidently perceived by players ($p < 0.01$) in addition to a significant change in the relationship score ($p < 0.01$). The favourite strategy to build relationships with the NPCs was giving favourable items to them, with exploring Skyrim world together as the second choice.

Stella is perceived as a person who is positive thinking, generates a lot of enthusiasm, is considerably outgoing and sociable, is relaxed and handles stress well, is emotionally stable, not easily upset, and is polite to others, in contrast with Max. Most of the participants (87%) judge Max as an extremely unpleasant person. 40% of players realised that it was easier to have a negative relationship thus decided to build a negative relation with Max as a winning strategy, even if they already gained a positive relation with him.

Moreover, the models provide a new experience in playing games to the player ($p < 0.02$), particularly in relation to the emotional attachment to the NPCs and how they build a social relationship with them. The models provide a more realistic manner to interact with NPCs and forge relationships with them. The results indicate the players are more engaged and emotionally immersed when the models were implemented ($p < 0.02$). The players were also interested to see how the game's event would progress ($p < 0.01$).

As a future research direction with these models, additional variation for interactions with the NPCs (e.g. accomplishing a quest together and more conversational topics) can be added to enhance the user experience when playing.

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