

Concept Summary for EMgine: A Computational Model of Emotion for Enhancing Non-Player Character Believability in Games

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Revision History

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October 23, 2022	1.0	• Initial version

1 EMgene Concept Summary

EMgene is a Computational Model of Emotion (CME) for Non-Player Characters (NPCs) to enhance their believability, with the goal of improving long-term player engagement. EMgene is for *emotion generation*, accepting user-defined information from a game environment to determine what emotion and intensity a NPC is “experiencing”. How the emotion is expressed and what other effects it could have on game entities is left for game designers/developers to decide.

You can find all Software Development Artifacts (SDAs) related to EMgene at:

<https://github.com/GenevaS/EMgene>

Design Goals EMgene aims to provide a feasible and easy-to-use method for game designers/developers to include emotion in their NPCs, which they perceive to be challenging with the current tools and restrictions (Broekens et al., 2016). EMgene should:

- Be modular and portable such that game designers/developers can use it in their regular development environment
- Be flexible to allow game designers/developers the freedom to choose when, where, and which of EMgene’s components to use
- Not require knowledge of affective science, psychology, and/or emotion theories to use
- Be efficient with respect to computational resources
- Demonstrate that it positively impacts the player experience

Background: Computational Model of Emotion A *Computational Model of Emotion (CME)* is a software system that is influenced by emotion research, embodying at least one emotion theory as the basis for its stimuli evaluation, emotion elicitation, and emotional behaviour generation mechanisms (Osuna et al., 2020, p. 2, 14). This theoretical foundation helps define a CME’s mechanisms, components, phases, and architecture which software engineering techniques and methods can implement (Osuna et al., 2021, p. 139).

There are two types of CME, differing in requirements and validation: *research-oriented* and *domain-specific* or *applied* (Hudlicka, 2019, p. 130–131; Osuna et al., 2020, p. 4–6). Research-oriented models emulate structures, processes, and mechanisms in order to understand their design and structure in biological agents. In software engineering terms, research-oriented systems are white-box models because they must have explainable behaviours and mechanisms that lead to affective phenomena. In contrast, domain-specific models aim to produce specific aspects of affective phenomena and need only mimic the processes that produce them. They are black-box models, where the transformation of inputs into affective phenomena is not important, as long as it has the desired effects. Generally, the degree of realism in the CME’s mechanisms and behaviours is proportional to its design complexity (de Rosi et al., 2003, p. 83). This implies that domain-specific CMEs are unlikely to be exactly alike, even if they target the same domain. This also means that any emotion theory that satisfies the CME’s needs is a viable choice.

An emotion generation engine that strives to create a more engaging player experience via believable NPCs is a *domain-specific* CME. This imposes fewer design constraints than a research-oriented system as it is not a strict model of affective phenomena (Sloman et al., 2005, p. 233).

Validation also differs from research-oriented systems, as it is defined by how well it engages a player rather than how closely it resembles true affective phenomena (Hudlicka, 2019, p. 131). This bodes well for converting informal emotion theories into the formal domain of software, which necessarily includes making assumptions and design decisions that existing research might not support (Marsella et al., 2010, p. 21, 23; Hudlicka, 2019, p. 130). A software engineering approach would systematically account for these factors, producing a well-designed CME.

Background: Player Engagement *Engagement* is a quality of the user experience describing a positive human-computer interaction (O’Brien and Toms, 2013, p. 1094). It is difficult to define, as people use it interchangeably with related concepts like flow and immersion (Brockmyer et al., 2009, p. 624; Turner, 2014, p. 33; Glas and Pelachaud, 2015, p. 944; Cairns, 2016, p. 81; Doherty and Doherty, 2019, p. 99:4). It can also have a subtly different meaning in a given context. This makes sense given that it overlaps with different elements of each concept, such as attention.

Engagement is a multidimensional concept encompassing cognitive, emotional, and behavioural influences measuring the user’s temporal, cognitive, or emotional investment in the interaction (O’Brien and Toms, 2010, p. 62–63; O’Brien, 2016, p. 22). It is not an “all or nothing” quality, and can fluctuate over the course of the interaction (O’Brien, 2016, p. 19). Engagement is both a process and product of an interaction, existing both during and after human-computer interactions (O’Brien, 2016, p. 22). This dual nature of engagement results in a cyclical relationship—the process of engagement can lead to the product of engagement, which in turn influences the likelihood that the user will re-enter the process later (O’Brien and Toms, 2008, p. 945).

Engagement is difficult to measure due to its subjectivity and dual process-product nature, but it has common elements that makes it possible to compare experiences between users (Calvillo-Gómez et al., 2015, p. 41). These are broadly categorized as aesthetics, perceived usability, focused attention and reward.

Engagement with the game is a fundamental goal of games, having a key role in player satisfaction—“the degree to which the player feels gratified with his or her experience while playing a video game” (Phan et al., 2016, p. 1220). Players have a disposition towards being, and expect to be, engaged when they play (Cairns, 2016, p. 84). This could be because playing a game is a voluntary activity done for pleasure (Poels et al., 2007, p. 86–87; Yannakakis and Paiva, 2015, p. 459) in which they are an active participant (Mäyrä and Ermi, 2010, p. 94). Emotional engagement is one way to engage players, caused by the player’s personal feelings aroused by an in-game event, character, asset attributes, or another player which causes them to want to continue playing (Schönau-Fog and Bjørner, 2012, p. 406–407).

Background: Believable Character A *believable character* “...allows the audience to suspend their disbelief and...provides a convincing portrayal of the personality they expect or come to expect [from the character]” (Loyall, 1997, p. 1). Believability is not limited to “smart” or “normal” characters because it depends on the situational context and the character’s personality (Lisetti and Hudlicka, 2015; Loyall, 1997; Reilly, 1996). In short: an NPC must behave reasonably within the context of the game world. Generally, NPCs are believable when they (Lankoski and Björk, 2007; Loyall, 1997; Warpefelt et al., 2013):

- Appear to be self-motivated,
- Are aware of what is happening around them, and

- React in ways appropriate for their surrounding context while adhering to their personality.

Emotion, transient responses to changes in the environment (Lazarus, 1991), is one element of believable character design (de Melo and Gratch, 2015; Emmerich et al., 2018; Gard, 2000; Lankoski and Björk, 2007; Lisetti and Hudlicka, 2015; Loyall, 1997; Paiva et al., 2005; Warpefelt et al., 2013). It is an established aspect of believability in animation (Thomas and Johnston, 1995), and game designers have acknowledged its importance in NPC design (Hudlicka and Broekens, 2009; Yannakakis and Paiva, 2015).

Characters with emotion address the core features of believability because they convey a character’s goals and desires (*self-motivated*) by showing their *awareness* of, *responsiveness* to, and care (*personality-driven*) for their surroundings (Bates, 1994; Broekens, 2021; Reilly, 1996). It follows that one way to improve an NPC’s believability is to have them react emotionally to their surroundings (Togelius et al., 2013; Yannakakis and Paiva, 2015).

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