Dream Machine: A Creative and Autonomous Machine for Creating Stories and Worlds

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Abstract

Video games presents an immense dissonance between its narrative and interactive sections. These two elements are commonly presented in a format where each occurs at a certain time, but rarely simultaneously. Besides, other elements, such as the background music, are also usually pre-defined, denying for the users the condition to establish new forms of creative expression within the system. This work, therefore, intends to propose new systems and algorithms to fit this paradigm.

Introduction

Douglas and Hargadon (2001) described the principles of immersion and engagement as key factors for the involvement of an audience, capable to provide the experience of flow, as introduced by Csikszentmihalyi (1990). Even after decades of an intensive and accelerated development, digital narratives and its interfaces remain being addressed without an effort for making them intrinsic, denying to the video games the possibility to construct its own identity, capable of transmitting the narrative content through its own interactive structure.

Commonly, video games propose the merging between narrative and interaction in a way where the designer still has to manually create all possible states of the experience, and also in a way where different decisions still leads the player to a limited set of possible (and usually conducted) ends, fully foreseen by the developers (Mateas and Stern 2003). This limits the amount of possible states, thus limiting the experience as a whole, since its re-playability is low (Kartal 2004).

In the multi-agent systems literature, narrative generation and interactive stories are active topics of research (Julie Porteous and Cavazza 2013; Jonathan Teutenberg 2013; Bilal Kartal and Guy 2014; Jones and Isabel 2014). The narrative generation is seen as a planning problem, which can be solved globally, using techniques such as UCT Monte Carlo search (Bilal Kartal and Guy 2014), or locally, by each agent pursuing its own intents (Jonathan Teutenberg 2013). However, although the search may generate different narratives as it tries to reach the specified objective, the

story is still heavily hand-engineered by the designer manually setting possible actions and goals for each agent. Implicitly, the designer is still hand-engineering a limited set of possible states for the story, which is, from the player's perspective, a very limited view regarding the potential of interactive storytelling.

Many works also deal with automatic music generation starting from a musical corpus (Eigenfeldt and Pasquier 2013; Hoover and Stanley 2014). This work envisions that an external stimulus, such as sounds, can be used as a guideline for the creation of art in a different way inside the interactive projects. There are commercial games that uses music to influence the game experience. For example, in Vib Ribbon (Sony Interactive Entertainment , 1999), the user can load a song from a CD for it to transform the experience. The player must deviate from obstacles, which are presented according to the beats of the song. In this case, however, the impact of music on the gameplay experience is quite low. Thus, the impact of sounds into the dynamic generation of games has not yet been exploited to its full potential, and may be explored in the context of more complex games. It is also very important the development of new techniques where the sounds affects more aspects of the experience, such as its plot or even the behaviors of the NPCs (non playable characters).

Therefore, in this work we take the point of view that video games are an artistic expression that dynamically emerges from the interaction between a user and a computational system. Hence, we will allow several elements to be dynamically created through this interaction, rather than being pre-defined, such as the story and the background music. We will also use music as an input to automatically create elements of a game, enabling thus a dialogue between these two artistic media (and further emphasizing the artistic nature of video games). This work will be produced in three main steps: (i). a novel system that generates music in an emerging form for interactive games. (ii). a new algorithm that generates procedural interactive stories. (iii). a new algorithm that incorporates a musical corpus as an input for generating interactive procedural stories. These algorithms will also be generic in their output: it will be possible to generate visual games as well as audiogames, increasing the accessibility to artistic productions.

Related Work

This work relates to procedural content generation, interactive storytelling, automatic music generation, and emergent systems. Procedural systems have an enormous power to extend the lifespan of a video game, as they present new elements on each new session (Lidén 2004; Hoover and Stanley 2014; Pasquier and Sorenson 2010; Fernández-Vara 2014). For instance, Hoover et al. (2015) iteratively applies neural networks and evolutionary computing to generate levels for the Super Mario Bros. (Nintendo, 1983) game in a coherent manner. The method builds on the Functional Scaffolding technique (Hoover and Stanley 2014), which was originally developed to automatically generate a coherent accompaniment track of a song, based on a harmonization as input. Pasquier and Sorenson (Pasquier and Sorenson 2010) propose a framework based on a generative system for the automatic creation of bidimensional levels of a game. However, procedurality is applied in these previous works to the generation of levels and modularized labyrinths, but not for stories and rarely for other contexts. Some experiments with procedural systems tried to go beyond the environmental design and entered the narrative, such as Symon (Fernández-Vara 2014), an adventure point and click game that happens within the dreams of a patient with paralysis. However, the procedural system was still limited to the generation of puzzles, and several narrative elements still had to be pre-determined.

Emergent systems are very common in multi-agent systems field. But previous works were limited to solving optimization problems (Kennedy and Eberhart 1995), coordinating robots (Marcolino et al. 2016), playing board games (L. S. Marcolino 2015) or simulating flocks for visual productions (Reynolds 1987). This work, on the other hand, will emphasize the interaction between the player and the system for emerging a unique artistic experience in video games.

Methodology

This work will be based on the construction of the Dream Machine framework. Dream Machine will allow the emergence of an artistic experience during gameplay through the interaction of three fundamental parts: (i) an external input (such as a sound or music), (ii) a user/player, (iii) a game system. The narrative and the music of the game will be dynamically generated through the interaction of these three components. Building and studying a real system will allow us to explore both theoretical and practical/experimental contributions. This work will be divided into three main phases:

Phase 1: Musical generation on an emergent form. This is the stage we are currently working in, and of which we have some validated results. Recently, we presented a demo of a game that I am currently developing, called Jikan to Kukan (G. R. Martins 2016). In this game, the player's interactions are converted into melody while the system provides a harmony in its background. Thus, player and system collaborate to compose the game music.

We have also worked on a second project called Microbial Arts, that is an interactive experience that mixes music
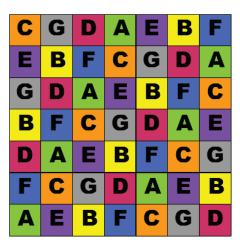

Figure 1: An example of a 7x7 musical "block" that fosters the generation of pleasant arpeggios.

generation with simple gameplay mechanics. In this game, a player controls a microbial creature to collect proteins to feed its body, and the environment responds with music to feed the player's mind and creativity. The underlying environment is a 3D colored grid, where musical notes are placed on the cells. A musical note is assigned to each cell as the player moves. The note generation scheme obeys a mathematical procedure that favors the generation of music. In other words, when the player moves, she will likely generate pleasant arpeggios (Figure 1). For comparison, the system also allows for two alternative procedures: one where notes are drawn uniformly random as the player moves, and another where a larger weight is placed in the random procedure to generate notes that might lead to arpeggios.

Phase 2: Generation of procedural narrative. Besides music, the story of a game can also emerge through the player's interaction with the system. Hence, instead of a pre-defined set of states, where the actions of the user decide a path through such states (as in global planning systems such as Façade (Mateas and Stern 2005)) or instead of a fixed set of actions and objectives for each character (as in local planning systems such as Teutenberg and Porteous (Jonathan Teutenberg 2013)), we propose to use the interactions of the user as an input to generate new states and/or agents behavior. This could be performed by multiple applications of neural networks and evolutionary algorithms, based on the functional scaffolding system (Hoover and Stanley 2014), where the neural networks would be trained to generate new possible story states based on the current user input and/or new behaviors for the NPC agents. It would also be necessary to have a global sign of the current plot stage (i.e., introduction, development, conclusion), so that the system could generate states with an appropriate flow from the introduction to the conclusion of the plot.

Phase 3: Incorporation of a musical input. We will study how to adapt an acoustic signal as input to train (and execute) the models proposed in Phase 2. It will be necessary to study which aspects of a musical production should be emphasized, and create an algorithm that transforms the

sound signal in order to be used appropriately in Phase 2. In a first instance, we tend for frequential analysis. We hypothesize that we can assign sentiments to tones and melodic lines, which could be used to dictate agents mood, and, consequently, agents behavior. Besides, such sentiments could also be used to influence the dynamic generation of plot states described in Phase 2.

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