# What needs to be considered when implementing an adaptive music system for games?

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## 1 Introduction

Since the early days of video games music has been used to enhance the users experience through in the beginning it was only some form of "beep" or other notification tone [1]. Space Invaders was one of the first games to utilize this to create a soundtrack. It consisted of a four-note pattern that was looped endlessly, as the alien invaders drew ever closer the tempo would increases enhancing the players sense of danger and urgency [2] [3, p. 1][4]. Since those very early days, there have been a considerable number of advances in technology which has allowed game audio to evolve and become more complex [5] [3, p. 1]. Furthermore, this has enabled developers to express grater emotion through music, similar to that of a Hollywood movie production, where soundtracks play an important role in expressing sentiments of the story[2] [6] [7, p.58]. But, unlike movies games are

non-linear in nature, since the player is in control of the sequence of events rather than the producer who has total authority over the layout of a film. This means that we need to have slightly different approach to music in games so the audio can adapt to the player instead of playing looped tracks that can ruin the emersion of an experience.

## 2 Event Based Music Loop

Traditional music in games is fixed based on its current state, a track will loop until the next trigger is reached where the next audio loop will start [8][9]. Although this is a relatively simple approach for a developer, from the players perspective it quickly becomes boring and repetitive [1, p. 14][9]. This is considered a linear approach in games, however as we seen earlier games are an interactive and non-linear form of media and the music in games should also be non-linear. The player needs to interact with world and the music should respond accordingly, whether the player is interacting with an NPC or unfolding a tragic event, the music should adapt to reflect and give grater empathize to the current situation. This adds an extra level of complexity required for the audio system and a decision needs to be made as early as possible on how to approach an adaptive music system. Adaptive music systems can be achieved in a number ways such as laying samples, using procedural generated music sequences that change based on the games state or even use a mixture of both.

# 3 Approaches to adaptive Music

# 4 Triggers and transitions

# 5 Audio systems

Once the decision have been made to approach the adaptive audio, it time to choose an audio engine. If your working in a common game engine such as Unity or Unreal Engine you can use the built-in audio systems, but if youre working in a custom or in-house engine you may want to use middleware or create your own custom audio engine. Creating your own requires a lot of resources, time, money and knowledge of DSP which is only really available to AAA game studios, it may more beneficial to use middleware such as FMOD, Wwise or Pure Data. Using middleware can even be beneficial when using engines such as Unity and Unreal as they can provide a more flexible and convenient workflow that built in audio systems do not offer [10]. [Maybe a bit about there feathers] In the AAA game Spore developed by Maxis, the player acts becomes god and gets to create there own universe starting with a single cell organism which evolves right up to the space age [SPORE]. The planets environment is mostly procedurally generated and the player can dream up a creature based of predefined parts and the game engine will animate it based on the users inputs. They also decided to utilizes procedural music techniques and used a version of Pure Data that was modified by Electronic Arts that they called EAPd. Pure Data uses a graphical interface to visually display events that are link together by lines, to create a sort of flowchart, similar to an animation tree. This allowed them to devise a system to improvise music consisting of different rhythmic elements such as bassline, ambience, harmonic progression and even key switching based on parameters that have been set in the game. For instance if you give you creature a beak then a bird-like screech might find its way into the music or if you add combat elements like claws or buzzsaws to your critter the audio will subtly

shift to a minor key and take on more sinister overtones. This approach allowed them to give spore its own unique sound, that wasnt repetitive, was playful and responded to the player [11] [10][2, p. 28] Another AAA game that used an adaptive audio system was Tom Clancys EndWar a real-time strategy game developed by Ubisofts Shanghai studio [ENDWAR]. The player take control of a chooses of 3 army's that matches there tactical style and create a strategy to defeat their enemies. They also went beyond the traditional RTS controls and allowed the user to use there own voice to control there units. In addition to this they created a unique "cell-based" music system that allowed for extremely responsive. [Add stuff about cells here please!] They created the game using a heavily modified version of Unreal 3 that had the built-in audio system removed and replaced with Ubisofts in-house DARE audio engine. [12]

## 6 Conclusion

Conclusion here

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