socio-ec(h)o: Sound Intensity Gradients for Ambient Intelligence Audio Display

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Background

Our current research involves the design of an ambient intelligent (AmI) environment for a multi-user physical game named socio-ec(h)o. AmI environments rely heavily on a meaningful and clear, yet ambient response. In socio-ec(h)o we introduce a new concept of providing intensity-based audio display with a gradient approach.

Borrowing from the field of sonification, socio-ec(h)o uses sound that is coherent in its basic characteristics of pitch, rhythm and timbre within the same game level, and represents success rate in the game by intensifying these basic sound characteristics (see Table 1.)

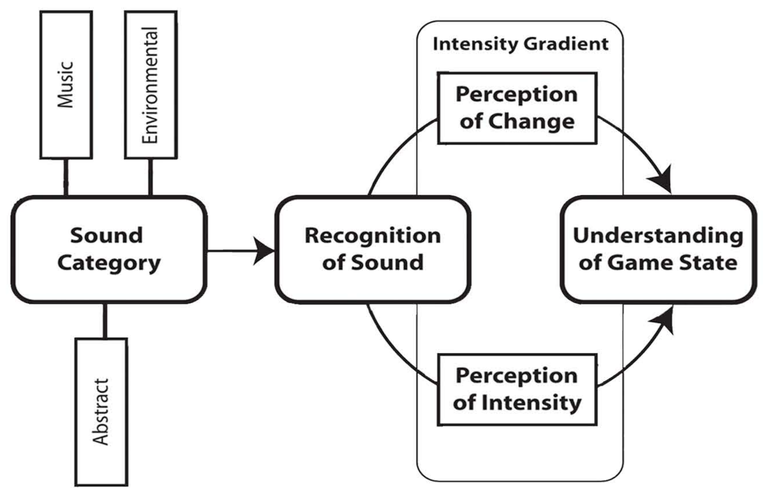

Fig. 1. A model of our sound intensity perception approach.

The meaningful choice of sounds aids in the understanding of the game state and the affect on players' actions. We felt we could modulate this understanding by increasing or decreasing the rate of intensity and change in the sound along a gradient. Players acquire an understanding of the game by recognizing the sound, perceiving change, and interpreting the intensity gradient.

Audio Display Schema

The audio display consists of three components: a real-time ambient sonification that has a different soundscape for each level of the game; an anticipatory feedback sound to signal when all participants are working together towards the goal; and a confirmatory feedback sound, which signals the completion of the goal and the progress to the next level.

Level	Dynamic Process	Polarity	Scaling	Description of Effect	Perception Modality
1	Amplitude	Positive	0-120 units	Sound levels slowly come up	Volume
2	Phase shift Layer fader	Negative	8-0 cycles	Tempo goes up, crossfade of 5 sounds	Tempo and Timbre
3	Layer fader Low-pass	Positive	250Hz - 17000Hz	Crossfade of 5 sounds, muffled-to-bright	Timbre and Association
4	Layer fader Low-pass filter	Positive	250Hz - 17000Hz	Sound crossfades and is muffled-to-bright	Timbre and Association
5	Phase shift Pitch shift	Negative	8-0 cycles 0.5-1.5	Sound goes up in tempo and pitch	Tempo and Pitch
6	Layer fader	Positive	N/A	Crossfade of 5 sounds	Timbre and Association

Table 1. Audio Display Schema for each game level.

Table 1 details the approaches to creating sound intensity gradients in each of the six levels of the game. Essentially, we varied three sound characteristics: sound content (choice of sound); polarity of change, and sound parameter processing (which sound parameter will be dynamically varied). Scaling of sound parameters and amplitude were constant.

Intensity Gradients in Sound

In its simplest form, the approach can be described as dynamic soundscapes that are recognized by players and interpreted to determine the state of the game (Fig. 1.). The soundscapes are made of sounds that can be categorized as musical, abstract and environmental.

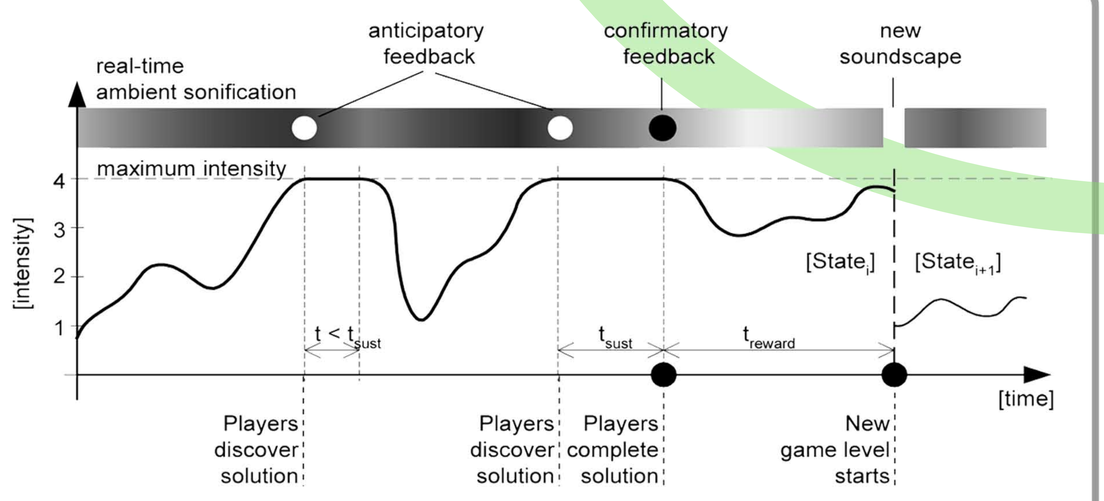

Fig.2. Mapping from progress state to sound intensity gradient.

Reading from left to right, the players explore different combinations of movements and actions. As some players discover a combination, the intensity of the real-time sonification increases, in this case to a value of 2 out of a maximum of 4. As more players discover the solution, an anticipatory feedback sound occurs signaling to the players that they're on the right track. However, we see that the players are unable to hold the combination and the intensity level rapidly decays to 1. When players resume the previous configuration the anticipatory feedback sound occurs again. This time players complete the solution by maintaining the configuration for the required duration, and the confirmatory feedback sound occurs.

Preliminary Results

The environmental sounds were more recognizable, and players had an easier time interpreting changes in them. Players found environmental sound more contextualized and richer in narrative. It seems, if players have prior experience with a sound, they have a sense of its inherent scale of intensity, i.e. they know what full-blown fire sounds like, as opposed to a faint crackle. This accounts for the difficulty with unfamiliar abstract sound. The players lacked a sense of scale and therefore found it hard to interpret the gradient of change.

Am-I-Able
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