SONIFICATION FOR THE ART INSTALLATION DRAWN TOGETHER

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ABSTRACT

This extended abstract describes Drawn Together, an interactive art installation in which a person takes turns drawing with a computer. We describe the process of the interaction and the methods used to creatively sonify the process and the animations. There are three main states in the interactive process that are sonically represented using audio samples in a mix of background and foreground sounds. The lines drawn by the computer are sonified using a set of features describing length, rate of time drawn, location, and curviness.

1. THE DRAWN TOGETHER PROJECT

Drawn Together is an installation art piece in which an individual and computer draw in a turn taking interaction. It was developed by the Open Ended Group in collaboration with the Georgia Tech College of Architecture and the Center for Music Technology. A camera, projector, two computers, four microphones, and numerous LEDs are encased in a table designed specifically for the piece. An individual is encouraged to draw on a single black sheet of paper. The computer responds with a 3D projection on to the same paper based on an analysis of the person's drawing. The participant responds to the computer's drawing with additional drawings on the paper, the computer responds again, and the process continues as a conversation unfolds between participant and computer via the shared drawing surface. There are three primary states to the piece: 1) the human drawing state 2) the "thinking" state and 3) the computer response state. The entire event includes an auditory component that enhances the experience through a sonification of the drawing and the state of the system (in terms of the three states). The audio is played through a pair of headphones worn by the individual currently interacting with the installation. There are also two loudspeakers on either side of the table allowing everybody else in the room to experience the sound.

2. TABLE DESIGN

The design of the table was influenced by the notion that in addition to a drawing surface the table could be a musical instrument. We consulted with a luthier to determine how best to achieve this and created a structure that acoustically manipulates the sound of the drawing implement on the table. The elongated table top serves as a resonating body and is filled with honeycomb shaped boxes, which filter the sound. Each honeycomb is an enclosed box with

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Figure 1: An individual interacting with *Drawn Together* as others observe

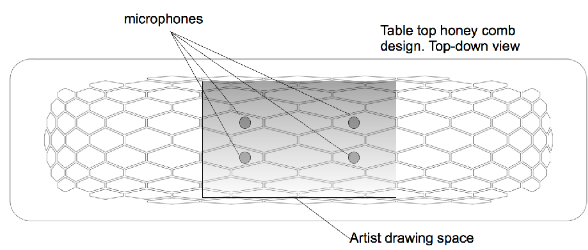

Figure 2: Honey comb design of the table top and microphone placement

an F-hole at the bottom. The F-holes differ in both size and location for each honeycomb allowing for subtle auditory variation. Additionally, different size boxes add a variety of filtering characteristics. The sound becomes dependent on the implement being used (chalk, pen, pencil, pastel, etc) and on its point of contact with the table.

3. SONIFCATION

The purpose of the audio is to provide a sonic component that is beautiful, creative, and relevant to the visuals, the state of the system, and the process of drawing. To achieve this we use a combination of techniques including a persistent background drone throughout and a foreground layer having different textures specific to each state.

3.1. Background

The background sound sets the tone for the entire installation. It was created by taking a recorded sample of a person drawing on the table, convolving the sample with an impulse response of the table, and convolving that result with a bowed cello note. The result of this process is a low drone which is present throughout. The drone changes pitch when convolved with a new cello note. A change in pitch signals a state change to a different phase of the interaction. This change in pitch sonically shifts the sound and also gives outside listeners not currently interacting with the table a sense of the rhythm of the interaction between the computer and the individual.

3.2. Foreground

In contrast to the background, the foreground audio was developed to give a more precise representation of the drawing activity of both the participant and the computer. This needed to be accomplished while still being aesthetically pleasing and maintaining the gentle ambiance desired.

In State 1 the person drawing hears the sound of his or her drawing implement on the paper. The sound is amplified and slightly filtered to soften the undesirable frequencies. The four microphones embedded in the table are located directly below the paper and spaced so that the output creates an auditory spatialization identical to the implement's location relative to the center of the paper. The two microphones on the right are mixed and sent to the stereo right channel and left side microphones are sent to the left channel. In our original implementation we used binaural filters to create a 3-dimensional sound spatialization. This was an attempt to further make the listener feel as if he were sonically immersed in the experience with the sound revolving around his head along a horizontal plane. Though after listening, we concluded that the binaural filters reduced the quality and effectiveness of the natural sound of the implement on the table.

State 2, the "thinking" state, is the interval of time between the point the person finishes drawing and the point when the computer starts its response. During this time the computer is analyzing the drawing and determining an appropriate response. In addition to the background pitch change a sample of a slow ticking clock is played to indicate the state.

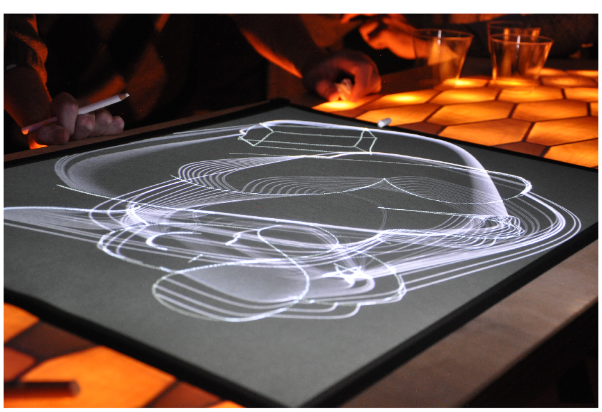

Figure 3: An example of a computer generated response with a person's drawing

State 3 provides the most challenging and interesting part of the sonification process. The foreground audio sonifies the computer's response in real-time. The current iteration of the music uses a large library of sounds taken from recordings of several human drawing gestures which were classified into groups such as straight lines, curvy lines, dashed, dotted, etc. In addition to these drawing sounds we also recorded and labeled sounds from a rain stick, wooden drum, and guitar. These samples are mapped to the 3-dimensional lines the computer draws. A large set of features describing each line and the density of lines being drawn at one time determines which samples to use. Some of the individual line features include location, length, and rate at which it is drawn. Each line is defined as a Bezier curve so it is also possible to get a measure of "curviness." Depending on the sample the algorithm selects, the sample is either looped or the playback speed is adjusted to be the same duration as it takes the particular line(s) it is representing to be drawn. Similarly to State 1 the sounds are spatialized to a stereo field so that events occurring on the right side are played through the right channel and events on the left side through the left channel.

The dynamic variety of the computer's response makes the algorithmic sonification somewhat challenging. At times the computer may draw thousands of lines in a span of a few seconds while at other times may draw only one line across ten seconds. Through observation and testing we implemented several hardcoded thresholds so that the audio chooses the appropriate sample based on the circumstances of the drawing. When the features describe a scenario between two thresholds the samples are crossfaded based on the distance the value is from each threshold. For example, when there are less than six lines being drawn simultaneously the system will sonify each one using an appropriate sample from the gesture sound library. As the number of simultaneous lines being drawn rises above six the system continues to sonify the individual lines with gesture sound samples while accompanied by an additional rain stick sample. The rain stick sample volume increases as the individual line sample volumes decrease until a threshold is reached and only the rain stick can be heard. From empirical data we found the sonification to be ineffective when using a unique sound for more than 15 lines simultaneously. For this reason we used a single sample with a dense sonic quality (the rain stick) to represent events in which more than 15 lines were being drawn.

4. CONCLUSION

Drawn Together had a soft opening in February, 2012 and is still a work in progress. There is still more which can be done in order to improve the sonic material. Tweaking current thresholds, adding additional samples to the library, and different processing techniques may produce better results. We hope to explore some of these options and implement them in future installments of the piece.

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