DRAWING SOUNDS

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Drawing Sounds is an interactive installation that explores the translation of drawings into sounds. This custom system provides to the audience an immersive and acoustic experience resulting from light drawings. The incident light is momentarily absorbed by phosphorescent ink contained in the canvas surface. These reminiscent traces of light are then translated into sounds, allowing the users to create and experience their own sound compositions.

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1. INTRODUCTION

The evolution of technology is promoting the experimentation and the adoption of novel computational approaches in areas such as art or design. Today, technology provides the opportunity to create and mold parameters of image and sound in imagined and unimagined ways. As John Whitney Sr. (1994) stated: “the computer is the only instrumentality for creating music inter-related with active color and graphic design”. Exploring this relation between sound and image, Whitney Sr. developed his own equipment to create sounds directly on the soundtrack section of the films. With this equipment, he and his brother, James Whitney, generated and composed sound and image simultaneously. The piece *Five Film Exercises*, created between 1943 and 1944, is an example of their seminal work (McDonnell 2007).

Karen Frimkess Wolff also established a relation between sound and image. In her work *Drawing with Sound* (1991), “sound lines” were defined as “the movement of a virtual point source of a sound in a space so that it is perceived as describing a line in the space”. These “sound lines” were generated according to the sound of a voice speaking and electronic tones and the movement of the sound point was equated to the act of drawing.

The process of conversion of data – e.g., images, gestures, weather conditions, and sentiments – into sound has been largely investigated in the past and is commonly called sonification. Previous work on image *sonification* can be divided into two different types: high-level and low-level. The first, is a “symbolic” sonification, e.g., the translation of visual information into natural language. In contrast, the second type of sonification transforms data into abstract audio signals. Works such as *Elementary Gestalts for Gesture Sonification* where the gesture is translated to a sound (Yoshida 2011) and *From Shape to Sound* where the authors generate synthesized friction sounds according with human drawing gestures (Thoret 2012) are examples of low-level sonifications. Likewise the work presented in this paper also explores non-symbolic sonification.

In *HCI Design and Interactive Sonification for Fingers and Ears*, Mikael Fernström, Eoin Brazil, and Liam Bannon (2005) seek to relate sounds and actions in the design of auditory displays. In their work, they explore what people hear and how they associate a particular sound to a particular action. They state, “If the sound will enhance the interaction, we need to explore ways of creating and testing auditory metaphors. We should also investigate to what extent the use of sound contributes to the users’ performance and subjective quality of use.”

Considering this background as basis for this work, and following the footsteps of previous researchers, we explore the relation between gesture, image and sound, with the additional motivation of investigating and exploring new creative possibilities using algorithmic and computational approaches.

2. CONCEPT AND OUTCOME

This work explores the translation between ephemeral visual registries and sound. It comprises an installation, which works as an instrument, allowing the audience to create traces in a canvas, that are then translated into sounds according to their characteristics. The peculiar characteristics of the canvas cause the progressive loss of visual registries over time.

The conversation between the user and the installation is achieved by the simple and natural action of drawing on a surface with a light source. The incident light is momentarily absorbed by phosphorescent ink contained in the canvas surface. The light traces remaining on canvas are then translated into sounds. This translation is achieved by a transformation of the traces’ characteristics into sound parameters: the horizontal axis of the canvas represents time, and can be perceived through two rows of lights placed along canvas; the vertical axis represents the sound pitch; the thickness of the traces represents the intensity of sound.

A video presenting the interactive installation and including explanatory notes is available at the following address: *http://cdv.dei.uc.pt/2014/drawing-sounds.mov*. The sound of the video was recorded with the camera causing some sound distortions. Figures 1–2 present a selection of photographs of the installation.

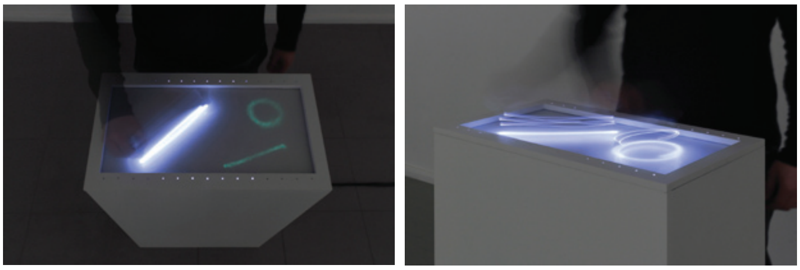

Fig. 1 Overview of the installation space **Fig. 2** The user drawing on the installation canvas with a flashlight

3. THE PROCESS

The initial step for the implementation was to build a box in MDF material. The structure was designed to be positioned vertically in order to allow the audience to interact and draw comfortably on its top. The top of the structure was designed to support a surface painted with phosphorescent ink – a material that absorbs the received energy and slowly releases it in form of light. Therefore by using light sources such as flashlights the audience can create drawings on this surface that will remain visible for a few minutes. The top of the structure also includes two rows of small holes with LEDs inside, which gives to the audience feedback on the translation instant of the drawings into sound. Electronic components such as a power supply unit that powers the electronics, an Arduino[1] microcontroller that controls the brightness of the LEDs, and a camera that sends in real time the light drawings contained on canvas to the computer, are embedded in the structure.

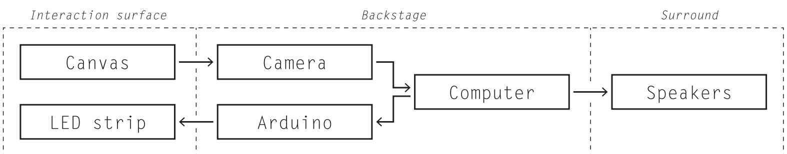

Fig. 3 Scheme of the installation pipeline

Figure 3 outlines the information pipeline, which can be summarized as follows: a camera captures the canvas and sends the images to the “canvas analyzer”, a pro-

1 *http://arduino.cc*

gram written in Processing;[2] this program processes and interprets the images of the canvas and sends instructions to the “synthesizer”, an application created in Pure Data;[3] this application generates sounds based on the received instructions.

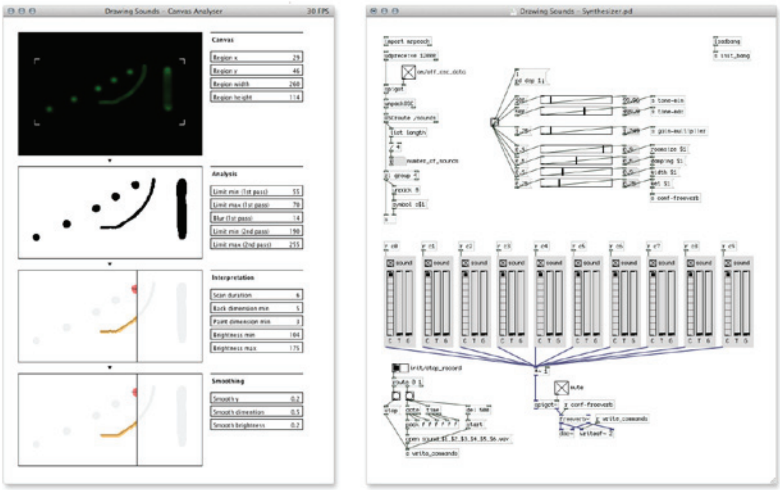

Fig. 4 Screenshot of the canvas analyzer (left) and the synthesizer (right)

The canvas analyzer is responsible for the translation of image into sound. The program includes a chain of processing stages and enables the fine-tuning of the translation parameters. The interface, depicted in figure 4, also provides feedback regarding what is happening at each stage of the process. The different stages are graphically represented through vertically arranged zones, which help perceiving the flow of information and processing.

In the first processing stage, the canvas area is selected from the image coming from the camera. In the following stage the program detects the bright and greenish regions of the canvas. This image processing operation integrates mechanisms such as functions of threshold, erosion and noise reduction. In the third stage the various spots and traces that were drawn on the canvas are identified through the analysis of the image processed in the previous stage. Each detected trace is associated to a sound stream, which allows the simultaneous acoustic representation of multiple traces. In the last phase, the position, brightness and morphology of the drawings are smoothed removing noise caused by the poor contrast of the image captured by the camera. These characteristics of the traces are translated into acoustic parameters (see figure 5), which are then sent via OSC protocol to the synthesizer that generates the sound stream for each individual trace.

2 *http://processing.org*

3 *http://puredata.info*

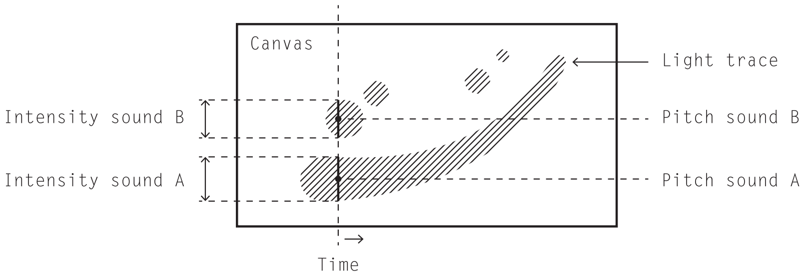

Fig. 5 Translation of drawings' morphology into acoustic parameters

The canvas analyzer is also responsible for instructing, in real time, the Arduino microcontroller, which in turn controls individually the LEDs positioned near the canvas area.

The system was designed to generate simultaneous sounds, enabling the public to acoustically perceive different traces. In terms of sound design, we favored the creation of organic and immersive soundscapes. To attain them the synthesizer produces several smoothing and processing operations.

The fact that the surroundings of the installation require a relatively low luminosity hinders the process of image capture and processing. To overcome this limitation, we used a DSLR camera, whose configuration allows capturing more light in low luminosity conditions. Nevertheless, in the conceptualization stage the brightness of each trace was associated to the intensity of the sound generated by them, and their vertical dimension to sound dissonance, however the low contrast of the captured image didn't allow an accurate reading of brightness. Thus, the dissonance was not applied, and the vertical dimension of the respective trace controlled the intensity.

The sound system consists in two individual channels. Each column is positioned in opposite sides of the installation. The current position of the "canvas reading" sets the panning of the two channels, i.e., the scanning of the canvas is perceived acoustically.

4. CONCLUSION

Today, the adoption by artists and designers of programming as a fundamental component of their creative process allows the development of author tools promoting the creation and exploration of new possibilities. The mastery of technology and programming allows the development of specific tools that enable the creation of new options and paths. In this sense, and taking into account the state of the art in the area of sonification, we perceive that this type of explorations can generate new creative and multi-disciplinary paradigms.

The experiments involving participants show that they quickly understand the behavior and creative possibilities of the installation. In few minutes, the participants start to use the canvas as a musical score. Although the sound generation is properly created according to the public drawing, the analyses of the brightness of the traces is problematic and further steps must be taken to overcome this limitation.

Future work will contemplate new drawing possibilities to increase recognition accuracy; new types of visual feedback through a video projector positioned under the canvas; and the possibility of using a palette of different sounds.

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