Interactive Environmental Sound Installation for Music Therapy Purpose

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ABSTRACT

This paper details one approach where music and media technology augment music therapy, and documents the interaction of composers, multimedia artists and music therapy scholars. By taking advantage of techniques in sound mapping, sound spatialization, algorithmic music and microtonal music, we created a „healing environment“ within a hospital.

1. INTRODUCTION

The project aim was to find a musical solution to relieve the pressure and the, at times, lethargic atmosphere of waiting in a hospital. Previous research like that of the signification of movement to improve patients' motor function or enable more communication[1], may be more related to helping the patients with a musical approach in a practical sense. But this project concerns more the mental and emotional problems arising from waiting in emergency waiting rooms (NOT), private waiting rooms (PRIV) and in a peri anaesthesia care unit (PACU). Our installations are designed to be part of the environment, rather than a tool or toy inserted into the environment.

There has also been research into playing live music and tape-recorded music in hospitals[2][3]. These works are an inspiration for our projects. But our project required that there be no clear beginning or end to the pieces we chose.

This project was a collaborative work by professors and students from Hamburg University of Music and Drama (HfMT, Departments of Composition/Music Theory/Multimedia,and Music Therapy) and University Medical Center Hamburg-Eppendorf (UKE).

2. OBSERVATION AND CONCEPTUALIZATION

After several seminars with music therapists, we made analyses of the spaces in the clinical environment with a specially formulated questionnaire. Together we also formulated a table for recording our observations in the three waiting rooms (Appendix 1).

Then we made two hospital observation sessions at the University Medical Center Hamburg-Eppendorf. As the table shows, we wrote down every audible event within intervals of 5 minutes, including the kind of the sound, the dynamic and whether it occurs regularly. After that, we uploaded them to a shared folder and reconvened to discuss the data.

The emergency waiting room (NOT) is about 60 square meters, with a vending machine. The private waiting room (PRIV) is about 20 square meters. The PACU is more than 200 square meters, with a huge amount of machines.

We collected the requirements that we found for the environment, as well as those raised by our colleagues, and summarized the following points for the music to be produced in our installation:

1. Continuity :
   Music should constantly play but without memorable features.
2. Sense of one's surroundings:
   Surrounding sound gives patients more sense of security, and merges the sound better in the original sound environment of the room itself.
3. Compensation for ambient noise:
   As per our observations, the noise of the vending machine in the emergency room is quite disruptive. The refrigeration process happens intermittently, and it exhibits an prominent resonance around 709Hz. It is also our task to fix this problem with our installation.
4. Reaction:
   Sounds reacting to patients' activities can make patients feel more welcome, giving the environment more of a human quality.

5. Sounds from the installation shouldn't interfere with "functional" sounds, like doctor's/nurses' voices and machine alerts in PACU.

3. APPLICATION

3.1 Djster

For continuous sound generation, we needed a "performer" whose "musical style" can be defined in detail, and will be able to play non-repeatable music constantly. All the while the music should be as neutral as possible, without creating a bias towards particular musical styles. Such an environment is provided by the application called AUTOBUSK—a real-time pitch and rhythm generator written by Clarence Barlow between 1986 and 2000 [4]. A modern version of this program is called DJster. Different from its ancestor, DJster is fully compatible with Max and Ableton Live via the Max for Live API. DJster was programmed by Georg Hajdu originally in MaxMSP 4.6, "preserving as much as possible of the original layout of the parameter input interface of AUTOBUSK,"[5].

With DJster, we can change the scale, the meter and 12 other parameters (pulse length, eventfulness, event length, metriclarity, hamoniclarity, melody scope, tonic pitch, pitch center, chordal weight, dynamics and attenuation) individually by manipulating the GUI or inputting data from via Max messages. But there is also an easier way which is more practical in our case: setting each parameter beforehand and saving different scenes as presets. When the installation is running, the data going to DJster changes the number of presets.

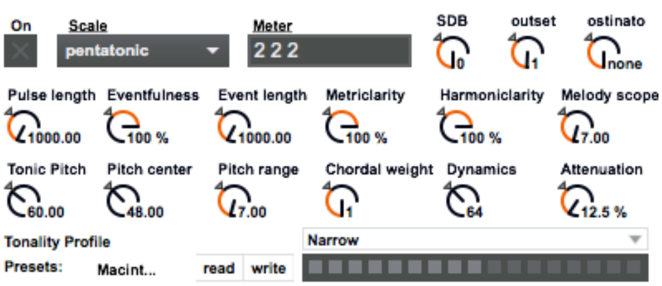

Figure 1 shows the GUI of the 2016 version of DJster running in Max.

We use several DJster objects in our installation to manipulate different sound samples. The MaxScore Sampler, another Max object created by Georg Hajdu, gives us the possibility to create our own sound bank and define different instruments. Each DJster instance uses one instrument from the MaxScore Sampler and sends the sound to the spatialization part.

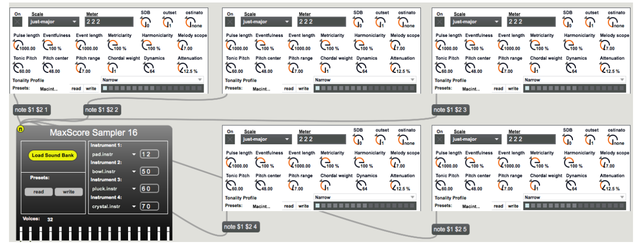

Figure 2 shows how 5 Djster instances play the sound bank created by the author for the emergency waiting room (NOT).

3.2 Spatialization

A student in the multimedia composition program implemented the sound spatialization in a hall simulting the wating room scenario with the Max object HOA[6]. The basic idea is to have 1-2 sounds which have fixed positions, and the other sounds to always keep a same distance to each other in 3D space. The sounds that have no fixed position rotate in space at a certain speed depending on different sound environments. Given that NOT has an irregular shape we may have to resort to vector-based amplitude panning (VBAP) eventually.

3.3 Microtonal Scale and Noise Detection

To fix the problem caused by the noise of the vending machine we discussed generating the same frequency with equal but opposite phase of the machine noise. But because of the huge diffusion of the noise (compared to the room size) we decided on another solution: making it a part of the soundscape. 709Hz happened to be an F, so I composed some DJster presets for which all notes were supposed to be in just intonation and planned to attach a microphone to the vendor machine. One of these presets works with a sound detection component. It was triggered when the microphone detected the 709Hz noise.

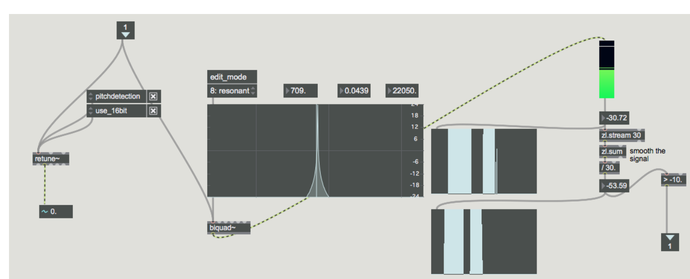

Figure 3 shows the noise detection subpatch, the inlet is connected to the audio inlet from the microphone.

3.4 Mapping and Sonification

Sonification is "the use of sound within a tightly closed human–computer interface where the auditory signal provides information about data under analysis, or about the interaction itself, which is useful for refining the activity"[7]. Another student designed a sound mapping which sonifies the patients' movements in the private and emergency waiting rooms. He used a Kinect camera to capture the variation of the height of patients' heads, in order to detect whether someone is standing up or sitting down. The change of the movement and the status of most people triggered different presets of the Djster instance.

In order to not interfere with the functional sounds such as the alerts created in the PACU by the machine gauging the vital functions of the patients, we decided to avoid certain frequencies. For instance, in the PACU we are planning to only use sounds lower than 250 Hz.

4. CONCLUSION

Music and multimedia arts can be helpful in medical scenarios, where the intention is to create a "Healing Soundscape". With sonic and interactive techniques we translated the demands of patients and therapists into solutions to help them in this regard. We hypothesise that this project could potentially have benefits in the psychological health of patients, as well as the relationship between patients and hospital staff, although further enquiry would be needed to establish this, and perhaps further empirical data would need to be collected to form the basis of any pilot study. The first version of all three sound installations was tested in sound labs of the Hamburg University of Music and Drama by music therapists, musicologists and specialists in the field of medicine. But further experiments are needed to test the psychometric properties. We plan on improving these protocols and on testing them with real patients, with the assistance of equipment like the EEG monitor before finally installing them into the hospital.

5. ACKNOWLEDGMENT

I would like to thank all the participants in this project. professor Georg Hajdu and professor Eckhard Weymann who led and supervised this project. My colleague Taizhi Shao did the sonification part, Stefan Troschka did the sound spatialization part. Luong Hue Trinh, Alessandro Anatrini and Pedro González Fernández designed sound banks and DJster presets for different rooms with me. Thanks also to colleagues of the music therapy group and the staff of the University Medical Center Hamburg-Eppendorf for trusting and supporting us. Thanks to Benedict Carey for correcting this paper.

6. REFERENCES

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Appendix 1: table for description of soundscape by

Katharina Nowack

31.10.16, 17:48

Protokollbogen für die Beschreibung von Klanglandschaften

Katharina NOWACK (in Anlehnung an SCHAFER 2010)

S= Sprechstimme, **M=** Musik, **G=** Geräusch, **m=** menschlich, n= natürlich, **t=** technisch

Beobachter:

Raum: **Datum:**

Dynamik= Musikalische Dynamik z.B. p (piano), f (forte)

Zeit= E: Einzelerscheinung, W: Wiederholung, ungefähre Dauer

Zeit										
Lautstärke Mittelwert										
Lautstärke Minimum										
Lautstärke Maximum										
Art des Klanges										
S, M (m/t), G (m/n/t)										
Dynamik										
Verlauf des Klanges										
Zeit										
Art des Klanges										
S, M (m/t), G (m/n/t)										
Dynamik										
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Zeit										
Art des Klanges										
S, M (m/t), G (m/n/t)										
Dynamik										
Verlauf des Klanges										
Zeit										

Anweisung: Alle 5 Minuten werden die drei signifikantesten Klänge dokumentiert.

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