Pythagorean Domino

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1. PROJECT DESCRIPTION

Pythagorean Domino is an improvisatory composition composed in 2019 for an augmented Theremin and a gyro-based gestural controller. This work aims to integrate music concrete techniques and an algorithmic compositional approach in the context of composition for gestural controllers. While music concrete compositional practice brings out the concept of "composite object"—a sound object made up of several distinct and successive elements [1]—in the piece, our algorithmic compositional approach delivers an interpolation technique which entails gradual transformations of the composite objects over time.

Our challenge is to perform a chain of short fragmental elements in tandem in the way to form a single musical unit, while the algorithms for transformation are autonomously changing synthetic and control parameter settings. This approach derives closely interconnected triangular interactions between two performers and a computer.

2. TECHNICAL NOTES

2.1 Setup

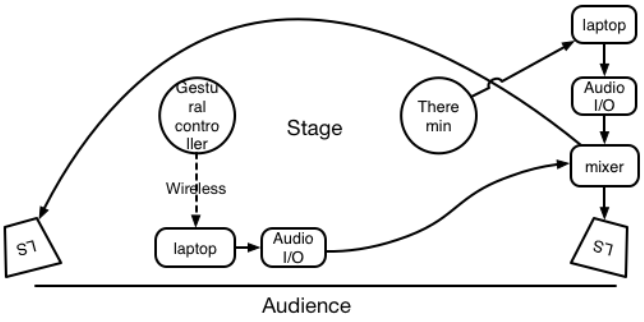

Fig. 1. The system configuration for Pythagorean Domino

We both stand on stage during performance. The required equipment is below; 1 stereo PA system which projects the two stereo outputs from two laptops (we both use an RME Babyface audio interface), 2 monitor speakers (one for each of us), 1 small table for Ana's laptop and audio interface, 1 microphone stand for the Theremin. The system configuration is illustrated in Figure 1.

2.2 Augmented Theremin

Augmented Theremin is an integrated analog/digital musical instrument, which consists of an Etherwave Plus Theremin used as a controller to detect

performer's hand motions and body localization, an iPad-mini running Mira application to control the computer at a distance, and Max for sound synthesis (Figure 2).

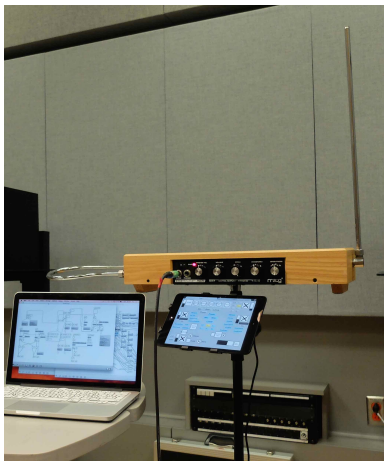

Fig. 2. The augmented Theremin

Audio signal from the Theremin is converted into data via *peakamp~* and *sigmund~* objects in Max. At the first level, the Max patch collects amplitude and frequency values from the Theremin. For each antenna, the values' delta can be adjusted by the user in order to reduce the field of detection of the instrument and thus avoid parasite triggering by nearby people or objects in case of a small or crowded stage.

The Max patch consists of five modules. The first one is a classic audio processing module. It includes a granular synthesis submodule and a frequency shifting submodule that process the incoming signal from the Theremin. Both antennas keep their original function (amplitude and pitch variation) and the control of the submodules' parameters are accessible via the iPad which is displaying a set of presets buttons.

The second module consists of pre-recorded sound file players (*sfplay~*). The iPad controller is used to select a specific sound file and a default pitch. The Theremin's amplitude and pitch antennas control respectively amplitude and speed parameters of the players. The pitch antenna also controls the size of grains of an optional granular synthesis submodule. Furthermore, this module can invert the antenna's detection. Originally the Theremin's signal amplitude is at its maximum when the distance with a body is bigger, but this can be swapped for instance for scenography or theatrical purposes.

The third module is a speed detector: it detects the speed of hand motion and when a specific threshold is exceeded it triggers - or otherwise stops - a pre-recorded sound file picked randomly from a folder in the computer's hard drive. This module also detects the direction of hand motion and can be set on "push" or "pull" mode to play/stop a sound file by using only one specific direction besides of speed. In the case of slow motion, the module only vary the sfplay~ speed parameter without triggering any other sound. In addition, this module activates a specific values threshold that takes into account when the user touches an antenna.

The fourth module is a sample player that reads and loops a fragment of a sound file stored in a buffer (using *groove~*). The amplitude and pitch antennas control respectively the onset and length parameters of the sample.
The fifth module is an elaborate speed module in which the user can choose between two folders (A with attacks sounds and B with resonance sounds) in the computer's hard drive by touching or releasing the pitch antenna.
Finally, the patch Max offers the performer a choice between a free improvisatory mode or a concert mode. The first mode displays on the iPad a maximum of controls for improvisation or "unexpected" situations. The second mode only displays buttons of presets or automations according to the piece's chronology in order to limit the iPad's interventions during the performance and thus let the musician focus on gestures.

2.3 The gyro-based gesture controller

The gyro-based gestural controller is a wireless Digital Musical Instrument, which senses its tilt and transpositions.

Fig. 3. The gyro-based gestural controller

This DMI consists of a physical controller and a Max patch. The physical controller is covered with a boxy form exterior (Figure 3) and constitutes an accelerometer, a gyro-sensor and a Wi-Fi module built in a Wemos microcontroller as well as two buttons underneath. The accelerometer is used to detect the performer's shake motion three dimensionally, in response to which, the Max patch triggers sounds. The gyro-sensor detects the controller's tilt of the controller also three dimensionally, according to which the triggered sounds transforms. The two buttons are used to recall preset settings. The Wi-Fi module transmits all the data collected by the sensors and buttons to the Max patch in a computer.
The Max patch constitutes four modules. The first module is a set of detectors for gesture acquisition. The detectors classify acceleration of the controller into six distinct categories of shake gestures: to the left, to the right, up, down, forth and back. The tilt on the yaw-, pitch- and roll-axis of the controller are, without classification of gesture types, mapped with a preset storage, the master volume and a pitch shifter, respectively.
The second module is a set of sound generators: granular oscillators and pre-recorded sound file players. Both of which generate various sounds in response to every shake and vary their synthetic parameters according to a preset recalled from the preset storage or a sequence generated by an indeterminate automator.

The third module is a real-time pitch shifter mapped with the tilt on the roll-axis of the controller for transposing sounds produced by all the sound generators.
The fourth module is the preset storage mapped with the two buttons underneath the controller and with the tilt on the yaw-axis for recalling presets for the sound generators. The preset storage imports one preset file selected by the two buttons from a preset library. Each of the files consists of two preset states, which are interpolated according to the tilt on the yaw-axis, thus creates a gradual transition of the parameters. This Max patch offers a graphical user interface, which shows a current state of the parameters, as well as enables to store a desired state of parameters during a compositional process and rehearsals.

3. PROGRAM NOTES

Pythagorean Domino is a work for augmented Theremin and gyro-based gestural controller. This work aims to integrate music concrete techniques and an algorithmic compositional approach in the context of composition for gestural controllers. We construct a dialogue of fragmented sounds forming "composite objects" (sound objects made up of several distinct and successive elements). Our materials transform gradually from one state to another as if metamorphoses of a living figure, thanks to an algorithmic system that we developed specifically for this project. Our sounds are scattered through the loudspeakers system as an extension of our bodies and a way to enhance our gestural performance on stage.
Our challenge is to perform a chain of fragmental elements in space as a single musical unit in tandem, while the algorithms for transformation are autonomously changing synthetic and control parameter settings. This approach derives closely interconnected triangular interactions between performers, computers and a performance environment.

4. MEDIA LINK(S)

- Video: https://vimeo.com/312451384

ACKNOWLEDGMENTS

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REFERENCES

[1] P. Schaeffer, *Traité des objets musicaux*. Essais interdisciplinaires, Paris, Seuil, 1966