

THE ENTANGLING TURNER - MOTION SENSING GLOVE WITH LIVE ELECTRONICS

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ABSTRACT

The Entangling Turner is a project that adopts accelerometer and gyroscopes in the motion sensor through Arduino. It detects movements in X, Y, and Z axes, and sends the numbers to the patches in Max. The continuously changing data from the motion sensor is manipulated and triggers programming events to control the parameters of audio signal processing. It controls the location, density and frequencies of the grains in granular synthesis while it controls the spectral centroid, deviation, frequencies and amplitude in some presets. Digital waveguide modeling, cross synthesis, convolution, comb filter, time stretching, and other effects are included as the components of the piece.

The project portrays the imaginary movement of lines and grains in 3D platform which leads to their twist and entanglement with different density and tension in pulling and pushing force. The entanglement forms shape, and somehow reaches a state that all is one and one is all. The invisible forces could drive the spectral components of the lines and grains in polarity yet bring it back to unity in the underlying and barely noticeable currents. Gradually, they might be absorbed, form a singularity or might vanish in the traces of lingering sounds remaining in our sensation.

1. DESCRIPTION OF THE PERFORMANCE

The Entangling Turner portrays the imaginary movement of lines and grains in 3D platform which leads to their twist and entanglement with different density and tension in pulling and pushing force. The entanglement forms shape and somehow reaches a state that all is one and one is all. The invisible forces could drive the spectral components of the lines and grains in polarity yet bring it back to unity in the underlying and barely noticeable currents. The performer expresses the motions of the strings through visual hand gestures, and somehow the strings are dismantled and turned into tiny grains and particles which gather or detach from each other according to the forces of the motions. Imagine that the grains might develop autonomy and consciousness in their colors, brightness, shape and form when forces are exerted. What would their consciousness lead them to and how do they develop? The strings

and grains express the quality of time, and the entanglement forms the motions to decorate our experience in time. Gradually, they might be absorbed, form a singularity or might vanish in the traces of lingering sounds remaining in our sensation.

2. USAGE OF ARDUINO

The Arduino board could be connected to a computer via USB, where it connects with the Arduino development environment (IDE). Participants will use the Arduino code the presenter offered in the IDE and upload it to the microcontroller, which executes the code, interacting with gyroscope and accelerometer. Participants are encouraged to take reference to open-sourced libraries because they provide basic functionality, and participants could elaborate them on their devices by following the logic of the Arduino programming structure, which includes Setup, Input, Manipulate Data and Output.

The programming language of Arduino is in C++ program. The IDE allows participants to do text editing in Arduino programming. The IDE translates and compiles the sketches of the participants into code that Arduino could read. After compiling the Arduino code, it will be uploaded to the boards memory. Once the upload is complete, the program will start running automatically.

3. TROUBLESHOOTING

A green line at the bottom specifies whether the code runs successfully or not. If done compiling is printed, participants could choose a specific serial port their Arduino is connected to in serial monitor. The Arduino LEDS flicker after the participants upload the compiled sketch and the data is transferred. Participants also need to choose the corresponding serial port in Max. A print message has built in Max patch to display the serial port number in Max console. Participants are suggested to double check the information before further implementation. Participants could enter the available COM port in the serial object, and write the COM port that have set in Arduino. After that, participants can turn on the toggle, which is the on/off button for receiving the data. The metro object allows adjustment in sampling rate of data in Max.



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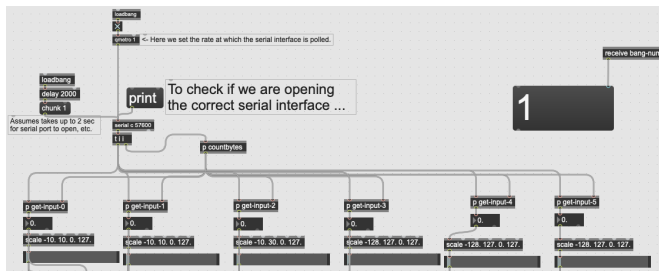


Figure 1: Connection of serial port and display of data of gyroscope and accelerometer in Max

4. ELEMENTS IN DEMO MAX PATCHES

All the values/numbers are scaled to a desirable range and they will be sent to other elements of the Max patches, which includes audio effect processing of the synthesizers. To create diversity in the audio effects, the synthesizers are routed to different audio effect processing sub-patches. All the routing are completed in the matrix object, so as to simplify the structure of the codes. Participants are encouraged to build their audio effect processing sub-patches and insert them inside the matrix object. The simple step would allow participants to create their own tailor-made sounds of their motion sensing gloves.

To control the gates of audio effect routing and on/off of certain presets of the synthesizers, knobs and faders are used in a MIDI controller to determine when and how much do users open the gates. A simple controlling-sub-patch in Max was built to send bangs in the performance of the instruments, and to trigger programming events.

Digital waveguide synthesis models were used in the Max patches and it is used for assimilating the plucking of string, which gives it a crunchy sound. Bangs are sent to change different presets in the switch object. The presets control the speed and direction of the listening position to listen to different position of the delayed line loop. Counter object is used to limit the scope of the listening position, and a metro object is used to control the speed of the reading. The counter object is set with different reading directions in different presets. A single pole low pass filter and a cut-off frequency was built inside the sub-patch to control the timbre of sound. A noise burst is placed there to produce pink noise according to the hand movement.

The audio files are in 0, 1, 2, 3 of the input of matrix for audio effect processing and audio files are also used in cross synthesis, where amplitude of one audio file could affect the other ones. The control parameters of playback rate, loop size, loop offset, FFT frame, amount of time (ms.) between successive FFT frames, and phasor rate correction for different loop sizes are inside the cross synthesis.

One of the effects inside the matrix object is comb filter and it is a filter that add a delayed version of a signal to itself. Feedforward and feedback in comb filter can change the direction in which signals are delayed before they are added to the input. By changing the feedforward and feedback, overtones are highlighted in the audio input and are emphasized for a longer time. Participants could choose their own audio files with desirable overtones or

frequencies to be highlighted to produce diversified effect.

More audio effect processing sub-patches would be introduced in the workshop.

5. RUNDOWN OF THE WORKSHOP

The workshop will take approximately 1 hour and 20-50 participants are preferred in the workshop. The contact person and the presenter are the same person, Ka Hei Cheng. The Motion Sensor could be demonstrated as an electronic instrument and it encourages participants to explore different hand gestures to trigger the movements in XYZ platform in the motion sensor. Along with the motion sensor, a MIDI controller would be connected to the music programming software, Max. Participants could turn on different presets of audio signal effect processing with the knobs in the midi controller and experiment with the sounds and movements.

Non-musicians and musicians could design the shape, form and growth of the performance with the alternation of different components of audio effect processing, such as deviation, grain density, frequency range, time stretching, spectral centroid etc. These were programmed to different presets of synthesizers and the sounds in different presets are distinct among the others. Participants could also mix and match with different synthesizers together to form desirable sounds.

The demonstration would start from the explanation of the components of the motion sensor and the explanation of the programming in the software. Afterwards, it will introduce different application of the glove. For example, performers could use the glove during their performance with acoustic pieces, which are specifically written for the glove. The extended techniques of some instruments, including violin and piano would be demonstrated with the synthesizers OR the audio signal of the live instruments could be processed with audio effects in live according to the movement of the motion sensor. Hence, it can extend/enrich the sounds from the extended techniques while audiences could appreciate the connection of movements and sounds. The connection gives meaning to different performance gestures and would add colors to the transitions among different gestures.

6. REQUIREMENTS AND SETUP

Workshop participants are encouraged to download Max 8, and to equip Arduino UNO and 3 Axis Gyroscopes + Accelerometer Module for Arduino. Presenter will send the code to workshop participants and explain the code, so that participants could adjust the codes according to their needs. Besides, some sample Max patches will be sent to participants, so that they could try to make music with the max patches. The control parameters of the Max patches are adjustable according to users needs. Selected participants who do not have the software and hardware would be invited to the stage and make music with the presenter. Several Motion Sensing Glove will be provided for selected participants. The performance of the performer/presenter is in stereo and two channels are required for the workshop setup. Presenter will provide a laptop, Arduino Motion Sensing Glove, MIDI controller and

audio interface. Setup time and sound check will be completed in 15-20 minutes.

7. PREVIOUS PERFORMANCE OF THE ENTANGLING TURNER



Figure 2: Performance of The Entangling Turner

Youtube link: <https://youtu.be/JViNRPw9vBk>