

Prototype GO: a Wireless Controller for Pure Data

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Abstract

This paper describes the development of a wireless wearable controller, GO, using Pure Data for sound processing. GO is built using a PIC micro controller, and various sensors. The data output from sensors, by the way of physical movements is processed by GO and further processed in Pure Data. Lights are an additional output from GO, and these are corresponding to movements in addition to audio processing. Performing with a sound and light interface is briefly discussed, as well as ideas of the performance context using a wearable interface. The wireless prototype GO is briefly described, as a structural composition, in its first performance.

Keywords

Wireless controller, Pure Data, gestural interface.

1 Introduction

This paper describes the development of prototype GO, a wireless and wearable controller for sound processing in Pure Data [1]. Various sensors are outputting data from human movement. Output from GO is, in addition to live sound processing, also made using various lights modules which are corresponding to physical movement. The first stage of development was described in *Designing Prototype GO for Sound and Light*. [2] To couple sound and light for live performance has not been examined within studies of interactive performances, and will be introduced here briefly, as well as the expressive qualities of wireless wearable computing. As Todd Winkler writes in 1995, “Interactive music systems can be used to interpret these data [movement], extending the performer's power of expression beyond a simple one-to-one relationship of triggered sound, to include the control of compositional processes, musical structure, signal processing, and sound synthesis.” [3] The sensors of a wearable interface, and the placement of it, define the way physicality of performance is defined. *The Hands*, a wearable interface by Michael Waisvisz [4] focuses the physical attention of the audience to the hands, and also focuses the movements performed to

the area of the hands. This relation between sensors, movements and sound processing, creates a specific “alphabet of gestures” .

2 Second Prototype GO

The first prototype of GO, made in 2006, is described in [2], being the first iteration of the design process. Some improvements and alterations have been made to the first prototype. The sound composition and interaction with it, has been improved. The circuit board with its light modules has been altered to improve maximum current output to the lights. The second prototype of GO, made in 2007, was tested, in an live performance at Performa07 Biennial [5] in November 2007, New York.

The circuit board holds a PIC micro controller [6], with an accelerometer sensor [7], two force sensing resistors [8], one micro switch [9], and one bend sensor [10]. The accelerometer sends out values depending on its relation to earth's gravity. It is a 2-way axis sensor, front-back / left-right side. The force sensing resistors act as digital switches, and the bend sensor controls volume. Information is sent via a wireless Bluetooth module [11] into Pure Data, as serial communication. See Figure 5.



Figure 1. Prototype GO

3 Interacting with Pure Data

There is in the current version of GO two ways of interacting with Pure Data, by the way

of switches and using sensors. The interaction with the three switches is advancement within the structure of the composition, for stepping through banks of sound files and synthesis, to control on/off of the lights, to control audio on/off. See Figure 2.



Figure 2. Switches

• By using continuous sensors, the performer can interact with GO in two ways.

- Volume level is controlled by a bend sensor. See Figure 3, to be able to control the overall audio level.

- An Accelerometer sensor is responding to the position of sensor in relation to the earth's gravity, and outputs 2-axis data, of movements back/forth, left/right. By using physical movements, the performer can interact with the composition to change synthesis parameters, and also to advance within the structure of the composition, with the motivation to make interaction using motion only.



Figure 3. Volume control.

4 Sound Composition

The sound composition of GO has changed since the first prototype and is targeted towards improvised performance. [5] The new version includes two different models of interaction.

- One is for interaction based on data sent by the accelerometer. This model is based on movements only, explained in [2], using the data output from the 2-way axis of the Accelerometer sensor. This model can be used if GO is inside an object, or used by an physically impaired person, where interaction is limited.

- The other mode is by using the switches as an input to reach different parts of the composition. By using switches the performer can step through to different parts of the composition, and also choose within different banks of sound files for processing. This model is adapted in GO for an improvised performance setting. The performer need not watch the screen during the performance, so there is visually a minimal set of information on the main interface.

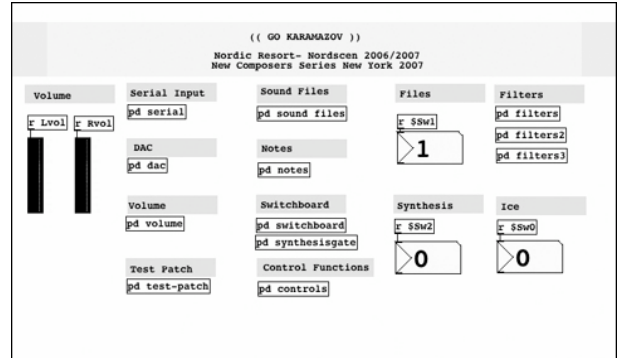


Figure 4. Sketch of Main Interface in Pure Data

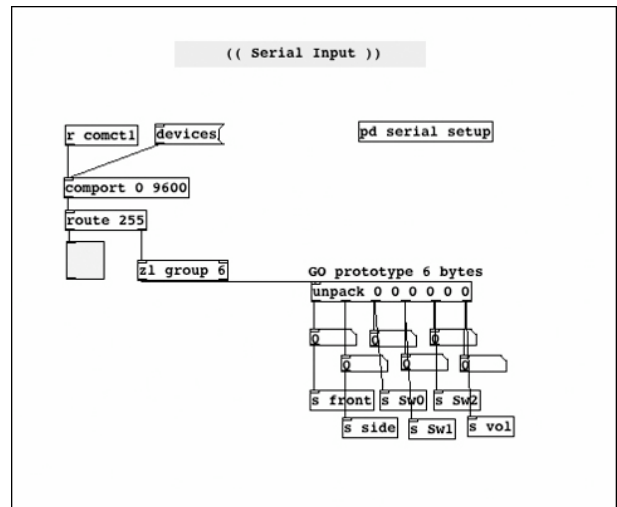


Figure 5. Serial Input into Pure Data

4.1 Structure

The composition is based on two main structures for improvisational purposes.

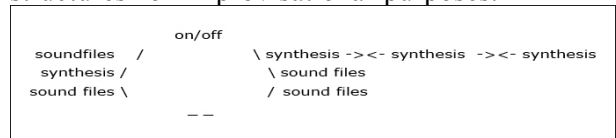


Figure 6. Structure of composition

Interaction is clockwise, as seen in figure 6, where the circle can be stepped through, and updated via switches. The structure on the right

side of the figure, starting with synthesis, is updated via movements sensed by the accelerometer, the position of GO in relation to earth's gravity. When GO is in a vertical position, there is a change in synthesis. The vertical position is counting the change based on prime numbers, 3, 5, 7, 11. This is for handling interaction without external switches. The use of prime number is to avoid the use of 2/4, and 4/4 beat structure.

There is a parallel set of interactive sound processes besides the structures just mentioned. There is a possibility for the performer to interact with two sound sources at the same time, this is a linear interaction, based on movements sensed by the accelerometer. The purpose for this parallel processing is the creation of character related environmental sounds. See section 7.

5 Notes on Performing

Wearable interfaces are an expressive form of performing computer based sound. This form of interaction with computing was prepared for us in the last century, performing with electric interfaces. In the first decade of 1900, Russolo created sonic interfaces for the industrialized era, using mechanics. Around this time new interfaces were invented based on electric interaction, as the *Theremin* and the Minstrel of *Electric Bones* [12], where the closing of an electric circuit created electrical sparks and corresponding sounds, in a rhythmic performance. Sound performances were enhanced using interfaces of oscillating devices with buzzes, hissing sound from electricity and variable voltage, as entertainment in the beginning of music industry. [13]

Performing with a wearable interface, using improvisation, with a total absence of a screen visualization, put certain demands on the way the interface is designed and integrates with hardware and software. This is where mapping of the input, and tactile feedback of the hand interface itself is an important part of the design.

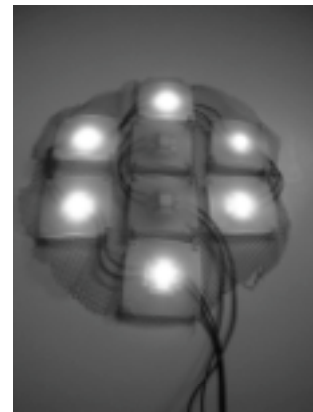
Performing with a wireless controller gives a possibility of movement, which are quite different from a wired performance, in a sense that the spatial restriction of movements is

removed and therefore changing the performer's relation to the space, audience, and performance context.

6 Performing with lights

Light has always been part of the performing arts. Leonardo da Vinci was experimenting with optics, and coloured lights in the theatres, using filters for light sources. Du Bois Duddell, when experimenting with carbon street lights, using variable voltage discovered sonic properties of street lights in 1899,. He connected a keyboard to the circuit, to create an instrument combining sound and light. In France, in 1883, an engineer working with portable technology, Gustave Trouvé, was commissioned to invent portable batteries for wearable interfaces for lights for a Ballet. Early interfaces, as the ones mentioned, are examined in *Gestures, Interfaces, and Other Secrets of the Stage* [13], where also more recent sound performance with lights is explored.

Performing with a small amount of light sources is not very common. Most music performances are taking place in a fully lit environment, where the musical performer is fully visible to the audience. A laptop musician is often using light coming from the laptop, where the audience's gaze is focused on the often un-expressive face of the performer. Prototype



GO is an experiment to perform sonic performance with light sources, corresponding to movements and being part of the performer's costume.

Figure 7. Light module 1.

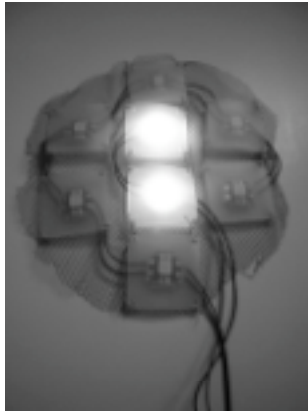


Figure 8. Light module 2.

7 The Karamazov Character

For the first performance at Performa07, a performance piece was created, using GO prototype. For clarification, the GO prototype can be used as part of various performance pieces. In this case, the character, Karamazov was constructed, from sections of Dostojevskij's novel the Karamazov Brothers. In Go Karamazov, a fifth, unknown Karamazov brother is constructed out of random sections from the novel, in addition to the four brothers in the novel.



Figure 9. Karamazov

This expands the sound piece to use prototype GO in a setting as an interactive musical instrument in an expanded field. If Michael Waisvisz instrument *The Hands*, is a musical interface for gestural performance, Go Karamazov adds an experimental narrative to the musical performance, as sonic hybrid performance.

8 Future Developments

GO is a work in progress. Future developments of GO will be focused on construction of more

complex, computational light modules as output, corresponding to the sound composition and motion of the performer. Some improvements will be made to the final circuit board, using an additional switch as an input, to add tactile feedback to the performer, a necessary addition when performing without a screen. The final Printed Circuit Board (PCB) is made in Eagle [14]. One of the design criteria of the final board, is that the size is as small as possible, since the board is not visible during the performance. The final board will be distributed to a group of sound performers, to be tried out in a performance setting, as a concert hall, club or other, for evaluation.

9 Acknowledgements

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References

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- [5] PERFORMA07 Biennale, in New York <http://www.performa-arts.org/biennials/performa07/>
- [6] <http://www.microchip.com>
- [7] The Accelerometer outputs data, of position of the sensor, relative to the earth's gravity.
- [8] Force Sensing Resistors, responds to pressure, can be used as switches on/off
- [9] Micro switch, has a tactile feedback

[10] Bend Sensing Resistor, responds to amount of bending.

[11] The Bluetooth module is communicating via the computer's Bluetooth module, which can be used as serial communication with RS-232 protocol.

[12] Minstrel, entertainment and theatrical form in the United States, starting in the 1830s, which gives rise to the music industry. The show included dance, variety acts, music and wisecracks. It was replaced by Vaudeville, but continued in its form into early 1900. Unfortunately Minstrel has a strong racist aspect, but is interesting for historical purposes. See Wikipedia for more information.

[13] Eva Sjuve. 2006. Gestures, Interfaces, and Other Secrets of the Stage. In *Proceedings Digital Art Weeks 2006*, Zürich, Switzerland

[14] <http://www.cadsoft.de/>