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, and also from 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 described, as well as composition structure, 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 controler for sound processing in Pure Data [1]. Prototype GO can be seen in Figure 1. Various sensors are sending data from movements to be processed in Pure Data. The output from GO is, in addtion to audio processing, uses various lights modules 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. It will be introduced here. The focus of the development of this project has been to introduce light to wearable interfaces for sound. The expressive qualities of interfaces for audio is also described in this paper. Developing an interface for improvised music includes several layers of movements and processes, as Todd Winkler writes in 1995 are examined, “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 wearble interface, and the placement of them, define the physical expression in performance. *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 *Designing Prototype GO for Sound and Light* [2], being the first iteration of the design process. Some improvements and alterations have been made to the first prototype. The sound composition has been altered, and is still under development. The circuit board with its light modules has been improved to give 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 board is built so all inputs, as sensors, switches, and all outputs, the lights, can be replaced in the form of modules. In this first experiment there is a limited set of external modules. 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].

Prototype GO is placed on the upper arm, as in Figure 1, but can be placed on the leg, or as part of a physical object. 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. The bend sensor controls volume.

Data from the sensors is sent via a wireless

Bluetooth module [11] on the GO board, into Pure Data, as serial communication RS-232., via the laptop's Bluetooth module. Se Figure 4.

Figure 1. Prototype GO

3 Interacting with Pure Data

There are in the current GO prototype two ways of interacting with Pure Data, by the way of switches or using physical movements. The interaction with the three switches is advancement within the structure of the composition, for stepping through banks of sound files and different forms of synthesis, to control on/off of the lights, and to control audio on/off . Se 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 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. The focus on the development is for improvised performance. [5] The new version includes two different models of interaction.

• One mode of interaction is based on data sent by the accelerometer from physical movements. This model is based on movements only, using the data output from the 2-way axis of the Accelerometer sensor. This model can be used if GO is part of a physical object, or used by an physically impaired person where interaction is limited.

• The other mode is by using switches to control parts of the compostion. 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. Physical movements processes the active sound file/files through filters responding to physical movements.

4.1 Compositional Rules.

Pure Data receives data from the accelerometer and based on variations on the Y- and X-axis controls different filters. The largest part of synthesis is performed in the frequency domain, as spectral synthesis. Variation of the filters are based on reoccurring measurements, in intervals of prime numbers, (3, 5, 7, 13). These reoccurring measurements also control frequency shifts, methods for synthesis and change of filters.

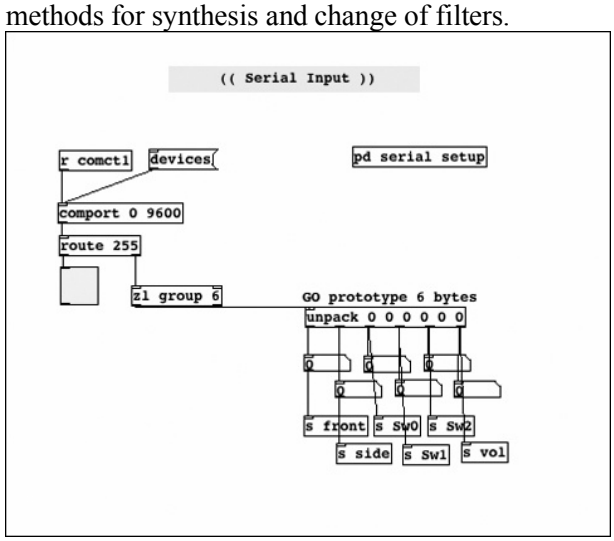

Figure 4. Serial Input into Pure Data

4.2 Improvisation

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

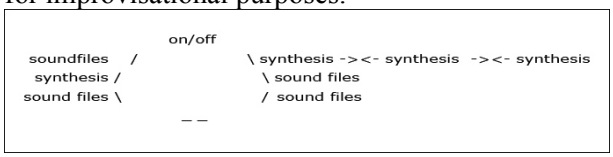

Figure 5. Structure of composition

Interaction, as seen in Figure 5, centre, can be updated via switches. The structure, top right of the figure, is updated via physical movements sensed by the accelerometer.

There is a parallell set of interactive sound processes besides the structures just mentioned. There is a possiblity for the performer to interact with one aditional sound synthesis, processed by physical movements. The purpose for this parallell processing is the creation of character-related, and environmental sounds.

This model is adapted in GO for an improvised performance setting. The performer does not watch the screen during the performance, so there is visually a minimal set of information on the main interface in Pure Data, as can be seen in Figure 6.

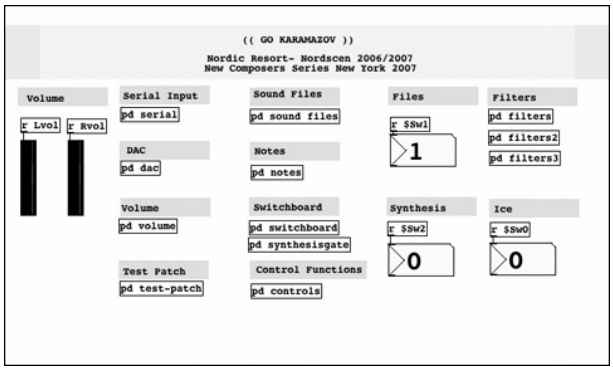

Figure 6. Main Interface in Pure Data

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 in performances of music and theatre, using custom built electric interfaces. In 1913, Russolo created sonic interfaces for the industrialized era, using mechanics. Around this time new interfaces were invented based on electricity, as the *Theremin* and the Minstrel of *Electric Bones*[1], where the closing of an electric circuit created electrical sparks and corresponding sounds, as rhythmical music 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 [12].

Performing with wearable interfaces, using improvisation, with a absence of a screen visualization, require a certain design of interface functionality, respons, and integration with hardware and software.

Performing with a wireless controller gives a possibility of movement, which is quite different from a wired performance, in a sense that the spatial restrictions of movements are 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 experimented with optics, and coloured lights in the theatres, using filters for the lights. 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 a wearable interface, including a portable battery for dance performance. Early interfaces , as the ones mentioned, are examined in *Gestures, Interfaces, and Other Secrets of the Stage* [13], where more recent sound performance with lights is explored as well.

Performing with a small amount of light sources is not very common. Most music performances are taking place in an 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 not very expressive face of the performer. Prototype GO is an experiment to perform sonic performance with limited light sources, see Figure 7 and 8, corresponding to movements and being part of the performer's costume.

[1] 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 tracing historical interfaces [12]

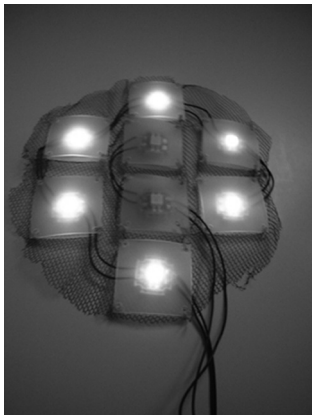

Figure 7. Light module 1.

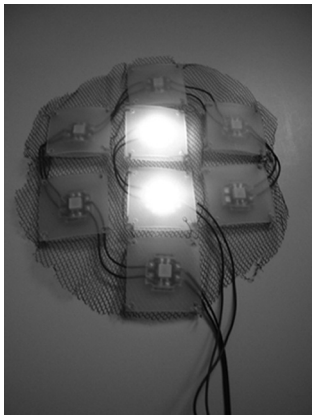

Figure 8. Light module 2.

7 The Karamazov Character

For the first performance of prototype GO at Performa07, a performance piece was created. For clarification, the GO prototype can be used as part of various performance pieces. In this case, the character, Karamazov, se Figure 9, was constructed, from sections of Dostojevskji's novel the Karamazov Brothers. In Go Karamazov, a fifth, unknown Karamazov brother's character is constructed out of random sections from the novel.

Figure 9. Karamazov

This expands the sound piece to use prototype GO in a setting as an interactive musical instrument . 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 performance.

8 Future Developments

GO is a work in progress. Future developments of GO will be focused on the construction of more complex, computational light modules as output, corresponding to the sound composition and motion of the performer. There will also be a set of modules constructed for variation of inputs. One additional board, a light receiver board is under development. The receiver board, OFF, is based on light sensors, which reacts to GO, to be used by a second 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 layout of the final printed circuit board (PCB) is being made in Eagle [14], but a switch of software is under way to PCB [15], which has industry standard output files, running under X11. PCB files are accepted by manufacturers, such as BatchPCB [16].

Some tools have been used during the development of GO, and some tools are under consideration. These will be briefly mentioned here. Small Device C Compiler (SDCC) [17] has been used, and the Odyssey [18] programmer, but a more in depth examination of various software and hardware will be made. Upcoming test of bootloaders, that can be used under Linux, as B-bootloader [19], will be considered as well. The discussion on hardware design is very interesting, but better left to a paper of its own, as this paper has focused on improvised sonic performance.

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 tested in a performance setting, as a concert hall, club or other, for evaluation.

9 Acknowledgements

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[6]Microchip, http://www.microchip.com

[7] The Accelerometer outputs data, of the 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 on GO is communicating via the computer's Bluetooth module, which can be used for serial communication using RS232 protocol.

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