New Open-Source Interfaces for Group-Based Participatory Performance of Live Electronic Music

Timothy Barraclough
Victoria University of Wellington
New Zealand School of Music
Wellington, New Zealand
barraclough.tim@gmail.com

Jim Murphy
Victoria University of Wellington
School of ECS
Wellington, New Zealand
jim.w.murphy@gmail.com

Ajay Kapur
California Institute of the Arts
24700 McBean Parkway
Valencia, California
Victoria University of Wellington
School of ECS
Wellington, New Zealand
ajay@karmetik.com

ABSTRACT

This paper describes the Modulome System, a new hardware interface set for group-based electronic music performance and installation. Taking influence from a variety of established interfaces, the Modulome is a modular controller with application dependant use cases.

Keywords

Musical Interface, Collaborative performance, open-source

1. INTRODUCTION

We live an age where the nature of our social interaction is rapidly changing in response to, and aided by, technological development. It seems that the creation and consumption of electronic music has not developed accordingly, in that division of audience and performer still occurs on a large scale: it is becoming more evident that we must create new technologically-afforded experiences for social interaction in electronic music if electronic music performance is to remain relevant in this ever-changing technological landscape.

By transferring the hardware semiotics of music controllers into social settings, we can create new, novel musical interfaces and experiences that reflect changes in our social and technological landscape to challenge the nature of the division between performer and audience. Without the hardware semiotics, the legitimacy of smartphone/tablet interfaces as transparent performance tools can be questioned.

This paper presents the construction and implementation of a networked system for electronic music performance by group participation that is both inclusive and accessible to performers of any experience level. Inspired by the social nature of smartphone technology and designed with modularity in mind, Modulome attempts to avoid the often criticized technological obscurity of electronic music performance and explore the second order abstraction of an audience within electronic music performance.

This paper's first section discusses the construction of the Modulome System, a modular hardware interface for wireless communication and the resulting hardware communication network (Figure 1) . The second section presents a custom-built Java application for the handling of the wireless communication and the parsing into both MIDI and OSC protocols. The third section discusses the community-based nature and importance of creating open source hardware controls and will provide links to Gerber files, PCB layouts and links to instructions for construction of the wireless hardware interface(s) specified in this paper. The final section is an discussion of one of the system's applied performance contexts.

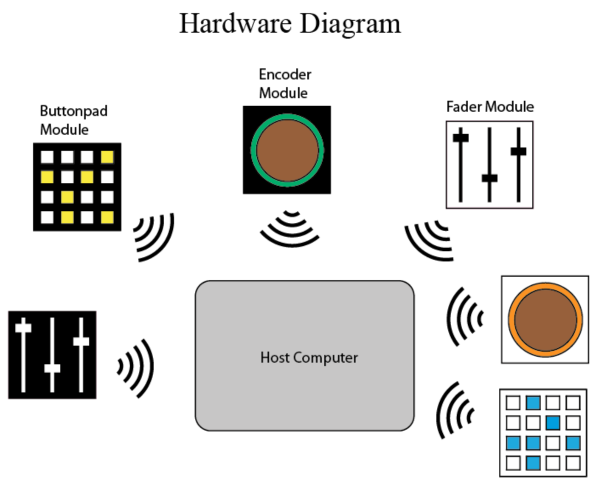

Figure 1: Diagram of the Hardware communication

2. MOTIVATIONS AND RELATED WORKS

Recent investigations into group participation in live electronic music have focused on utilising mobile phone technology [6, 3] to communicate data to a 'master' performer, which could either be a musician on stage or a computer manipulating parameters of a digitized performance. Although novel, the separation between the participating group (from the audience) and the performer is still integral to the performance. Of a group-based, participatory performance, we should expect that the participatory experience for audience members should behave as the performance itself and the audience participation would subsequently be directly causally related to the music performed. For this kind of experience to truly be novel, the participatory experience of the group performing must be essential to the resultant "work". Although the possibilities afforded by emergent

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smartphone technology allow for interface design as implemented within smartphones, the aesthetics of a tactile control still remain a predominant factor in live-performance of electronic music and, as such, should be echoed within a group-based electronic music performance in order to truly challenge the issues of audience-performer dichotomies.

Although the Modulome diverges from the smartphone technology previously mentioned, they both share a common ancestry of networked music performance groups such as The Hub [2], The Machine Orchestra [4], SLOrk [9] and PLOrk [7] specifically in the utilisation of technology to facilitate group collaboration in performance music. The use of networks themselves as instruments has been highly influential in the creation of social music controllers as a way to give control over the network and subsequently, the sonic direction of a performance. The Modulome system was developed with the philosophy of network based instruments in mind, but is interested in the behaviour and the social relationships of individuals within the network, attempting to showcase the network wholly without compromising the autonomy of individuals.

The name "Modulome" is a portmanteau of "Modular" and "Monome", the controller family the Modulome is based upon[1]. The minimalist design and open-source nature of the Monome system has been adapted and built upon, inspiring a lineage of designs with open-sources including the Arduinome and Chronome projects [8] and a community built around the devices themselves. Modulome proposes a significant difference to these other designs by being both modular and wireless.

Investigations into multi-performer instruments, such as the EDholak [5], and the Tooka [1], have revealed that these instruments are targeted towards performers/players with prior musicianship training and the resultant music is semiotically related to the physical construction and aesthetics of the instruments themselves. This suggests the importance of semiotics in the relation to the intended musical output of the instrument itself. Following from this, the "Modulome" system intends to adapt the semiotic language of electronic music performance from both contemporary and historic MIDI controllers and DJ equipment to present controllers and instruments that have a level of intuitive use cases and resultant music.

3. MODULOME CONSTRUCTION

Each module consists of a variety of sensors, an XBee wireless module, an Arduino Pro Mini (5 V) and a lithium-polymer rechargeable battery, resting on a custom-built PCB (Figure 8). Enclosures are constructed from a combination of black and white 6 mm acrylic and 6.7 mm bamboo plywood, laser cut to specific dimensions from Ponoko[2]. Each module is named independently, after the moons of Saturn, prefixed with the name "%me" (Modulome) (Table 1). Following are the three specific sensor arrays' differences that have currently been implemented in separate modules.

3.1 Button-Pad Module

The Button-pad module (Figure 2) houses 16 single color LEDs within 16 buttons arranged in a matrix. The LEDs and switching mechanism are decoupled, such that the LEDs can be addressed and operated independently of the buttons. This allows for application-specific visual feedback. For applications in which a large amount of modules are being used simultaneously, the LEDs can be mapped to the

Figure 2: The Button Pad-Module

button inputs directly in order to minimize the necessary communication.

3.2 Rotary Encoder Module

Figure 3: The Encoder Module

The Rotary Encoder Module (Figure 3) houses a 128 pulse-per-revolution non-detented rotary encoder with push switch. Surrounding the Encoder knob is an array of 32 LEDs driven by two TLC5940 LED Drivers. Similarly to the Button-pad Module, LED interaction is decoupled from the rotary encoder input. The encoder has multiple modes of operation (Figure 4). In "Wrap Mode" the encoder will output 128 values mapped directly to the encoder's rotational position which will be illuminated by the LEDs. "Fader Mode" functions similarly except does not allow for the input to wrap from maximum to minimum, allowing the encoder to work similarly to a rotary potentiometer where the value (between 0 and 127) is illuminated by the LED ring. "Pan-Pot Mode" is fundamentally identical to "Fader Mode", however it maps the LED ring as a distance from the center value (63) to function like a pan-pot on a mixer. The switch on the encoder allows for two modes of operation to be operated at one time (with the switch pressed and unpressed).

3.3 Fader Module

The Fader Module (Figure 5) contains 3 linear slide potentiometers, but is designed in such a way that any combination of 3 analog sensors (of any variety) could replace these potentiometers without any significant change to the Fader Module's firmware. Although the simplest of the modules, the fader module allows for the most easily customizable modules. This is because any 3 voltage dividers could be used in place of the faders, or additional sensors could be added (with minimal firmware changes) as the fader module does not require any additional libraries or strong timing mechanisms (due to the lack of visual feedback) that the other two modules require.

[1]www.monome.org
[2]www.ponoko.com

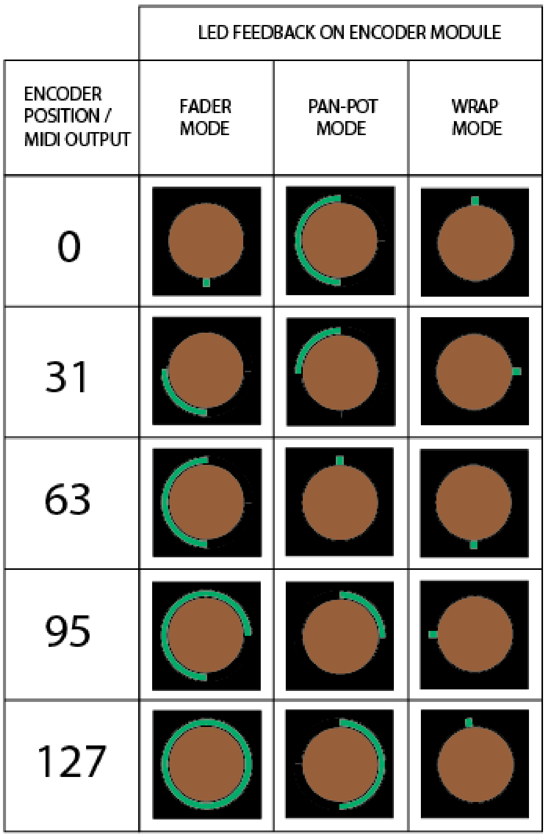

Figure 4: Diagram of LED feedback for each encoder mode

4. JAVA INTERFACE

In order to coordinate and process the serial data transmitted by the modules, a custom Java application was programmed (Figure 6) to consolidate and communicate between existing protocols (Figure 7). If the application detects a new module, by referencing the XBee address the application will dynamically resize to allow for visualization of the incoming module. The application is able to tell what kind of module has been added based on the XBee address. Settings can be adjusted per module to alter the type of communication protocol (MIDI or OSC) and the parameters of this output. For MIDI, the parameters are whether a module outputs Control Change messages or NoteOn messages and the parameters of the messages. For OSC the parameters are those specified by the Monome Protocol[3], however, also included are settings for adjusting the size and shape of the Monome Emulation (in regards to the Monome Arc and Grid arrangements). Additional options include the ability to choose the feedback the modules receive. The feedback can either be directly from the module sensors, echoed through the Java application or set to external control via MIDI or OSC. The ability to customize the parameters is the key to making the system modular; it can be utilized in any number of different ways, i.e. communicating to multiple different applications simultaneously. This is done without having to make any changes to hardware or firmware and can be decided by the composer or artist working with the system to fit their specific use case.

[3]www.monome.org/tech

Module Name	Module Type	Java/ LED Color
anthe	Fader	Indigo
daphnis	Button-pad	Warm white
dione	Encoder	Lime green
helene	Encoder	Amber
iapetus	Button-pad	Red
loge	Fader	Turquoise
pallene	Encoder	Yellow
pan	Button-pad	Emerald green
tarvos	Encoder	Cool white
tethys	Button-pad	Blue

Table 1: Module names and colors

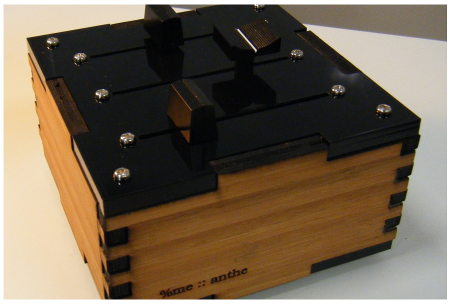

Figure 5: The Fader Module

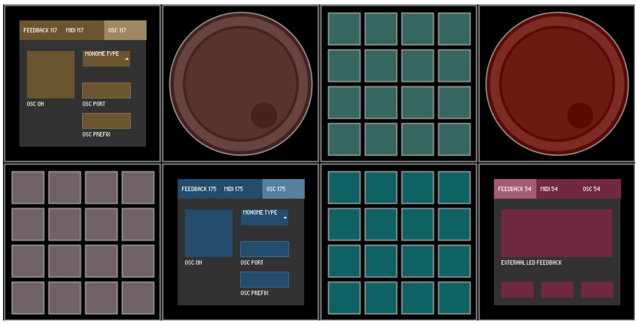

Figure 6: The Java Interface

5. OPEN SOURCE HARDWARE

Following in the footsteps of the Monome, Arduinome and Chronome projects, the build files, including laser cutting .eps files, the Gerber files for the printed circuit boards, electrical schematics, build instructions, Arduino code, the Java application and source code have been released. The logic behind this decision is two-fold. Firstly, the project is heavily based on the above projects and the communities built around them. It follows that Modulome can itself become part of the chain of influence, modification and community driven design. The second reason is based on the philosophy and aesthetics of the concept of the interface itself: given the idea was to create interfaces that could be diffused into audiences in a way that is symbolic of breaking down the barrier between audience and performer, releasing the source of the interface can be symbolic of taking the philosophy to the logical extreme, whereby the knowledge of how, and ability to create and operate the Modulome is, itself, diffused.

6. ORBITS - INTERACTIVE INSTALLATION

The following is a discussion of an interactive multimedia installation created specifically to demonstrate the social

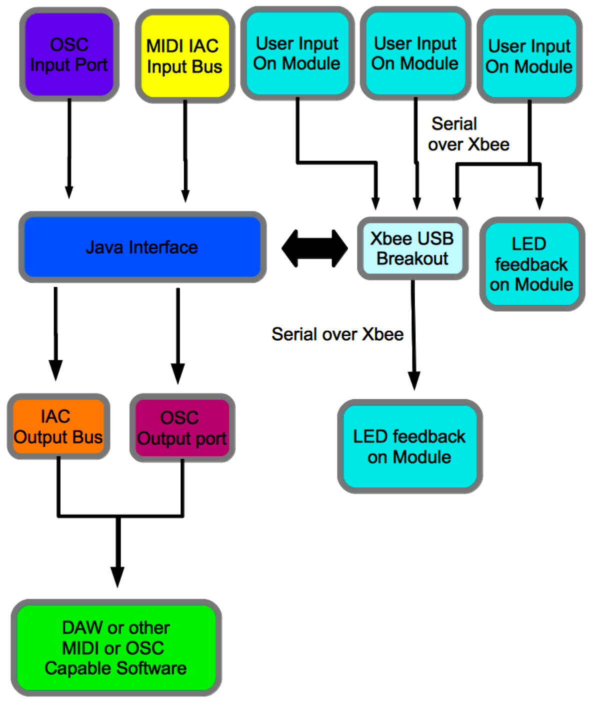

Figure 7: Illustration of Communication Protocol

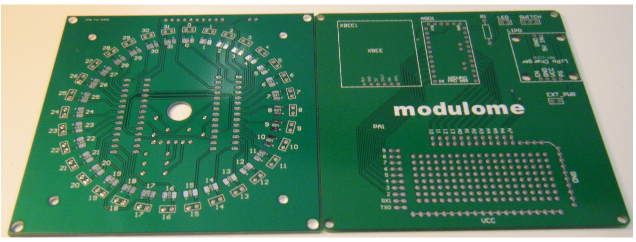

Figure 8: Printed circuit boards: Encoder module board (left) and Modulome base PCB (right)

nature of the Modulome system. Orbits (Figure ??) is an installation for four button-pad modules (pan, daphnis, iapetus and tethys), stereo audio and visual display. Each module controls the speed, direction and radius of four 'planets' of corresponding color to the button-pad LEDs. As planets collide, their direction reverses. As planets in nearby 'orbits' pass each other they exert a 'gravitational pull' upon one another. As planets pass a predefined point they trigger a piano-like sound. Users are able to interact with their planets (and subsequently the sound) through the button-pad modules and influence other users' planets by colliding planets on the same orbits. The result is a novel sequencer that exhibits different sonic characteristics depending on the amount of players.

The core of the installation was programmed in ChucK, receiving MIDI from the Modulome Java application and output OSC to Processing for the visual elements, MIDI back to the Java application for LED feedback and MIDI to Ableton Live for the sound design components. Orbits was presented at the Sonic Arts Engineering Expo 2013 at Victoria University of Wellington on the 12th of October, 2013.

A video demonstration of Orbits can be found at:

`https://vimeo.com/76930204`

Figure 9: Television showing visual component of Orbits

7. CONCLUSION

The Modulome System is a novel group performance controller that can be utilized in a multitude of different performance and installation settings by virtue of its modular design. It provides new opportunities for group-based performance by offering traditional hardware controller elements in dispersible wireless modules that strongly link user input to sound and visual outputs. The result is new social musical experiences resulting from participation and collaboration.

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