M.I.T.S.

Musical Interface for Touch Screen

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INTRODUCTION

The History

While the history of electronic music dates back to the early 20th century with the invention of the telharmonium in 1906[1], it was not until 1982 when it really began to be embraced by the musical community at large. This was the year in which the musical language known as MIDI (Musical instrument digital interface) was developed, effectively allowing a means for electronic instruments to communicate with each other in a synchronous fashion. This new language enabled a performer to control multiple instruments from a singular location and therefore, changed the role of the musician from being strictly a performer to that of a role closer resembling a conductor. In its early days, however, most of the capabilities of electronic music were focused on the composition, production and editing of studio music. The technology itself was young and suffered from a rigid structure and mechanical sound. Many live performers shunned it for these reasons and only recently, with improved sound quality and ease of use, has it begun to be fully embraced in main-stream live musical performances[2].

Since its inception, electronic music has existed predominantly in the form of physical modules such as drum machines, samplers and keyboards. Nowadays, due to the improved processing power of personal computers, many of these instruments have found their way out of the physical medium and into the digital. Through this transition, however, most of what is created tends to simply emulate the traditional hardware functions. This tendency to mimic is actually quite common for all things moving into the digital domain. Also quite common is the tendency for developers of the new medium to fail at embracing the newly-introduced attributes. This is evident in the software package Reason, a widely-used set of digital instruments and effects, in which the instruments available resemble their hardware counterparts with intense detail. In his book Electronic and Computer Music, Peter Manning discusses this issue in his conclusion when he says:

> “This approach is entirely consistent with the craft of the traditional composer working with an ensemble of tried and tested acoustic instruments but it nevertheless passes up the opportunity to explore the true potential of these powerful synthesis and signal processing resources. It is only by unlocking the door to new sound worlds and techniques that such perspectives can be profitably extended. These processes of education and discovery are impaired by the continuing shortcomings of the various software and hardware interfaces used to link these technologies to their users.”[3]

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[1] Roger T. Dean, The Oxford Handbook of COMPUTER MUSIC (New York, NY: Oxford University Press, 2009) p.16

[2] Early uses by such popular musicians such as David Bowie, Peter Gabriel, Duran Duran, etc are easily found, however electronic instruments only played a small role in their performances.

[3] Peter Manning, ELECTRONIC and COMPUTER MUSIC (New York, NY: Oxford University Press, 2004) p. 406

Fortunately, not all development has been hindered in this manner. Inventions such as the Kaos effects pad *have* introduced novel means of interaction between performer and music. This device is largely comprised of a small touch screen which is programmed to associate the range of X and Y coordinates to degrees of affect such as pitch and volume. It can also be programmed to apply an assortment of effects like distortion and delay within the provided matrix. Another example of a similar system is the Lemur, a touch screen device with a sampler-like interface which allows the performer to interact with computer software in a new way. These two examples illustrate the growing fascination with touch screen devices and begin to form a foundation from which this type of musical performance can be rethought.

Project Objectives

Issue 1: The linear sequencer

As with most musical forms, electronic music often uses rhythm patterns to establish the timing of the music. The instrument which is used most often to provide this structural backbone is known as a drum machine. Within the drum machine is a device known as a sequencer which is a series of 16 virtual slots into which sounds can be arranged to form a pattern. Sequencers can be found in hardware and software modules alike, and are almost exclusively limited to a linear format for the 16 positions. Time progresses from left to right until reaching the last position at which point it returns to its beginning. The repetition of this process is referred to as a loop and makes up an enormous part of electronic music. However this linear representation of time strays from the circular manners evident in nature such as planetary orbits which create years and the revolution of a planet on its own axis which create days and hours. Why can't the loop follow the natural order and resemble its function more closely?

Issue 2: One instrument at a time

Within a single device, such as a drum machine or keyboard, the electronic musician is capable of arranging multiple patterns and sequences of sounds. For example, a single drum machine could be playing the pattern for a kick drum, snare, hi-hat and cowbell simultaneously. The problem, however, is that the device only has one sequencer interface of 16 spots so that the performer must toggle through each sound to see and edit its respective pattern. Imagine if the conductor of an orchestra could hear all the performing musicians, *but only see one at a time*!

Issue 3: Performer and audience connection

In addition to issues of interface, electronic music has also largely failed to find new ways to foster the interaction between performer and audience. Because many digital instruments exists on computers, performers are often hidden behind the monitors of their laptops where the audience is entirely cutoff from the physical acts of performing. To combat this modal barrier, electronic musicians have adopted the use of audiovisuals to reengage their audience. This can be seen in the performances of electronic bands such as The Prodigy and The Chemical Brothers where the visuals are often no more than clips from music videos. While pleasing to look at, this eye candy rarely serves as a connective tissue between those perform the music and those who witness the performance. By hiding the action of performance, the actual abilities of the musician are put to question and the audience is denied the physical modality of the live performance.

THE PROJECT: Musical Interface for Touch Screen (M.I.T.S.)

From the beginning, this project aimed to explore the possible ways in which touch screen technology could be applied to the live performance of electronic music. What I developed was essentially two things:

1. A software interface for live musical performance
2. A touch screen console on which the above interface could be interacted with

Between these two pieces of my project I was able to address, at least in prototypical form, the three observed issues I established in my research.

The Interface

To create the interface, I used a program called MAX/MSP which is almost exclusively used for the production of musical interfaces. The interface I designed was, simply put, a redesigned sequencer which I refer to as a *module*. Within the total interface were 7 modules, an audio sampler and a series of macro-controllers such as global tempo and an on/off switch for the entire interface. While a nice addition to the interface, the sampler played a minimal role in the development of this project whereas the bulk of my efforts were focused on the modules. Each of these modules consists of a circular 16 step sequencer, volume and pan controls, a LOAD button which allows the user to browse their computer for the desired sound clip and a PLAY/STOP button which plays or stops the sequenced pattern of sounds. While simple in design, the module possesses two distinct attributes which make it unique to everything else I found to have existed[4].

The first attribute is that it reorients the linear format of a traditional sequencer to a circular format. As the internal metronome of the device cycles through the 16 instances of the 4/4 scale, time is allowed to progress in a naturally cyclical manner. By doing this, the performer is able to see and understand the created patterns in a more intuitive manner. This new orientation also emulates the format of an analog clock since time, for both, travels around a series of markers in a clock-wise direction. Playing off this traditional model of perceived time allows for fewer epistemic actions in this case, making it easier for a new user to acclimate to the interface. When a sound has been loaded into a given module, the user then clicks on the instances around the sequencer where they wish the sound to occur. Selected instances are visually designated by changing from a white border to a yellow one. The PLAY/STOP button also changes color and title depending on what function it will next serve. For example, once the loop is playing, this button is black and displays STOP. Conversely, when it is stopped, the button appears white and displays PLAY. Such supportive scaffolding only offers what is available at that given moment. The circular format also allows the user the ability to turn on up to 5 locations on the sequencer(one per finger) at once. The user could train

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[4] Disclaimer: I did eventually come across circular sequencers such as the Future Retro Revolution towards the end of my project, however these still suffer from the issue of only showing one sequence at a time.

themselves to remember the finger positions required to program a given sequence much in the same way a pianist memorizes the finger positions for various chords on a piano. Learning to play this device then affords a reduced cognitive load on the user, allowing them to make quicker and more natural decisions.

The second attribute is that each sound sample has its own dedicated sequencer. *Every* pattern being used is visible and able to be edited. Such a function allows the performer to manage the entirety of their performance with a quick glance of the eyes, thus reducing the epistemic actions traditionally associated with programming sequencers. Separating the instruments into individual units then provides a more panoramic view of what everything is doing and drastically reduces the cognitive load of the performer, allowing them to focus on more macro-level decisions. This distribution also affords for the learning of transitive association. If, for example, one module is programmed mostly in beats 1-4, and another is programmed with 5-12, then when it comes time for the user to introduce a third loop, they are able to visually see that beats 13-16 have yet to be filled. Not only can they hear it, but its immediately obvious by *looking* at the interface. The programmed sequences can begin to visually lock into each other in a way previously impossible. Relationships between patterns can be quickly learned and used based on the desired outcome.

The Console

To be able to interact with the aforementioned software in the necessary way, I also needed to build a working touch screen. After researching the numerous types of this technology, I decided to utilize the FTIR (frustrated total internal reflection) technology developed by Jeff Han in 2006.

In this system, infrared light is projected into the sides of a sheet of acrylic plastic, illuminating it with this invisible light. An infrared webcam is then aimed at the acrylic, which it sees to be a rectangular field of light. When a user touches this screen, light is allowed to pass out of the acrylic and the camera will see a black dot where the user's finger is touching. Using open source software, the coordinates of the infrared screen can be associated with the coordinates of the user's desktop and the black dots generated by the user's fingers can be translated into mouse clicks. Now that the user can interact with their own computer via this new screen, an external projector is attached to the computer which projects the desktop onto the back of the screen. At this point, the user can simply use the touch screen to interact with their computer.

Aside from the relative simplicity of the technology (some IR led's, acrylic, webcam and a projector), this type of touch screen also affords for the user's computer interactions to be visible on both sides of the screen. Therefore, because the interface is projected onto the back of the acrylic, not only can the audience see what's being done, they actually have the best view! Unlike most other touch technology which contains its workings immediately behind the screen, this transforms the computer interface into nothing more than a floating translucent surface. Additionally, because the acrylic is polished, the projected image also ends up bouncing off the back of the screen and projecting on the floor in front of the console. Thus providing two instances of the musician's interface which are viewable to the audience. By reopening this visual dialog between performer and audience, greater responsibility is placed on the performer and greater reward is bestowed upon the audience. This also begins to educate the audience which will only reinforce appreciation of a mastery of craft.

MOVING FORWARD

The Interface

What has been designed and built so far is considered a working prototype. It has received only a rudimentary level of testing and requires much more before any additional development occurs. One focal area for development will include the refining of the interface in the hopes of making it more intuitive to navigate and use. This could be done by developing a cohesive color scheme and better designed controls, however these decisions should be determined from the testing results. Additional functions such as effects will also be considered. Another area for further consideration is that the user is currently unable to customize the interface in any way. To better guide the next wave of design decisions, I would like to submit this interface to several online user groups and forums for feedback and guidance.

The Console

The design of the physical artifact is also in a prototypical phase now and needs to be rethought. From the limited testing it has received, several preliminary issues have been identified:

1. Accuracy of calibration is a problem, where the finger touches is not where the mouse clicks
2. Because of disruptive reflections, the projector had to be angled in relation to the screen which created a foreshortened image(a probable source of calibration issues)

To address the first issue of calibration, the screen could be made larger and thus require less accuracy. By slightly bending the acrylic, the projected image would be refracted and hopefully eliminate the problematic reflections noted in the second issue. This could also improve the accuracy of the calibration by allowing the projector and screen to be perfectly perpendicular to each other, eliminating the foreshortened image. Assuming this method of bent acrylic works, it is conceivable to link a series of projectors and screens to create a circular screen which could wrap around the user.