SynthSonic: An Exploration of Technology and Computer Programming's Influence on Music

By

Brandon Vassallo

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Sponsor: Lee Tusman

Second Reader: Paul Thayer

I grew up in a musical family and learned to play the drums at age 2, and music very quickly became one of my strongest passions. However, as I have gotten older and progressed throughout my academic journey, I have had an increasing interest in computer programming. If not selfishly for the economic leverage, it seemed to be a skill worth investing time into for life skills and benefits. Throughout my New Media degree, I have found myself torn between these two parts of my being; doubting the connection between them and treating them as two separate entities that I have a simultaneous passion for. With much consideration to our technologically driven social network, I have come to realize that I was wrong this whole time. Computer programming has had a massive impact on the world of music, as there are many examples of this throughout history. Digital processing, mixing, mastering, 808s, and drum machines - all of these are done through not just technology, but computer programming. But most importantly, in the current state of music and under the fear of technological overtaking, we can still see how technology continues to influence today's musical sound design. Therefore, I want to capitalize on how computer programming has changed the landscape on music production by making a free VST multi-effect synthesizer plug-in. Developing this program has demonstrated how the technology of the past has led to the significance of computer programming technology, in which developers can simplify the distribution process and lower pricing, leading to the expansive and innovative sonic discography of today, and the groundbreaking sound design of tomorrow.

Electronic instruments are a concept that has been around for as long as electricity itself. Although, it was in the 1970s and 1980s that we saw a popularized movement into electronic soundscapes, and one of the most crucial components of the electronic music movement was the drum machines. While rhythm machines have been around as part of organs for a long time before becoming their own instrument (Newquist 90), the 1970s would bring us a wave of drum

machines from companies such as Linn Drum and Oberheim, which would find their way into many studios when they came out. The ease of use, comparative price, and slim form factor when compared to a full-size drum set or percussion section made it a staple for studio production. Later on, the integration of MIDI, or Musical Instrument Digital Interface, would make its way around the music realm in the 1980s, which stored each note played on the electronic instrument as a piece of data rather than an audio sample. This gave drummers access to samplers, synthesizers, and anything else that could be triggered (Newquist 92). In a realm where we had access to nearly any sound in the world, we now found ourselves with no limitations to what we could create. However, with an unexpected turn from the company Roland, we were about to enter a new phase in music history.

The Roland TR808 was a drum machine that sounded like no other at the time. Released in 1980 at a time when drum machine companies were boasting of realistic depictions of drum kits or percussion sections, Roland focused on the uniqueness of their drum sounds by making a drum synthesizer. Made from electronic impulses, these Roland sounds (which would later be referred to as "808s") would be the defining drum sound for dance music, hip-hop, pop, and so on. But despite the TR808 going on to be recorded on more hit records than any other drum machine (Wells 18), the initial release of this groundbreaking piece of equipment was nearly a complete failure.

When released, the public had no idea what to make of it, with reviewers criticizing its inauthentic sound quality. One reviewer in particular, Dominic Milano, wrote in *Keyboard* magazine that he believed that the machine sounded like "...marching anteaters" (Werner). Because of this, the 808 was discontinued after two years of production, and was replaced with the TR909, a drum machine that had a similarly large following after lukewarm reviews (Jones).

However, it's clear that the initial release of the TR808 is almost unimportant compared to the colossal impact it had on the world of music, and it proved that music sounds were about to be dictated by electronic discoveries. These sounds would not stop here in the 1980s, and the future had many plans for the continuation of the 808s influence, especially in the realm of hip-hop.

While many artists used the 808's sound pallet in hip hop many years prior, there's no denying the significance of Kanye West in revitalizing the machine in the mainstream over two decades after its release. With his album *808s and Heartbreaks*, Kanye revamped the original sounds of the 808 as well as experimented with voice recording, adding autotune on top of it from computerized Digital Audio Workstations along with other post-processing manipulations such as compression and distortion (Carmichael). Progressing into the 2010s, world-famous producer Metro Boomin - the beat maker behind trap hip-hop legends such as Future, Travis Scott and Drake - is mainly known for his drums sounds which came from the original 808 sound pack (Hasnain). These sounds would not only be influential on these particular artists, but would go on to inspire a whole new wave of New Atlanta hip-hop, which would take over the music industry for nearly a decade (Hasnain).

Another crucial element to the development of modern sound design was the rise of home recording access - starting with the ability to record. Home audio recording was actually something that was around long before the tape recorder, with that piece of technology being the phonograph. Many people don't realize that most phonographs came with the ability to record audio as well as play it out, as it was a very popular form of entertainment for people in the early 1900s. There were many events of people recording each other at parties for entertainment, sending each other recorded messages, and, of course, recording songs or demos for friends to hear (Katz 69). Eventually, phonograph recording became obsolete due to the rise of CD players

and tape cassetes (Katz 69), but the popularity of this tool shows not only the importance of the technology, but also illustrates the innate desire for people to make their own recordings rather than go through the trouble of having it professionally produced at a record company. This was only the beginning though, as it would be in the late 1970s and early 1980s that home recording becomes a crucial element of the progression of music.

It was undeniable that studio time in a major label music studio space was both a heavy expense and unattainable for most people. With studio sessions costing upwards of nearly £10,000, and major record companies not willing to sell albums unless hitting a certain threshold of sales (Chanan, 170), people did not have options to distribute their music unless they owned the recording gear. It was here we see the rise of personal record players and tape recorders, which made it possible for people to create and distribute recorded music (Chanan, 170). Later in the 1990s, coming with the rise in popularity of personal computers, we would see an extension of this power that the modern consumer now holds in the upcoming digital age - the Digital Audio Workstation.

As personal computers became more popular into the 1990s, people could now download their own DAW (Digital Audio Workstation) software onto their computers. This software was not only easy to access on their own for many common folk who wanted to tinker with music production, but made it very easy for users to access new sounds and create their own through plug-ins and effects packages, allowing users to experiment with audio who were on limited budgets and time. This era of music production was referred to as “ubicomp”, or ubiquitous computing, in which we now have a system of computers that are not only cross-platform and cloud-connected, but also have access to libraries across the internet that allow for limitless sound possibilities and sound design (Reuter 114). People who purchase and download DAWs

also now get access to plug-ins that act as emulations of physical devices they may not have previously owned, such as synthesizers or drum machines, or old vintage instruments. Through Digital Audio Workstations, it becomes evident that software development and computer programming are now at the forefront of music creation. The development of coding and software development was not only pushing society into the future through social media, it was creating new pathways for creativity in art while making it easier to distribute and easier economically. As the landscape would change, the music would change with it, allowing for new genres of music to take over the mainstream.

To fully appreciate the role and influence of computer generated music and the tools created with it, we must first examine the origin of computers. While there many various manual computing devices that existed before, the story of the first general-purpose electronic computer begins in 1942, when two electrical engineering students from Pennsylvania were looking to create a way to calculate data for military weapon creation for the Second World War (Manning 182). This leads to the invention of the ENAIC which stands for ElectroNic Integration and Calculation, one of the first computers ever created. While there were similar prototypes created beforehand, the ENAIC provides the groundwork for future computers to be built upon. Later on the UNIVAC (UNIVersal Automatic Computer) would become the first commercially available computer, which was followed up in 1953 with the IBM 701 (Manning 182).

The computer clearly was not built with the idea of artistic expression in mind, and it certainly was not able to present itself as such with all of the shortcomings of early computing. For one, the processors were way too slow to keep up with the speed of artistic creativity, with high intensity programs taking as long as 24 hours to complete on original CPUs (Manning 184). Also, before the 1980s, the average computer had somewhere between 4 and 64 kilobytes of total

storage, which was fine for World War II millitary calculations, but as far as music production was concerned, it wasn't even large enough to produce a single second of high quality audio (Manning 185). It wasn’t until some major events took place in computer development that we were able to get a manageable tool for creativity. Some of these landmark moments include the creation of the Basic Input Output System (BIOS) - which was a language used to store primary function of the computer, and the creation of Random Acess Memory (RAM) - a system of constantly changing memory that can be overwritten at anytime (Manning 185). On the software front, progress was also expedited by the new programming languages like BASIC, Lisp, Pascal and C replacing the languages of the 1970s such as ALGOL and COBOL (Manning 186). All of these events created a much easier device to use, which allowed society to move into the 1970s and 1980s and explore new possibilities of sound.

One of the biggest areas that computers allowed for innovation was the expansion in popularity of the synthesizer. While synthesizers have been around for decades before the computer, the computer allowed us to control amplitude, allowing for us to produce frequencies in the form of waveforms in a much easier fashion and smaller package (Manning 190). These primary waveforms include the sine wave, square wave, sawtooth wave, and triangle wave which at different sample rates can produce different pitches with differing sonic characteristics (Manning 190). In real-world applications, we can see the use of these instruments in the disco era. Disco became one of the prominent genres of music to use these electronic instruments, and proved to the world not only the much improved and instantaneous power of the new computer, but also the new scenarios in which these devices can influence culture. Hits such as “Never Can Say Goodbye” by Gloria Gaynor and “Waterloo” by ABBA are prime examples in a sea full of music where these instruments are used to their potential (Manning 178).

Another critical moment in the evolution of music was the sequencer. Where music hardware like tape recorders was limited to 2 stereo channels, the software that was included in sequencers allowed for multiple tracks to be recorded at a time, so long as one had the storage for it (Newquist 196). This new way of recording also had a major effect on timing, whereas once musicians were able to sway in time as a collective group of human beings, a computer could now effectively quanitize all notes being played and put them into perfect timing (avid.com). This gives modern music a new feel; there is no longer any interpretation of time, it is now according to the gavel of a numerical calculator system, giving genres of the 1980s such as synthpop, techno, and dance music their distinct robotic feel.

Lastly, MIDI provided a way for electronic instruments to interact with the computer. Because all of the notes were stored as a piece of data, they can be moved around wherever they want, quantized to match up perfectly to a grid even easier than before, and also be used for an unlimited amount of sounds that are stored on the computer rather than the device (Wright). Computers never had any way of having an artistic perspective in the same way that a human being would, but the 1970s and 1980s showed us that the computer was a driving force for musical exploration. The limitless sonic potential of these new tools and instruments was not only important for the era, but they would permanently affect the trajectory of music to come.

The development of technology was inevitably the inspiration for the development of many genres of music. While electronic instruments became heavily involved in mainstream music towards the late 1970s and 1980s, we can also go as far back as the year 1948 to Paris where famous electronic engineer Pierre Schaeffer would be leading a new revolution in what was called “electronische Musik”. While computerized music was decades away from becoming a viable tool, Shaeffer was someone fascinated with recordings, and would play music

backwards, forwards, and all kinds of ways to manipulate the sounds (Manning 3). These pieces were often performed to crowds with mixed reactions, as the pieces were abstract and boundary-pushing along the lines of artists such as John Cage. While newer genres of electronic music were groundbreaking in pop music, older works were created in a much more experimental field. The creation of this music was for the sole purpose of discovery and ambition, as nobody knew what these instruments were going to be used for in the future.

However, as we enter into the 1960's, electronics become almost entirely responsible for the creation of many mainstream genres as well. The electric guitar, while such a common instrument now, could be credited for the creation of so many different genres that it could take up an entire thesis paper on its own. The inclusion of pickups and amplification are a staple of rock and roll, blues, and metal music (Manning 4). Effect pedals such as the wah-wah (an amplitude and low pass filter combination) and the phaser pedal (a pedal that copies and alters the phase of the two guitar sounds) are staples in funk music, disco, and other popular genres of the 1960s and 1970s (Manning 169). And this is without mentioning the plethora of other effects that were once groundbreaking discoveries in the 1950s and are now basics in music production such as reverb, echo, and delay that not only affected the guitar but synthesizers as well (Manning 169).

Today, one of the most forward-thinking genres that is both grabbing the mainstream's attention and pushing sonic boundaries is hyperpop. Serving as a highly stylized rendition of pop music, hyperpop is known for its loud, distorted, and energetic sound due to its highly industrial and alien-like sound design in drums, synthesizers, and vocal production (vice.com). With the ease of access to all of the effects mentioned before, artists like Sophie, 100 gecs, A.G. Cook, and Charlie XCX have made some of the most futuristic-sounding music to date. The sounds of

the electronic age were a massive influence on sound design, but it was the genres of music that were created with them that earned their right to exist.

Of course, we cannot have a discussion about electronics in music without discussing the importance of music production. While we previously discussed the origins of audio recording, the style of how we recorded the music had an extreme impact on the genre, and vice versa. Recording music was something that held back the realism that one could experience from records, and in an attempt to achieve realism, we would end up stumbling on many stylistic sounds representing different genres and eras of music. One of the greatest examples of this would be the drum kit, as drums were a notoriously difficult instrument to record in studios being both the loudest acoustic instrument in traditional settings and one of the core fundamental instruments for modern music. In order to compensate for this, we needed to figure out how to control them while making them sound realistic yet full of life.

One way that was popular in the 1960s and 1970s was the use of teatowels, made famous by rock and roll drummer Ringo Starr who used them to dampen the sound on songs from their critically acclaimed album *Abbey Road* (Trzcinski). Later on in the 1970s, Kansas Joe McCoy and Memphis Minnie would record John Bonham's drum track for the song *When the Levee Breaks* by Led Zepplin in the lobby of Headly Grange (Moss). This drum track was not only a breakthrough in modern production, but also became one of the most sampled beats of all time being used by such artists as Beastie Boys, Eminem, and Björk (Moss). In the 1980s, drum machines would affect sound design, as well as the creation of electronic drum kits from companies such as Simmons (simmonsdrums.net). In the 1990's we would have the unique sound characteristics with genres of music such as metal, punk and grunge music heading into the mainstream (Ujam).

In the 2000's we would hit what I would consider the peak of realism, as most music from this era sounds clean, well-tuned, and fairly realistic. But from the 2010s on, I would say we are in an era of exploration, taking modern drums and processing them to an entirely new sound that is both reminiscent of different genres yet still taking it somewhere new. Dan Mayo, a drummer made famous from social media, can be seen hooking up an entire board of guitar pedals to his kit as a way to process his sound in a stylized manner (moderndrummer.com). Brody Simpson, another drummer from social media, produces his drums to be reminiscent of hip-hop sample packs and electronic drums while showing that his drum sounds originate from real drum recordings (drumeo.com).

Now, up until this point, we have talked about the significance of technology leading up to the modern era. As we have gone throught the importance of home recording, the development of the computer, and the design of audio effects, you may have noticed that each section has landed in the same exact place: computer programming, and software development. By developing code that can emulate audio effects, simulate studio spaces, and interact with audio interfaces, the process of making music has completely changed. We can make music creation cheaper, faster, and easier to use for younger aspiring music creators by having developers on the front end of innovation. Furthermore, we can create effects never before seen by building off each other at a rapid speed. No, none of the figures previously mentioned have any real knowledge of C++ or python, or at least you cannot directly attribute a knowledge in programming for their direct success. But lurking in the background of every song heard on the radio today is a developer who worked countless hours in order to make an effect that achieved a desired sound.

Billie Eilish, for example, attributes much of the success of her debut album *When We all Fall Asleep, Where Do We Go* to her brother Finneas' modest home studio set up. This setup consists of headphones, speakers, a microphone, audio interface, and - you guessed it - an Apple computer running Logic Pro X, one of the most popular DAWs amongst music producers (Harvey, Steve). Quoting Fineass directly, he also attributes the success to one of Billies' most sucessful songs to the Logic Pro X Vocal Transformer plug-in, stating "It's really good at making a vocal sound crazy and unique. It's not necessarily the most intuitive plug-in, but if you twiddle the knobs and change some dials, it makes things really interesting. That's the plug-in I use on 'Bad Guy' for the 'rattlesnake' vocal."(Harve, Steve). Currently there is no physical analogue effect that can replicate the sound made in the so called "rattlesnake" vocal, and it is with digital creations and innovation that we can create these unique effects

What's important to note here is that the Vocal Transformer plug-in effect, used on one of most popular songs of the year *Bad Guy* by Billie Eilish, comes completely free with Logic Pro X. While you still have to pay for the DAW, this makes the barrier for entry much easier to access. This is just one of plenty of examples of free software that people can use for music production. DAWSs like Waveform and Audacity are completely free with no strings attached, and my final project utilizes the trial version of Reaper, which won't do anything that give you an annoying pop-up if you don't pay the price. In fact, my entire final project was made completely for free, full of multiple effect that you would have to pay hundreds of dollars for if they were physical. A price tag is a deterrent for most creators, and a young creator with no money will most likely opt out of buying an effect if the price is out of their range. Therefore, due to the established pricing of programming, software development allows for the

experimentation of sound design by allowing more people to use them, leading to the discovery of sounds and styles never done before.

Getting into this field, I remember feeling nervous about my future and how connected I could be to both my passions, computer programming and music. But now that I have spent an exorbitant amount of time exploring both the history and the modern implications of technology and computers in music, I am more excited than ever to know that I can be a part of the future. The history of music and technology shows that it has been technology all along that has been the driving force of innovation. As someone who is interested in computer programming, I feel confident that my skill set will be used to my advantage as I can not only utilize them for my own artistic accomplishments, but be of service to those who are creating music in the world alongside me.

To demonstrate the significance of programming in music production reguarding accessibility and innovation, I decided to produce my own VST plug-in from scratch. A VST (Virtual Studio Technology) plug-in is a module that can add effects to a DAW (Digital Audio Workstation) such as Logic or Ableton. Essentially, I would be coding an audio effect in C++ that could be used to manipulate audio in real-time. With my computer, I can take in audio from an electronic drum kit as a microphone input, which I can process through the computer using my effects. I could then use audio monitoring to play the effect out loud for audience members to hear, and I planned to perform this piece alongside other audience members and musicians. The performance would include myself and a friend of mine who plays drums going back and forth, with one of us performing a solo on a set of Roland V-drums while the other manipulates the audio. This would create a similar effect to what you would hear in a studio recording environment done with timed automation in the DAW, but instead, done in real-time as an improvisational performance. Two headphones and a speaker were set up for audio output, with the speaker being turned on occasionally when I or one of my friends was there to perform it and showcase the effects. When my friend and I were not present, the speaker was left off, and the piece was intended to be open for the public to try the effects themselves and experiment with sound design.

The main tools used to create my final project are three applications: Projucer, Xcode, and Reaper. Projucer is an application that provides a C++ framework with modules and libraries for creating the audio plug-in, as well as taking care of some core backend coding such as communicating with the DAW and providing basic sliders. This made the creation of the plug-in significantly easier especially when creating multiple effects and prototypes, as I could get away with not memorizing hundreds of lines of boilerplate code and move on to the actual

development of the project. Xcode was my main development environment for running, building, and debugging all C++ files, and it was the most natural environment to use being I was running all of this code on a Macbook, and any tutorial I saw online for Projucer was using Xcode and not Visual Studio. As someone who has had experience in both Visual Studio and Xcode, I will say that Xcode - as is tradition with native Apple software - runs extremely fast, which helped make the whole process of prototyping much faster as a result. Lastly, Reaper was my DAW of choice not for any technical reason, but because it was the only DAW that would discover my plug-in made in Projucer with no issue. Garageband would not be able to find my plug-ins, and I did not want to spend $200 on Logic to find that it still doesn't work.

The part I left up to chance was the performative aspect of the project. I wanted to perform for people who visited the exhibition, however, during the exhibition, I noticed it was much more fun when there were people around to see. This made it difficult for people to experience it in its fullest form, as some days were significantly busier than others. During the reception, when there were 30 people in the space at a time, we would draw a crowd rather quickly making the performance feel more natural. However, the next day only a handful of people showed up, which puts a big damper on most performance art, especially on the type of performance I'm used to doing in front of a hundred people or more. For most of this, I left the drum kit there for people to play with if they passed by the exhibition space, but I found people got bored of that rather quickly unless they had a friend there to play with them.

The expectations were both based on the functioning and form of the art piece. First, I wanted to learn C++ so that I could get a good understanding of a common language used in software development. Up until this point, I only knew basic web design languages such as HTML CSS, and JavaScript, along with a few coding libraries and alternate languages such as

processing and p5. However, none of these were impressive to the field I am interested in, and some would only be useful to me in the context of personal projects and art pieces. To be of service to businesses, I needed more languages under my belt to at least get the conversation started. As much as I was interested in the artistic presentation of this piece, it was important that this project be a learning opportunity for me as well.

The second expectation I had was that I wanted to make multiple effects that could interact with each other or be disabled independently. After a bit of thinking, the effects that I wanted to include were reverb, distortion, compressor, delay, phaser, and pitchshift. The compressor effect was scrapped because I couldn't find a good simple tutorial that I could use and manipulate to fit my project better, and the phaser effect was ditched because I couldn't find any tutorial for it online at all. Nonetheless, the effects I was left with were still more than enough for nearly endless combinations of sound design and experimentation. When interacting with each other, the effect could be used to amplify or intensify each other. The distortion effect could intensify the feedback loop of the delay effect, the reverb could give more sound waves to be distorted by the distortion, etc.

This brings me to my third expectation, which was that the project would be reminiscent of different genres and eras of drum sounds. As explained in my research, the ways that drums were recorded have had a significant impact on the development of musical genres and styles, and so I wanted to show the different ways a drum kit could sound and how they can inspire different musical ideas. The distortion pedal is typically associated with metal music and punk, the reverb and delay effects can be associated with genres such as 80s new wave, and the pitch shift can be attributed to genres such as hip-hop. Furthermore, we can combine these effects to reveal more genres of music; the distortion and delay effects can be combined to create an

intimidating amount of feedback often associated with 90s harsh noise music, and the distortion and reverb effects can combine to create a sound often associated with shoegaze, the reverb and delay together create textures found often in ambient music, and the pitch shift can combine with reverb to create and vaporwave sound.

These are only a few examples of the genres that are historically recorded, but it's important to note that there are still ways to use these effects to create new sounds and applications. This brings me to my fourth expectation - a piece that can explore the future of sound design and possibly future music genres and styles. Anybody who knows music is aware that it is not only the effects that define a style of music, but also how the musician plays them. The rhythms, beats, time signatures, tempo, and dynamics all have an attributed style of music that people will recognize. When combining these effects with atypical beats, we can get a look into the future of music genres to come. Throwing distortion on a funky beat may inspire a fusion of metal and funk or metal and hip-hop. Using some delay on a jazz beat may call for a disorienting electronic-fuzed form of jazz. Encouraging experimentation was a big focus of my project, and I wanted to exemplify how historical figures arrived at the sound pallets that they landed at, which was throwing things at the wall and seeing what stuck.

Lastly, I wanted the project to be easy and inviting for people who visit the exhibit. When building this software, I was worried that people would be too afraid that if a viewer saw a bunch of knobs wired to a loud drum kit, they may be intimidated by the appearance of the project. However, because I ended up making the project simpler than I originally intended, I think this worked out fine in practice. When busy, most of the people there were excited to see a plethora of colorful effects and were interested in navigating the soundscape. Additionally, being that we go to a music school with a fairly large music composition and production department, many of

the students that came were able to utilize their skills for the performance, setting an example for others.

The one major thing that didn't happen was that I wanted to create effects that were more unique and ominous. Researching before my development, I thought about a lot of guitar pedals made by Bliss Audio and Earthquaker, which had their own unique personalities and styles that made them desirable. However, hopping into a new coding language proved to be more difficult than I imagined, and I spent most of my time just trying to get a grasp on what I was doing. As presentations became more prominent in my Senior Seminar class, I found myself focusing more on having something to present rather than getting lost in the cool thing that I was doing. Because of that, the end result became more of a basic effect board rather than an inventive innovative one. Another thing that didn't happen is that I couldn't get a toggle working that dissables the effects. Each effect could still be disabled by simply turning the effects down, but I wanted there to be a button that cut each effect independently. When attempting to make this, I would land on a deafening feedback loop that would break the entire plug-in, so I stuck with utilizing the parameters to turn the volume down. Regardless, I still ended up with a functioning project that displayed enough of what I was trying to present in the space, as well as served as background entertainment for the exhibition.

The main process of making the project was to first brainstorm the most interesting effects that I could use for drums that were within reach for me to create for my first time making audio plug-ins. Then each week I would set my mind on an effect I wanted to make, make it over and over again until it functioned properly or didn't crash, and repeat that every week so that I had something to show. As a result, I have around 30 plug-ins saved onto my computer, not including the ones where I would just wipe it completely and start from scratch multiple times.

Only about 5 of these plug-ins work as intended, around a third of them crash upon opening, and around half of them make any sound at all. I consider myself a very hands-on learner, and while I find it very exciting to do and create, I think it can also be utterly dull to read in the form of textbooks. There were times I was forced often to use databases and online text-based sources, but most forums I came across were speaking at a level beyond my understanding, which threw me back to websites like YouTube.

Outside of the core development of the project, I would observe other projects and take some inspiration from them. The biggest inspiration for the performative element is a drummer named Dan Mayo, who has had people perform alongside him with a set of guitar pedals that manipulate the audio in real time. I figured the best way to do this would be to have me and another drummer perform this together, where one of us could manipulate and the other could perform, and then switch. When creating the effects, I used a snippet of my playing from a song I recorded a year ago where I played a very basic drum beat. After experimenting with it for a bit, I found that simplistic yet tasteful drum beats were what fit the performance the best, as turning on all the effects at once could make things hard to distinguish what exactly was happening. Still, it was fun to see different styles of playing take place over the effects, as when the performance occurred, I had drummers come by that played genres from punk and metal to jazz and latin. This allowed me to see alternate angles of my project, and experiment with what I believe was the best presentation of my work.

It was important to maximize my time when creating this project, so a lot of my time was spent trying to develop as much code as possible while learning along the way. This was a great help with learning how to make these plug-ins, and after all has been said and done, I can confidently say I can make an audio plug-in from scratch using Projucer. However, I would be

more wary of saying I could code anything in C++. Unfortunately, I didn't find that I could sit and study C++ while building my project, so most of my learning was done through building what I could from tutorials. This leads me to the biggest problem I ran into when building this project: there is such little information on Projucer and how plug-ins and effects are made. So many times I would find myself researching how to build very common effects like a compressor or a phaser and found essentially no information on it. Also, anybody who has ever coded before knows that online troubleshooting can be a nightmare to sift through, and having it be a little-known niche field of coding did not help me in the slightest. Reddit was mostly barren of any support, so if I ever needed help I needed to go on the Projucer forum website, where you're lucky if people have answered questions within the past decade. Whenever I had an issue, I was typically forced to either give up or spend an exorbitant amount of time researching and building the solution.

Occasionally, if I ran into an issue in my code or could not find a tutorial online for the desired effect I was after, I would attempt to use ChatGPT to get me started on a basic effect. For a vast majority, ChatGPT would create code that either didn't make sense, or didn't do anything to the audio. For example, if I asked it to make a compressor effect, it would do something along the lines of creating a variable called "compressor" and then calling the compressor effect in the "processBlock" class, where the effect would be manipulated. However, nothing would happen because it didn't create any logic for it to affect the audio. If I asked it to fix this, ChatGPT would then assign a number to the compressor variable, which would still not do anything. The only good thing about ChatGPT is that it gave me additional practice for making plug-ins and how the functions are placed throughout the 4 pages. Afterwards, if the project didn't work, I would still be able to confidently utilize sliders, figure out how to set up variables in the headers,

floats, and call variables to other pages. Other than that, I don't think we have to worry about ChatGPT replacing coding jobs any time soon.

Leading up to the performance, my last steps were to put together the front end and combine all the effects into one. This is where I encountered a few more small issues, one of which being that Projucer doesn't come with many different graphical options for the dials, and in order to customize them further, I needed to download other modules and effect packs. Due to my previously failed attempts at getting information on how to go about doing this, I was not interested at this point in going down another dead-end rabbit hole, so I opted for the basic sliders and manipulated the size and colors to make them more appealing. Additionally, the plug-in started to crash significantly more often as I put all the effects into one. Sometimes it would crash in the middle of adjusting effects, and other times crashing before opening causing the whole program to quit. The only solution I found to work for a majority of the time was to clear the cache in the plug-in folder and redownload the effect into Reaper. Sometimes I would load up the plug-in to find that no sound would come out at all for no reason, then when reloading it I would find sound coming out but no effects being applied. By the time it was ready to go, it was a coin toss to see if it worked properly, and would take up to ten startups before achieving sucess.

During the performance, one thing I noticed was that because all of the outputs were connected to each other, it was very easy to accidentally blow the volume way too loud, especially when using the distortion effect. Sometimes people visiting would accidentally play the volume too loud and then walk away, presumably because they were too afraid to make more mistakes. I found that I had to be there most of the time to make sure my friend's eardrums weren't getting damaged. I also noticed how a lot of people got the most entertainment out of just

turning all the effects on at once, but after hours of playing that can get very tiring, so I tried to encourage them to switch off certain effects after a period of time. There was also one time in the beginning of the exhibition when the effect crashed, but it never happened again and didn't affect any performances.

Through all of my exploration, research, and development, I landed on a project that was not only useful from a resume perspective, but more importantly, something I am genuinely excited and passionate about. This project was meant to be a statement of the importance of developers when it comes to music production, and while I believe this is only the beginning of what I can achieve, the people who understood my assignment fully understood how powerful of a tool this was - especially if they were music producers themselves. To be able to make a tool that is not only powerful, but completely free, is an exciting feeling that many people can relate to. This is technology that you will not only see at an art exhibition, but one you can go find in our own music department. Outside of my New Media degree, the majority of my time at SUNY Purchase has been spent not in the CMFT building, but in the Music building. Throughout my time, I have been in around 10 different bands on campus, not including the other various artists I have done work for outside of Purchase. I have performed at the Music And Technology Festival hosted by Professor Rebecca Haviland at Purchase 3 times, and have preformed at various venues across Manhattan ranging from East Village to Hudson Yards, including an Amateur Night at the Apollo Theater.

Along with these performances and musical collaborations, I have developed a keen interest in the process of producing music. Presently, there is around three hours of recorded music tracks that are on streaming services of which I am playing drums on, with nearly an hour or more music that is yet to be released this summer. In fact, by the time done reading this, my

friend Luke Munson has probably released a song I played drums on titled *Lemur*. It has gotten to the point that the professors of my friends' studio production master class know very well who I am despite never meeting me in person. It's here where I got to witness first hand the collaboration of coding with music, as the effects used were all plug-ins bought or built into the DAW. People know who is playing by the time I strike a snare drum, and they all smile at each other marveling at the drum sound that my producer friends and I are able to achieve. These sounds, with the right knowledge, can be taken even further so long as there is a developer who is willing to build it, as well as an aspiring artist who is willing to sit with it until they find something new.

The point I'm trying to make here is that I have to spend a ton of time interacting with the technology that is used as a means to deliver an artistic experience to a viewer, be it the microphones and their positioning, the rooms we choose, and - yes, the plug-ins used to manipulate the sounds to a desired aesthetic. Most of this makes me feel like a stranger, an outsider, a rolling stone that has no defined place in the world because he has to leave a recording session to host an art exhibit at the passage gallery at Fort Awesome, or come late to a soundcheck because he has to finish a test for his Data Analytics Harvard Certificate course, or come to a rehearsal early so that he can put masks on his bandmates and take pictures so that he can finish his final assignment where we make up a holiday complete with paraphernalia, decorations, and a ritual that is used to celebrate. But all this time caring about everything mentioned takes away from time I could be spending utilizing my skills in a meaningful way. All of these things were fun, they're just strange to explain to people. Maybe that just one way of looking at it, some people have nothing to talk about when they come home from work. Most people have the same assignment to complete every day, and seep away into an office chair in

where they yearn for the day they can retire. So if there's one thing I learned about at the end of my time here, it's this: where there is anxiety of ones future, there is also the desire and power to change it. And so long as I have an ever-permeating awareness of my place in the world, I don't think I will ever have anything to truly worry about.

Links to Documentation:

https://drive.google.com/file/d/1pUazNGH72u78kmvbKy9k6HJCimK3glAt/view?usp=sharing

https://drive.google.com/file/d/1pVkal7g2jgvcVledq4QsXr2FC4r290Bt/view?usp=sharing

Bibliography

Katz, Mark. *Capturing Sound : How Technology Has Changed Music*. Rev. ed., University of California Press, 2010.

Chanan, Michael. *Repeated Takes : A Short History of Recording and Its Effects on Music*. Verso, 1995.

Reuter, Anders. "Who Let the DAWs Out? The Digital in a New Generation of the Digital Audio Workstation." *Popular Music and Society*, vol. 45, no. 2, 2022, pp. 113–28, https://doi.org/10.1080/03007766.2021.1972701.

Marcone, Stephen. "Choosing a Career in Music." Music Educators Journal, vol. 69, no. 2, 1982, pp. 36–36, https://doi.org/10.1177/002743218206900212.

Newquist, H. P. (Harvey P. .. Music & Technology. Billboard Books, 1989.

Wells, Peter (2004), A Beginner's Guide to Digital Video, AVA Books, p. 18, ISBN 2-88479-037-3, retrieved 20 May 2011

Jones, Andy. "'it Sounds like a Drum Machine Instead of a Machine Playing Drums - a Sore Disappointment': What Critics Said about the Iconic Roland TR-909 Drum Machine on Its Release (and How They Actually Helped Define Dance Music Today)." *MusicRadar*,

MusicRadar, 24 Nov. 2023, www.musicradar.com/news/what-critics-said-about-the-iconic-roland-tr-909-drum-machine-on-its-release.

Werner, “The Roland TR-808 and the Tale of the Marching Anteaters.” *Ethnomusicology Review*, ethnomusicologyreview.ucla.edu/content/roland-tr-808-and-tale-marching-anteaters. Accessed 28 Nov. 2023.

Wells, Peter (2004), A Beginner's Guide to Digital Video, AVA Books, p. 18, ISBN 2-88479-037-3, retrieved 20 May 2011

Carmichael, The Awl. “Kanye’s ‘808s’: How a Machine Brought Heartbreak to Hip Hop.” *The Awl*, www.theawl.com/2011/09/kanyes-808s-how-a-machine-brought-heartbreak-to-hip-hop/. Accessed 28 Nov. 2023.

Harvey, Steve. “Finneas on Producing Billie Eilish’s Hit Album in His Bedroom.” *Mixonline*, 5 July 2022, www.mixonline.com/recording/finneas-on-producing-billie-eilishs-number-one-album-in-his-bedroom#:~:text=It’s%20just%20a%20regular%20bedroom,nearfields%20with%20an%20H8S%20subwoofer.

Hasnain, Zainab. “How the Roland TR-808 Revolutionized Music.” *The Verge*, The Verge, 3 Apr. 2017, www.theverge.com/2017/4/3/15162488/roland-tr-808-music-drum-machine-revolutionized-music.

Kefauver, Alan P.; Patschke, David (2007-01-01). *Fundamentals of Digital Audio, New Edition*. A-R Editions, Inc. p. 133. ISBN 9780895796110.

“This Is Hyperpop: A Genre Tag for Genre-Less Music.” *VICE*, 27 Oct. 2020, www.vice.com/en/article/bvx85v/this-is-hyperpop-a-genre-tag-for-genre-less-music.

Trzcinski, Matthew. “How Ringo Starr Used Towels to Create the Beatles’ ‘Come Together.’” *Showbiz Cheat Sheet*, 5 Jan. 2023, www.cheatsheet.com/entertainment/ringo-starr-used-towels-create-the-beatles-come-together.html/.

Moss, Clementine. “Behind the Beat: ‘When the Levee Breaks’ by Led Zeppelin .” *Roland Articles*, 15 Sept. 2022, articles.roland.com/behind-the-beat-when-the-levee-breaks-by-led-zeppelin/#:~:text=Captured%20in%20the%20lobby%20of,legacy%20as%20its%20playing%20specifics.

2022, On 29th Jul. “Dan Mayo - Drummer.” *Modern Drummer Magazine*, 29 July 2022, www.moderndrummer.com/drummers/dan-mayo/.

“Brody Simpson: The Life of a Recording Engineer - Drumeo Beat.” *Free Online Drum Magazine | The Drumeo Beat*, 19 Aug. 2022, www.drumeo.com/beat/brody-simpson-the-life-of-a-recording-engineer/.

Ujam. “Producer’s Guide to Creating 90s Drums: Tutorial.” *UJAM*, ujam, 23 Aug. 2021, www.ujam.com/tutorials/producers-guide-to-creating-90s-drums/.

“History.” *Simmons Drums*, 3 Oct. 2022, simmonsdrums.net/history/.

“Sequencers in Music Production: Recording Your Ideas.” *Sequencers in Music Production: Recording Your Ideas*, www.avid.com/resource-center/what-is-a-sequencer-in-music. Accessed 12 Dec. 2023.

Wright, Gavin. “What Is MIDI (Musical Instrument Digital Interface)? – TechTarget Definition.” *WhatIs*, TechTarget, 24 Jan. 2023, www.techtarget.com/whatis/definition/MIDI-Musical-Instrument-Digital-Interface#:~:text=Musical%20Instrument%20Digital%20Interface%20(MIDI,from%20its%20own%20sound%20library.