



Grgur Raič
1907332
Development (ADAD7005_LON)
Development Assessment
Ciarán Robinson

Element 2b - Instrument Essay

New technological inventions have always presented avant-garde figures in the music industry with the possibility to express their musical concepts in innovative ways. The violin, that experienced a development over hundreds of years, from nomadic equestrian cultures until its final development into its today's known body in the 16th century in Northern Italy, presents just one creation that enabled composers and virtuosos to express in completely modern fashion (Hoffman 1997). Paganini, Mozart, Haydn, Beethoven; an endless list of genius that used new technologies to create timeless music. This progress of modernity has never ended and it reached a new height with an even more sophisticated instrument, the Minimoog. Similar to the violin, this instrument changed music forever. Phil Collins, Herbie Hancock, DEVO and Dr. Dre were just one of the names that created new sounds within music with this analog synthesizer. The unique usage of the Minimoog of the latter of these musicians is going to be in the focus of this essay. Dr. Dre's way of using the Minimoog in the songs "Light Speed", "Housewife" and especially "Nuthin' But A 'G' Thang" inspired me to recreate this signature sound, the "West Coast Whistle" (SampleMan 2009). This recreation process of this sound in Native Instruments' Reaktor 6 is the focus of the following text.

Maker and Hacker Culture

The maker culture that is to a large extent connected to a DIY approach to things, is the centre of the decision of using Reaktor 6 created by the music company Native Instruments as the modular software music studio to create the desired Minimoog sound. This software enables the user to create new sounds from scratch by using plugins that are routed to one another, which resembles the structure of physical pieces of hardware. I decided to use a software, as accessibility was easier and I am more experienced working "in-the-box". The hacker culture, a subculture of the maker culture, carries with it a "spirit of playfulness and exploration" (Stallman 2002). The "playfulness" was an integral aspect of the working progress, starting with the decision of using the "West Coast Whistle" as the focus point of my synthesizer, to the design of the instrument in Reaktor. This underlines certain hacker attributes that were described by author Steven Levy; especially the principles that "You can create art and beauty on a computer" (Levy 2010). This

art aspect is not only shown through the unique design of the instrument but also its plugin routing, and decision which oscillators and filters are going to be used, which is similar to the decision which brush and color a painter is using to create a piece of art on an empty canvas.

One other aspect is central to my decision of using Reaktor 6 and thereby trying to step closer into the realm of being a hacker culture participant, which is that “all information should be free” (Levy 2010). Although Reaktor 6 has an initial buying price of 199 dollars, it provides a user library where creators of presets can upload their sounds for others to download for free. Native Instruments also provides “Reaktor Player” a free version that allows users to play Reaktor instruments. My synth is available for free on Native Instruments’ website and underlines one of the fundamental ingredients of hacker culture.

The Instrument

The desired sound I created with my instrument is the “West Coast Whistle”, which predominates in a lot of Dr. Dre’s productions. For referencing, at minute 0:04 this sound can be heard in “Nuthin’ But A ‘G’ Thang”, a song that was released in 1992 on the “The Chronic” album. After some research on blogs such as Reddit, it got clear that this sound was created with a Minimoog Model D, an analog synthesizer first manufactured in 1970. The instrument is famous for its “dirtiness of its filters”, which was achieved through a calculation mistake by one of the engineers of the Minimoog (Moogmusic 2020). It has also been used frequently for basslines in pop music, one example for this is Phil Collins “Sussudio”. However, Dr. Dre did not use this instrument in the same way it was previously known for, but rather, the avant-garde producer decided to create an unconventional sound with it: a high pitched, thin sound that glides from note to note and pierces through each song but still manages to not take up the limelight in the song.

The Process

The first step in creating this sound was to define these trademark features and begin the detailed research on how they were achieved. Next I started finding its components in Reaktor 6 and then routed them to one another. The whole instrument consists of several elements: a sawtooth wave oscillator; an ADSR envelope routed to the oscillator; a Ladder FM Filter; an ADSR envelope routed to the filter; a multiplier; a pitch glide; an amplitude control and several other control knobs. In this section of the essay I will explain the routing system and go into detail on the function of each module.

The first step was to decide which waveform the oscillator has to have in order to achieve the truest sound. In this case I decided to use a sawtooth wave, as a characteristic feature of this type of waveform is its many harmonics. This richness in harmonics creates a sharp timbre, which leads closer to the desired sound (Crute 2019). A MIDI keyboard is used as the input for the oscillator, which means there is no need to route the two inputs that are shown at the beginning of the creation process in the structure view of Reaktor to our oscillator. This is due to the reason that we are not passing any sound into it but rather generating the sound directly from the instrument; a characteristic feature of modular synthesis (Ressel 2015). In consequence, whenever one key is pressed, the oscillator is triggered and moves according to its frequency intake. However, to achieve this effect in the software, control modules have to be created, namely: 'Gate MIDI In' and 'Note Pitch MIDI In'. These controls are generated by pressing the 'Enter' key in Reaktor's structure view and entering the names of the modules. These two modules are then routed to the inputs of the sawtooth wave oscillator: the GMI is routed into the amplitude input and the NPMI is routed into the pitch input. To create sound, the virtual output cable has to be linked to the two output channels in the circuit board (or structure view), which are connected digitally to either speakers or headphones. After this short process the gritty sound of the sawtooth oscillator can be heard by pressing a key on the keyboard now that pitch and amplitude were defined, however, it is far from what the "West Coast Whistle" should be.

To get closer to the desired sound, the next step was to generate an envelope generator that provides control over the attack time, decay time, sustain time and release time of the amplitude of the sawtooth waveform of the oscillator. This ADSR envelope provides a “dynamic contour” to a played note, getting us closer to the sound of the Minimoog (Corman 2015). When looking at the parameters that the Minimoog Model D has, this is one of its main features and provides musicians with the ability to control the sound in more detail. In order to have control over the single features of the ADSR envelope, control modules have to be added for its attack - , decay - , sustain - and release time. These are generated by right-clicking on the respective event inputs “A, D, S, R” and pressing “create control”. This makes it possible to control each of these parameters individually in the panel view of Reaktor. Nonetheless, before it is possible to get actual control over this envelope the “Gate MIDI In” has to be routed with a virtual cable to the input of the envelope, and the output of the ADSR envelope has to be linked to the amplitude input control of the sawtooth oscillator. The envelope is linked to the amplitude control as the ADSR envelope provides control over the rise and fall in the volume of a note (Electronic Music Wiki 2020). The attack knob in the panel view tells us when the volume of the sound will set in; when setting the attack high it will take longer, when setting it short it will happen instantaneously. When changing the decay value, we can manipulate when the volume will fall to a constant amplitude value. The amount of this volume amount is controlled by the sustain knob, the higher the value the longer the note will last when triggering it on the keyboard, the lower the sustain the quicker the volume will fall. The release knob makes it possible to control the fade away of the volume, if it is set to a short value the sound will stop as soon as we remove our finger from the keyboard. However, if the release time is set higher the sound will play even if we stop pressing a key.

At this point, the control over the sound is quite sophisticated, however, after listening closely to the desired Minimoog sound it becomes clear that there is a portamento in every note transition. This glide between notes is the most important feature of the instrument. A glide influences the pitch during the transition of one note to the next. Changing the glide rate will make transitions between notes either instantaneous, when the rate is low, or take up several seconds when the

glide rate is high. In order to achieve this effect in Reaktor, a macro has to be generated which goal is not to cluster up space in the structure view. A macro makes it possible to store a lot of information and modules in a separate view section, but it appears as only one module on the main structure view in Reaktor. When double-clicking on the macro we are provided with an empty space that makes the working process much easier. This macro, that I renamed to “Glide” in the main structure view, consists of a highpass and lowpass filter module called “H/P 1-Pole Filter” in the software. What was mainly used in this instrument is the lowpass filter which allows us to “smooth out the pitch value” that is coming into the “Glide” macro through the “Gate MIDI In” (A Wild Sound 2020). In order to control the slide of the transition between notes I generated a pitch control or cutoff control by right-clicking on the event input “P”. In this case however, this parameter is going to function as a “Rate” control of the glide. The values for this rate control go from a maximum of -60 and a minimum of 60, so when the knob is turned to its maximum value the portamento will be at its highest. As mentioned already, we are only using the lowpass function of the filter as we do not want to open up the sound whenever it transitions from one note to the other. This low-pass output is linked to an “audio to event converter”, as the LP icon is colored white, indicating it is an audio signal which makes it impossible to connect to our output that also is an audio signal. This “A/E” converter makes it possible to connect our LP signal to our output by converting it to an event control (indicated as it is yellow), which fixes the problem. Now that everything is connected within our “Glide” macro we can connect the “Note Pitch In” control to the input of the macro, and the output of the macro to the pitch input of the sawtooth oscillator. When moving to the panel view we can now adjust our “Rate” knob that manipulates the portamento of the notes. In order to get the right amount that resembles the “West Coast Whistle” the most, I decided to set the rate at -20.

Moving on, another very essential feature is a filter which provides the user with more control over the movement of the frequencies that are being triggered. I decided to use Ladder FM Filter as it “is based on Bob Moog’s original ladder filter” (Moogmusic 2020). This is underlined by the description in Reaktor which states: a “resonant filter modelled on the classic circuit patented by Bob Moog”. To control the high-pass and low-pass filtering of the frequencies I added a

‘Filter Cutoff’ control-module by right-clicking on the respective F-symbol on the Ladder FM filter. The “Note Pitch In” control module is linked to the P-symbol on the filter which makes it possible to control the pitch of the filter when playing different notes on the keyboard. Next I created a control parameter for the resonance of the filter. Resonance is achieved by “applying feedback to the filter” and boosting “the frequencies around the cutoff frequency” and depending on what value the resonance knob is set at, the “feedback increases” (Rolandcorp 2020). Lastly, the output of the sawtooth oscillator is connected to the filter and the output of the filter is routed to the two outputs. This filter enables the user now to control the filter cutoff and the resonance of the instrument. To achieve our desired sound, I set the filter cutoff value to 1000, cutting a lot of the high-end.

To finalize the instrument, I added another ADSR envelope which controls the Ladder FM filter. Different from the first ADSR envelope, which controlled the amplitude, this envelope will control the frequency and how our filter behaves. For instance, by setting the attack value of the envelope quite high (1600ms) our Ladder FM Filter or low-pass filter will engage only after 1600ms. When changing the setting on the decay value, it will change the amount of time when the sustain will engage the filter on the pressed note on the keyboard. The sustain knob makes it possible to control how long the filter will stay on a certain value until it falls off again. This “falling off” can be controlled by the release value of the envelope, the higher it is set the longer the filter will engage until it fades off. In order to create this control of the filter, I duplicated my already existing ADSR envelope that is linked to the oscillator with all its controls already in place. The “Gate MIDI In” is linked to the input of the gate signal on the new envelope. A problem arises now, as the frequency input of the Ladder FM Filter is already linked to the filter cutoff control, and our ADSR envelope output cannot be linked to the frequency filter at the same time as the filter cutoff is linked to it. In order to circumvent this issue, a multiplication module called “Multiply” is needed. It multiplies the 0 to 1 output of the ADSR envelope, which is determined by the “Gate MIDI In” control, with the setting of our filter cutoff knob. This “Multiply” control enables us to link our envelope output and filter cutoff control to the multiplication module, and then route the output of the multiplier to the input of the frequency

cutoff “F” of our Ladder FM Filter. This issue can also be fixed with an “Adder” or “Add” module in Reaktor.

At this point, the synth has all its essential functions, still, to ensure even more control I decided to add a mixer at the end of the circuit that enables the user to set the amplitude of the instrument in the panel view, without having to adjust it in their DAW. By right-clicking on the “Lvl” event symbol I generated a level control that makes this adjusting of amplitude possible in the first place. As for the last steps to finish the instrument, the output of the Ladder FM Filter is linked to the “Amp/Mixer”, and the output of the mixer is linked to the plugin out channels 1 and 2. With this last routing the instrument is finalized. Now it is possible with a number of parameters to not only create the Dr. Dre’s signature “West Coast Whistle” but also create new sounds. The correct values for the exact Minimoog sound are as follows: 1000 on the filter cutoff; 0.1417 on the resonance knob; -20 for the rate of the glide; 0 attack, 14 decay, 1 sustain, 49 release on the ADSR envelope for the filter; 0 attack, 21 decay, 1 sustain, 44 release on the ADSR envelope for the oscillator. The notes have to be played in the octave of c5 to c6 in order to get the right pitch of the “West Coast Whistle”.

Result

During the process of creating this sound I was faced with several difficulties. One of which was that the original Minimoog synthesizer uses three oscillators of which one can be used as an LFO. The oscillators can be switched between a variety of different waveforms; triangle, sawtooth, ramp, and three varieties pulse waves; which provides the user with a wide range of possibilities to create new sounds. In my synthesizer in Reaktor I decided to create only one oscillator, a sawtooth, which cannot switch between different types. This switch function can be created in Reaktor 6 and has to be generated at the very beginning of creating the synth. It is a straightforward mechanism consisting of the desired amount of oscillators, a “Selector/Scanner” module, a volume fader control, a “Note Pitch In” and a position knob. The volume fader control is linked to the amplitude input of each oscillator, so is the NPI. The outputs of each oscillator

are routed to the inputs of the selector. The position control knob is generated as it allows switching between each oscillator type. Lastly, the output of the selector module is linked to two output channels. It is, however, possible to simply edit the synth in the structure view and replace the oscillator with any other type. Still, it is a longer process and might affect the musician during a creative burst of inspiration. Unfortunately I only realised this possibility towards the end of my creation, it would be interesting to create a new instrument with this feature and step away from focusing on Dr. Dre's signature whistle sound.

Another disadvantage of the synth is that it is only monophonic, meaning it cannot play chords but only play single melodies. Although this is a characteristic feature of the "West Coast Whistle" it is an additional drawback that could push certain users away from the instrument. This limitation is partly compensated by the fact that the synth provides flexibility with its ADSR envelopes, which can be used to create a variety of new sounds.

User feedback from two students from Tileyard Education underlined the drawbacks of only having one oscillator and its monophonic limitation. Although the different envelopes let them create pluck sounds; swell saw sounds that are characteristic in Future Bass songs, and resemblances to Reese pads, the instrument could not hold up with digital synthesizers such as Serum or PhasePlant. The design of the instrument, which I will go into detail in the last section, was complemented by both users. This is also one aspect that made both students state that they would come back to using the synthesizer.

In comparison with the Mini V3 from Arturia, a digital audio software company that created an emulation of the Minimoog Model D, my synthesizer comes very close to sounding the same way on specific settings. To be able to make this test, I set the values in the Mini V3 to the ones that were supposedly used by Dr. Dre to create his "West Coast Whistle" in the song "Nuthin' But A 'G' Thang". When playing both instruments back the similarity was incredible, the only difference was that my synth was a bit brighter than the sound of the emulated Minimoog. This

came to a surprise as my synthesizer only consisted of one oscillator and the creation was quite straightforward in Reaktor.

Design and Marketing

Native Instruments Reaktor 6 provides the user with the ability to create a custom design to their newly created synths. Reaktor makes it possible to create a custom structure of all the individual knobs of the synth in its panel view. It also lets the user import PNG files to the program and have it as its background synth design. This feature can not only underline the uniqueness of one's synth but it can also make the custom synth stand out even more. This component of Reaktor provides a singularity to each single instrument created in it. In order to exploit this opportunity to create something unique in my synth, outside of its sound design abilities, I decided to use this function extensively. After positioning every single knob control in my panel view and adding the visual representation of the ADSR envelopes to it, I went on to create a custom background PNG file that I used as the background in the panel view of Reaktor. This picture file was created in an external program called Adobe After Effects. Here I added the Tileyard Education logo, the Minimoog logo and the words “West Coast Whistle” to the design.

All of these aspects together makes the instrument stand out in comparison to other synthesizers that are accessible in the online user library of Reaktor. Many of the instruments that are free to download usually simply color their synth backgrounds with one single color that is available from the stock collection in Reaktor 6. This uniqueness in my synth makes it a product that can stand out in a broad pool of other creators. This approach however, does not represent the correct values of the hacker culture. The goal of this synth is not to reach as many people as possible, it is more an instrument for fans of Hip-Hop music and sound designers that want free access to one of the signature sounds of the 1990s. The additional design to it is simply a feature that motivates the users to come back to it, as it is aesthetically appealing.

Conclusion

The process of how music is created has changed enormously over the last decade. Novice's in sound design have been provided with the tools to create completely new synths in programs such as Max for Live or Reaktor. Only 20 years ago analog synthesizers were only affordable to established musicians and having a Moog instrument in the studio would have been a privilege. Today it is possible to create new instruments easily and make it shareable to a large audience for free. In the case of my instrument this is no different, as it is now available on the user library of Reaktor under the name "West Coast Whistle". This process of learning how to create synthesizers from beginning to end has taught me a lot of things. A very exciting aspect of the creation process was the uncertainty if the instrument will eventually reach its goal of sounding the way I wanted it to sound. Going back and forth with how to route certain things, and trying out different modules was fascinating. Additionally, as a fan of hip-hop music creating a synth that was used in songs that changed the direction of its genre was a factor that motivated me to go into detail with the process. I learned a lot about the Moog, a synthesizer that I heard a lot about but never researched extensively. Finding out that the Minimoog had such a big influence on music creation was new to me and I was quite surprised that Dr. Dre used one of these models in his hip-hop songs. That is because my association with rap songs from the 90s was always associated with sampling music and creating a beat around it, which was still the case also for Dr. Dre's songs. Finding out that the legendary producer tried to think outside of the usual palette of sounds that was used in hip-hop music gave me an even bigger incentive to try new things in my music creation and use custom instruments that have never been heard before.

Bibliography

A Wild Sound (2019). *Reaktor Tutorial - How to create PORTAMENTO & GLISSANDO*.

Retrieved from April 3, 2020

<https://www.youtube.com/watch?v=A77BQ2ERKNs>

Corman, Emmett (2015). *Simple Synthesis: Part 2, Envelope Generators*. Retrieved from April 3, 2020

<https://www.keithmcmillen.com/blog/simple-synthesis-part-2-envelope-generators/>

Crute, Adam (2019). *The science of wavetable synthesis*. Retrieved from April 5, 2020

<https://www.musictech.net/guides/essential-guide/science-wavetable-synthesis/>

Electronic Music Wiki (2020). *Envelope generator*. Retrieved from April 4, 2020

https://electronicmusic.fandom.com/wiki/Envelope_generator

Hoffman, Miles (1997). *The NPR Classical Music Companion: Terms and Concepts from A to Z*. New York: National Public Radio.

Levy, Steven (2010). *Hackers: Heroes of the Computer Revolution - 25th Anniversary Edition*.

Sebastopol: O'Reilly Media Inc.

Moogmusic (2020). *A Brief History Of The Minimoog Pt. 2*. Retrieved from April 5, 2020

<https://www.moogmusic.com/media/brief-history-minimoog-pt-ii>

Moogmusic (2020). *500 Series Ladder Filter*. Retrieved from April 1, 2020

<https://www.moogmusic.com/products/500-series-ladder-filter>

Ressel, Paul (2015). *NI Reaktor 101: Building a Synth (FFL!)*. Retrieved from March 28, 2020

<https://www.youtube.com/watch?v=vtn63OYo70E>

Rolandcorp (2020). *The A-to-Z of Synthesizer Terms*. Retrieved from April 4, 2020

<https://rolandcorp.com.au/blog/a-to-z-synthesizer>

SampleMan (2009). *West Coast Whistle*. Retrieved from April 5, 2020
<https://www.gearslutz.com/board/rap-hip-hop-engineering-and-production/425863-west-coast-whistle.html>

Stallman, Richard (2002). *On Hacking*. Retrieved from March 30, 2020
<https://stallman.org/articles/on-hacking.html>