

Development Element 2b - Instrument Essay

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Originally, as we began attending lectures and learning about the various methods we could use to create our instrument, I had several ideas that I was interested in pursuing. A 'square wave fuzz auto wah' guitar pedal (Price 2021, Guitar Gear Finder 2021, Puzzle Sounds 2021), a Max for Live plugin that emulated spring reverb (Bloom 2018) and even a 'Telelele' (a small CRT-TV reincarnated into a ukulele style instrument) created by the likes of 'Electronicos Fantásticos'. After doing some initial research, I discovered that experimenting with guitar pedal builds without prior experience with electronics would be extensive and difficult, especially considering that often numerous specific physical components are required for each build. The Max built spring reverb would almost definitely be too simple, unless I either modelled various reverbs used in classic amplifiers or combined the reverb with other famous stomp box type effects, such as the Boss CE-1, MXR Phase 90 or Electro-Harmonix Memory Man.

Although I suspected it might be a very challenging task, I was most interested in building a CRT-TV based instrument. However, upon taking advice from individuals with knowledge in the field of electrical engineering, I was made aware of the dangers associated with tampering with CRT-TVs. Since the 'Telelele' uses an optical sensor to create different pitches, it was suggested that using an optical sensor could be the basis for my instrument. Upon looking at various 'optical theremin' circuits (Instructables 2015, Synth Rotek 2021), I found that there wasn't much room to modify the circuits. So, I found that all my original ideas had some sort of issue that made them unviable.

After a lecture on sample instruments in which the lecturer mentioned his favourite part of the topic was 'creating an instrument that would be practically impossible to play due to the nature of performing it', and seeing a fan being played in Electronicos Fantásticos. I was inspired to try and sample the resonance created by circling the rim of a wine glass with your finger, after my father suggested it would be an interesting experiment. I could imagine it making a great pad type instrument, using long sustained notes to create tension.

I assembled numerous glasses and tested them to see whether they would resonate, and if so, at what pitch. A large gin glass allowed me to go down to an F#4 and a champagne flute could play a piercing E6, with three normal sized glasses that varied slightly in size to cover the pitches in between. At first, I was worried that this wouldn't be enough of a range to create a viable sample instrument, but, to my surprise, adding water to the glass actually lowered the pitch of the resonance so I could reach an F3.

Prior to recording each resonant frequency (pitch), I would fill the glass with water and use trial and error to 'tune' the glass. I would start the recording during this process to get the sound of the water being poured which I thought could add a unique layer to my instrument. When tuning, in the first instance, I was using Ableton's stock tuner to attain the correct pitch but later moved to a phone application called gStrings which is predominantly a guitar tuner. Although I have a natural bias against Ableton's Tuner due to its dissatisfying interface, gStrings did seem to provide more accurate and consistent pitch monitoring. Nonetheless, the pitch would nearly always fluctuate to some degree. This is generally the case when using acoustic instruments but depending on the way the glass was being played, could become particularly inconsistent. At this point, I thought it would be interesting to experiment with automatic pitch correction in software like Melodyne or Waves Tune, but in the end decided it would colour the instrument in a completely different way to how I had envisioned. I didn't want to risk it sounding noticeably unnatural.

From my research into the science behind the glasses ringing, I learnt that rapid vibrations cause the air inside the glass to compress and expand in waves. These vibrations are caused by the simultaneous expansion and contraction of two opposite sides of the glass, along with this effect

occurring the opposite way around in the two sides peduncular to these 'original' sides. (Murmson 2017). Therefore, when water is added, the pitch is lowered, as the glass must vibrate against the water. In terms of physics, we can say that the resonant frequency is inversely proportional to the time it takes a wave to pass down the glass and back up again. (Ken G 2016)

Amongst the scientific articles on glasses as instruments, there also seemed to be a relevant history to their use in making music. Scientific American explains that this tradition dates back to the Middle Ages and Wikipedia states their use was documented in 14th century Persia. The glass harp, which was invented by Irishman Richard Pockrich in 1741, was made from upright wine glasses. A mechanical version of the so called 'angelic organ' was invented a decade later by Benjamin Franklin and named a glass harmonica. The modern glass harp was invented by Bruno Hoffmann who devoted his whole life to the promotion of glass music, and it is him we have to thank for its renaissance today (Glass Duo).

With subsequent experimentation I found that I could create between two and four different velocities for each note. But this was dependent upon how much water was in a glass as I found more water reduced the greatest amplitude that could be attained. This, in turn, reduced the dynamic range that the glasses could produce. The two other factors that affected the volume of the resonance were dictated by how the glasses were 'played'. These included how much pressure was exerted on the rim of the glass and how quickly you circled the glass. This meant that as the overall dynamics of playing increased, the specific timbre of the playing changed too, which seemed to be because as the rate of circling increased, less frequent tones and harmonies become more noticeable. At the lowest and highest dynamics of playing, I was quickly aware that dissonance, pauses in resonance and atonal overtones would occur too frequently to avoid. But in many ways, I thought this added to the character of the sound, almost like a disconcerting vibrato.

When playing the glasses slowly and with a more delicate touch, sometimes the resonance wouldn't remain consistent when I rotated my finger at a consistent speed due to the nature of the fingertip. It does not provide consistent friction, even with a moistened figure to form a cushion that reduces resistance and allows your figure to slip around the rim. This would create a jarring stuttering effect. Then again, if I were playing the glass very quickly and exerting a lot of pressure several problems could potentially occur. Firstly, my finger might slip either partially or entirely from the sweet spot of the resonance. This was extremely agitating at first, as I was aiming for takes of each pitch and velocity to last around thirty seconds and I was having difficulties completing a take without this occurring. I tested using a slower speed and pressure but found that it didn't give enough character to differentiate it from previous for samples I would use for lower velocities. The second issue came when an entirely new resonance would suddenly overpower the pitch of the initial resonance, usually being much higher or lower and of a completely different note. These obstacles were almost unavoidable and had a big impact on my ideas for the marketing of my sample instrument.

An intriguing element to playing the glasses was that each seemed to produce varying complex tones. But it became more of an annoyance as each glass had to be played differently, with added water having a knock-on effect. The completely full gin glass and empty flute took a couple of seconds and attempts to begin to resonate at all.

Unfortunately, there was one more complication when recording that became my primary frustration, that being background noise. For reasons beyond my control, I don't currently have access to a professional treated studio and thus must suffice with a lo-fi home studio. Combining this with an assortment of other factors, such as requiring a very sensitive microphone preamp setting to detect the subtlety of the wine glasses resonance and living with my parents who, under the

restrictions of COVID-19, work from home and are frequently in communication, made recording the samples an even longer and more tedious task than I anticipated.

Eventually, once I had recorded all the samples I required, I discovered that the organisation and mixing of said samples to be a particularly monotonous task. Browsing the internet revealed the hurtful truth, that Ableton lacks many of the mixing capabilities of other DAWs. Without any variation on Pro Tools strip silence or Reaper's helpful grouping and region functions, manually processing every sample was very time consuming.

I thought my final task within Ableton would be to normalize the volumes of my recordings. I investigated using Waves Loudness Meter to measure the LUFS and bring everything within a suitable range. However, I discovered that a significant proportion of sample and sample instrument creators find that this process 'sucks the life' out of a sample or instrument, so swiftly decided not to pursue this chore. From the beginning, I had planned to use Native-Instruments' sampler, KONTAKT. It provides friendly user interface to which I would import my samples. Then I learned from David Hilowitz video on sampling using KONTAKT, that this much of my production could be realised within KONTAKT itself. This included sampling tools like slicing and mapping, as well as more additive effects like delay, compression and reverb.

The solutions to the challenges I've outlined were relatively straightforward for the most part. The dissonance, and general unpleasant timbre of the samples, leant themselves perfectly towards the disturbing and sinister ambiances that might be used when composing for horror films, thrillers and could even find use in alternative musical genres like metal. So, I thought it best to embrace these characteristics. The background noise, on the other hand, required planning recordings in advance to avoid acute vibrations and then using iZotope RX 6 Voice De-noise to reduce the hum of my computer fan and outside noise.

The issue of sacrificing dynamic range to achieve some resonant frequencies could be largely solved using KONTAKT's auto spread velocity ranges, allowing any velocity ranges I didn't have to be automatically filled. Then I could replicate the natural fading of the resonance by editing the release time to a second and increasing it to 1.5 seconds as the velocity increased. I was also able to achieve a much greater octave span, C1 all the way to C8, using KONTAKT's auto spread key ranges by root keys. As much as some of the voicings you can now achieve sound quite unnatural, it ties in neatly with creating dark and disturbing atmospheres. For this reason, I also moved at which octave of C playing a middle C would trigger so that the immediate sound you hear when trialling the instrument is a more natural sound that is balanced nearer to the middle of the instruments entire range.

Overall, I am very happy with the outcome of my instrument. It was a much harder and longer process than I had anticipated. I suspect this is in part because I was attempting to keep the automatic synthesis of unattainable notes to a bare minimum. There's also the fact that my individual samples needed to be so lengthy, due to the nature of how a pad is played. And since a pad is described as 'a category of synthesiser patches which produce a soft pleasing sound' by the Electronic Music Wiki (a definition I wholeheartedly disagree with), there is a question as to whether my sample instrument truly is a pad.

The volume disparity between glasses is obvious, and a possible solution would be to normalize using a batch processing based on RMS levels in software like Sound Forge or Twisted Wave, similar to the normalization process I nearly attempted with Waves Loudness Meter in Ableton. (Audiosex 2017). Yet this sort of process would likely change the sonic characteristics of the samples since it is a form of compression. Numerous notable sample instruments share this flaw, such as LABS by

Spitfire and, personally, I have had similar difficulties using Spectraonic's Omnisphere. (KVR Audio 2020). If I were up to the challenge, I could simply go through each sample in KONTAKT and make sure they sound equally loud, adjusting when necessary and trying to keep intact some sort of natural dynamics.

Although LABS and Omnisphere are different in the way they use samples. LABS simply presents the samples in an easily understandable user interface with some minimalist but engaging effects, whereas Omnisphere tends to use samples more constructively in order to synthesise a variety of patches. They both have a large array of peculiar instruments. LABS sampled instruments include an assortment of both predominantly atmospheric and predominantly musical samples, such as London Atmos, Textural Pads and Arctic Swells, and Sleigh Bell, Music Box and Moon Guitar, respectively. Omnisphere's libraries are much more extensive seeing as it's not a free piece of software like LABS, but includes categories like Retro Land, Ethic World and Playable Textures which can be further refined by what genres and moods they're best suited. Part of the beauty of my sample instrument, is it possesses novel characteristics that are such a fundamental part of well-respected sample collections.

Before testing, I suspected that I might need to loop some samples to essentially create a never-ending source of noise that could be input as a single note in MIDI. I didn't have any problems with the sample lengths because most were around 45 seconds which is more than enough for most situations. However, for the sake of professionalism I went back into KONTAKT and using the in-built wave editor was able to create an endless loop. During this process I did encounter a couple of hurdles. KONTAKT only allows you to crossfade loops from the beginning of a loop, but I was set on using my samples from the very beginning to maintain the organic attack of each sustained resonance. This meant that some loops sounded more apparent than others and didn't always flow naturally back to their starting points. Whilst this barrier prevented the absolute fluidity of my instrument, some was redeemed by setting the loops to end on release. This meant that once a key was released, the sample would continue past the point of the loop as opposed to returning to the start of the loop.

I haven't found the atonality or natural pitch drift of the instrument to be a problem so far, as the instrument would largely be used in a more atmospheric capacity than a musical one, even though both uses are possible and work well. Be that as it may, this is obviously quite a niche instrument since the imperfection of the sounds that can be achieved are somewhat unsettling, making it unlikely to be used in popular music. Per contra, I have observed similar tonalities during the intro to pieces like Starboy by The Weeknd or subtly throughout current charting tracks like Astronaut in The Ocean by Masked Wolf. These examples are the exceptions to the rule since dissonance is almost always shunned within commercial popular music.

Less commercial alternative genres such as noise, stoner and indie rock or metal rely heavily on dissonance, often in simple forms like guitar feedback or distorted vocals. But the constant experimentation and progression within these genres might use a sample instrument with as many oddities as mine.

Regarding film scores, we need simply look to famous pieces like Time by Hans Zimmer containing violins with a comparable saturated vibrato or again, increasingly recent scores to films like Tenet. The introduction to Tenet contains the hugely suspenseful RAINY NIGHT IN TALLINN which employs seemingly random moments of inharmonious sound to flawlessly build tension. I think Fine Dissonant Wines, as I've named my instrument, could be used in any of these types of pieces successfully. I'm currently working on a film documentary score based around how students have

been affected by the Corona virus epidemic and my artifact could provide a great atmospheric underlay to parts of the piece, to convey a tense, and sometimes, sombre tone.

Before I began the process of creating Fine Dissonant Wines, one aspect I didn't study was whether similar instruments already existed and, if so, what they brought to the table. Realistically, I suspected that some might sample glasses as a form of percussion, as I had explored this idea myself to no avail. In all honesty, I was more intrigued as to whether there would be many patches that employed the use of additional effects and, moreover whether I should do the same. I imagined that a ping pong delay would add a compelling component to my instrument. Soon after I realised that any affects you could potentially add in KONTAKT could be applied more simply and, in all likelihood, more effectively in a DAW with specialised plugins.

If you search for 'sampled wine glasses music' via google, the first result is a free KONTAKT patch called Musical Wine Glasses. Testing it revealed that there are some key differences between my instrument and this patch. It was immediately noticeable that the attack has been standardised, which gives the pack a more well-crafted feel. But it also means each individual key has less character. This might be helpful if a producer requires a very polished sounding instrument upon immediate usage or if the instrument is going to play a precise or overnice role. Baring that in mind, it could instead, simply be the product of a smaller set of samples that gives the instrument its refined feel. And on inspection of the patches mapping, I could see that four different glasses had been sampled, using only their natural resonant frequencies. The other notes have been filled in using KONTAKT's automation. As much as I like the sophisticated feel of Musical Wine Glasses, it serves a very different purpose to Fine Dissonant Wines, which even in its naming, clearly caters to a different audience and provides a different set of unique features.

Another KONTAKT patch that samples glasses is called Imbibaphones from Sound Iron. This fascinating patch samples a champagne flute, martini glass and broken glass hit with a mallet to create a beautiful form of tuned percussion. The patch also includes a unique resonant sustain that lies somewhere in between Fine Dissonant Wines and Musical Wine Glasses in its dissonance. Unfortunately, this patch isn't free. Retailing at \$29, I couldn't take a closer look at the intricacies of Sound Iron's samples and how they've used the features within KONTAKT without buying the patch. Although, it might have been worth the money as the pieces that Sound Iron share on their product page sound expertly composed and demonstrate the diversity of tones the patch can accomplish. Using a singular wineglass Fracture Sounds produce a very similar pack to Imbibaphones simply titled Water Glass. The percussion elements of the patch were created by hitting the glass with the finger and fingernail to obtain two different tones. The examples of the patch in use don't match the quality of Sound Iron's and so I would argue that Water Glass isn't as good an instrument, albeit retailing at a lower price.

Each of these KONTAKT sample instruments I've scrutinised have included a key feature that Fine Dissonant Wines didn't originally possess. That being a distinctive interface with exclusive aesthetic features. Even though this might seem like a trivial element to creating an instrument, on deeper analysis, I concluded that it is a vital part of marketing your instrument and how a user reacts to utilizing the instrument. For instance, my distaste for some of Ableton's stock plugins (such as the Tuner mentioned earlier) is purely due to their appearance and user interface, irrespective of their functionality and/or merit.

I knew I wanted the wallpaper of my instrument to reflect learnings toward the horror genre so found some stock images of a haunted house and wineglass filled with red liquid. I used the online image editing software Pixlr X to combine the images and added some gothic style font as well as

some effects to give a 'homemade by a serial killer' vibe to the artwork. When I tried to add the wallpaper to my instrument, I found that the patches size in the user interface wouldn't automatically adapt to the wallpaper's proportions. Luckily, I quickly found a guide with the necessary scripts and was able to adjust the wallpaper's size.

Next, I endeavoured to borrow some custom UI elements from Resomonics' Chillerscapes, which included blood spattered knobs that could apply distortion and a pulsating effect. This was a step too far as it required an intense amount of scripting that seemed very complex and would be difficult for me to modify to fit my instrument. There are some very thorough guides on scripting within KONTAKT that I would consider pursuing if this were to be a commercially released instrument. I suspect that paid for glass samples, as I've mentioned previously, have such a seemingly broad range of tonal colours available due to intricate effects employed within KONTAKT.

To conclude, there are clear pros and cons to Fine Dissonant Wines, with its most characteristic elements fulfilling both criteria depending on what one is looking for in a sample instrument. Although not in the typical sense of commercial appeal within the music industry, within the realm of for-profit music production software, other almost identical instruments have been successful. So, I strongly believe that with the correct marketing campaign playing to the strengths of the instrument, and some professional tweaking, it could be equally successful. If I were to make another instrument artifact, I would try and merge several ideas that I found enthralling. For instance, if I had been able to load Fine Dissonant Wines into an optical theremin circuit or Telelele, it would have added another distinctive ingredient to my artifact that would be nearly impossible for others to replicate.

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