

From BEEP to Beauty

Why I Still Make Music on a Machine with a Horrible Little Speaker

by Andy 'Uglifruit' Jenkinson

Andy recently displayed his ZX Spectrum installation exhibit in The LCB Gallery, Leicester and performed with ZX Spectrums in Bristol as part of the run up to Machina Bristonica electronic music festival, where he also had a Teletext Art installation. Here, he talks about his relationship with the Spectrum's brave little beeper.

I can admit it now. It's taken me four decades, but I can say it: "The C64 was better," but only if I then hurriedly add "if solely taken on the merits of its sound". Commodore's machine had the famous SID chip - an actual-factual synth that, in the right hands, could do very impressive things. The ZX Spectrum had ... a beeper. The C64 had an incredibly versatile multi waveform, three-voice polyphonic sound chip with ring modulation, ADSR and multimode audio filter. If you don't understand that sentence, just trust me - it's very impressive. Conversely the 48K Speccy had the ability to put the in-built speaker in one of two positions: forwards or backwards, that was all. And the sound we heard was generated only when switching the position at high frequency. This '1-bit' audio approach was hardly cutting edge, and can be traced back to 1949 (on the BINAC computer), and the wider world hearing the CSIRAC computer beeping musically in 1951.

If you've programmed in BASIC on a Spectrum, you'll know that the BEEP command makes a pitched note of a given duration, but here's the stinger - under the hood all other operations cease while that happens. The reason for this is that there's no internal clock to choose how fast to cycle the forwards and backwards of that speaker - if you want a 440hz note 'A', you need to make sure your machine code instructions take exactly the right time to execute before they move the speaker to its forward or backward position. Then repeat. Every 2.273 milliseconds, to keep the note steady. The ROM routine can't do anything whilst it carefully runs through enough instructions to make the noise until it's finished. You can't print anything. You can't read the keyboard. You can't buffer a command. Nothing. That's why BEEP 10,45 was such an annoying command in Dixon's. 10 seconds of a piercingly high note which no-one can stop without pulling the plug.



Andy's original 1983 Spectrum running his installation software

Despite the technical limitations - and much like not having hardware sprites or hardware scrolling - programmers of Sinclair's machine were forced to use very clever techniques to fake something much more impressive with its audio. By calculating how long each machine code instruction was taking (measured in numbers of T-states - or 1/3500ths of a second) a canny Z80 programmer could do other things whilst killing time waiting for the precise moment they flipped the speaker to its other position. Whilst sound effects don't require this critical timing, music does, and any attempt to do other things whilst music played, was often limited to checking to see if a key was being pressed on a menu screen.

At this point it's pertinent to mention Manic Miner. Matthew Smith did two things of particular note in the ZX Spectrum audio world. Firstly, he had music playing while the actual game played. This was achieved by interleaving the action with repeated calls to a music routine which flipped the status of the speaker if needed (and updated song pointer to next note/frequency as required). He also did something really clever on the title screen. That screechy rendition of Strauss's The Blue Danube uses a different trick. It tries its best to play a second set of notes at the same time as the first, so at the end of phrases it toggles the speaker at two different frequencies simultaneously. And thus polyphonic 1-bit magic begins in earnest on the ZX Spectrum.

I'd learnt classical guitar at quite an early age, and had a ZX81 – so was delighted to upgrade to a ZX Spectrum having both colour and sound – although those sounds were, in honesty, not its best feature. But soon there emerged games with *actual music* that were clearly pushing the boundaries of what the ZX Spectrum could do. My purchase of *Wham! The Music Box* in 1985 surprised my parents. I wasn't a Wham! fan, but this miraculous piece of software took the idea of two multiple lines playing simultaneously, and allowed the user to write their own music. And it sounded notably (pun intended) more musical than Manic Miner's efforts. You could have also use 'percussion' instead of notes at any step if you wanted. I was hooked.

1985 also saw the 128K Spectrum released (at least in Spain) and finally the Spectrum had a proper modern sound chip! ...Or did it? It was an off the shelf three channel AY-3-8910 chip dating back to 1978. It was *alright*, but it wasn't as individual and evolving as the ZX Spectrum beeper music seemed to be. 1986 brought us Konami's Ping Pong where Joffa Smith's 1-bit audio routine was used on the title screen with a sawing pwm style monophonic lead style, as well as percussion. And Tim Follin wowed everyone with his mind-blowing technical skills and musicality on his music routines for the release Agent X, (plus his music on Chronos and Agent X 2 the year after). Despite being on the older 48K models these sounded *nothing* like the things that'd gone before, and were far more characterful than the 128K sounds. Those felt like the sounds I'd been hearing in arcades for the past years, so somehow seemed less impressive, and they also didn't sound as good as the Commodore machine. [It should also be noted I didn't own a 128K Speccy, so I was probably somewhat biased with my love of the 48K model].



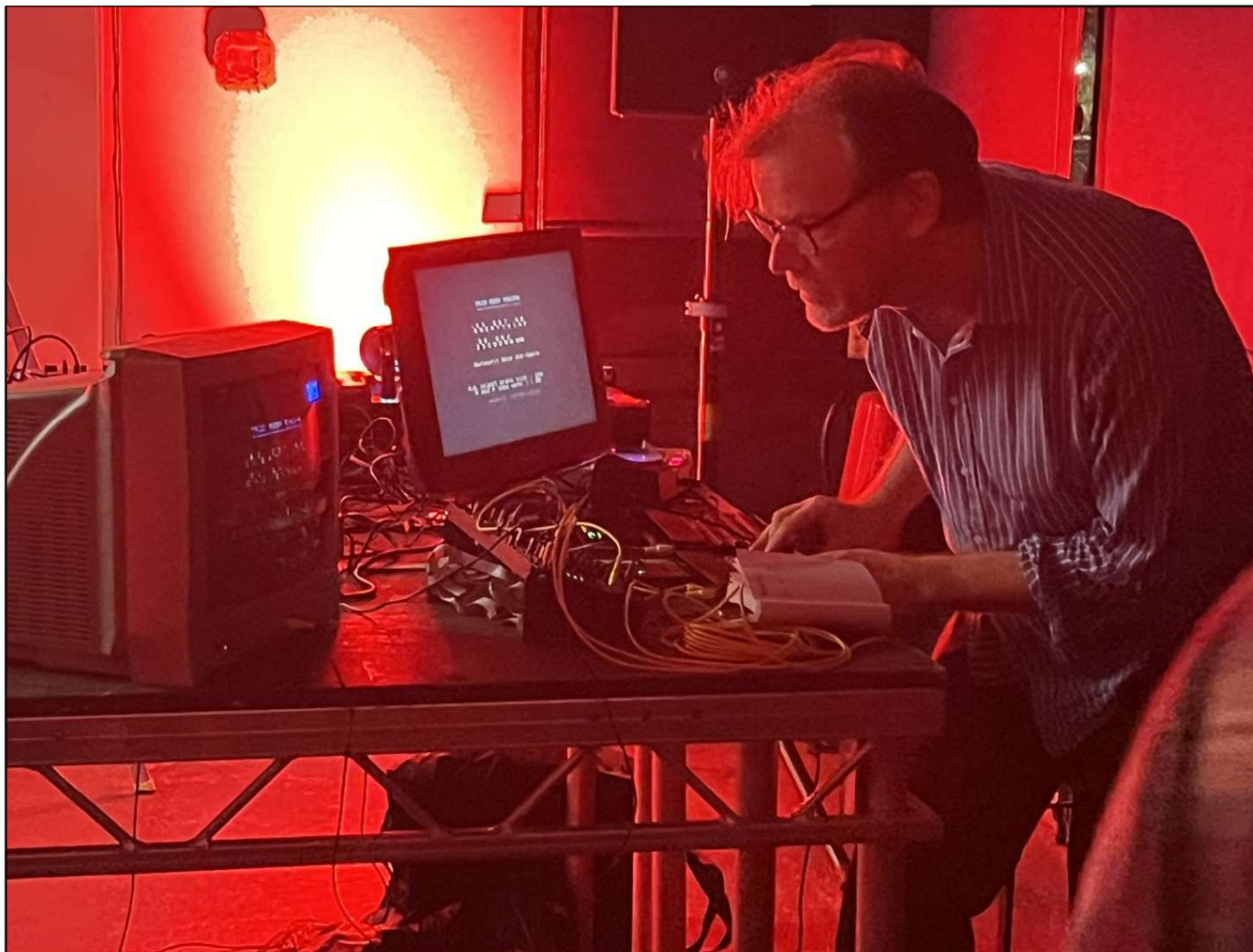
Andy presenting at the LCB gallery

Obviously as the commercial era of the Speccy ended, the programming talent didn't and notable contributions by talented hobbyist coders such as Shiru, utz and many others brought more 'engines' that further expanded what the ZX Spectrum beeper was capable of, and allowed others to compose music playable on a ZX Spectrum beeper. In 2010 Chris Cowley wrote the Windows application Beepola, which allowed non-programmers an easy way of composing using some of these audio engines – inserting their own musical compositions to be played back with clever tricks of pseudopolyphony and timbre that the aforementioned programmers had discovered... and thus a secondary 'scene' emerged with amazing beeper music being made thanks to these more accessible tools. Whilst the ZX Spectrum 'demoscene' generally used the AY chip alongside clever visuals, the beeper lot, with all their Spectrum's processor energy being taken up just making the sound, quietly (or noisily) made brilliant (if rather fizzy sounding) music.

Having been on the sidelines, doing some competent, but not exceptional, Z80 programming as a hobby all my life - and writing and teaching music - the ZX Spectrum very much still appealed to me. As an artist I like to explore pushing things up against their intended purpose, and I've been

pleased to have written some ZX Spectrum music that's been used as the backbone for a musical about videogames, and recently had an interactive piece in an art gallery exhibition of exhibits curated around sound art using repurposed things. My Spectrum sat in the gallery for a month with visitors choosing which pieces of my music they wanted to listen to on it. Some people no doubt wondered why it was making an objectively horrible sound, but others told me they'd been transported to a place of their youth and genuinely enjoyed it.

I've also - in my own limited way - been pushing the ZX Spectrum as a device for musical performance. This is definitely not what the computer was designed to excel at! By writing some of my own routines (and very much building upon the work of other, better, programmers), I've developed software that I can use to gig with. I wanted to ensure that as performer I'm integral to the art - allowing my music to be shaped by my key presses as it plays. This can be performed like a musical keyboard (a challenge on a rubber-keyed Speccy!), or by selecting sections of tunes to play next, depending on how I've written each composition. Sometimes I'll use two ZX Spectrums making complementary noises so I can create more complex layered pieces - but still grounded in that recognisable 1-bit sound that drew me in as a child, and that I still want to create music with today. The results can vary from impenetrable artsy-noise, to beautiful chordal pieces that I hope are more than just technical exercises in programming.



CH00N! Andy performing at Machina Bristonica

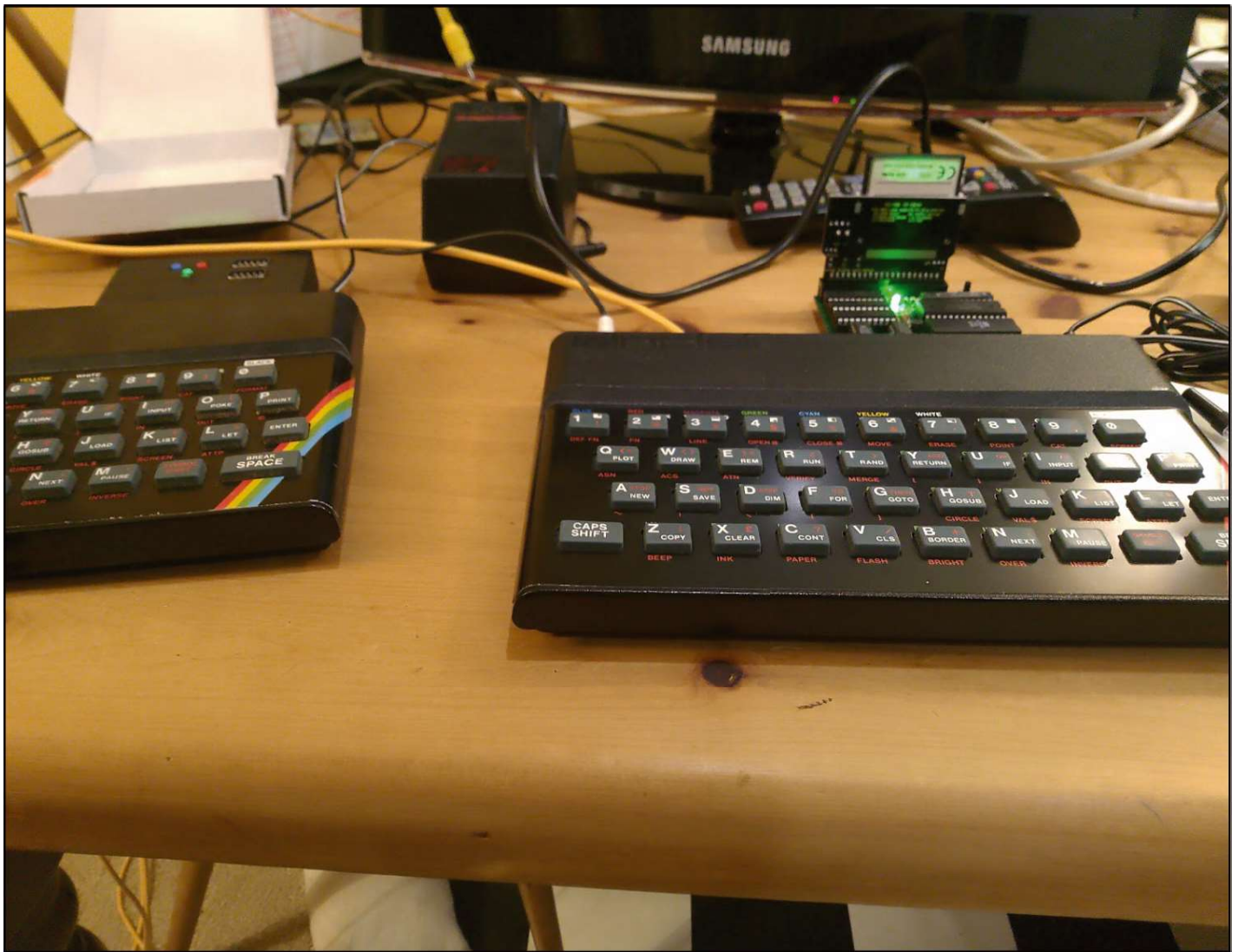
The C64's SID chip may have been a marvel, but the Spectrum's beeper forced ingenuity. From Matthew Smith's interleaved *Hall Of The Mountain King*, to Tim Follin's jaw-dropping routines, to today's Beepola composers and programmers still pushing the envelope, the story of 1-bit music is one of creativity against the odds. My own 1983 Spectrum still plays a part in that story - in galleries, on stage, and in the odd corner of musical theatre. Some hear only a horrible fizz. Others are transported instantly to their childhoods. For me, it remains proof that beauty can come from the most limited of machines.

Andy's software will be made available at SpectrumComputing.co.uk, so you can replay the LCB art installation.

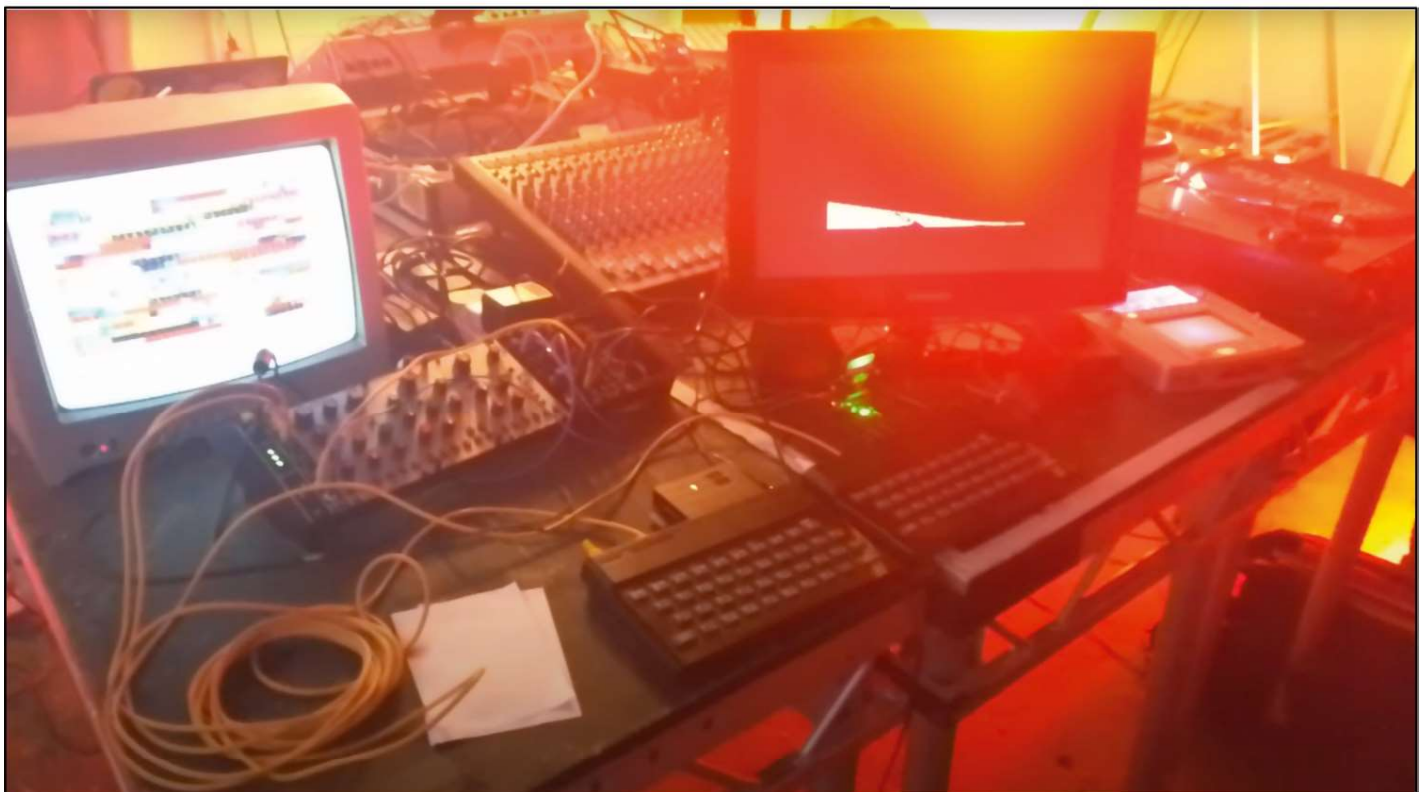
Hardware details :

Gallery Install: Spectrum with composite modded video out, and Comcon programmable joystick interface (Frel, 1984) simulating keypresses using a Joystick. DivMMC to flash load software at the start of the day - keeping it simple for the gallery staff, and keeping grubby fingers off the precious rubber keys. Headphones straight out of the Spectrum!

Live: Two ZX Spectrums into a modular audio mixer and home made volume pedal to adjust levels relative to one another, plus external Korg Kaoss Pad for reverb, if the room deserves it. A DivMMC and DivIDE to flash load my software, and some tellys to peer at.



Andy's twin-Spectrum setup at home, getting dolled-up for a night out on the town...



...and hooked up to the nightclub sound system.