

Circuit Bending.

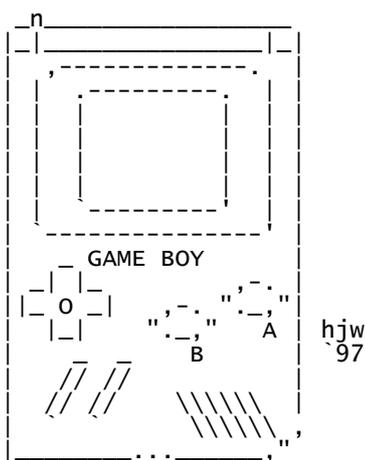
The Web is littered with step by step guides for hardware hacking projects, from making your own old-school video game cabinet complete with authentic joysticks and buttons, to using a PDA to control a synthesiser. 'Circuit Bending' is the name given to an obscure musical subset of hardware hacking. As a UK based Circuit Bending site explains, "While Texas Instruments machines are the usual suspects in Circuit Bending, it is common for 'Benders' to have a go at modifying virtually any electronic device that produces a sound. The Casio SK-1 sampling keyboard can produce some astonishing sounds with a little doctoring and even a Furby can be skinned and rewired for musical purposes." To be a Circuit Bender requires no knowledge of electronics but it does require an acceptance that you may completely destroy the circuit being 'bent'! Reed Ghazala, the originator of the term, produces circuit bent Casio keyboards and 'Speak and Spell' games and counts the likes of Autechre, Nine Inch Nails and Damon Albarn from Blur among his customers.

Bending and hacking are just new names to describe the urge to customise technology, an urge which is arguably as old as technology itself. Some people will never think to use a piece of technology for any purpose other than the manufacturers intended one. For others, their first thought on encountering a new piece of technology is 'What else can I make this thing do?'. For example, some people might buy a Nintendo Gameboy and think 'This is great. Now I can play lots of games!', while others might think 'This is a portable device with a screen, a 4 voice stereo synthesiser, a strange serial link (gamelink), a ROM cartridge port and an interface (4 buttons and a digital joystick). Now, what can I use this for?'

Console Hacking.

The Gameboy is the biggest selling game console ever and are very popular with hardware hackers. On his website, electronics hobbyist Reiner Zeigler attempts to explain the popularity of the Gameboy as a platform for development. He says, "What makes the gameboy attractive to the hobby designer (besides its slick look and low cost) is the great wealth of publicly available hardware and software support. Most games machines are black boxes containing custom made hardware with little if any information on their inner workings. But a few dedicated individuals have literally taken the gameboy apart and documented what they have found."

Zeigler is one of these 'dedicated individuals' and his site, which is a treasure trove of information on the Gameboy, is littered with circuit schematics, documentation of chip pin-outs, images of hacked ROM carts and links to further information. He is part of a reasonably large online developer community which provides the budding Gameboy-developer with the tools and support needed get started. Gameboy cartridges can be programmed in C, Gameboy BASIC or assembler. Full development kits are freely downloadable from the web : free compilers, assemblers, linkers, loaders and emulators. There are also free tutorials on how to program games, along with plenty of code examples not to mention the ubiquitous hardware hacking guides : how to connect an IBM-PC keyboard to a Gameboy, how to turn the Gameboy Colour into a universal learning remote or how to connect a Nintendo 64 controller to a Gameboy. There are even instructions on Herr Ziegler's site for converting a Gameboy into an Oscilloscope! Most of the low level Gameboy information available on the Web dates from around 1999/2000, which appears to have been a sort of Golden Era of Gameboy hacking. Many of these sites are now littered with dead links indicating that the people involved have moved onto other projects on other platforms.



Gameboy Soundchip Programming Tips.

There are two sound channels connected to the output terminals SO1 and SO2. There is also a input terminal Vin connected to the cartridge. It can be routed to either of both output terminals. GameBoy circuitry allows producing sound in four different ways:

- Quadrangular wave patterns with sweep and envelope functions.
- Quadrangular wave patterns with envelope functions.
- Voluntary wave patterns from wave RAM.
- White noise with an envelope function.

These four sounds can be controlled independantly and then mixed separately for each of the output terminals. Sound registers may be set at all times while producing sound.

When setting the initial value of the envelope and restarting the length counter, set the initial flag to 1 and initialize the data. Under the following situations the Sound ON flag is reset and the sound output stops:

1. When the sound output is stopped by the length counter.
2. When overflow occurs at the addition mode while sweep is operating at sound 1.

When the Sound OFF flag for sound 3 (bit 7 of NR30) is set at 0, the cancellation of the OFF mode must be done by setting the sound OFF flag to 1. By initializing sound 3, it starts it's function.

When the All Sound OFF flag (bit 7 of NR52) is set to 0, the mode registers for sounds 1,2,3, and 4 are reset and the sound output stops. (NOTE: The setting of each sounds mode register must be done after the All Sound OFF mode is cancelled. During the All Sound OFF mode, each sound mode register cannot be set.)

NOTE: DURING THE ALL SOUND OFF MODE, GB POWER CONSUMPTION DROPS BY 16% OR MORE! WHILE YOUR PROGRAMS AREN'T USING SOUND THEN SET THE ALL SOUND OFF FLAG TO 0. IT DEFAULTS TO 1 ON RESET.

These tend to be the two most important equations in converting between Hertz and GB frequency registers: (Sounds will have a 2.4% higher frequency on Super GB.)

$$gb = 2048 - (131072 / Hz)$$

$$Hz = 131072 / (2048 - gb)$$

Taken from : http://www.xs4all.nl/~engage/Gameboy/gb_spec.txt

Nanoloop.

In the Summer of 2000, a friend sent me a link to a German website: www.nanoloop.de, home to the Nanoloop, a cartridge for the Gameboy. Instead of a game however, the cartridge provides the user with an interface to the Gameboy's onboard 4 voice, 4-bit sound-chip, harnessing the console's ability to make sound and turning the Gameboy into a combined synthesiser and sequencer! For my masters thesis project, I had programmed a synthesiser which was controlled by an audio input and a Playstation gamepad. The audio input was analysed to provide the pitch and rhythm of the synthesised sounds, while manipulating the controls on the gamepad changed their timbre. A friend hacked the gamepad so it could communicate with the DSP chip I was using as a development platform for the synth. The idea of the Nanoloop intrigued me because it also inhabited this fertile territory between gaming hardware and music making, so I ordered one as soon as they were available.

Nanoloop's main interface is a simple 4 X 4 grid of squares each of which represents one beat in a bar of music. (As any musician will tell you, there are 'sixteen beats to the bar'.) Each beat can contain a note or silence. The user moves tiny markers within these squares to select the pitch and duration of the note on that beat. Other buttons allow the user to switch notes on and off, copy and paste notes from one beat to another and choose which of the 4 synthesiser voices they want to adjust. Each voice can be muted independently of the others and all changes are executed in real time, making it possible to let the sequence of sounds loop while you tweak their parameters. 'Playing' the Nanoloop in this way creates an interesting flow of sound in a manner comparable to the legendary 'Roland tb-303 bassline', although the Gameboy interface is somewhat more restrictive than the 303's. A Gameboy running Nanoloop is more like its long lost lo-fi digital cousin.

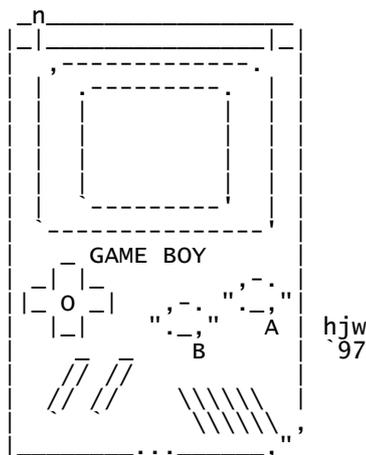
The sound of Nanoloop is the sound of the Gameboy: very low resolution bleeps and crunchiness. Gameboys come equipped with a 4-bit sound chip, half the resolution of the 8-bit technology which formed the basis for the first commercial samplers back in the Eighties. (Most modern audio hardware which uses 24-bits to represent an audio signal.) Other factors contribute to its distinctive sonic signature. In sound synthesis, enveloping is the name given to the variation of a sound's parameter like pitch or volume, over the duration of a note. The Gameboy envelopes its sounds very distinctively, creating glitches at the end of some notes under certain circumstances.

Gameboy Music.

Nanoloop is by no means the only cart to exploit the music making possibilities of the Gameboy. There are a whole host of others. 'Little Sound DJ' is similar to Nanoloop, but it attempts to mimic the sound of the classic Roland drum machines (cr-78, tr-606,707, 808 and 909) with preset drumkits. A Gameboy running Little Sound DJ can also be synchronised with a Gameboy running Nanoloop by connecting a special cable to the gamelink port on both consoles.

'Pocket Voice' is a cart with a built in microphone and speaker which was created to allow game developers to record realistic sound effects and voice for use in games. Up to two and a half minutes of sound can be recorded onto the cart, and then dumped onto a PC. 'Pushpin' is a MIDI synthesiser kit for the Gameboy. MIDI is a standard communications protocol for music making, allowing computers to control many MIDI equipped devices like synthesisers and samplers at once. Pushpin allows a musician to use a computer to control a Gameboys sound chip just like they would any other synthesiser. The makers of PushPin (www.dsperado.com) also make another synthesiser which uses a Palm OS device to control a DSP development board running custom software.

In recent years 'Gameboy music' has become a recognised, albeit still somewhat obscure musical genre. A quick Google for "Gameboy music" turns up around 1500 results. The Austrian Gameboy site www.endlos.at/gameboymusic/ is a hub for the Austrian Gameboy music scene. They run a club called, appropriately enough 'Hot Gameboy Action Club' and refer to Gameboy Music as "neue volksmusik" (new folk music). A list of Gameboy bands from their site is shown below :



Gameboy Bands

6955
8cylinder
adam vanderberg
aleksi eeben
amomi
amphibious -two_shades_of_blue.mp3
beek (chris j. hampton)
bitshifter
blasterhead
bubblyfish
bud melvin
chesterfield
chromix - timepants.mp3
clone quartet - big smoke (pfp mix).mp3
colon pipe krew
covox
cow'p
deafguy
drumaam
egocentric - form laborer.mp3
eitan teomi - this sky and love says.mp3
felix kubin - ich träume nur in super8.mp3
gameboyzz orchestra project
glomag
handheld
hex125
jim crawford - 44.mp3
k->
lo-bat
marc resibois
mark 4 / daniel p
mark denardo
mmfan316
monokini
nitro2k01
nullsleep
october71
oliver wittchow - nanoloop.mp3
ostinato - gameboy girl.mp3
plasticflesh
pontonius
press the reset
produkt
puss
reconstructing richard
role model
rugar
saitone
samuraiskillz
spoonbender
team5547
teamtendo
the hardliner
trash80
vim!
virt (jake kaufman)
w2x
widgetphreak
woodrose
zid

Gameboy Music (cont).

These artists are distributed around the globe (Europe, Asia, Canada and America) proving that wherever there's a Gameboy, there is a potential Gameboy musician. Irish musicians, such as Herv and Richie Egan (Jape), have also harnessed the Gameboy's bleep and hiss as part of their sonic arsenal. In 2002, the Disco Bruit label released a compilation of Gameboy music called Nanoloop Vol. 1. Here they describe the project :

"While it is said that the Powerbook (with programming interfaces such as Max/MSP, Reaktor, Super Collider or PD for PC) has almost endless possibilities for music creation - the Game Boy certainly ain't and that's where it's getting interesting. How do the invited artists work in such a limited environment? How can they push these limits (including their own)? Actually some "failed" and gave up after a few weeks trying. Others easily adopted the app into their usual set up and some took an almost scientific approach to it. The results are certainly capable of showing the different working methods of the musicians involved and the many possibilities of the Nanoloop software and the Game Boy, as limited as they might seem at first sight. The musical styles on the CD may range from simple pop songs to pure micro-(and macro-)tonal sound creation, yet the significant lo-fi sound of the 4-bit soundchip makes for a coherent overall listening experience."

www.micromusic.net is another site which focuses on "low tech music for high tech people". Describing their activities as "musical research", the site has become the focus point for a large online community of musicians who make music with game hardware, mostly the Gameboy and Commodore 64 with its legendary SID sound chip. Since the foundation of the site in November 1998, their activities have spilled over from the web into the real world where they run club nights, promote tours for micromusic artists and organise micromusic workshops.

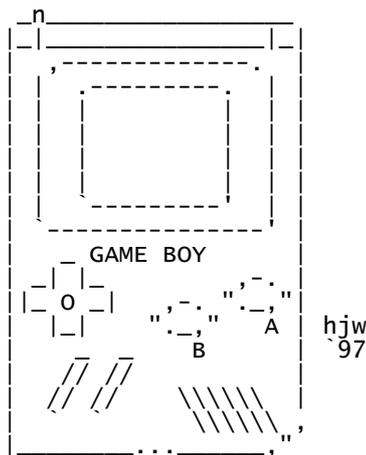
It has to be noted that all this activity takes place a very grass roots level and at present Gameboy music is still very much an underground phenomenon. Occasionally, it pokes its head above ground and into public consciousness as evidenced by "the Gameboyzz orchestra's" performance at last years Ars Electronica Festival(2002) but in general its like any other small, web-based, technology obsessed sub culture, carrying on oblivious to and some would say, in spite of the interest of outsiders.

Mobility.

These days, mobile devices are ubiquitous. Although they're ostensibly designed for different purposes and aimed at different markets, PDAs, mobile phones and new mobile gaming devices like Nokia's N-Gage share a lot of physical and functional characteristics. For example, almost all feature some sort of local wireless communications protocol, from lowly Infrared to Bluetooth to 802.11b (WiFi). The N-Gage for example, uses Bluetooth to facilitate wireless multi-player gaming. For the user, this ability to network portable devices and especially portable gaming devices is an interesting and welcome development. Following the success of Nanoloop, its creator Oliver Wittchow began working on a music application for iMode phones and although he has admitted that it was somewhat limited in its execution by the iMode's architecture, he is still exploring the interface between non-musical hardware and music making. And who knows, in a world where electronic musicians are networking their computers together to create multi-user electronic instruments, maybe hacking mobile gaming devices can provide us all with a new kind of musical experience.

Dennis McNulty works with sound.

more @ www.dennismcnulty.com



Links.

<http://www.nanoloop.de>

<http://www.littlesounddj.com/>

<http://www.micromusic.net/>

<http://www.disco-bruit.de>

http://www.xs4all.nl/~engage/Gameboy/gb_spec.txt

<http://www.anti-theory.com/soundart/circuitbend/>

<http://www.reinerziegler.de/>

<http://defaced.co.uk/bung/>

<http://www.plasmaworks.com/gbsound/>

<http://www.endlos.at/gameboymusic/>

<http://gameboyzz.terra.pl/>

<http://come.to/6955>

<http://www.mark4.net/1.html>

<http://groups.yahoo.com/group/databenders/>

all ascii art from <http://www.ascii-art.de/ascii>