Tristan Burfield.Major Project

Introduction

The handheld Gameboy received its first international release in 1989, since it's inception Nintendo and has now sold more than 100 million items relating to the Gameboy. Countless game titles have been released, including well known favorites like *Tetris*, *Mario Bros*, and *Zelda*- as well as different accessories like cameras, printers and lights. But some of the most interesting releases so far, have not been flashy Nintendo endorsed games- yet a new breed of pirate musical applications [*LSDJ*, *Nanoloop*]. The Programs effectively allowing the user to hack into the Gameboys soundest and produce retro computer game style soundtracks. Throughout the course of this essay I wish to explore the cultural and socio-economic motivational factors that have spawned these new breed of portable programs, and the theoretic implications that have arisen through the subversion of this common consumer device into an complex and thought-provoking musical tool. In the latter half of the project, I shall explain how I used the research of the previous chapters as a basis for further practical work.

Before we begin exploring the history and development of Gameboy music we must first briefly explore the history of the video game and its musical accompliament. Through understanding the music in it's original context we can then explore the cultural reasons for its subversion and transformation via the international artistic community.

Chapter 1: A brief history of computer games and computer game music

The social use of computer games

The first home video game to hit the international market was the *Odyssey TV system*, this machine was released in the early 80's- the box allowed the user to plug the pre-loaded game into the television and control the action of a highly vectorised tennis ball [similar in aesthetic to *Pong*]. Later progressions in videogame technology allowed users were able to play games on a home computer- the main platform of the time being the *C64*. Users could play different games via the purchase of game cassettes, floppies or cartridges. The game console world soon followed suit allowing the user to load specialized cartridges into their machines. In 1989, a market developed for portable gaming, users could buy cartridges to play on their portable machines, the main market leader of the time was the Nintendo Gameboy.

The Psychology of computer games

Computer games are all about escapism and immersion, a role, which is further supported via the musical soundtrack. Cultural critic Kohler below in his study of Japanese game culture: *Power up* [2004], describes the role-playing element of computer games:

> Computer games are virtual play spaces which allow home-bound children...to extend their reach, to explore, manipulate, and interact with a more diverse range of imaginary places that constitute the often drab, predictable, and overly familiar spaces of their everyday lives ...that today's video games depend heavily on fantasy role. Playing with different genres of games allowing children to Imagine themselves in alternative roles or situations
> [Kohler 2004: 4]

Sinclair in his study of the games industry *the fat man on game audio* [2004] argues a similar point:

> A true game player knows that his world is temporary, his Character is as an illusion, and if it is a good game and he gives it his all he and his foes will all be able to laugh about it when the game is over. But it is only fun if at the time of the game it's all as real as real can be so he gives himself a kind of temporary amnesia, turning over every fiber of his being to the illusion that he is actually in the game
> [Sinclair 2004: 84]

Computer games and movies

> Many people have said that I should make movies. But I don't feel like a movie, I feel like a creator. For me, game design is like expression through music or poetry- while I'm always trying to hit on new ideas, I place a lot of importance on tempo and sound effects. The designers that use rhythm are successful- when I hold the controller and set the tempo, I feel like I'm making my own personal game
> [Game designer Miyamoto, Tokyo National Game designer's conference: 1999]

As the industry has progressed, the games have become more impressive faster and with better graphics. The gaming industry to some extent has become the little brother of the major motion picture industry. With developers aiming to create ever more realistic cutting edge graphics, and cinematic soundtracks- a new benchmark has been set for the current generation of game makers.

Since Nintendo released *Donkey Kong* in the late 80's, game developers have latched on to the notion of the *cut scene*. When a user completes a level, the gamer would often be rewarded with a short cinematic sequence revealing the next chapter or narrative progression of the story. *Donkey Kong* was one of the first games to exploit a common narrative, the game hinged around three main characters, a *King Kong* type figure referred to as *Donkey Kong*, *Daisy*- Donkey Kong's captive and

Mario- a humble plumber who has to rescue daisy. The game takes place in a construction site, Mario has to jump over barrels and climb various platforms to free daisy. As the game progresses there are various cut scenes in which daisy and *Donkey Kong* interact thus adding depth to the game via narrative structure.

As Kohler notes in *Power up,* the function of the cut scene is clearly psychological- a reward for the user completing a level [Kohler, 2004: 41]. As games have progressed cut scenes have become more elaborate and cinematic.

The technology of early computer game music

As is noted in the retro gamers bible *Freax [2005]* many of the early bleeps and bloops of the vintage gaming era were generated by wave table synthesis using built in FM chips and wave table generators [Anon. *Freax.* 2005: 21]. The Author later explains this technology to now be commonly superseded by recorded sound, not only is sampled data considered to be easier to handle it also offers less in the way of restrictions for the programmers [Anon. *Freax.* 2005: 21]. He continues:

> Whereas Programmers of the vintage age weren't able to store large amounts of sampled data due to storage limitations these constraints no longer exist…For this reason, sound cards that are capable of sound generation are already fading out of fashion. Often we can't FM chips or Wavetable generators on today's soundboards and only digital recording and replaying matters.
> [Anon. *Freax*. 2005: 21]

He concludes:

> Wave table synthesis is now seen as antiquated sound generation, But are still used in cellular phones and cheap quartz watches.
> [Anon. Freax. 2005:21]

The aesthetic of early computer games

In it's infancy early computer game music had a disposable ethic, games for early systems such as the *C64* used to only cost a matter of pounds! Game companies at the time truly couldn't envision users paying more for such transitory products. Micheal Katz, formerly of *Sega* remembers the era well:

There were so many cartridges already available to *Atari* player from *Atari*,
that we couldn't imagine that any consumer needed more cartridges.
Nobody thought that they [consumers] would perceive any kind of difference
in the cartridges...and we couldn't perceive of anyone paying 3 dollars to
5 dollars more at retail value for this
[Kohler.2004: 22]

The psychology of game music

Computer game music in its infancy mirrored the simplicity of the technology and the games of the time. At times it could be annoying, overly repetitive too such an extent that gamers would often turn off the music and play the game silent [games such as *Minesweeper* and *Jet set willy* were noted as having particularly frustrating soundtracks amongst gamers]. At times it could be truly absorptive as in the case of Pacman. As Sinclair notes in *The fat man on game audio,* Pacman was one of the first games to pioneer the concept of *adaptive audio* [audio that responds to user interaction], 'whenever Pacman was too eat a revitalizing *powerpill*, the music would become faster and more energetic in response'. [Sinclair. 2004: 203]

The problem that hindered early game music was overuse of repetition; the reason for this was often purely practical. Programmers could only dedicate so much space to the music, and so much to the visuals- with the music often being bottom of the programmers proirities. The over-repetitive music would sadly often hinder game play, as Sinclair notes:

> The more you hear and notice repetitive devices your subconscious is acutely aware that this is not in fact reality. Gaming after all is essentially an immersive experience
> [Sinclair. 2004: 213]

As he points out good game music should ‘Involve, immerse, elevate, and reward, excite’ [Sinclair. 2004: 213]

The art of modern computer game music

As the games industry has been dominated by an increasingly technocratic aesthetic, bigger graphics faster game play, demand for high quality games has risen. In response games prices have rocketed, with users expecting to pay up to 40 pounds for a PC or home console game. Sinclair in *The Fatman on Game audio* discusses the current standard of Game audio explaining it’s technocratic aesthetic:

> Contemporary computer game these days mostly consists of digitized samples generated via the midi protocol. These samples are often arranged and played back by the DA converter, a process pioneered via the Virgin release *7th Guest* for PC. [Sinclair. 2004: 314]

As computer game music has become more advanced, so has the artistry and conception of the medium. It's easy to forget that game music isn't just about music it also involves real time sequencing and sound design. Sinclair describes computer game music to be like a form of ‘real-time sculpture’ in the sense that ‘the sounds can vary from whatever angle you look at it’. [Sinclair.2004: 315]

Recently several forward thinking developers have been pioneering a new breed of game that combines music and visuals in a competitive context.

Japanese culture and competitive musical gaming

As Kohler explains, Japanese culture has seen a recent influx of competitive musical games, including *Parappa the Rapper, Drum master, Donkey Konga* and *Guitar freaks* [to name a few]. *Parapa the rapper* is a quirky game in which a cartoon dog learns to rap through users activating buttons in correct timing- matching the lyrics makes your character rap through adaptive audio and interactivity techniques [Kohler. 2004: 205]. Programmer Yano speaks of his ideas behind the game:

> When your playing jazz, and yr taking solos from each other its this kind of battle oriented thing. Your saying 'hey look my phrases are better than yrs' while the other guys saying 'hey screw you my phrase is cooler than yours' [Kohler. 2004:152]

The popularity of Game audio

Computer game has become ever more popular over the last few years with a number of game composers taking the position of pop stars, and a number of pop stars taking the position of game designers [for reference see NIN's infamous soundtrack to Quake].

As Kohler notes, a notable figure of popular acclaim is Nobo Uematsu [the composer of the final fantasy 7 series] who has recently sold out the Walt Disney concert hall in Los Angeles three days in a row. [Kohler. 2004:132]. A phenomenon that Kohler explains is especially big in Japan, with *Tower Records* in Shibuya, Tokyo aswell as countless Anime and comic shops dedicating whole sections to the style [Kohler.2004: 132]. Outside of Tokyo, the game industry has also sold countless spin off CD's of it's product, for instance *Lucas arts* in 2001 released a *best of...* compilation , with Namco quickly following suit. As the games industry aspires to be more like the movie industry, it's CD in the same manner are thought of in the same vain as movie soundtracks. Kohler indicates that in many Japanese shops games CD's are filed next to or adjacent to the movie soundtrack section [Kohler. 2004: 132].[16]

Fans appreciate the cinematic quality of Uemetsa's music, the liner notes to a recent tribute CD [a tribute to Nobou Uemetsa] to the artist read:

> For a long time the adolescent blips and bleeps of our time have shrouded many composers true talents...our aspirations for this project were to take old songs fellows gamers have grown to love,and arrange them in ways we've only pondered hearing them, ways that would only be entertaining to us, but even to those who knew nothing of the games [Kohler. 2004: 146]

Conclusion

Throughout this chapter we have explored the psychological role of music and sound in games new and old. Through using an immersive aesthetic, users are forcibly encourage to become one with the game and through role-playing techniques. We also discovered the changing landscape of game audio whereas older games used trackers and hardware specific musical chips, newer games adopted the aesthetics of sampling using environments such as Reason and Cubase to generate sounds.

Recently many gamers have found the hi-tech complexity of modern games somewhat isolating. Whereas the average family would often unite over a simple game of pong [with dad trying his hand at the Joystick]. These days, gaming has become even more youth-centric[18]. This climate has set the scene for a new retro revival. Against this background of retrospective thinking, a generation of artists and musicians have arisen to celebrate this antiquated form of sound generation for its primitive aesthetic appeal and unique sonic resonance.

Chapter 2: Demo scene and Tracker music

Pre tracker music and the demo scene

Before we examine the current wave of Gameboy musicians and there musical ideologies we must first consider the roots of the scene and the context in which the scene was born. Much of the foundations for modern subversive Gameboy music [otherwise known as *Chiptunes, Chip music* etc] can be traced back to the early 80's demo scene, and it's later sub-independent offshoot tracker Music.

1.3 Demoscene and the C64 movement

The demoscene came into prominence in conjunction with the widespread appearance of the *Commodore 64*. The *Commodore 64* was unique in its time as it was one of the first truly affordable home computers to enter the marketplace in the early 80's. Once bored of playing games, the system attracted a wave of young fanatics interested in using the machine for creative endeavors. Tasajarvi explains below in his document of the scene *Demoscene: the art of real-time:*

> It’s a culture created by the first generation of kids who grew up with home computers and computer games. This was done using modems and diskettes by different global groups...The computers available for home users were fairly rudimentary as far as producing graphics or music went, but using them for creative endeavors soon started to interest the kids after the novelty of the rather basic games wore off...this gave birth to the first generation of artists that started expressing themselves digitally
> [Tasajarvi. 2004: 6]

1.4 What is a demo? and what was the demoscene?

A demo is short for its literal meaning *demonstration*, or a demonstration of skills. In essence [as Tasajarvi explains] the scene was a 'creative offshoot of early 80's hacker culture, today the scene has an almost non existent link to the illegal underground' [Tasajarvi. 2004: 6].

The Author of *Freax* elaborates on this point:

> Ultimately a demo in a demoscene sense, is a piece of free software that shows real-time rendered graphics while playing music. Often the music is tightly synced to the visuals. Modern pc demos run linear from start to finish and are non interactive. There is no whatsoever rule what a demo can show, the creator is free to decide whether he wants to show stylish and or impressive effects, an epic story, funny bizarre, satirical audiovisual artwork, or a distorted mind-fuck, a scene demo is not a try out version of a commercial an application or game
> [Anon. *Freax* 2004]

Tasajarvi below describes the nature of an average demo:

> In the early 80's the demo scene had explicit links with gaming. When hackers would crack a particular game they would often add a brief visual introduction, which would often include the crackers logo and occasionally animated text extolling his skills and speed as a programmer-aswell as computer graphics that moved to the beat of the accompanying background music. These introductions became know as crack intros or more commonly cracktro's.
> [Tasajarvi. 2004: 12]

He continues:

> In a demo the objects and effects you see are created in real-time calculated and generated by the computer as you watch. Movement and effects were

> mathematical algorithms that the computer use to calculate what kind of element was drawn on the screen and how the element was moved and shaped. In demos everything you see on the screen is drawn several times per second so the movement looks as smooth and impressive as possible. [Tasajarvi. 2004: 17]

At this point in time there was no standard tool for creating custom visuals, and most importantly music. As Tasajarvi explains 'Teams with aliases like *evil cracking association* were formed to program original music and visuals for the cracked game' [Tasajarvi. 2004: 14]. Music was created using the limitations of the system at hand.

Due to memory limitations, and file size issue [the original C64 had 8k of memory!] programmers saw it as a macho sort of challenge amongst competing teams to see who could create the most dazzling artwork from limited circumstances. This aesthetic mindset of creativity from extreme limitations was to later influence and continue through to the post *C-64* wave of *Amiga* trackers aswell as inform and inspire the next generation of retro-futurist Gameboy musicians.

2.1 Soundtracker and Tracker music

In 1987 the demoscene was blessed with a commercial application called *Soundtracker* that could produce demo-style music that equaled if not surpassed the custom made tools that came before. Aswell as appealing to people on the demo scene *Soundtracker* began to appeal to a wider audience of amateur musicians [who were interested in putting together there own ravey if slightly generic self composed tunes.]

Whereas there had been previous tracking programmes for the *Commodore 64* and other platforms *Soundtracker* was one of the first programmes to introduce to *Amiga* users the luxury of sequencing clear high quality 16-bit quality sound and samples.

2.2 Soundtracker and the birth of Tracking

Soundtracker has gone down in history as the program that gave birth to a style of musical composition called *tracking* or *tracker music*, a scene that had its roots in the demoscene but expanded to a new demographic who weren't necessary aware of the programs connotations and roots.

What is a Tracker?

An elegant description of the *Tracker* concept can be found on the Wikepedia website:

> Tracker is the generic term for a class of software musical step sequencers, which, in their purest form, allow the user to arrange sound samples stepwise on a timeline across several monophonic channels. A tracker's interface is primarily numeric; notes are entered via the keyboard, while length, parameters, effects and so forth are entered into the sequencer via a hexadecimal number system. A complete song consists of several small multi-channel patterns chained together via a master list. The edit window of a tracker resembles a player piano scroll, moving from the bottom of the screen upwards.The first trackers allowed for only four channels of 8-bit music. [Anon. 2005*. Tracker: 1]*

Soundtracker was a programme unparalleled in its flexibility, and relative ease of use as it aloud the user to save basic four channel output into a finished .mod file [still commonly used to this day], meaning consumers and demosceners where now able to create and compile varied musical material at their own leisure. *Soundtracker* was a limited environment but an effective one, all sounds were obtained from the floppy disks, provided with the program he first musicians had 5 affects at there finger tips portmento up and down, secondary tempo, setting, and arpeggio.

Soundtracker set a standard for modern tracking and was immediately taken on by the demoscene who developed further and cloned the program at an astonishing rate several new versions were published. As the *Wikipedia* article explains, Tracker music could be considered as an early example of the open source art making in that anyone could look at how the song where output together and re-use the samples. [Anon. 2005. Tracker: 1]

Famous Tracker artists

As documented in the *Wikipedia* article, Tracker music took off mainly in the UK. Mostly its appeal was mainly within the closed circles of its own underground network. As the scene grew a number of key players emerged including *Necros, Basehead* and *Spyder* to name a few, Support grew via a newsletter called *Trax weekly* which gave a weekly report of the scene. [Anon. 2005. Tracker: 1]

The article concludes by considering it's impact on the music scene of the age. Despite brief adoption by popular acts such as the *Pet shop boys, Art of noise* and *Altern-8*- tracker music was never properly adopted into the mainstream. [Anon. 2005. *Tracker*: 1] the genre suffered from an acute image problem, 'tracker music' became something of a term of derision for 'stereotypically ravey, computer-game-style pop tunes'. The main problem being the 'difficulty involved in adding 'swing' to the tracker style mechanistic style, the monotonous 4/4 rhythms and the hypnotically strict four-bar sections, and over use of similar samples' [Anon. 2005. *Tracker*: 1]

The evolution of the Tracker scene, the birth of doskpop and other styles

Most of the music produce during the scenes prime era often showed a strong influence of techno and other popular styles. Trends starting developing during the scenes progression where artists would embrace various influences in their demos, in 1991 a notable offshoot of the tracker genre was the *doskpop* style. As the author explains in *Freax*, *doskpop* was a computer disco hybrid; the style consisting of a simple drum rhythm varying with snare- and at each eight beat a hi-hat. One of the

main components of this genre Lizard king caused a lot of controversy through his demo style, while others saw him as ‘god of the gaming scene’, others saw his output as ‘mere dilute lousy synth pop’. [Anon. 2005 *Freax*: 134]

Chiptunes

Perhaps the style to show most influence on modern post tracker music was the Chiptunes style. As the author of *Freax* explains, this sub-genre was pioneered by *4 mat* of anarchy. Instead of relying on samples *4 mat* created content that was purely melodic- relying solely on a pure waveform sound rather than recorded samples. The style had a retro feel reminiscent of the old *C-64* sound, and was favorable with programmers as valuable space was saved via a patent non-reliance on samples. [Anon. 2005 *Freax*: 136]

Tracker music: Conclusion

Although there is a still an active tracker community, its popularity has waned due to a] the decline of the *Amiga*, and b] the rise of the modern PC and it's increased processing power and storage capacity. With the PC’s increased power came a new breed of sequencers and samplers [which superceded the tracker tradition] such as *Cubase* and *Pro-tools* which raised the benchmark of quality realistic sound recording.

This is not to say Tracker music became obsolete, as the Wikipedia article explains Tracker music ‘is still commonly used within the Computer games industry’ [it’s most recent utilization in games such as *Unreal series* and *Deus Ex*.] [Anon. 2005. Tracker: 1]. As the author explains the new generation of Trackers such as:

> Buzz, ModPlug Tracker, MadTracker, Renoise, Skale, CheeseTracker, BeRoTracker and others offer features undreamed-of back in the day (hi-quality output, automation, VST support, internal DSP's and Multi-effects, multi I/O cards support etc.). [Anon. Tracker 2005: 1]

Chapter 3: Modern Gameboy Trackers

> 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
> *[liner notes to nanoloop version 1.0*: gameboy compilation cd, 2002]

The rules of evolution state that nothing really dies; it is simply recycled and made anew. After a lapse in popularity, by the dawn of 2000 Tracker music made a precedented comeback. Previously scawned old school Trackers now had jobs at flashy media companies, no longer designing music for outdated computers, but now working on the latest mobile device or mobile phone. As the Wikepedia article explains, with the birth of many new E-devices new media companies found that 'Tracker programs took up little space in comparison to MP3's and other forms of high audio' [Anon. 2005. *Tracker*: 1]

Spawned by the release of two major programs for the Gameboy in 2000 *[Nanoloop, Lsdj],* Tracker music also made a comeback sub-culturally. Tracker music was now being reborn as an art, rather than a necessity. Just as Piccaso had salvaged the junk from his backyard and converted it to high currency art, a new generation of Trackers dug out their old Gameboys from the loft and breathed new life to the movement.

Mclaren and 8 bit punk

The movement was also given boosted subcultural kudos through the journalistic talents of Malcolm Mclaren [the former subcultural media hacker of Sex Pistols fame]. In his seminal article 8-bit punk Mclaren dubbed this Post tracker Gameboy music *Chip music*, describing this new breed of musicians as 'forging a new kind of folk music for the digital age'. [Mclaren, M. 2002: 1]

Chip music and Pro Tools

> ‘I don’t think it’s about nostalgia, but technology, Right now there’s too much fetishization of new technology. This music is all about simplicity’. 8-bit music promoter Ihu Anyanuwu.
> [Lofus. T. 2003: 2]

Mclaren interestingly considers Chip music's adoption of retro technology in the light of modern sequencing and music production, claiming Chip music to be the antithesis of the glossy 24-bit luxuries of Pro Tools:

> Until recently, I was feeling stifled by the tyranny of the new. New corporate lifestyles for doing everything well. Too well. iPod this. PowerBook that. Listening to albums, like Madonna's latest, that were made using Pro Tools - software that reduces Virtually every mix-down effect to a mouse click - left me with a depressing sense of sameness, like everything on TV...Then I discovered chip music. [Mclaren, M. 2002:1]

Throughout his article, Mclaren makes a case for Chip music to be a reaction against modern recording techniques. Mclaren claims the gameboy to be the perfect tool for modern punker:

> LSDJ may be technically illegal, but who cares? It's the only way Role Model and his cronies can afford to make their music. It's *Le Resistance*. Chip musicians plunder corporate technology and find unlikely uses for it. They make old sounds new again - without frills, a recording studio, or a major record label. It would be facile to describe the result as amateurish; it's underproduced because it feels better that way. The nature of the sound, and the equipment used to create it, is cheap. This is not music as a commodity but music as an idea. It's the Nintendo generation sampling its youth...They like being pop-culture pirates,

> and they have little use for the mass market. Their output is deliberately inaccessible to radio and TV, indeed to anyone in the music industry who still believes in hi-fi.
> [Mclaren, M. 2002: 1]

In the same vain as punks primitive language of musical minimalism, Chip music has created its own democratic aesthetic favoring a simple interface and instinctive control method over a complex programming environment and eons of garbage code. Like punks Chip musicians also share a common DIY aesthetic aswell as a distain for fame, and pandering to an audiences common consensus.

Chip music and 80's nostalgia

> “This is not music as commodity. This is the Nintendo generation sampling it's youth" Mclaren, 8-bit punk, 2003
> [Mclaren, M. 2003: 1]

Aswell as displaying a definite punk aesthetic, the Chipmusic style is also notable for its hallmark sense of 1980's nostalgia. Many artists have paid homage to 80's artists and musicians in various compilations and release. For example Nullsleep's *Depeche mode* EP gives four *Depeche Mode* tunes the bleep bloop treatment and the *8bitpeoples* compilation ironically gives the syntherific *Beverly Hills Cop anthem*, the Chip music treatment.

Tools of the trade

> ‘I hope people see that there is some degree of musical sophistication, There is a novelty factor, yes. But we are making deliberate aesthetic choices. You’re really pushed to improve your skills more than you would be working in an environment when you can just say, toss some extra effects on it’ Bitshifter, 2003
> [Lofus, T. 2003: 3]

As Mclaren explains the two main tools of the chip musician's arsenal are the programs *LSDJ*, and *Nanoloop*. Both programs hack into the Gameboys internal sound-chip and allow the user to create musical patterns, and phrases. Wheras *Nanoloop* is more geared towards techno music and musical synthesis; LSDJ is a more of a traditional style tracker, which allows the user to construct melodic compositions in a more traditional vein.

LSDJ

LSDJ follows the outlines of a basic tracker, but is notable for its utilization of retro drum sounds [from vintage drum machine such as the Roland 303 and others]. On designing the program LSDJ Designer and programmer Johan Kolinski discusses how the limitations of the hardware informed the programmes design:

> It forced me to innovate some interface solutions and concepts
> that would seem out of place in modern pc's but makes total sense
> on the Gameboy...the small screen and the few buttons help allot
> it means you never have to shift your focus or move your hands between the
> mouse and the keyboard
> [Tasajarvi. 2004: 41]

On the popularity of the programme Johan comments:

> I think the reason that LSDJ is so popular is that allthe people who
> were kids when this was popular have now now grown up and come into a
> productive age, also because of the obvious 80s retro influence that seems to
> be everywhere at the moment
> [Tasajarvi. 2004: 42]

Nanoloop

Nanoloop is another popular tool amongst chip musicians. Below sonic artist Deniss McNulty describes the Nanoloop concept:

> The program empowers the user with an instinctive interface consisting of a 4 X 4 grid of squares each of which represents one beat in a bar of music [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 four synthesizer 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.
> [McNulty, D. 2003: 5]

Nanoloop programmer and designer, Oliver Wittchow discusses the programs inception below:

> [NanoLoop] was primarily intended to be a testing program for 'mobile interface design'. I was bored with all the soft-synths and sequencers that just imitateold hardware, instead of utilizing the computers potential for representing data.
> [Tuley. M. 2003: 1]

He continues:

> NanoLoop was really only meant as an experiment, but when I first showed it, it was apparent that people really do need this. The response was very enthusiastic, even though the sound itself

was really awful those days. And the premonitions did prove true. Already there are quite a large number of electronic musicians using the Game Boy, NanoLoop and Little Sound DJ or other music programs to produce lo-fi techno for disc, live and mp3.
[Tuley. M. 2003: 1]

Nanoloop Version 2.01

In reaction to the increased capabilities of the Gameboy Advance, Oliver Wittchow released Nanoloop v2.01, an updated version of the original Gameboy catridge catering for the systems improved 16-bit audio spec.

Gameboy platform shift

The jump from 8-bit to 16 bit has meant immense improvements in the sound quality for Nanoloop. Long gone are the blocky textures of '89, the sound is clearer- yet somehow less unique.

In the *Complete Guide to Game Audio* the author explains that bit rate values can be thought of in the same light as audio rate values:

> Wheras in the past 8 bit sound could only store 256 different values, 16 bits could store up to 65,536 different values- in real terms this signified a dramatic improvement in the smoothness and general body of the sound. Wheras 8 bit sound was often notable for its ugly quantisation noise [a hissy static background noise],16 bit was clear and clean allowing developers to explore quieter dynamic effects and a greater subtly of sound.
> [Anon. *The Complete Guide to Game Audio.* 2001: 433]

The Verdict

Bitshifter in interview below explains his take on the new nanoloop:

> To me it's a little bit less interesting as a creative medium. Its soundset is more versatile, but more generic; the sound of the Classic Game Boy is really distinctive, but to the ear there isn't Much separating the Advance from any other basic synthesizer. That said, I certainly don't disown it, Oliver Wittchow recently released Nanoloop 2.0 for the Advance, and it's got some really fascinating capabilities. Music-making on the original Game Boy Is interesting because it involves an unmistakable soundset being redirected in new ways. Music-making on the Advance is interesting more because of the ability to do pretty powerful synthesis in a tiny handheld unit -- I'm dying to try it on the new Game Boy Micro -- and less because of any unique character of the sound of the device.
> [Burfield. T. 2005: 1]

Key players

As Mclaren notes, the Gameboy scene is one of international proportions with centers in Vienna, New York, Japan etc. Amongst this diverse community many artists have attempted to introduce interesting new slants and takes on the Chip music genre. Below I will be exploring some of the key players on the scene and there contribution to the musical style.

Bubblyfish

Bubblyfish [Haeyoung Kim joined the Chipmusic scene in early 2001 after encountering the scene in her native New york. Bubblyfish is a classically trained pianist, and her pieces have an almost formal electro-acoustic flavor to them. Her classical leanings were recently put to use on Malcolm Mclaren's latest post-modern concept album *Fashion Beast* [in which various artist re-scored famous cover songs

and pieces of different eras and traditions]. For this album Kim re-scoured a piano piece by Poulenc:

> Malcolm suggested I weave in my so-called Bubblyfish sound, but I was finding it difficult to identify exactly how I should try to re-compose Poulenc through an eight-bit portable video game system. In adapting the Poulenc piece for McLaren's album, I doubted that it would be possible to transform a 20th-century classical piece into a GameBoy tune because they seemed stylistically opposed...But as I began to compose the piano lines using GameBoy sound and Poulenc's impressionism was updated to a sweeter, eight-bit, Mario Brothers Sound—less motivational infomercial, more smiling Takeshi Murakami flowers—everything came together for me in an instant as the music unfolded.
> [Bubblyfish. 2003: 1]

Kim creates her textures through combining the old and the new, feeding the gameboy into her laptop and creating aural landscapes that many critics such as Lofuss liken more to ‘movie soundtracks than video games’.[Lofus, T. 2003: 3]

Kim appreciates what she calls the Gameboys ‘warm 8-bit sound.’ ‘When I make music, it’s about the music itself and not the idea of using a Game Boy’ [Lofus, T. 2003: 3]. Kim talks about initially approaching the instrument:

> Initially, it was my curiosity in music technology and the warmth of the lo-fidelity sound that led me to pick up the Game Boy. At first, this simple device didn’t seem powerful enough to express complex musical ideas. Nanoloop, an application for GameBoy music composition is designed for making loop-based music. After trying to compose in my usual way on the GameBoy, I quickly realized that I needed to embrace the restrictions of the Nanoloop system. As a result, the limitations of the GameBoy helped me to be more creative and reinforced the evolving nature of my music.

[Bubblyfish. 2003: 1]

Despite her classicist roots, Kim is keen to make a break from the past, currently her shows she confesses attract ‘very serious electro musicians’, Kim however believes that her music and Gameboy music in general has potential for mass appeal. ‘Gameboys are part of the Pop culture we grew up with’ she says ‘Andy Warhol didn't separate art and pop culture he combined the two’. [Wilson, S. 2003: 1]

Bud Melvin

Bud Melvin like Bubblyfish also hails from NYC. His style often displays a certain odd all eccentricity, perhaps best displayed in his most recent album the return of Bud Melvin a Gameboy country record with banjo accompliament, vocals, and poignant slide guitar and vocals. Bud Melvin has also exhibited his Gameboy Camera generated visual art at several prominent New York galleries.

Gameboy and Gabba: DJ Scotch Egg and 8 Cyclinder

8 Cyclinder

Recently Gameboy music has been adopted by the Gabba scene with acts like Brighton based DJ Scotch Egg and 8 Cyclinder mixing elements of noise and dance to aggressive effect. DJ Scotch Egg has recently recieved radio 1 airplay from DJ's as unlikely as Steve Lamaq and Phil Jupitus!. His trademark Megaphone and chaotic live show has wowed Dance-hall's aswell as indie venues across the country

8 Cyclinder is notable for his superlative programming, whilst the majority of Gameboy musicians use standardized Gameboy programmes such as *Nanoloop*, and *LSDJ*. 8 Cyclinder prefers to code his programs using a customized Gameboy developer kit called GBDK. The programs he uses range from basic brownian noise generators to customizable Tracker style affairs, often processing these sounds via PC.

Lo-bat

Lo-bat is thought by many to be one of the most virtuosic flashy musician's on the gameboy circuit. His tool of choice is *LSDJ*, often creating complex beats and melodies with a distinct IDM flavor. In interview Lo-bat was asked about how an average song of his would come to life, he replied:

> I just make a lot of wicked sounds in the Gameboy and try to bring some structure in them. It's a very natural, slow process. I composed a lot on the bus when I was driving home from work. Since I didn't know anything about electronic music when I started composing, I developed my own style based on two things: first of all, I listened too much Jimi Hendrix when I was younger- and second, I tried to find the sounds I was hearing from other people also using Gameboy. The only thing I found out later was that not all of these sounds were done on the Gameboy. In other words: I was trying really hard to make sounds on the gameboy nobody else thought were possible. So I discovered a lot of nice sounds that are typical for my work. Together with a good feeling to mix funky stuff together
> [Anon. 2003. *Lo-bat:* 1]

Gameboyzz Orchestra Project

The Gameboyzz Orchestra was formed in Poland in early 2001 by ensemble founder Jarek Kujda. Kudja explains that he stumbled on the orchestral formula almost by accident. After playing in rehearsal with a basic drum machine for a generic art project, Jarek began to consider the possibility of exploring gameboy music on an extended scale. He swiftly formed the Gameboy Orchestra and by the end of the following year secured a slot at the infamous *ars electronica festival 2002*.

The Gameboy Orchestra is a six-member operation, with members referring to themselves as formal composers or performers [sometimes both]. All the sounds are

made by six Nintendo Gameboys. The orchestra consists of older gameboys and newer models [including the advance], the Gameboyzz Orchestra Project tweaks the software a bit, and then connects the units through a mixing board. As Journalist Metz explains in her interview with the band: Six Game Boys are linked together to work like groove boxes while the other two act as drum machines. To create and manipulate sounds, members use a sound-editor called Nanoloop, sometimes they manipulate sounds from games like *Tetris* and *Super Mario Bros*, they also use delay and reverb effects to modify the noises [Metz, R. 2004: 1]. The group explains their influences to Metz as including club music, electronica legend Kraftwerk and punk rock. [Metz, R. 2004: 1]

Metz continues:

> Before concerts, the group meets and decides what direction the music should take. Sometimes, they'll simply improvise, mixing and working patterns in front of an audience. The group, says Kujda, keep things pretty free form.
> [Metz, R. 2004: 2]

Jarek Kujda explains:

> Gameboyzz Orchestra Project is more improvisational project, I think. We prepare some patterns before a concert, and then make improvisation on the concert.
> [Anon. Global Hit 2004: 1]

Soloist Malgorzata Kujda alternatively claims the project to be ‘A lot of noise’, she continues: ‘For example, I make music more hard beats and noises. But each of us make another music, different music. And then in the concert we just improvise, and that I think is more fun for us.[Anon. Global Hit. 2004: 1]

Jazzman

Another impressive project for the seminar circuit was performed in 2003, by the Jazzman. The performance was simply titled Techno Teddy. An nice example of a recent trend towards using Gameboy's in installation style work. Jazzman explains below:

> The Techno Teddy is a teddy bear equipped with three ultrasonic Sensors and a Gameboy Advance. You can use it to make music with it, controlling it with the three sensors. One is located on the top, one on the left and one on the right. By moving your hand close to these sensors it is possible to execute commands and to control the music output. For example, if you issue the command left-left-top, the Techno Teddy records a pattern you play on the right and top sensors...You can clearly see the three driver circuits for the ultrasonic sensors and the Gameboy Advance. They're now of course hidden inside the Techno Teddy's body. We had the idea to do This just one week before Mekka&Symposium, on Friday the 22nd. Then immediately the first software version was designed and tested in an emulator, the next day a Gameboy Advance was bought, on Thursday the 26th the sensors were bought and the GBA was modified, the final assembly was then done on the following days and on Mekka itself.
> [Anon. 2004. Flugeldufel: Techno teddy: 1]

Mainstream Gameboy artists

Alec Empire and Beck

Although Gameboy music has yet to officially break into mainstream music, it has shown promising signs. Alec Empire of Atari Teenage Riot in 2001 released *Nintendo Teenage Robot*, one of the first mainstream electronic acts to catch onto

the genre. The record showed all the trademark anarchic aggression one associates with DHR, and has become a cult favorite amongst fans.

Somewhat surprisingly Beck has also been an avid supporter of the scene. Whilst promoting his new album “Geuro”, Beck has performed live in concert with a Gameboy, whilst also incorporating gameboy sounds into the records production.

Malcolm Mclaren

Mclaren has also recently hijacked the scene with his recent project “Fashionbeast”. In this project Mclaren aimed to create a postmodern covers record selecting a variety of songs, and repertoire from varied traditions and programming the results direct to gameboy. He explains below:

> I began working in Ivry Sur Seine, programming Game Boy
> Sequences, then overdubbing analog synths, guitars, and vocals.
> I sent an MP3 to DeNardo, who, I learned, is a classically trained violinist and
> keenly aware of Steve Reich's orchestral minimalism
> and John Cage's I Ching-driven randomness. He'd picked up LSDJ
> from Björk's Web site thinking it would make his music different.
> He created a Game Boy sequence to accompany one of my favorite
> old blues tunes, "Mighty Long Time" by Sonny Boy Williamson. Then
> he rewrote the lyrics and roughed out the chords on an acoustic guitar. We
> called the new track "Fashion Horse.
>
> [Mclaren, M. 2002: 6]

He continues:

> I remained in the factory for the next few months, cutting and
> pasting the ruins of Jimi Hendrix, John Lee Hooker, and Muddy
> Waters into a video-game wall of sound. I rocked with Adlib.

DeNardo flew in from Chicago. We translated the modernist Classical music of Francis Poulenc into Game Boy sequences and arpeggios.
I went to China and developed a post-karaoke sound with Wild Strawberries, an all-girl group from Beijing. I found the look of music. This was fashion at its most cutting edge. So chic!”
[Mclaren, M. 2002: 6]

Chapter 4: Conclusion

Summary

Throughout the course of the study we have explored Gameboy within it's traditional context, yet also the history that has led to people rediscovering video-game music and subverting it in new and interesting contexts. Whether this be to re-interpret the classical music of Poulenc [Bubblyfish], create music for a catwalk [Mclaren] or to make a quirky country record [Bud Melvin]. Although the artists come from a variety of different viewpoints and disciplines, they are all united by a similar fascination in exploring a musical vocabulary of limitations. As one tracker user notes, on the tracking notice board, ‘has anyone noticed that by tracking you end up hearing more? . I mean that you end up consciously noticing effects like panning, and you break music down into its component parts. [Anon. *Hearing more*. 2002: 1]

As a Tracker user it seems that one becomes more aware of the miniature of events, more critical of harmonic relationship, aswell as rythmic variety. Through limitations ones musical appreciation literally expands.

Paradoxically though the act of tracking music can also be “double edged”. Other Gameboy musicians such as Bitshifter have found the limitations a curse as much as a benefit: ‘Familiarity and facility with a tool can sometimes trigger tunnel vision, and I feel like that's happening lately. It can be hard to shake -- once you develop patterns of efficient working, happy accidents become a lot less frequent, and that can be difficult to deliberately counter.’ [Burfield, T. 2005: 1]

Longevity of the medium

Whereas figures such as Beck, Alec Empire and Mclaren have given the medium much exposure, the attention hasn't always been well received, as Role-model reacted: ‘Can’t they leave my hobby in peace? [Anon. *Boy Playground.* 2003: 1].

Whether the music remains an underground phenomenon breaks into the mainstream or remains at all is yet to be seen.

The answer to some extent lies beyond artistic control; the long-term survival of the Gameboy within the context of market pressures and economic considerations will probably be the ultimate decider on the scenes future. Without support for the technology from Nintendo or the pirate trade there will be no new musicians meaning a deprivation of new ideas, and creativity in the scene.

Philosophy of Technology

To some extent one could see the progression of technology as a slash and burn culture. Consider for instance the replacement of vinyl with compact discs in the 1990's and the visual replacement of VHS with DVD in 2000. Consumers were convinced by media companies to repurchase and relive their favorite artworks through a new platform. As the Sci-fi writer Sterling explains:

> As a digitized information rich culture nowadays, we have to artificially invent ways to forget stuff. I think this is the real explanation for the triumph of compact disks...The real advantage of CD's is that they allow you to forget your vinyl records. You think you love this record collection that you've amassed over the years but really the sheer choice, the volume, the load of memory there is waying you down
> [Sinclair A.S. 2004: 435]

He continues:

> But if you buy a CD player you can bundle up all of those records and put them in attic boxes without so much guilt pretend that you've stepped up a level. That your now more even intensely into music than you were. By dumping the platform, you dump everything attached to the platform and my god what a blessed sacred relief

[Sinclair A.S. 2004: 435]

Sterling later comments on the temporal nature of the video-game industry in comparison to the book business:

> Computer games are especially vulnerable to this as they live and breath through the platform. Books are harder to kill and don't lose anything by being reprinted. My art; ‘science fiction writing’ is pretty new as literary arts go, but it labors under the curse of 3 thousand years of literacy. In some weird sense, I'm in direct communication with Homer and Euripides. I mean these guys aren't in the SWFA, but their product is taking up valuable rack space. You guys, on the other hand, get to reinvent everything every time a new platform takes over the field. This is your advantage and your glory. This is also your curse. It’s a terrible kind of curse really.
> [Sinclair A.S. 2004: 434]

He continues:

> The problem is computer game techies measure stuff against things that don’t exist like ‘boy floppies are slow cant wait till CD Rom’, or ‘artificial characters are great, can’t wait till A.I’. For a novelist like myself this is a completely alien paradigm. I can see that it’s very seductive, but at the same time I can't help but see that the ground is crumbling under your feet. Every time a platform vanishes it's like a little cultural apocalypse. And I can imagine a time when all current platforms might vanish, and then what the hell becomes of your entire mode of expression. I don't think it is accident that this is happening ...I don't think as a culture today were very interested in tradition or continuity
> [Sinclair A.S. 2004: 437]

Chiptunes and hacking

The Gameboy Chiptunes scene is a vulnerable scene in a cultural sense as like Sterling states it ‘lives and breathes through the platform’ [Sinclair A.S. 2004: 435].

Central to the Gameboy music philosophy is the concept of platform hacking. Through using pirate cards and software scenesters aim to hack into the Gameboy console, and are able to save information to computer and card. The scenes two key programs *Nanoloop* and *LSDJ* have both in there lifetime been available on flashed pirate cards [currently Nanoloop v2.01 is sold exclusively on a f2a pirate gba card]. Through subverting and creating new users for a common consumer item Gameboy musicians raise some interesting cultural questions.

The Philosophy of Hacking

Cox, Krysyn and Kerwin explore the nature of capitalism and its affect on art-making in their book *Economizing Culture*. The Authors later relate these concepts in relation to the work of Cereau:

> In examining how individuals can reclaim a sense of autonomy from the forces of commerce and politics, Michel de Certeau asserts that users operate opposing established rules in the most ordinary of circumstances (1984). The concern is the mode of operation, not human subjects as such but their actions that together form a culture wherein models of action are characterized by user in ways that resist the idea of passive usage or consumption.
> [Cox, G. Krysyn J. and Kerwin A. 2004:6]

The book then continues to explore the subversion of consumer ideology present in the work of the Gameboy orchestra through the theories of Cereau:

> The Gameboyzz Orchestra reconfigures the use of the Gameboy console

> as a musical instrument, changing it into a productive tool of expression. In de Certeau's terms, consumers negotiate discipline and power exerted On them by tactical forms and makeshift creativity, through what he calls "antidiscipline. [Cox, G. Krysyn J. and Kerwin A. 2004:6]

Hacking

As they explain in relation to the gameboy orchestra:

> The tension here is between the common use and prescribed use of technology; or rather, the relations between consumers and the mechanism of production is made complex and contradictory. Mass culture, then, holds the potential to contain ways of making in Which social relations are reconstituted or hacked.
> [Cox, G. Krysyn J. and Kerwin A. 2004:6]

He continues

> Thus, there is self-evidently a political dimension to everyday practices. Everyday practices, such as shopping or cooking, are potentially "tactical" in character offering new and strategic ways of operating. Hacking might be usefully described in these terms, as a tactical form of re-coding supplied materials and structures (code and rules), transforming one person's property into another's.
> [Cox, G. Krysyn J. and Kerwin A. 2004:5]

Nintendo vs the Pirates

The dilemma that faces the scene at this point is that. Not only have Nintendo stopped manufacturing the original 8-bit gameboy, so have the pirate trade. Currently the only pirate card still catering for the original gameboy is the f2a card, and this card only provides support via an adapter [which drastically limits saving

abilities, making it harder for musicians to save and create music on the original hardware]

Nintendo

Nintendo have interestingly been cracking down on the original Gameboy card traders, meaning many of the companies are currently being sued and liquidated by Nintendo. This is bad news for musicians as they are forced to trade with elicit often-Chinese companies, and often bare the brunt of buggy semi functional software and hardware.

Sadly it seems that many developers are also turning against the medium in reaction to Nintendo's policies. In attempt to improve the quality of there games Nintendo in the early 90's screened potential developers for there platform by making sure every developer was endowed with an official license. Essentially this intervention created an divisive corporate hierarchy alienating both hobbies and enthusiast programmers. Despite their immense popularity both *Nanoloop* and *LSDJ* where turned down for licensing by Nintendo, forcing the applications underground. Oliver Wittchow below states his reasons for discontinuing the production of Nanoloop:

> I am not going to develop for the Game Boy anymore (unless someone asks me to...) because it's not an open platform. It can only communicate with other Game Boys and software must be distributed on expensive cartridges. The complete system belongs to Nintendo, theoretically you need to ask and pay them for a license for anything you do with it.
> [Tuley, M. 2003: 1]

Bitshifter below notes the impact of Nintendo's anti piracy policies have had on the scene:

> Nintendo's crackdown on "developer" gear manufacturers as a means of curbing game piracy definitely had an impact on the Gameboy music scene; it

> prevented Oliver and Johan from continuing to sell their programs on physical cartridges once their supply was depleted. Johan still sells LSDJ as a ROM image that buyers can download and burn to their own blank cartridges if they have them, but that still doesn't help new people looking to explore music making on actual Gameboy hardware rather than in an emulator. It's really a drag, people are scrambling to locate blank cartridges and transfer gear, scouring eBay, etc. As far as the demoscene as a whole is concerned, this is really only going to affect Gameboy programming. The Game Boy "disk" format, obviously, is proprietary, as opposed to other computing consoles, which used common diskettes or floppies or data cassettes or whatever. And while on one hand I can understand Nintendo feeling compelled to take steps against game piracy, it seems strangely late, it's not like the company is still developing games for the first generation Gameboy. Commercially it's a dead platform, and it seems strange to get territorial posthumously. It's definitely badly timed in terms of independent Gameboy development.
> [Burfield, T. 2005: 1]

In terms of Nintendo's input into the problem the situation seems to be improving [within the last few months]. The latest Nintendo DS model is backwards compatible with all cards, meaning a possible re-birth of the old Gameboy cartridge in the pirate and consumer worlds. The polish division of Nintendo has also helped fund *Gameboyzz Orchestra's* latest tour, a tolerant gesture on the part of the company- and here's hoping for more to come.

Moving towards new mobile technologies

As Bitshifter points out, it is not only technological change that determines a scene's longevity but also artistic expression: 'I think that whatever external attention and internal participation this stuff is enjoying now will naturally give way to other things, but for reasons other than technology.' [Burfield, T. 2005: 1]

Much of the appeal of composing and performing on the Gameboy lies in its mobility. The Gameboy allows musicians greater mobility in terms of touring aswell as the ability to informally compose in any given place at any given time. Perhaps Gameboy music is only really the tip of the iceberg? with the birth of new technology and E devices [some with bluetooth and advanced networking capabitlies] one can foresee a rich and dense heritage ahead of us.

Nanoloop creator Oliver Wittchow is currently working with a Japanese media company in developing a mobile composition programme for mobile phones. Below Wittchow discusses the program in development:

> As they are sound devices by definition, cell phones are my choice for future development. The possibility of transmitting audio, data and even cash over the air allows whole new types of applications and distribution. Software-wise i am interested in additive synthesis, networking and automatization, so a future application could look like this for example: a server-based mp3-synthesis system of personalized learning algorithms which create a spectral matrix (synth) along with a pattern of predefined samples (sequencer), controlled by a cute little WAP interface. Algorithms could be edited and saved on the phone and exchanged through a Pokemon-like trading system.
> [Tuely, M. 2003: 1]

He continues:

> There are prototypes of Smartphone music distribution in Japan, but it will take years till they come to Europe…On European (Nokia-) handsets the only yet possible sound application is server-based ringtone generation. I like ringing tones for their reduced and fleeting character, so my next project is an automatic online melody generator, which will be introduced on a new site soon.
> [Tuley, M. 2003: 1]

Bibliography

Anon 2005, *Freak: The Brief History of the Computer demosc*ene*: Volume 1*, CSW Veltag
Anon. 2001. *The Complete Guide to Game Audio: For Composers, Musicians, Sound Designers, and Game Developers,* CMP Books
Barthes R 1997. *Image-Music-Text*, Fontana
Chion M 1990, Audio Vision: Sound on screen, Columbia University Press
Cox G, Krysn J. and Anya Kerwin. 2004. *Economising Culture: On the [Digital] Culture Industry* Autonomedia
Emmerson, S. 2000, Music, Electronic media and culture, Ashgate publishing
Frith, S, Thorne H 1987, *Art into pop*, Routledge
Kohler C 2002, *Power up: how Japanese video games gave the world an extra life*, Brady Games
Reynolds S 1998, *Energy Flash: A Journey through Rave music and Dance Culture*, Picadore Books
Sincair A S 2004, *T he fat man on game audio: tasty morsels of sonic goodness, New Riders publishing*
Tasajarvi L 2004, *Demoscene: the art of real-time,* Lake Studios
Weis E, Belton J 1985, *Film sound: theory and practice*, Columbia University Press
Theberge P 1997, *Any sound you can imagine: making music consuming technology*, [Weseleyan University Press]

Internet Sources

Anon. 2003. *Lo-bat*, http://www.calculatinginfinity.nte/int_16.php
Anon.2004. *Flugeldufel:Techno teddy* http://www.flugeldufel.org/teddy/hardware.htm,
Anon. 2003. *Boy Playground* http://www.kraak.net/boyplayground/ Anon. 2003 Hearing More
http://www.unitedtrackers.org/modules.php?name=conte&pa=showpage&pld=1&page=3
Anon 2005, *8cylinder*, http://rhinoplex.org/8cylinder/,
Anon 2005, *gameboymusic*, http://www.gameboymusicclub.org/links.html,
Anon. 2004. *Global Hit: The Gameboyzz Orchestra Project*
http://www.gameboyzx.com/bbc.htm
Anon ,2005, *Nullsleep*, http://www.nullsleep.com,
Anon 2005. *Aleksi Eeben*, http://www.cncd.fi/aeeben,
Anon 2001,*Tracker*, http://en.wikipedia.org/wiki/Tracker,
Appleford, S. 2005, *Push the button,*
http://www.lacitybeat.com/article.php?id=2467&IssueNum=114
Bubblyfish 2003, *[Re]making an eightbit masterpiece*,http://www.nyfa.org/level3.asp?fid=6&side=17
Lofus, T. *Play that funky music, Gameboy*, http://msnbcmsn.com/id13131157, 2003
Anon. 2005. *Tracker*, http://en.wikipedia.org/wiki/Tracker
Mclaren, M. 2002. *8-bit punk,*
http://www.wired.com/wired/archive/11.11/mclaren.html?pg=1&topic=&topic_set= , Metz, R. 2004. *The sound of gameboys* http://www.gameboyzz.com/wired.htm
Tuley, M. *Nanoloop: Gameboy Catridge Synth*

Sequencer,http://www.sonicstate.com/articles/article.cfm?id=12&page=2
Wilson S. 2003. *Gameboy Composers*, http://www.bubblyfish.com/bf_mtv_mag.pdf

Miscellanous

Varios Artists, *Nanoloop Version 1.0 [liner notes],* Discobruit 2002.

Primary Research

Burfield T. 2005. *Bitshifter interview*, Anti Digital Productions
Burfield T. 2005. *DJ Scotch Egg Interview*, Anti Digital Productions
Burfield T. 2005. *Herbert Wrexhalam Interview*, Anti Digital Productions