

## **The History and the Future of Console and Arcade Emulation**

Game consoles and arcade games turn over at exceedingly rapid rates; every few years, game console companies invent faster platforms with greater technological prowess to remain competitive in the market. As these consoles and arcade machines fall from common use, their history, in a sense, becomes lost. Emulators, computer programs designed to mimic another electronic system, provide the means to revive and recover such lost history. By emulating video consoles and arcade machines on home computers, anyone wishing to play a game from past eras may do so without needing to possess hardware no longer available for purchase. However, the notion of video game emulation has been plagued with many legal qualms. In this history, the definition, origins, and purposes of console and arcade game emulation will be laid out, in stride with their advantages and drawbacks.

### **What exactly emulation entails**

Emulation is the act of simulating the integrated circuits or silicon chips used in any electronic system; emulation is not restricted only to video games.<sup>1</sup> For example, running a Windows operating system on a Macintosh is considered emulation. An emulator, then, is software that is used to perform emulation. In terms of video games, emulators simulate chips and circuitry used in the hardware of gaming consoles or arcade machines. For emulators of cartridge-based consoles and for arcade machines, copies of the original software contained within the game cartridge or game board can be saved on a home computer as a disc image called a ROM.<sup>1</sup> Creation of such ROMs from game cartridges requires a piece of specialized hardware. For emulators of CD-based game consoles such as the Sony PlayStation and the Sega Dreamcast, the same CDs used in the console can be inserted into a home computer and run through the emulator. In either case, video game emulators utilize the same code that the actual gaming machine would; thus, if an emulator is well-written, emulator users would experience the same phenomena that users of the original machines would: graphics, music, and gameplay. Of course, the input devices usually differ between the original gaming machines and the host computer on which the emulator is run. Most emulators are coded in C or assembly languages,<sup>1</sup> though some emulators exist written in Pascal or other languages. Some technically simple games, such as Pong!, can be emulated online with Java, as demonstrated by Professor Lowood in class.

The development schedule for emulators is usually lengthy. This occurs mainly for two reasons: firstly, most emulator developers do so as hobbyists and not as part of a career, and secondly, because of the technical challenges that the developer must overcome.<sup>1</sup> For example, a developer would need to examine all the specifications of the chip and circuits used in a machine and subsequently convert the logic and commands of those elements into code in order to match the operating system and the processor of the hosting machine. Because of the time required, many emulators are abandoned at alpha

versions or beta versions before ever reaching a bug-free version. Occasionally, all (or most) of the bugs are removed, and an emulator capable of running commercial games is born.

### **Why video game consoles emulators arose**

The video game industry has been compared to the film industry in many respects: both offer forms of video-based entertainment from a variety of genres, and both industries have been successful in raking in billions of dollars from consumers. Since the year 2000, the video game industry's revenue has exceeded that of the film industry.<sup>2</sup> Video games continue to be a growing part of world culture,<sup>3</sup> but unlike cinema, the video game industry, particularly the console games industry, must reinvent itself in terms of technology in order to remain profitable. For example, Nintendo's reluctance to adopt newer forms of technology, such as the compact disc, led to the late release of the Super Nintendo Entertainment System (SNES) relative to the release of its market rival, the Sega Genesis.<sup>4</sup> Because of this drive for faster processors, better graphics engines, higher-quality sound, and overall newer technology, current game console systems tend to become obsolete rather quickly; essentially, game consoles can only last two to three years before being superseded by more recent and more powerful consoles.

Thus, every few years, gamers tend to place their current consoles on a shelf, and in their stead, replace them with new ones. This poses a substantial problem for anyone wishing to study or play games from an era long past: the hardware (consoles) and software (games) that were popular only a few years ago are no longer sold. To make an analogy to the film industry, one could imagine that as soon as a movie moved off the *New Releases* shelf at a video rental store, it went into the clearance bin. A second and perhaps more convincing analogy to film would be to imagine that VHS-players, having been superseded by the more technologically advanced DVD-players, were no longer sold. Thus, all movies in the future would only be released on DVD format, stimulating the eventual loss of all movies originally released on VHS. However, this has not come to pass in the movie industry, as almost all films that were released for VHS have also been re-released on DVD; moreover, new movies are released for both VHS and DVD. Furthermore, the exponential increase in the graphics capabilities of video game consoles has not been paralleled by a comparable increase in the film community. Thus, the rapid turnover from one generation of consoles to the next necessitates a mechanism for the historical preservation of console games. How many universities, besides Stanford, house gaming consoles in their library's media collection? Because of the historical desire to prevent the extinction of older-generation consoles, gaming console emulators have arisen.

### **Why arcade machine emulators arose**

Similar to game consoles, arcade machines turn over at a very rapid rate. Who can go to an arcade today and play the original *Street Fighter* or *Mortal Kombat*? Emulators can and do preserve arcade games; however, the first attempts at arcade emulation began for a less noble purpose. Soon after the inception of *Pong*!, others attempted to duplicate to work of Al Alcorn for profit.<sup>5</sup> Because of the nature of the circuit board on which *Pong*! was made, the hardware was the software; there was no microprocessor off which a ROM

could be run.<sup>5</sup> Thus when others essentially copied and sold the Pong!, they were emulating it. This can be contrasted with the pirating of Tetris, in which the idea and software were copied but not the hardware.<sup>6</sup>



Screenshot of the original Street Fighter (1987) on MAME

### **Who makes game emulators and why**

Most emulators are made by hobbyists who “create them for fun,” and distribute them freely.<sup>7</sup> When emulators for game consoles became popular around 1996, many people hailed emulators as “programming coolness”.<sup>7</sup> The hobbyists who created emulators of the Atari, Nintendo Entertainment System, SNES, and Sega Genesis did not intend to change the gaming scene or obtain a salary; for the most part, they were simply interested in preserving older games and wanted to find some way so keep them alive,<sup>7</sup> and the internet provided the perfect forum for them to spread their emulator and allow others to enjoy older games on platforms which are no longer available for sale. As with all cartridge-based emulators, ROMs under copyright are illegal to possess unless one actually owns the cartridge.<sup>8</sup> Websites distributing such ROMs were shut down by the threat of legal action from console companies, though no legal action has been threatened or attempted against the makers of emulators of the aforementioned consoles for use on the home computer.

### **Ethical and Legal Emulation**

Aside from the emulation of Pong! for profit, there have been other cases in which the reverse engineering of video game machines have occurred. Clearly, reverse-engineering is necessary for emulation because in order for an emulator’s programmer to simulate the actions of a machine’s circuits and chips, he needs to first understand exactly how those components function. Also, the use of the principle of reverse engineering is not confined to emulation; there are plenty of other reasons why one would reverse-engineer a console. For example, Electronic Arts (EA) attempted to reverse-engineer the Sega Genesis in order to circumvent the need to acquire cartridges from Sega.<sup>9</sup> In doing this, EA could avoid paying Sega a substantial licensing fee of around \$8.00 per game unit sold.<sup>10</sup> Considering that the cost of new console-games over the years has been roughly \$40.00-\$60.00, about one-fifth to one-seventh of the revenue for game sales goes to pay licensing fees.

Although the intentions of emulator developers originated in nostalgia for old games, in January of 1999, two emulators were released that substantially influenced console gaming companies and threatened their financial profits. First, a freely distributed

Nintendo64 (N64) emulator called UltraHLE (for Ultra High Level Emulation) was developed, designed, and released by two hobbyists who called themselves Epsilon and RealityMan.<sup>11</sup> This emulator was significantly different than its predecessors in that this emulator replicated almost perfectly the performance of a newly released console rather than that of an obsolete one. Because games for the N64 are distributed in the form of cartridges, users of the emulator would have to import the code for games onto ROMs in order to play games on the emulator. The circulation of such ROM images was anticipated by the developers of UltraHLE, and thus, they posted this warning on the UltraHLE website:

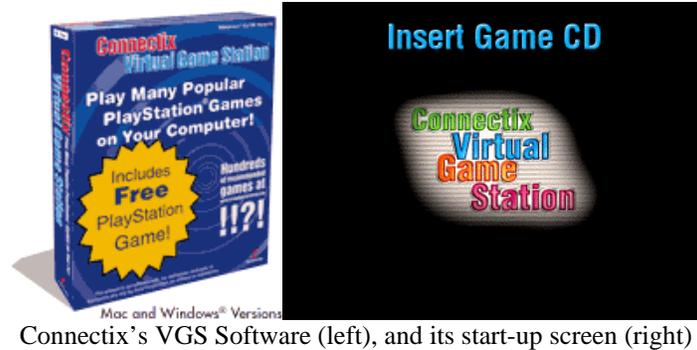
If you use rom images which are illegally in your possession you are in violation of many United States and international laws. The authors of UltraHLE do not condone the illegal use of rom images.<sup>11</sup>

Despite the legal notice that users of UltraHLE were required to agree to before downloading the emulator, Nintendo saw the emulator as a tool for piracy and thought that UltraHLE could herald the end of sales for both its N64 console and cartridges running on it. Thus Nintendo publicly and vigorously threatened legal suits against Epsilon and RealityMan, though none have been filed to date.<sup>11</sup> At this threat, however, Epsilon abandoned the UltraHLE project. Soon after, RealityMan followed, and excerpts from his last public statement appear below:

"I have done some hard thinking this evening and decided that my hobby is no longer of public concern. As far as I am concerned UltraHLE is dead and buried and I will be deleting the source, roms and all the documentation I have... some people will say that this is another smoke screen or delay but to be honest I have had enough of the back biting etc that I have received... [Ultra]HLE is dead now but it set out to achieve its aim and succeeded - to prove N64 emulation was possible..."<sup>11</sup>

Obviously, the game console industry has not perished, but nevertheless, Nintendo and other game console companies bear no warm feelings towards the makers of emulators. Sony faced a slightly different threat from Connectix, a San Mateo, California, computer software company that premiered a commercial emulator.<sup>7</sup>

Connectix's emulator was the Virtual Game Station (VGS), a program sold for \$49.99 at any local software store, which emulated the Sony PlayStation console on the MacOS, and later, on the PC. Getting wind of this, Sony straightway filed suit against Connectix to block them from selling the emulator.<sup>7</sup> Sony's claims were at first dismissed by the U.S. District Court in San Francisco on the ground that the emulator did not violate intellectual property rights.<sup>7</sup> However, Sony press on and in April of 1999, the court granted Sony an injunction against Connectix which required them to cease shipment of additional copies of the emulator because Sony had proven that Connectix had directly copied the PlayStation's basic instruction set.<sup>7</sup>



Connectix's VGS Software (left), and its start-up screen (right)

The situation of Sony and the VGS differs in several ways from that of Nintendo and UltraHLE. Because PlayStation games are sold and distributed in CD format, consumers who played games on the VGS also contributed revenue to Sony through that \$8.00-per-game licensing fee. Moreover, most of the income of console companies comes not from the sale of the console itself but rather from licensing fees.<sup>10</sup> In actuality, console companies *lose* money per console unit sold in hopes that they will recoup losses through the sale of games via licensing fees.<sup>10</sup> Thus, it is natural to wonder why Sony so adamantly pursued lawsuits against Connectix. Publicly, Sony claims that emulators promote piracy and that their legal actions were not taken in malice towards emulators but rather in preemption of game piracy.<sup>7</sup> However, Connectix went through special measures to ensure that replicas of game CDs (*burned* copies) would not be playable on their VGS. Therefore, Sony's argument is not internally consistent; any individual unwilling to purchase an expensive PlayStation might be willing to buy the cheaper Virtual Game Station along with a handful of games, by which Sony would profit in a scenario in which it wouldn't have otherwise.



Screenshot of ChronoCross from a new PlayStation Emulator for MacOS X, FlareStorm

### **The extinction of gaming consoles?**

So why *did* Sony file suit? Is Sony's corporate pride more important than added revenue? Perhaps this is so, considering this statement made by the president of Sony Entertainment of America Kazuo Hirai, during an interview in May 1999: "It's a matter of principle to us. I don't think I would want to be ... in a position where I am profiting from sales of software to run on something that is based on copyrights and intellectual properties that are, by the way, being stepped all over! I would say, 'OK, we don't need that extra unit sale,' if that means I get to protect my copyrights."<sup>7</sup> The drive to quash

Connectix's emulator was so paramount that eventually Sony paid an undisclosed sum to Connectix for the complete termination of their Virtual Gaming Station project. As a historical aside, Sony also prevailed in a lawsuit against the makers of Bleem!, a commercial PlayStation emulator for the PC.<sup>12</sup> This sets a precedent which discourages companies from making emulators, for good or for worse.

The existence of UltraHLE, Virtual Gaming Station, and Bleem! all bring into question the very existence of consoles. If high-quality emulators for modern gaming consoles can be developed swiftly after the release of a new gaming console and subsequently circulated (freely or for a comparatively small fee), the console industry would surely fail. Because all of the leading consoles now on the market utilize CDs and DVDs for the distribution of games, console companies no longer enjoy the luxury of a special cartridge that is inherently incompatible with personal computers. Thus the strategy of blocking the circulation of ROMs will no longer work. If emulators such as UltraHLE and the Virtual Gaming Station were allowed to persist and mature, consoles would deteriorate from dedicated hardware to superfluous machinery. By setting precedents of swift action against those individuals or companies who create emulators of modern-day consoles, Nintendo and Sony have ensured the survival of the console industry for a long time to come, bolstering the barriers between gaming consoles and personal computer.

### **On arcade emulation and the future of arcades**

The most widespread arcade machine emulator is the Multiple Arcade Machine Emulator (MAME) for PC, which has a MacOS port, MacMAME, along with a Unix port, X-MAME. Created and maintained by Nicola Salmoria, MAME is an open-source project aimed at documenting and preserving the hardware and software of arcade games.<sup>13</sup> MAME was first released in February of 1997 and since then has grown to accommodate over 2000 playable arcade games and currently includes a team of about 100 volunteer programmers.<sup>13</sup> Though this emulator permits one to enjoy extinct arcade games, the main purpose of the project aims to historically preserve the hardware of older arcade games. An account from the MAME homepage reads, "There are already many dead arcade boards, whose function has been brought to life in MAME. Being able to play the games is just a nice side-effect."<sup>13</sup> MAME achieves its goal of preserving arcade hardware, and several ROMs are publicly available for use with MAME, including clones of popular arcade hits such as Pac-Man. MAME forbids the distribution of ROMs with the emulator, since possessing the ROM without owning the arcade board is illegal.<sup>14</sup> To this author's knowledge, no suits have been brought against the developers of MAME, though ROM sites such as [www.mame.dk](http://www.mame.dk) have been forced to remove all their copyrighted ROMs. Moreover, playing ROMs or clones on a personal computer will not replace the arcade environment or experience; therefore, the MAME project provides a free service to the gaming community without financially harming the arcade industry.

In conclusion, the makers of some emulators have helped preserve the history of console and arcade games, while others have attempted to reap monetary rewards. If console emulators are allowed to be developed for newly released systems, the console gaming industry will not thrive. Lawsuits have been filed against the makers of UltraHLE, Virtual Gaming Station, and Bleem!; the actions taking by console manufacturers has

successfully discouraged the release of emulators for modern-day consoles. However, emulators for obsolete consoles and arcade machines exist without doing harm to the gaming industry and serve as a historical repository of hardware and software. It seems that the older a system becomes, the historical value of its emulation grows greater while the economic burden of its emulation dwindles to insignificance. Perhaps Al Alcorn said it best: “If people now-a-days emulate Pong!, I couldn’t care less.”<sup>15</sup>

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