

Video Games Evolve



1960s



2007



A Brief History from
Spacewars! to MMORPGs

An interactive exhibit at the Federal Reserve Bank of Boston, 2007

Today's youth are more "wired" than any previous generation. At the Federal Reserve Bank we recognize this and employ an interactive video game as the central tool of the New England Economic Adventure, our flagship program for teaching middle-schoolers and high school students about economic history. Interactive learning is hands-on and immediate. The experience is dynamic and exciting for participants and, we hope, makes a lasting impression. Games are an integral part of our culture and our economy. They are here to stay.

Video games comprise much more than an important segment of American leisure time and entertainment spending. They represent a multibillion dollar business—\$7 billion, according to the 2006 Entertainment Software Association (ESA) study. This is almost double the \$3.6 billion spent in 1996, and closing in on the \$9 billion spent at the movie box office. Games today are in direct competition with movies and television for our leisure hours and dollars.

Video and computer games are part of our culture and part of international culture, as Asia and Europe rapidly develop their gaming businesses. Electronic games are played by all age groups. In the United States, according to the 2006 ESA report, the average player's age is 33; and the gender split is 62 percent male and 38 percent female. This, of course, varies by the type of game: action and sports games are heavily male, for example; puzzle games and those played on cell phones are primarily female.

The game market has become so popular that players are now divided into subcategories including core, casual, and occasional gamers. Games themselves are divided into classes, such as action, role-playing, sports, mazes, and a category of "serious" games, which includes military recruiting games like **America's Army**, educational games, and virtual worlds like **Second Life**.

The skills needed to produce today's games have increased dramatically: computer programming, engineering, and artistic modeling and rendering skills are common requirements. Several colleges and universities hold classes now in game development, and some, like Worcester Polytechnic Institute, Southern Methodist University, and the University of Southern California, even have degree programs in interactive media and game development. These multidisciplinary degrees draw on a wide variety of subjects and include classes in computer science, engineering, art, mathematics, artificial intelligence, and philosophy.

The skills needed to play today's games have also evolved and expanded. The days when an intricate arcade game took 15 minutes and a few quarters to catch on are over. Consider the MMORPG (pronounced "More Peg" and standing for Massively Multiplayer Online Role Playing Game, a game in which thousands of people are online playing with each other in real time). The MMORPG called **Legacy** has a player's manual 184 pages long! The **World of Warcraft** does not have a manual. Instead the web site has "massively multiple sections and subsections with detailed instructions on how to navigate elaborate landscapes and fend off warlocks, druids, trolls, and other combatants. Then there is **Second Life**. The only way to explore **Second Life** is through an avatar, or alter ego, of one's creation. The avatar can then attend numerous daily classes to learn how to navigate "in-world," build things, start businesses, learn scripting language, texturing (designing realistic 3-D surfaces for objects), and more. All these games have steep learning curves.

SPACEWAR! and the Arcades

The new era of games began over 45 years ago with the first interactive game called **Spacewar!**, developed at MIT.^{1,2} In 1961 Ken Olsen, founder of Digital Equipment Corporation (DEC),

gave a \$120,000 computer called a PDP-1 (Programmed Data Processor) to MIT's Electrical Engineering Department, expecting that bright students would use it to cure cancer, win the space race, or solve world hunger. Instead, Steve Russell, a Dartmouth graduate working at MIT's Research Laboratory of Electronics,³ and others used it to create the first interactive computer game. By 1962, the link between computers and games was established, and game development was tied to computing power from that point forward.

In an interview with *Rolling Stone* magazine, Russell recalls those days. "We had this brand new PDP-1. It was the first minicomputer, ridiculously inexpensive for its time.⁴ And it was just sitting there. It had a console typewriter that worked right, which was rare, and a paper tape reader and a cathode ray tube display. Here was this display that could do all sorts of good things! We started talking about it . . . we decided that probably you could make a two-dimensional maneuvering sort of thing, and decided that, naturally, the obvious thing to do was spaceships."⁵

Spacewar!, a simple black-and-white game in which two spaceships move about the screen and shoot at each other, took off among the university geeks who had access to this type of computer. The standard PDP-1 on which **Spacewar!** was played came with four kilobytes, with 18 bits per byte. Compare that to the kind of computer required to play today's **World of Warcraft**—an 800 MHz Intel III processor, 256 MB of memory, and 4 gigabytes of disk space.⁶ **Spacewar!** was also used as a

method for testing glitches in new PDP-1s—whoever bought the computer automatically got the game. Improvements to the game were made very quickly since the code was open source; hyperspace and gravity, for example, were introduced within a month. *Analog* magazine noted that students working on **Spacewar!** "were learning computer theory faster and more painlessly than before . . . and a background of real-time interactive programming was being built up."⁷ But **Spacewar!** still resided on large mainframe

computers used in academia and business and way out of the reach of the general public.

Enter the microprocessor.⁸ Invented by Marcian E. Hoff of Intel Corporation in 1971, it quickly became a general-purpose technology. This tiny "computer on a chip" integrated computing processes in one place and could be programmed like a regular computer. This small chip aided the quick development of personal computers, video games, and other electronic machines such as calculators.

New lines of game development—arcade games, consoles, and computer games—sprang up immediately. (The first Internet game would arrive much later.) Using the new microprocessor technology,⁹ Atari's founder Nolan Bushnell translated **Spacewar!** into a smaller device containing electronic circuitry that, along with a monitor and control panel, he set into a tall, floor-standing plastic cabinet. This game was called **Computer Space**. Its profits went into developing and marketing the wildly popular **PONG**, which came with an instruction card reading simply: "Avoid missing ball for high score."¹⁰

MMORPG
stands for
**Massively Multiplayer
Online Role Playing Game,**
an interactive game in
which thousands of people
are online playing in
real time.

Meanwhile, coin-operated arcade games were picking up where pinball machines left off. The object of the games was generally straightforward, such as “eat” as many dots as possible before being eaten oneself. Most had simple two-dimensional graphics and cultivated the player’s speed, manual dexterity, and strategizing techniques for getting special bonus points. One of Atari’s lasting innovations (beginning with **Asteroids**) was to let players put their initials next to their scores. This encouraged competitiveness among arcade gamers,¹¹ although they did not need to play face-to-face to square off.

Arcade games found their way into a variety of settings during their heyday in the 1980s. Someone joked that the only place where they couldn’t be found was in funeral parlors. **Space Invaders**, one of the premier arcade games of the 1980s, was so popular in Japan that it caused a shortage of 100-yen coins. **Pac-Man** was a hugely successful game and became a merchandising phenomenon with the recognizable “dot” proliferating on T-shirts, lunchboxes, and other products. *Time* magazine reported that in the United States, an estimated 20 billion quarters were spent playing arcade games in 1981.¹² Debates raged in various parts of the country over the destructive influence of games on youth. Oakland, California’s City Council even went so far as to ban minors from playing arcade games during school hours. Other towns and cities connected gaming and truancy and sought to enact “protective” laws.

Beginning with **PONG**, the most popular arcade games were successful moneymakers for the store, bar, fast food eatery,¹³ or mall in which they were located. A **PONG** machine cost \$400 to manufacture, sold for \$1,200, and brought in an average of \$200 per week. In six weeks, it paid for itself. Popular pinball games of the time brought in just \$50 per week. As home consoles increased their market share, the decline of arcade games began.

While still played today, their total share of the gaming market is significantly lower than at the height of their popularity in the early 1980s.

Odyssey and Home Video Games

Home video games, another line of gaming, started in 1966 when Ralph H. Baer, an engineer working for Sanders Associates, Inc. (a defense contractor specializing in airborne radar countermeasure and antisubmarine warfare electronics),¹⁴ came up with the idea of hooking up a machine to a commonplace television receiver. He realized that over 90 percent of American homes had televisions by the late 1960s and that those televisions “weren’t busy all the time.”¹⁵ In 1972 Magnavox licensed Baer’s invention, calling it **Odyssey**, and created the home video game market with a ping-pong game. Ralph Baer holds the first patent for home video game consoles, dated 1973, and is often referred to as the father or, most recently, the “godfather” of video games.¹⁶

Home video game consoles developed rapidly. The earliest had one or more games hardwired into them and could play those games only. The company Fairchild Camera and Instrument came up with a design called the Channel F that ran on preprogrammed interchangeable cartridges—an innovation. As J.C. Herz describes in *Joystick Nation*, “Suddenly software and hardware were two separate enterprises. And once the games themselves were separate from the machines on which they were played, consoles were no longer the big, expensive, disposable razors. They were big, expensive razors with disposable blades.”¹⁷

Atari was quick to see the potential of home consoles and developed the **Stella**, the prototype for their 2600 VCS (video computer system), released in 1977. The **Stella** had 128 bytes

of internal RAM (random access memory¹⁸), with a MOS 6507 processor running at 1 MHz. The games could be no larger than 4K.¹⁹ Compare this to today's Sony PlayStation 3 with a processor speed of 3.2 GHz and 25.6 GB of RAM. Atari, by then owned by Warner Communications, launched its entry into the console market by licensing **Space Invaders** from the Japanese manufacturer Taito. This was the first instance of a home game that was based on an arcade game. **Space Invaders** became a double runaway hit, both as an arcade game and as the catalyst to Atari's record-holding 14-year production run as one of the most popular consoles of all time. Sony's comparable console, the PlayStation, was produced for 11 years and sold over 100 million units—finally going out of production just last year in 2006.²⁰

The development of optical disks presented yet another technological breakthrough for game creation and production. CD-ROMs (optical disks) have an enormous amount of space and have become much cheaper to produce than cartridges. CDs opened the door for incorporating music and sound into games. Cartridges simply had not had the space to hold large sound files. CD-ROMs changed that and added a new subset to gaming employment—musicians, composers, and technicians. At first the major drawback to using optical disks was cost, but costs quickly came down. Gaming consoles are powerful machines, and it is estimated that 40 percent of American households now own one type of gaming device: a console, a PC, or a handheld.

**"Avoid
missing ball for
high score."

This is the only
instruction that comes
with the game PONG.**

Computer Games

Spacewar! initiated the computer line of gaming. A further development came in 1975 when Will Crowther used his own experience exploring caves to create the text-based computer game called **Colossal Cave Adventure**, later known as **Adventure**. He did this work while at Bolt, Beranek, and Newman (BB&N) on a business computer, the DEC PDP-10, in the computer language called FORTRAN. A year later Don Woods from the Stanford Artificial Intelligence Laboratory (SAIL) modified the game by adding fantastical elements.²¹ George Fifield states that, "**Adventure** is a vitally important step in the history of gaming. Not more important than **Spacewar!** but certainly as important."²² **Adventure**, according to Fifield, had the first "actor," a character that could act independently of the player, a world that remained as the player left it, and a primitive artificial intelligence structure. It was the precursor to the game **Zork**.

Video Games like **Adventure** and **Spacewar!** were played by relatively few people until computers got small enough and inexpensive enough to expand the circle of users. It took even longer for an individual "generalist" to perceive the need to possess his own. In the late 1970s and early 1980s, the reality of a "personal computer" began to take hold with the advent of the Altair 8800, the Apple I and II, and the Commodore 64. Steve Wozniak, co-founder of Apple Computer and a former employee of Atari, noted, "A lot of features of the Apple II went in because I had designed **Breakout** for Atari . . . the features that really made the Apple II stand out in

its day came from a game . . .”²³ **Adventure** was ported to the PC and the popular text-based game **Zork** was modified for the Apple II. Text-based games began losing ground as graphics and colors became more sophisticated.

MMORPGs and the Internet

The Internet opened the door to today’s MMORPGs. High-speed broadband was a technological advance critical to the growth of these games. The first game of any consequence to spread via the Internet was **Doom** in 1993. An estimated 15 million people worldwide downloaded the free version. In *Joystick Nation*, J.C. Herz wrote, “**Doom** was a watershed event on a par with the Atari 2600 because it changed the way video games circulate and reproduce . . . **Doom** gave video games a way to proliferate in cyberspace . . . Down the line, you can see a point where video games will be sold in electronic form and jettison their bodies entirely. **Doom** points the way.”

Arcade games were primarily one-person games. Consoles, in contrast, were constructed for two and ultimately eight players. **Odyssey’s** marketing campaign was largely directed to families to encourage group play. Today MMORPGs are limited only by the game designer and server space. **Second Life** routinely has over 30,000 people playing at one time. This number is dwarfed by the several hundreds of thousands of people playing **WoW** in China,²⁴ mainly at Internet cafes.

A recent public talk on the IBM web site on gaming says:

*“If it all sounds both confusing and exciting, just wait—the line between carbon-based people and digital environments will only become more porous as technology, our understanding, and the possibilities for innovation grow.”*²⁵

Games are here to stay, but, as technology advances, their form is ever dynamic. The wires become wireless, and the devices we play them on morph, as computing power increases and platforms shrink. As one set of games becomes obsolete, a new set moves in to take its place, and the features become more advanced. Some, like **Zelda** and **Mario**, remain favorites decades later and are updated for new technologies. Two dimensions have become three or more; black and white has changed to vivid color; sounds and music and advanced animation and graphics are now the standard. Although we do not see the true identity of our opponents, we compete against them, and always against ourselves, as we work to master increasingly complex sets of rules and scenarios. As games continue to evolve and change, they still retain the power to engage, sometimes to educate, and always to entertain, connecting and reconnecting us with ourselves and one another, in seemingly infinite variation.



Image Credits

- Space Invader head courtesy of Taito Corporation, copyright 1978.
- 3-D head courtesy of The Guildhall at Southern Methodist University (SMU), 2007.

Endnotes

¹While some credit Willy Higinbotham at Brookhaven National Labs with the first “video game” (tennis for two on an oscilloscope), **Spacewar!** is generally thought to be the first interactive game. http://www.mitadmissions.org/topics/pulse/mit_inventions_breakthroughs.

²Ralph H. Baer holds the first videogame patent, issued in April 1973, establishing “commercial viability,” which **Spacewar!** did not have. See Ralph H. Baer, *Videogames in the Beginning* (Springfield, NJ: Rolenta Press, 2005), 198, or www.ralphbaer.com.

³E-mail communication from Steve Russell, dated 1/05/07.

⁴Remington Rand sold 46 UNIVAC computers in the 1950s for \$1 million each. In 1954 the IBM 650 cost \$500,000. See http://en.wikipedia.org/wiki/History_of_computing_hardware.

⁵See http://www.wheels.org/Spacewar!/stone/rolling_stone.html.

⁶*The Medium of the Video Game*, ed. Mark J.P. Wolf (Austin, Texas: University of Texas Press, 2001), 23. According to Wikipedia.com, “A bit is a binary digit, taking a value of either 0 or 1. For example, the number 10010111 is 8 bits long, or in most cases, one *modern* PC byte. Binary digits are a basic unit of information storage and communication in digital computing and digital information theory.” The standard definition is 1 kilobit (kb) = 103 bit = 1,000 bits. One megabit (Mb) = 106 bits = 1,000,000 bits = 125,000 bytes = 125 kilobytes (Kb). One gigabit (Gb) = 109 bits = 1,000,000,000 bits = 125 megabytes (MB).

⁷Albert Kuhfeld, *Analog* magazine, Volume LXXXVII No. 5, July, 1971.

⁸A microprocessor is a general-purpose electronic calculation, comparison, and storage device capable of high speed and inexpensive manufacture. Most important, its operation can be changed by programming, the process of providing ordered instructions and data to perform tasks. Singly or in groups, microprocessors can be programmed to perform or direct the performance of virtually any type of human labor. See Dennis Báthory Kitz, *The Impact of the Microprocessor or, Is 1984 Here Two Years Early?* Talk presented before the Rensselaer ACM in 1982. <http://maltedmedia.com/books/papers/s2-reuss.html>

⁹*The Medium of the Video Game*, ed. Mark J.P. Wolf (Austin, Texas: University of Texas Press, 2001), 29. The first microprocessor, the 4004, developed by Marcian E. Hoff for Intel, was released in 1971. It contains the equivalent of 2,300 transistors and was a 4-bit processor. It is capable of around 60,000 instructions per second (0.06 MIPS), running at a maximum clock speed of 740 kHz. Further, Intel’s online archives say, “This revolutionary microprocessor, measuring 1/8th by 1/6th of an inch—the size of a fingernail—delivered

the same computing power as the first electronic computer, the ENIAC, built in 1946, which filled an entire room and used 18,000 vacuum tubes.” <http://www.intel.com/museum/archives/4004facts.htm>

¹⁰Steven L. Kent, *The Ultimate History of Video Games* (Roseville, Calif.: Prima, 2001), 42.

¹¹Wikipedia; http://en.wikipedia.org/wiki/Asteroids_%28game%29.

¹²Kent, *The Ultimate History*, 152.

¹³Nolan Bushnell took the Chuck E. Cheese portion of Atari when he left and installed arcade games for people to play while they waited for a meal.

¹⁴Baer, *Videogames in the Beginning*, 18.

¹⁵See <http://www.tvhistory.tv/History%20of%20TV.htm>.

¹⁶James Sullivan, “The Godfather of Games,” *Boston Globe Magazine*, February 11, 2007, 27.

¹⁷J.C. Herz, *Joystick Nation* (Boston: Little, Brown, and Co., 1997), 36.

¹⁸According to Wikipedia, random access memory (usually known by its acronym RAM) is a type of data storage in computers. It takes the form of integrated circuits that allow the stored data to be accessed in any order — that is, at random and without the physical movement of the storage medium or a physical reading head.

¹⁹Van Burnham, *Supercade: A Visual History of the Videogame Age 1971-1984* (Cambridge, Mass.: MIT Press, 2001), 148.

²⁰See <http://www.gamespot.com/news/6146549.html>.

²¹See http://en.wikipedia.org/wiki/Adventure_game.

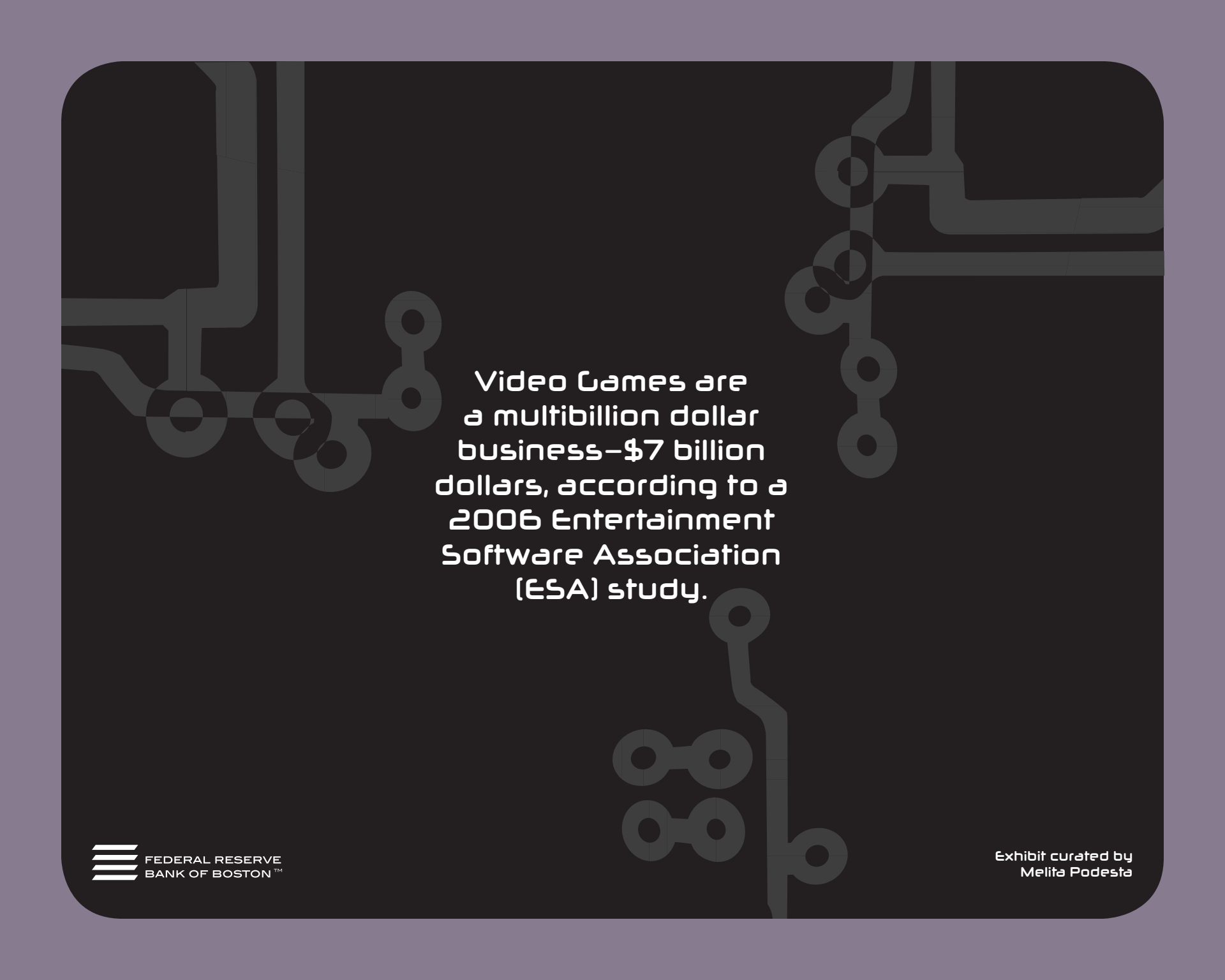
²²E-mail communication from George Fifield, director of BostonCyberarts Festival, dated 6/1/2007.

²³Van Burnham, *Supercade*, 156.

²⁴See <http://news.bbc.co.uk/1/hi/technology/4124530.stm>.

²⁵See <http://www.ibm.com/ibm/ideasfromibm/us/avatars/112706/index.html>.

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