Rise of the *faux* pixels

Erasures and extensions of the pixel concept in video game history

Carl Therrien
Université de Montréal
carl.therrien@umontreal.ca

ABSTRACT

Many different display technologies have been used throughout the history of video games, each providing specific visual qualities. This article presents the proliferation of visual elements identified as "pixels" in retro-inspired video games and beyond. These visual blocks are defined as *faux* pixels, since they are disconnected from the original material constraints and extend into many visual directions, from 2D and 3D blocks to the emulation of analog display technologies. The origins of various pixel styles are presented in relation with the rise of nostalgia in the community and concerns about historical authenticity. The resurgence of analog aesthetics is discussed in light of similar phenomena occurring in other visual media.

Keywords

pixel concept, pixel art, nostalgia, retrogaming, video game history, analog game studies

INTRODUCTION

On July 17, 1995, Alvy Ray Smith presented a famous technical demo at Microsoft. The title of this presentation repeated a central point three times: "A Pixel is *Not* a Little Square!"; "we cannot think of a pixel as a square—or anything other than a point. There are cases where the *contributions* to a pixel can be modeled, in a low-order way, by a little square, but not ever the pixel itself" (Smith, 1995; original emphasis). More recently, Smith contributed to this edification of the pixel as a major character in contemporary culture: *A Biography of the Pixel* (2021) presents an overview of this core component in the creation of "Digital Light," from its mathematical inception to its industrial takeover of the animation sector. The Pixar cofounder insists: the conflation of pixels with little squares "is perhaps the most widespread misunderstanding of the nascent digital age. The word *pixelation* has even institutionalized the misconception" (2021, p. 51, original emphasis).

In *Super Life of Pixel* (Super Icon Limited, 2018), a video game that proposes to take us on a historical journey of the medium, players are invited to embody the famous character, defined visually across video game platforms and technologies as a little square. In 2024, Billy Basso released *Animal Well*, a retro-inspired, low color / low resolution metroidvania full of wonderful pixelated creatures (see Figure 1). In this

Proceedings of DiGRA 2026

well, square pixel points are smoothed through shaders that evoke the analog aesthetic effects of an older imaging technology: cathode ray tubes. These emulated analog pixels are used to build the ultimate natural shrine housing all the amazing virtual animals created by Basso.

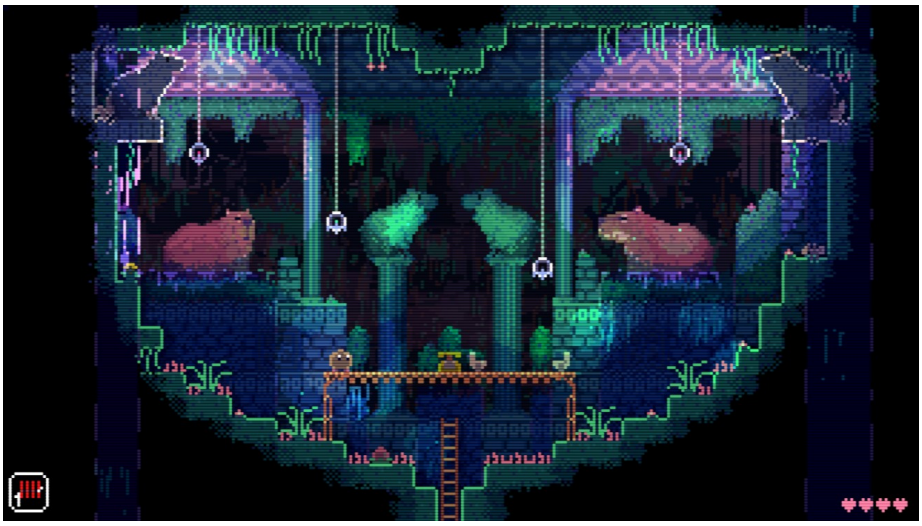

Figure 1: *Animal Well* (Shared Memory / Billy Basso, 2024).
Source: animalwell.net

In this article, we will document the evolving portrait of this fundamental picture element and emphasize how it morphed into a polysemic visual concept, spreading wildly in video game culture and beyond. We will explore a technical paradox that becomes even more apparent as our monitors, TV sets and projector screens grow ever wider and "high resolution": even though we now have access to hardware that make it possible to erase picture components completely, oversized "pixels" and other technological artefacts understood through the same concept continue to proliferate on these screens. After a frantic race towards the remediation of movie images in video games of the 1990s, followed by the development of photorealistic computer-generated visual simulations now reaching its apex, the attraction of this pixelated retro remediation attests to the importance of nostalgia in contemporary video game culture. At the same time, as Brett Camper pointed out in "Fake Bit: Imitation and Limitation" (2009), retro aesthetics as they play out on modern platforms are inherently disconnected from the original material restrictions leading to pixelated outputs on classic platforms from the good old days.

Through an inspection of the evolving nature of pixels as they are understood colloquially, this article will expose the shaky nature of the concept made manifest in our nostalgic revival efforts. At the core of this overview, we will expose the ongoing hesitation between the fuzzy analog and streamlined digital visions of the "little square." Ultimately, the goal of this paper is not to provide all the proper technical information about the various material configurations involved in the production of pixels over time, but rather to investigate how pixels have disconnected and continue to evolve beyond technical and material definitions in visual culture. Expanding on previous contributions on nostalgia and pixel art, we will study a pivotal moment when pixels became an object of fascination in video game history, and the multiple expansions of the concept in recent years.

ACADEMIC CONTEXT

The publication of Svetlana Boym's classic *The Future of Nostalgia* in 2001 has fueled a wave of interest for nostalgic affects over the last twenty years, in a great variety of media disciplines – from sound to film and video games. The topic has been covered extensively in game studies (Suominen, 2008; Whalen and Taylor, 2008; Garda, 2013; Fassone, 2014; Gazzard, 2016; Goetz, 2018; Belli and López Raventós, 2019; Bowman et al., 2023; Srirachanikorn, 2024; Navarro-Remesal and Pérez Zapata, 2025). In spite of its origins as a pathological term, evoking an intense longing for a lost time or home, nostalgia is commonly associated with positive affects and social experiences in contemporary culture (Wulf et al., 2018). As Domini Gee (2019) points out in his study of *Mega Man 9* (Capcom, 2008), a revival of the classic NES formula on modern consoles, retro-inspired titles need to convey part of the original experience in a way that still feels good to contemporary audiences, aiming for authenticity for some aspects, but letting go of other elements in the remix process.

Media and their specific technological components often play a major part in the lived experience of nostalgic affects; through this technostalgia, "media technologies not only construct and mediate memories but have also become the objects of memory themselves" (van der Heijden, 2015, p. 115). Just like any other memory, technological souvenirs reflect the intensity of the lived experience by focusing on specific elements. The so-called "analog revival" – from Moog synthesizers to film stock and board games – often overemphasize the material quirks of technology, going so far as to foreground material traces of decay or defects such as glitches or scratches. These elements confer a sense of authenticity to our nostalgic adventures, yet as Erika Balsom (2018) points out about the analog film revival movement, this notion of authenticity is deeply ambivalent.

The quest for authenticity is central to the ethos of the indie game movement, leading to the paradoxical notion of handcrafted pixels (Juul, 2019). Few elements can communicate the good nostalgic vibes of retrogaming as efficiently as the pixel style. At the same time, these pixels are far removed from the original material manifestations of these picture elements on our CRT screens, and from many other technological constraints that determined the production or appearance of these elements. In *Animal Well* and many other titles, visual artists refine digital algorithmic illusions that seek to bring back the vintage analog pixel feel. The rise of *faux* pixels presented in this article explores the history of a material disconnection: as pixels proliferate in our visual cultures, becoming a sort of fundamental brick to construct retro-inspired digital worlds, they have grown ever more detached from their original material conditions.

This article contributes to ongoing discussions about nostalgia and the paradoxical quest for authenticity by shedding light on visual lineages associated with the pixel concept. We will first present the context of the mid 1990s in order to reveal technological evolutions that sought to make pixels less visible on our screens, and how conceptual expansions of the pixel already emerged in parallel. A second section will show that video games were largely affected by nostalgia at that time, fuelling a wave of anniversary editions, retro collections and remakes. In the third section, we will dive into the paradox of analog pixel digital recreation, while the fourth section will introduce extensions of *faux* pixels in 2D and 3D games. The

discussion section will articulate these findings with other recent contributions on retro aesthetics.

TECHNOLOGICAL SPLENDOURS OF THE 1990S: HIGH RESOLUTION, MACROBLOCKS AND LOW POLY

At the turn of the 1990s, in a relatively short period of time, several video game studios managed to integrate digitized images and film sequences into video games. Important technological upgrades were essential to successfully carry out this remediation project: along with the increase of data space (memory expansions, wide adoption of the CD-ROM format), dedicated graphical cards expanding the IBM VGA standard could address a pixel grid of 640 x 480 or more. For computer enthusiasts growing up in the 1980s, screen resolution was the most common indicator referring to the amount of pixels displayed by a video game system, marking the forward march of the medium.[1] Thanks to higher screen resolutions on a typical 14-inch display, along with the development of larger color palettes and antialiasing techniques, video games were able to integrate digitized pictures more seamlessly. Pixels receded behind the illusions. Figure 2 highlights how the relatively low resolution of 640x480, along with 256 on-screen colors taken from an 18-bit palette, could effectively remediate airbrush paintings by famous artist H. R. Giger.

Figure 2. *Darkseed II* (Cyberdreams, 1995).
Source: myabandonware.com

While static backgrounds on high-end PCs could hide their pixelated output in the mid-1990s, restrictions in the algorithmic representation of movement during the same period made the concept of pixel "bleed" onto parallel technological constraints. The remediation of cinematic illusions carried along the ideal of transparency, yet the technical elements of these illusions were anything but invisible. Despite a relatively fast upgrade of hardware components in personal

computers, important compromises had to be implemented to bring fully animated images to our video screens.[2] For example, the different versions of the MPEG compression algorithms developed at the time encoded relatively large "blocks" (8 x 8 or 16 x 16 chroma / luma units). This process made it possible to encode changes between frames algorithmically, thus simulating motion while saving storage space. In MPEG-1 (used for the short-lived Video CD format) and MPEG-2 (the norm for DVDs), macroblocks could become visible thanks to data compression or media corruption; the visual output spontaneously became described as a form of pixelation (see for instance Rule, 2024).[3]

In parallel with these technological developments, the growing popularity of 3D video games at the time led consumers to upgrade their CPUs or buy a new game console with components dedicated to the calculation of a “building brick” carrying a heavy processing load: the polygon. The accumulation of these shapes and their real-time manipulation in response to player input required a significant increase in processing power. 3D engines opened up design possibilities that could not be achieved easily through data-intensive digitized filmed images. In the late 1990s, just as video games were starting to integrate movie images a little better, 3D games won the favor of the audience in spite of their blocky output. In terms of surface realism, early 3D games were less appealing at first glance than 2D graphics. Still, the malleability of polygonal images allowed for the integration of an aspect of cinematism, one of the central concepts defined by Thomas Lamarre (2009) in his study of animated cinema: gameplay could evolve in any visual direction, freed from the inherent constraints of 2D worlds.

In the increasingly popular context of 3D gaming, blocky picture elements became incredibly visible, yet undesirable. On the most capable platforms of the mid-1990s, (such as the 3DO, the Saturn, the PlayStation or a decent multimedia PC), simple polygonal shapes could be texture-mapped, providing surface detail to these abstract worlds. In a texture, a 2D image is broken down into small units (texels) stored in memory, and applied over geometry (with or without compression techniques and shading effects).[4] Unless the program explicitly restricted perspective or navigation, players could navigate close to any “pixelated” structure or character. Texture elements were blown up in a blocky, linear fashion, creating a pixelation effect beyond the actual screen resolution of the display. “Pixel” here does not refer to a minimal picture element in a display technology, but to the blocky appearance of a 2D image caused by low level of information encoded in most textures at the time.

A pixelated output emerging from low screen resolution, FMV compression or texture-mapping were commonly perceived as a shortcoming in the 1990s. Nowadays, in a not-so-surprising ironical twist, both MPEG macroblocks and low poly aesthetics have benefited from various forms of cultural redemption. For instance, the former has been featured as a “wow” moment in Blood Orange’s music video for *Champagne Coast* (see Figure 3), in which baroque domestic spaces appear to be created through digitization of analog photographic printouts plastered on simple geometric shapes – a clear throwback to early 3D adventure video games such as *Under a Killing Moon* (Access, 1994). The latter (low poly aesthetics) can now be called a full-fledged technostalgic hipster trend, thanks to ongoing X threads such as “Low Poly Animals” (see Zwiezen, 2021).[5]

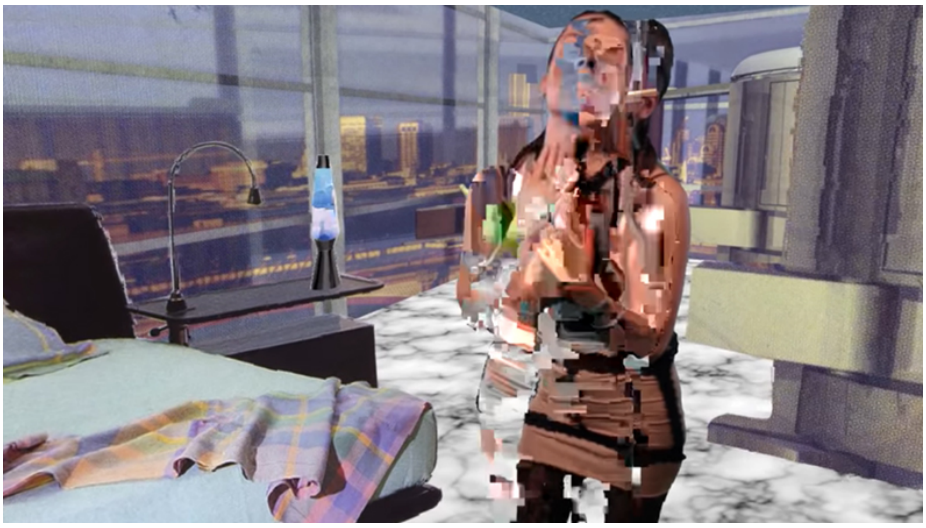

Figure 3. Pixelated video output in the *Champagne Coast* music video by Blood Orange (2012). Source: Devonté Hynes YouTube channel

TECH/NOSTALGIA IN VIDEO GAMES

In parallel with cinema envy associated with the technological developments briefly introduced in the previous section, one cannot help but notice a strong nostalgia for classic movies occurring in the same timeframe. This affection is manifest in Cinemaware's abundant production in the 1980s, which draws obvious, almost parodic inspiration from science-fiction, gangster or monster films from another era.[6] The classic hard-boiled film noir and its SF variation (tech-noir) are the main influences of for the aforementioned *Under a Killing Moon*, part of the Tex Murphy series of FMV games created by Chris Jones.

During the same period, video game creators also revisit their medium's own precursors. Thematic levels built from early childhood toys – playing cards, dominoes, stuffed animals, building blocks, miniature vehicles, etc. – proliferate within the most popular genres such as platformers and shoot 'em ups (for instance: *James Pond 2: Codename: RoboCod*, Millenium, 1991, see Figure 4; *Toy Shop Boys*, Victor Musical Industries, 1990; *Harlequin*, The Warp Factory, 1992; *Star Parodier*, Kaneko/Hudson, 1992). *Super Mario Bros. 3* (Nintendo, 1988) is presented as a "play"; the rise of a stage curtain on the title screen opens to a world built with cardboard, blocks, nuts and bolts.

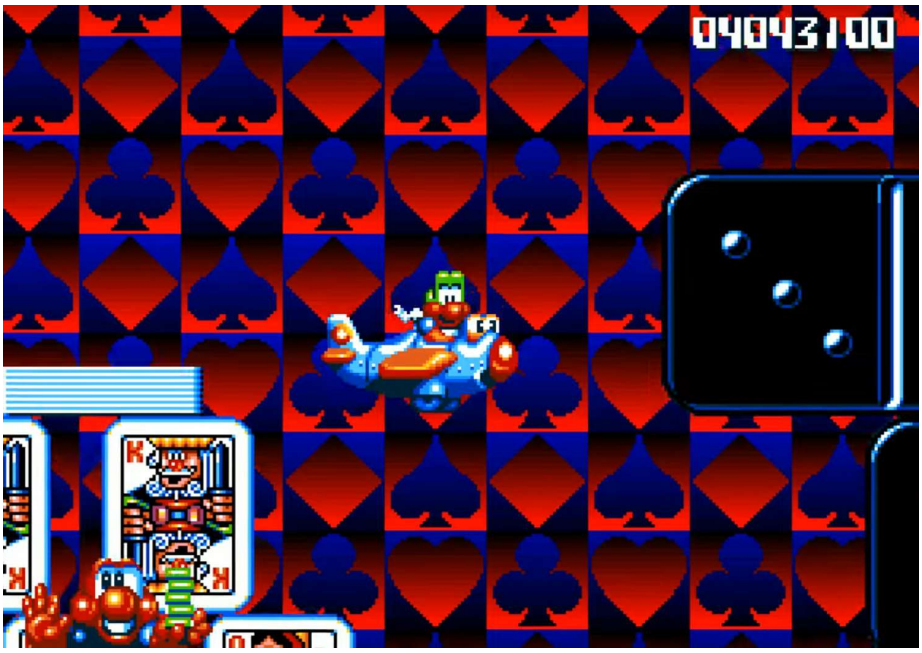

Figure 4. *James Pond 2: Codename: RoboCod* (Vectordean, 1991)
Source: AL82 Retrogaming Longplays YouTube channel

When does video game nostalgia for its own technological past emerge? Juul has demonstrated the rise to fame and excesses of the pixel style in the context of the Independent Games Festival from 1998 onwards (2014; 2019). According to a cover story on the re-emergence of pixel aesthetics in *JV - Culture jeu vidéo* (#57), the pixel was missed as soon as it was "erased" through higher screen resolutions in the mid-1990s. Indeed, in his review of the third *Monkey Island* game published in 1997 by LucasArts, reviewer Seb from *Joystick* magazine expresses his disappointment as he discusses the relative invisibility of pixels (Tastet and François, 2018, p. 35). Around that time, in a small town in Québec, a punk indie developer creates games that look like Atari VCS titles. When asked about his process, I-Grec told us that he wanted to value the beauty of low tech pixel art and push back against the rise of FMV games (Lessard and Therrien, 2021).

Perhaps the appreciation for overblown pixels surfaced even prior to their erasure, for instance in the early waves of retrogaming? Jaakko Suominen, Markku Reunanen and Sami Remes have studied the emergence of nostalgia in the Finnish specialized video game press. According to the authors, the practice became visible already in the late 1980s, for instance through the release of classic arcade game ports. The advent of emulators on popular computers such as the Commodore Amiga or Atari ST also provided "possibilities for nostalgic experiences," in spite of non-optimal performances (Suominen et al., 2015). Freeware or shareware remakes were circulated through the BBS networks, but according to the authors, these remakes were not created in a spirit of nostalgia: "Enthusiast programmers were like art students practicing their skills by copying old masterpieces with a reverse engineering mindset" (*ibid.*) In Finnish magazines, the first explicit wave of retrogaming became visible in 1997, with several mentions in *MikroBitti* and *Pelit* (2015). As the authors note, following J. C. Herz's account in *Joystick Nation*, "retromania" was also sweeping the United States at the same time.

According to the special feature "Revival of the fittest," published in *Edge* magazine #15, retrogaming emerged over the course of 1994. From this point onwards, the "Retroviews" section would become commonplace in the famous British magazine. Jeff Minter's *Tempest 2000* (a remake of the Atari game first released in 1979) holds a central place in the article (Edge editorial team, 1994). Paradoxically, Minter's remake became the "killer app" for Atari's new console, the Jaguar. This strange case of selling new hardware through a classic game highlights how nostalgia was spreading in the community at the time.[7] This coincides with the proliferation of anniversary editions and corporate collections, for instance the *Namco Museum* series on the PlayStation from 1995 onwards. Many of these titles offer visual improvements to the original or the ability to switch between the two versions, a feature that was already integrated in Meldac's port of *Heiyanko Alien* on the Game Boy (Live Planning, 1990).[8] But most interestingly for this study of pixel aesthetics, many of these remakes should in fact be considered "demakes" in terms of screen resolution. Along with the Minter Jaguar port of *Tempest*, the Game Boy port of *Battlezone* (in the Arcade classics collection, 1996; see Figure 5) features more evident aliasing – visible "staircase" pixelated artefacts on oblique lines – on its wireframe shapes than their original arcade cabinets, which used a high resolution vector display.

Figure 5. *Arcade Classics: Battlezone* (Black Pearl, 1996; original by Atari, 1980)
Source: MobyGames

THE ANALOG PARADOX

Nostalgic revival trends often emphasize the concept of "analog" to promote a variety of retro-inspired products. In game culture, "analog" now commonly refers to the broad category of non-digital games. In particular, there is a renewed interest in board games, with a strong academic development.[9] Definitions of the term from

Merriam-Webster highlights the contemporary expansion of the concept, potentially referring to “an analog computer” but also meaning “not digital: not computerized” at the same time (Merriam-Webster, 2026). Jonathan Sterne (2016) points out the difficulties of this expansion: not only does it obfuscate the fact that “analog” also referred to specific computer systems, it encompasses the rest of the world under the category “analog,” including technologies and practices that were never conceived within this category. In the world of games, it redefines many ludic instruments, paradoxically emphasising the strength of its opposite “digital” as the reference category. Sterne “cannot imagine a more hyperbolic way of figuring digital technologies,” (2016, p. 32) pointing towards the negative consequences of digital boosterism.[10] He also highlights the risk of creating a historical fracture between technologies that emerged before and after the advent of digital computers (ibid.) In the context of this article, this understanding of “analog” also obfuscates a significant element: during the first three decades of the medium’s commercial history, the analog aspects of the cathode ray tube technology largely co-defined video game pixel aesthetics.

Electronic analog devices process or output signals that can be modulated incrementally, while digital components process information transcoded into a binary metalanguage (Manovich, 2001). Smith’s overview of analog and digital from a mathematical perspective echo this distinction, and the author insists that digitization of an analog source can be lossless under specific conditions (2021, p. 41). It appears more natural to relate the notion of analog to capture-based media (such as celluloid and vinyl); in order to create an analogue of reality, the inscription process of these technologies rely on the principle of continuous variations through direct contact with the source. This indexical nature opened up media to the contingencies of the capture process, leading to the perceptible quirks evoked earlier, and manipulating the physical media typically created additional damage and “defects” over time. Much like pixels disappearing through high resolution displays, digital technology promised to make all these traces invisible, opening up a transparent window into imaginary worlds. Yet the retro revival crazes for analog media seek to bring back the warmth and proximity of the original material contact, including our beloved cathode ray tubes.

CRT technology gave video game pixels some of their most remarkable characteristics, which are being emulated today in titles such as *Animal Well*. It would be a daunting task to attempt any sort of rigorous description of a cathode ray tube in the context of this article.[11] In order to make pixels dance on the screen, a CRT monitor uses the variations of an analog signal received over the air or through a connector. Video game platforms modulate this signal to reflect the “live” performance of players in the various interactive scenes designed by game makers. In color television, three electron rays are directed line by line, with varying intensity, hitting three types of phosphors (corresponding to the three primary additive colors) on the internal surface of the screen. Screen masks focus the light on phosphor arrays to avoid excessive light bleeding.[12]

From the early arcade machines to the mid-1990s, manipulation of the beam through expertly crafted code would be perfected in order to create special effects taking advantage of analog CRT features. Programming tricks relying on the downwards race of the beam were used, for instance, to change color values or scrolling speed at specific points on the screen (Montfort and Bogost, 2009).[13] These programmer skills created opportunities to extend color palettes or create parallax

scrolling effects on platforms that had no hardware affordances to do so (see Figure 4 above for intricate rainbow effects on the Amiga). Beyond the obvious graphical benefits, one could argue these analog affordances contributed to the gameplay experience in many genres, for instance the platformer, where parallax scrolling and colorful backdrops could impact the visual challenges in a significant manner.

On Twitter around 2015, a series of publications emphasizing the impressive gap between contemporary "pixel style" and its CRT point of origin went viral (see Figure 6). J. Kyle Pittman has produced a complex CRT simulator to add the analog pixel feel to his own games (such as *Super Win the Game*).[14] The software attempts to reproduce a wide range of aesthetic effects associated with CRT technology, from screen curvature to the residual light ghosting and color bleeding that would surface through composited signals. In a detailed blogpost, Pittman summarized some of the specific aspects and challenges of simulating NES artefacts (2015). Remarkably, the simulator includes many adjustable parameters in order to reflect some of the CRT variations. Through these parameters, it is effectively possible to overemphasize the analog effects. This is clearly visible on recent retro remakes, which are commonly played on an emulator and LCD screen (for instance, a capture of the emulated *Gyrus* remake on the Amiga; see Figure 7).

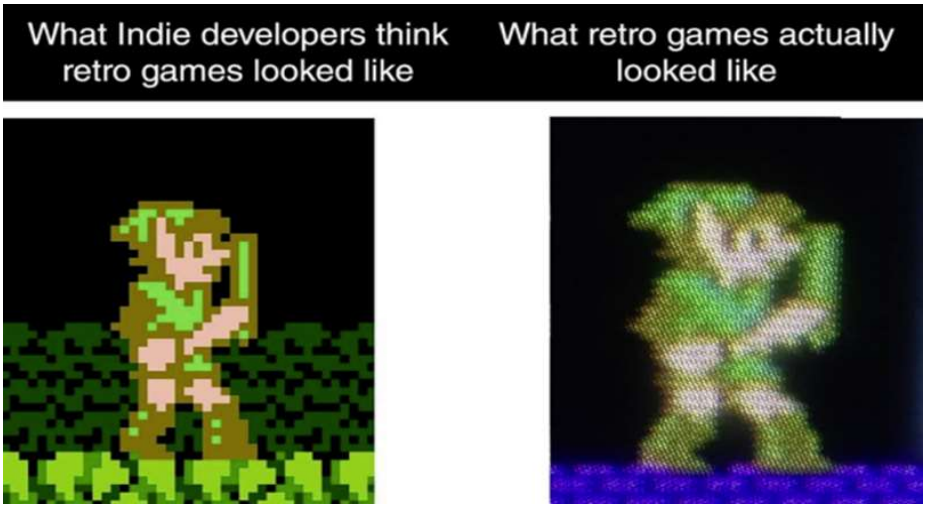

Figure 6.
Source: Pittman (2015)

Figure 7. *Gyrus* (Konami, 1983; Amiga port: jotd666, 2025)
Source: Just Jamie Retro Realm YouTube channel

Along with the worlds of cinema and childhood toys, analog TV nostalgia was also used to craft ludic worlds. In *Harlequin* and its "TV Wonderland" level, television sets and over-the-air antennas literally become the platforms that the protagonist must navigate (see Figure 8). Interestingly, the original game already featured a simulated CRT curvature (the small rounded effect added to each corner of the playing field), even though it was always meant to be running on a CRT monitor back in the day. In this setting, the TV set, like so many other media and playthings, was already starting to become a literal building block, much like the other *faux* pixels we will to introduce in the next section of this article.

Figure 8. *Harlequin* (The Warp Factory/Gremlin, 1992)
Source: author screenshot (WinUAE emulator)

EXTENSIONS OF THE *FAUX* PIXEL

The rise of the independent scene, as Jesper Juul has documented extensively, was associated with a specific work ethos; “Like the Arts and Crafts movement, this notion of independent games can therefore be said to embody a certain nostalgic or anti-industrial attitude” (2014). Juul defines the pixel style as a primordial visual signature of the scene, emphasizing its handmade aspect. To call this creative process “handmade” is already a stretch – all digital games are made by hand in a way, yet none imply direct handling of the gameworld elements – but the metaphor is easy to understand: compared to the process of creating a big budget 3D game, an indie graphic designer can maintain better control over the little bricks to shape the visual world and its style on the screen. In this section, we present how the creative process detached from underlying material restrictions, and connected us back to one of the elemental childhood toys: building blocks.

As Juul notes when he defines the pixel style, “these pixels are enlarged, giving the appearance of a lower resolution than what is afforded by the platform the game is running on.” (2014) In the early years of the scene, supersized pixels were distinctive, a marker of retro-savviness and authenticity. On the contemporary platforms where the pixel style took hold, “pixels” were not necessarily related to the screen modes and limitations of specific hardware components, nor the picture elements of the imaging technologies in use. To make sure it is perceived as such, the style involves blowing up the size of “pixels,” as if working in opposition to graphical affordances. Often, these retro-looking pixels appeared like hard-edged little squares, “leveled,” devoid of analog CRT artifacts on our high resolution digital LCD screens. The implementation of the pixel style on modern platforms often occurs in the context of 3D creative suites, like *Unity* (2005). While *Unity* sought to democratize the creation of 3D video games, the suite has integrated a 2D mode since version 4.3 (released in 2011). Juul (2014) points out how the software applies antialiasing by default on graphical assets, rendering pixel art in a blurry manner that appears contradictory to the hard-edged pixel style emerging in the scene, yet distinct from the analog effects discussed above.

2D and 3D extensions to the pixel concept have attracted a lot of attention over the past 15 years, eliciting our nostalgia for construction toys. Beyond the pixelated appearance of its textures, the “boxy” look of *Minecraft* (Mojang, 2009) and its low detail textures has contributed greatly to our appreciation of contemporary pixel aesthetics. A few years later, the movie *Pixels* (Chris Columbus, 2015) presented all sorts of classic video game heroes through a similar 3D extension of the concept, a process referred to as “pixelation” in the movie. In 2009, Silicon Studio – co-founded by a former vice-president of Silicon Graphics, Teruyasu Sekimoto – released *3D Dot Game Heroes* (see Figure 9) to popular acclaim. *Fez* (Polytron, 2012) and the apparent innovation of its “trixels” also played a big part in the proliferation of this new “3D pixel style” (Juul, 2014).

Figure 9. *3D Dot Game Heroes* box art (Silicon Studio, 2009)
Source: MobyGames

The 3D pixel is an interesting development of retro aesthetics: it appears to point backwards to early 3D games, yet this blocky appearance was not so common inside video games themselves.[15] From a technological performance perspective, early 3D games could not multiply cubic shapes carelessly; each vertex of a geometric shape that moves on the screen represents a significant amount of additional computation for processing units. The look of these virtual landscapes was decidedly abstract and low poly (see Figure 10), emphasizing the aliasing effect noted in the previous section. Clearly, the "retro" appearance of blocky "pixel" worlds relies on a connection to block games more than early 3D video games themselves.

Figure 10. *Starglider II* (Argonaut, 1988)
Source: Super Adventures in Gaming blog

One of the early manifestations of this "3D pixel" infused with game nostalgia can be found in *Virocop* (Graftgold, 1995), another reflexive title of the 1990s drawing inspiration from all sorts of ludic settings and instruments to create levels. D.A.V.E., a friendly little robot wielding an arsenal worthy of Rambo (yet who looks like a pixel version of a child's stuffed toy) must dive inside sectors of the "Gamedisk" in order to purge viruses. One of the ultimate bosses of this little-known classic is none other than *Space Invaders*. We're not talking about a handful of invaders here; players have to shoot the totality of the original setting, as it re-materializes (and explodes) into a frenzy of pixelated blocks (see Figure 11).[16] The 3D pixels in this scene are brought to life through the use of parallel projection, a two-dimensional drawing technique that simulates depth without a vanishing point.

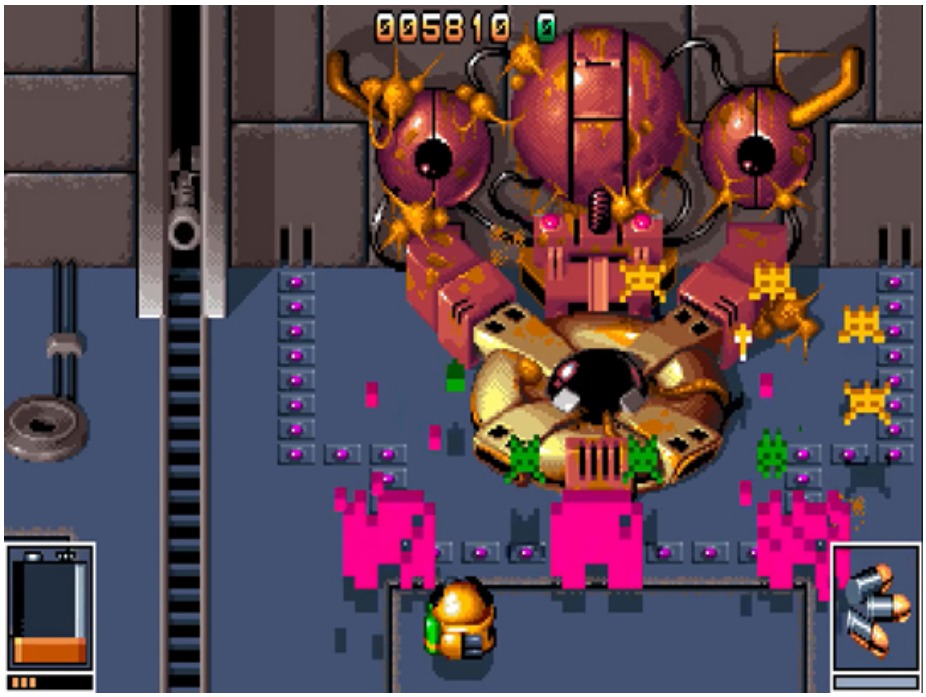

Figure 11. *Virocop* (Graftgold, 1995)
Source: EdHell YouTube channel

DISCUSSION

In David Whittaker's *Lazy Jones* (1984), players control a laidback janitor who must "clean" all the rooms in the building or, more precisely, clear his best score for every arcade classic pastiche installed on office computers. Today, this title can be seen as a forerunner to the retro-collection format and vintage video game remixing culture. It also highlights the centrality of CRTs in the experience (see Figure 12). *Wipeout* (the *Breakout* clone within *Lazy Jones*) adds another component in our overview of blocky picture elements: the rows of bricks to be destroyed were first assembled in the program by using ASCII character sets, or the color grid from the ZX Spectrum. While these graphical modes emerged in a context where computers did not have the necessary hardware resources to create intricate pixel art, in light of our inspection of supersized pixels they could be seen as stylistic affordances, forerunners to the pixel style that spread all over video game visual culture and beyond.

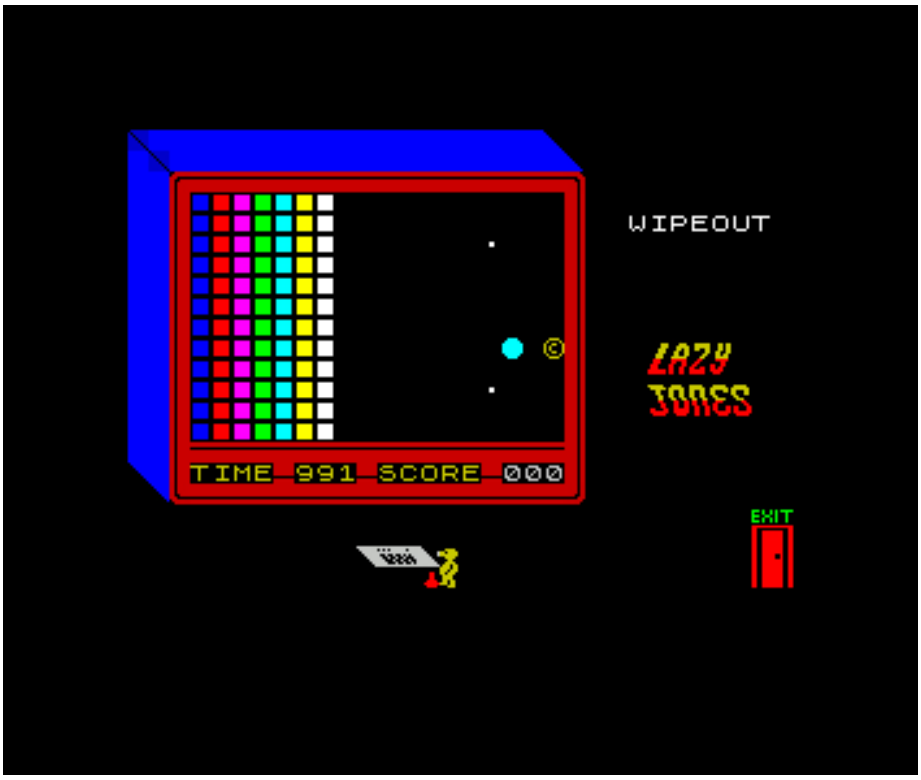

Figure 12: *Lazy Jones* (David Whittaker, 1984)
Source: MobyGames

As Maria B. Garda observed in "Nostalgia in Retro Game Design" (2013), the retro video games corpus is "exceedingly heterogeneous"; the same could be said of pixel aesthetics presented in this article. Building on Svetlana's Boym now famous distinction – as Garda does – between restorative and reflective nostalgia, one could associate some of the revival techniques presented in this article with restoration efforts, as if vintage pixels were a form of precious material or monument meant to be preserved as accurately as possible. Swalwell has illustrated the dedication of game lovers to the original experience, highlighting the attachment to CRTs (2013). Many communities, from retroplayers to collectors and archivists, engage with the original materiality through a restorative mindset. These communities do hard work and contribute to preservation efforts in significant ways, inside and outside of official memory institutions. However, even in a repository providing access to material platforms, it is difficult to imagine the recreation of any authentic video game experience, and many experts in software preservation invite us to move away from this "lure" (Lowood, 2023; Swalwell, 2013). Video game history is now commonly accessed in new material contexts, from anniversary editions to audiovisual archives on YouTube.

In contemporary retro-inspired games such as *Animal Well*, the new elemental brick of the supersized pixel is made smoother and warmer thanks to various shading effects in a way that seeks to approximate the appearance of pixels on older imaging technologies. A growing number of retro-inspired games seek to provide a sense of the original CRT pixel "feel" on modern systems. But as we have seen (Figure 1, Figure 8), even these attempts can exaggerate some of the retro-signifiers. This phenomenon is not specific to digital gaming at all; analogous effects are also spreading in contemporary visual culture. It can be understood through the notion

of “media hysteresis” proposed by Philippe Theophanidis and Ghislain Thibault, who studied similar developments in other media practices (2017).[17] In the case of contemporary digital cinema, for instance, analog effects such as lens flare persist beyond their original material conditions; they are simulated – and sometimes exaggerated – through digital filters.

Following Boym / Garda, we can observe that reflective nostalgia can move us beyond the restorative mindset and shift our appreciation of the past, and of course this process is inevitably amplified in a context of disconnection from the original materiality. Through reflective nostalgia, we delve in specific aspects of the objects and moments we long for, effectively dissecting the forever-gone original experience, infusing it with the affective impact it had on us, and with the fantasies we entertained at the time, or even newer ones. Taking part in video game communities at the turn of the 1990s involved a fair amount of anticipation, fuelled by a collective fascination for technological evolution, be it higher resolutions or the mimicry of cinema illusions. In a paradoxical way, vintage pixels are still caught up in these evolutionary dynamic: the hard-edged, “high res” *faux* pixel could be seen as liberated from CRT artefacts, and extended through cutting-edge shaders and 3D effects.

In *A Biography of the Pixel* (2021), Smith argues that the core mathematical principle of the digital pixel lies in the idea of a discrete sampling of another continuous analog reality. One of the main arguments of the biography is that this sampling process from the analog to the digital can be lossless under specific conditions, an idea the author traces back to the work of Vladimir Kotelnikov in the early 1930s (2021, p. 49). The cofounder of Pixar builds this edifying coming of age story by paying homage to the myriad of great innovators who sought to make Digital Light an important part of our media reality. Yet the persistence of analog effects and proliferation of *faux* pixels in our visual culture, as highlighted throughout this article, is a testament to our attachment to older imaging technologies. Not content with achieving its lossless digital dream, video game visual culture seems to embrace the loss of information, harkening back to simpler times where a few blocky elements were enough to construct complex realities.

Theophanidis and Thibault, echoing Sterne’s warning about the dichotomy between analog and digital and the progressive narratives emerging out of digital boosterism, propose the notion of media hysteresis in the hope of facilitating our apprehension of continuities between analog and digital media, beyond the material disconnection, in the realm of cultural significance and user habitus; “From this standpoint, the relationship between analogue and digital is not that of a clash, divide, or replacement, but of a necessary coevolution.” (2017, p. 18)

According to Theophanidis and Thibault, “hysteresis can serve a deflective function, allowing us to cling to the experience of what is known and familiar in order to confront the permanent flux of innovation that has come to characterise our lives” (2017, p. 12). Patrick Dolan argues, in a recent contribution (2023), that the ubiquity of *faux* pixels in modern video games goes beyond restorative or reflective nostalgia; we have now reached a “post retro” aesthetic phase, with pixel art and simple gameplay pushing against the mainstream obsession for more complexity and audiovisual fidelity. Balsom (2018, p. 76) also relates this trend to a form of resistance, countering technological cultures founded on accelerated progress and obsolescence.

In this respect, the rise of *faux* pixels can be seen through its transgressive potential, and this is certainly on display in the corpus studied by Dolan (*Dys4ia*, *Undertale* and the DIY community working with Bitsy). But as the author notes (2023, p. 20), in line with other studies on transgression in games, "transgressive at one time can be – and often is – adopted by popular media as the new norm." Ultimately, as Tastet and François point out (2018, p. 38), supersized pixels can also be disconnected from their historical referents, simply acting as a convenient building block for new generations of artists and users. This pragmatic reality is made manifest in some of Juul's interviews with contemporary pixel artists (2019), and in the proliferation of the 3D pixel block in popular culture.

At the same time, all these new vintage pixels can still be perceived as technological artefacts; they remain visible while a good chunk of contemporary video game production is still running after polygonal photorealism. In a story arc focussed on technological progress, *faux* pixel aesthetics feel like a "glitch." As Julian Kilker suggested in "Digital Dirt and the Entropic Artifact: Exploring Damage in Visual Media" (2009, p. 60), such "defects" could open up curiosity and investigations into the dark recesses of our gaming black boxes and silver screens. This would confer upon the proliferation of pixel aesthetics the same potential that has been leveraged in other media practices such as photography, exposing traces of material decay to promote aesthetic appreciation and a deeper understanding of the medium. Bowman, Condis, Yoshimura and Bohaty's recent empirical study with over a hundred participants (2023) provides evidence that nostalgia can foster a greater engagement with video game history. Kristian Ahm (2020) reached similar conclusions, inviting us to consider retrogamers as potential archaeologists and historians of technology.

CONCLUSION

In *Edge* magazine #67, in a feature entitled "The land that time forgot", Jez San (founder of Argonaut Games) declared "it's sheer optimism to think that 2D games will come back. It's been and gone, and we all fondly remember it […] but I can't see it happening again." (1999, p. 56) From the maker of the *Starglider* series and the man responsible to help Nintendo move into the 3D world (Arsenault, 2017), this prediction is hardly surprising. Other creators in this feature offer more nuanced perspectives, noting that 2D game design could stay active on mobile platforms for the visible future. None could have predicted the historical irony presented in this article: as soon as video game imaging technologies afforded to hide pixels, and game design was moving in a new dimension, the rise of 2D retro aesthetics emerged. A few years later, the proliferation of *faux* pixels would be unstoppable.

Throughout this article, we have presented various "reincarnations" of the pixel in video games. Altogether, these multiple parallel lives tell the story of the pixel's disconnection from material foundations (the various imaging technologies) and evolution into the conceptual realm. Nowadays, *faux* pixels rely on multiple actual invisible picture elements coming together on the screen, creating a "supersize" effect. In this regard, it is not surprising to see the extension of the concept in the 3D realm. Building blocks and large pixels are converging in our contemporary visual culture thanks to the ubiquity of *Minecraft*, to this day one of the most popular video games ever created.

As anyone can attest by looking at recent titles using 3D pixels, these blocky worlds are irresistibly cute; the 3D extension of the pixel appears to elicit all the good memories of "analog" play in itself, its block-like qualities taking us back to the scale and materiality of childhood. Even the much-dreaded MPEG pixelation glitch is spreading around. In *Observer: System Redux* (Bloober Team, 2017), we are invited to play a detective in a dark cyberpunk world. The proliferation of macroblocks during first person perspective movement is used as an indicator of the protagonist's state (see Figure 13). This pixelated presentation follows in the footsteps of horror fiction, in which techno-glitches have grown to signify troubled mental states. Much like the 3D block pixel, yet in an aesthetically antithetical manner, this blocky output feels close to us.

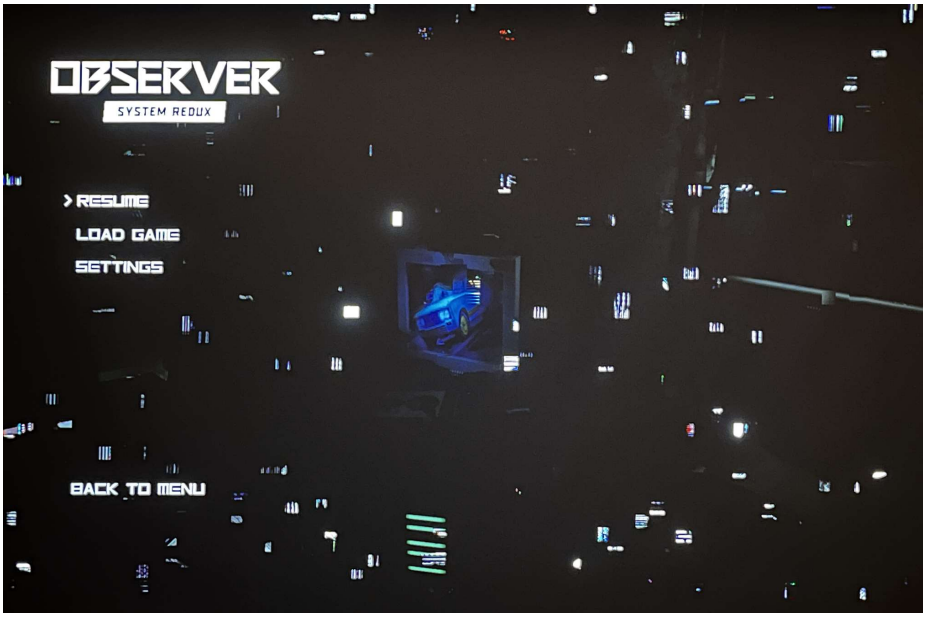

Figure 13. *Observer: System Redux* (Bloober Team, 2017)
Source: author screenshot

As we have seen, modern video game systems can mimic intricate CRT effects through dedicated algorithms running in high screen resolutions. Yet, it is fair to assume that a good part of the medium's audiovisual archives of the early decades will feature the perfectly square, rectilinear, levelled version of the pixel that Alvy Ray Smith decried more than thirty years ago. It is prominently visible on one of the most extensive audiovisual archives of complete video game playthroughs, the *World of Longplays* YouTube channel (featuring more than 20 000 videos, and counting). Lured, perhaps, by a restorative mindset and "screen essentialism" (Lowood, 2023, p. 103), some longplayers and streamers do turn on various CRT filters included in contemporary emulators, amongst multiple other filtering options.

Since the 1990s, commodification of the medium's early history through re-releases and anniversary editions complicate the notion of pixel authenticity. Through marketing discourse, restorative claims are often overblown. Concurrently, many developers now integrate extensive retro-pixel filter options, letting users customize the appearance of their nostalgic journey as they see fit. *Flashback*, the classic game from Paul Cuisset, was re-released in 2018 following its 25th anniversary (Microids; original release by Delphine Software, 1992). This reedition opens on a difficult choice between "classic" mode, featuring perfectly square emulated pixels, and

"modern." The latter applies a paradoxical mix of upscaling[18] and retro-pixel filters. On top of the upscaled 320x200 display, additional smoothing and a bloom effect have been added, mimicking to some extent the light bleeding visible on many CRTs. The *faux* curvature filter and *faux* scanlines are also applied by default, extending beyond the original 4:3 screen ratio to fill up 16:9 screens (see Figure 14). Only one option is turned off when you boot up this classic: the TV signal filter (adding an exaggerated disruptive *faux* TV signal noise to this already convoluted mix).

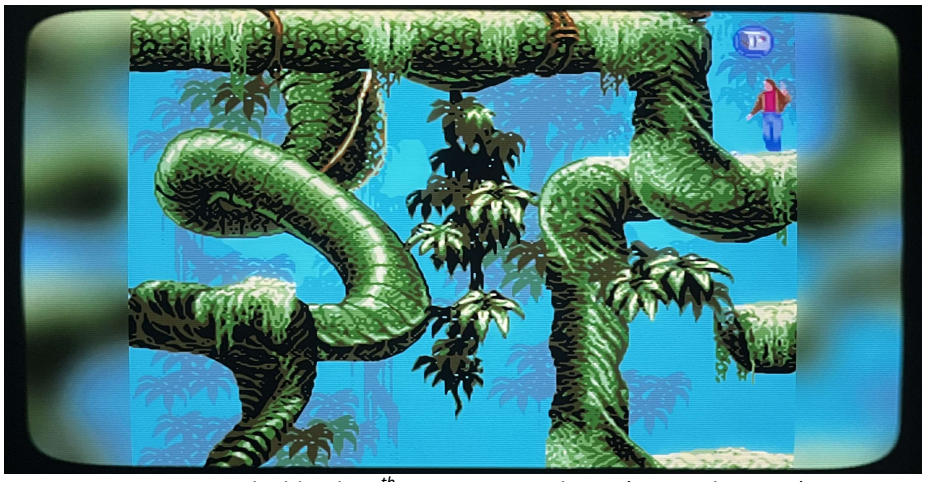

Figure 14. *Flashback 25th anniversary* edition (Microids, 2018)
Source: author screenshot

Aided with all these filters, this anniversary edition might claim some restorative authenticity. But as any retroplayer of the original could attest, the gap between this visual mashup and its point of origin is impressive. These retro-signifiers assemble in a new vintage look, and this visual mishmash brings up a renewed sense of loss more than the good vibes of the fantasized initial aesthetic encounter. Nostalgia, as David Lowenthal pointed out over hundreds of pages, tells it like it wasn't; in this case, like so many others in our reconstruction of video game history, we are witnessing a dedicated effort at "anachronizing the past" (2015, p. 554-84).

As a game lover working on visual media, I too may inevitably be attracted to the lure of screen essentialism and how we preserve the visual aspects of video games. In order to be able to let go of the original experience, we need tools to help us remember what shifted in the meantime, and this is what I tried to achieve with this article. Each new incarnation of the pixel attests to the power of nostalgia in the gaming community, yet the conflation of styles and technologies in contemporary pixel constructions points to the necessity to foster even more longing and curiosity for the history of the medium, and its essential components.

ACKNOWLEDGMENTS

The research presented in this article was financed by Insight grants from the Social Sciences and Humanities Research Council of Canada. Additional research on *faux* pixels and nostalgia was conducted for the exhibition *Retro-Play*, a collective project presented at Université de Montréal from September 2022 to March 2023. The web version of this project is hosted by the university's library services:

https://web.bib.umontreal.ca/retroplay/. Many thanks to the DiGRA reviewers, who provided invaluable constructive feedback. The author would also like to thank John Aycock, Samy Benammar, Alexis Blanchet, Logan Brown, André Habib, Alice Michaud-Lapointe, Laine Nooney, Laurie Mei Ross-Dionne, Richy Srirachanikorn and Darren Wershler.

REFERENCES

Access Software. 1994. *Under a Killing Moon*. DOS game. Access Software.

Ahm, K. R. 2020. "(Re)Playing (with) Video game History: Moving beyond Retrogaming." *Games and Culture*. 16 (6). https://doi.org/10.1177/1555412020955084

Andiloro, A. 2025. "Premiers to pixels: The discourse of cinema envy in 1990s video game magazines." *Convergence*, online first. https://doi.org/10.1177/13548565251404000

Argonaut. 1988. *Starglider II*. Atari ST game. Argonaut.

Arsenault, D. 2017. *Super Power, Spoony Bards, and Silverware: The Super Nintendo Entertainment System*. Cambridge: The MIT Press.

Aycock, J. 2016. *Retrogame Archeology: Exploring Old Computer Games*. New York: Springer.

Balsom, E. 2018. "The ambivalence of authenticity." In *Film in the present tense*, edited by L. Greenfield, D. S. Phillips, K. Schroedinger, B. Speidel and P. Widmann, 75-77. Archive books.

Basso, B. 2024. *Animal Well*. Nintendo Swtich game. Shared Memory.

Belli, S. and López Raventós, C. 2019. "Cultural Archaeology of Video Games: Between Nostalgic Discourse, Gamer Experience, and Technological Innovation." Paper presented at the *Applied Informatics second international conference (ICAI 2019)*, Madrid, Spain, November 7-9. https://doi.org/10.1007/978-3-030-32475-9_29

Black Pearl. 1996 [1980]. *Arcade Classics: Battlezone* [original: Arcade]. Atari.

Bloober Team. 2017. *Observer: System Redux*. PlayStation 4 game. Aspyr.

Bosman, F. 2023. "Video Game Romanticism. On Retro Gaming, Remakes, Reboots, Game Nostalgia, and Bad Games." *Journal of Religion, Film and Media*. 9 (1), 25-44. https://jrfm.eu/index.php/ojs_jrfm/article/view/347/296

Bowman, N. D., Condis, M., Yoshimura, K., & Bohaty, E. 2023. "Vicarious Nostalgia? Playing Retrogames Fosters an Appreciation for Gaming History." Paper presented at *The 24th Annual Conference of the Association of Internet Researchers (AoIR2023)*, Philadelphia, PA, USA. http://spir.aoir.org

Boym, S. 2001. *The Future of Nostalgia*. New York: Basic Books.

Camper, Brett. 2009. "Fake Bit: Imitation and Limitation." Paper presented at the *Digital Arts and Culture Conference*, Irvine, United States, December 12-15. https://escholarship.org/uc/item/3s67474h

Columbus, C. 2015. *Pixels*. Columbia Pictures.

Cyberdreams. 1995. *Darkseed II*. Windows game. Cyberdreams.

de Alencar, F. H . B . M . 2017. *Pixel Art & Low Poly Art : catalisação criativa e a poética da nostalgia?* Masters thesis, Universidade de Brasilia. http://repositorio.unb.br/handle/10482/24541

Dolan, P. R. 2023. "16-bit dissensus: post-retro aesthetics, hauntology, and the emergency in video games." *Replay.* 1 (8). https://doi.org/10.18778/2391-8551.08.01

Edge editorial team. 1999. "The land that time forgot." *Edge*. 67 (January), 52-60.

Edge editorial team. 1994. "Revival of the fittest." *Edge*. 15 (December), 65-67.

Fassone, R. 2014. "Sometimes They Come Back (Some of Them) Serialization, remaking, nostalgia. The case of Xbox Live Arcade". In *The Archives. Post-Cinema and Video Game Between Memory and the Image of the Present*, edited by F. Giordano and B. Perron, 125-138.

Foley, J. D., A. Van Dam, S. K. Feiner and J. F. Hughes. 1995. *Computer Graphics: Principles and Practice* (second edition in C). Addison-Wesley Professional.

Garda, M. B. 2013. "Nostalgia in Retro Game Design." Paper presented at the *Digital Games Research Association Conference 2013: DeFragging Game Studies (DiGRA 2013)*, Atlanta, USA, August 26-29. https://doi.org/10.26503/dl.v2013i1.651

Gazzard, A. 2016. "Between pixels and play: The role of the photograph in video game nostalgias." *Photography and Culture*. 9 (2), 151-162. https://doi.org/10.1080/17514517.2016.1203589

Gee, D. 2018. "Remixing Retro: Preserving the 'Classic Feeling'." *Journal of the Japanese Association for Digital Humanities*. 4 (1), 54-71. https://doi.org/10.17928/jjadh.4.1_54

Goetz, C. J. 2018. "'The Fantasy that Never Takes Place': Nostalgic Travel in Video games." *Loading… The Journal of the Canadian Game Studies Association*. 11 (18), 58-80. https://loading.journals.publicknowledgeproject.org/index.php/loading/article/view/203

Graftgold. 1995. *Virocop*. Commodore Amiga game. Renegade Software.

jotd666. 2025 [1983]. *Gyrus*. Commodore Amiga game [original: Arcade]. Konami.

Juul, J. 2019. *Handmade Pixels: Independent Video Games and the Quest for Authenticity*. Cambridge: The MIT Press.

Juul, J. 2014. "High-tech Low-tech Authenticity: The Creation of Independent Style at the Independent Games Festival." Paper presented at the *9th International Conference on the Foundations of Digital Games (FDG 2014)*, Liberty of the Seas, Caribbean, April 3-7.

Kaneko. 1992. *Star Parodier*. PC Engine game. Hudson Soft.

Kilker, J. 2009. "Digital Dirt and the Entropic Artifact: Exploring Damage in Visual Media." *Visual Communication Quaterly*. 16 (1), 50-63. https://doi.org/10.1080/15551390802620910

Lamarre, T. 2009. *The Anime Machine*. *A Media Theory of Animation*. Minneapolis: University of Minnesota Press.

Lessard, J. and C. Therrien. 2021. “Indies de Province. Two independent game developers in pre-Internet Quebec.” *Loading… The Journal of the Canadian Game Studies Association*. 14 (23), 15-35. https://doi.org/10.7202/1078726ar

Live Planning. 1990 [1980]. *Heiyanko Alien* [original: Arcade]. Meldac.

Lowenthal, D. 2015. *The Past is a Foreign Country Revisited*. Cambridge University Press.

Lowood, H. 2023. *Replayed: Essential Writings on Software Preservation and Game Histories*, edited by R. Guins. Baltimore: Johns Hopkins University Press. https://doi.org/10.56021/9781421445953

Manovich, L. 2001. *The Language of New Media*. Cambridge: The MIT Press.

Merriam-Webster. 2026. “Analog.” *Merriam-Webster.com Dictionary*. https://www.merriam-webster.com/dictionary/analog Accessed 29 Mar. 2026.

Microids. 2018. *Flashback 25th anniversary edition*. PlayStation 4 game. Anuman interactive.

Minter, J. / Llamasoft. 1994. *Tempest 2000*. Atari.

Mojang Specifications. 2009. *Minecraft*. Browser game. Mojang Specifications.

Montfort, N. and Bogost, I. 2009. *Racing the Beam: The Atari Video Computer System*. Cambridge: The MIT Press. https://doi.org/10.7551/mitpress/7588.001.0001

Navarro-Remesal, V. and B. Pérez Zapata, 2025. “The Flavor of Late Shōwa: Coziness, Food and Nostalgia in Gagex Games.” In *Handbook of Japanese Games and Gameplay*, edited by R. Hutchinson, 186-200. Japan documents / Routledge. https://doi.org/10.4324/9781003697107

Nintendo. 1988. *Super Mario Bros. 3*. Nintendo Entertainment System game. Nintendo.

Pittman, K. 2015. “CRT Simulation in Super Win the Game.” *Game developer* (April 20). https://www.gamedeveloper.com/programming/crt-simulation-in-super-win-the-game

Polytron. 2012. *Fez*. Xbox 360 game. Polytron.

Rule, M. 2024. “What Causes Pixelation on DVD? How to Fix Pixelated DVD Playback?” https://www.winxdvd.com/resource/fix-pixelated-dvd-playback.htm

Seville, A. 2019. *The Cultural Legacy of the Royal Game of the Goose. 400 Years of Printed Board Games*. Amsterdam University Press. https://doi.org/10.2307/j.ctvsr51mq

Sherr, S. 1996. *Electronic displays* (2nd edition). Hoboken: Wiley-Interscience.

Silicon Studio. 2009. *3D Dot Game Heroes*. PlayStation 3 game. Atlus.

Smith, A. R. 2021. *A Biography of the Pixel*. Cambridge: The MIT Press. https://doi.org/10.7551/mitpress/13470.001.0001

Smith, A. R. 1995. “A Pixel is Not a Little Square, A Pixel is Not a Little Square, A Pixel is Not a Little Square (And a Voxel is Not a Little Cube).” Technical Demo 6 presented at Microsoft on July 17th. Retrieved from http://alvyray.com/Memos/CG/Microsoft/6_pixel.pdf

Srirachanikorn, R. 2024. “Lost Again. Refractive Nostalgia and Video Games.” *Press Start*. 10 (1). https://press-start.gla.ac.uk/index.php/press-start/article/view/294

Sterne, J. 2016. “Analog.” In *Digital Keywords: A Vocabulary of Information Society and Culture*, edited by B. Peters. Princeton University Press. https://doi.org/10.2307/j.ctvct0023.7

Suominen, J. 2008. “The past as the future? Nostalgia and retrogaming in digital culture.” *The Fibreculture Journal* (November). https://fibreculturejournal.org/fcj-075-the-past-as-the-future-nostalgia-and-retrogaming-in-digital-culture/

Suominen, J., Reunanen, M. and Remes, S. 2015. “Return in Play: The Emergence of Retrogaming in Finnish Computer Hobbyist and Game Magazines from the 1980s to the 2000s.” Special issue of *Kinephanos: Cultural History of Video Games* (June). https://www.kinephanos.ca/2015/emergence-of-retrogaming/

Super Icon Limited. 2018, *Super Life of Pixel*. PlayStation 4 game. WhiteMoon Dreams.

Swalwell, M. 2013. “Moving on from the Original Experience: Games history, preservation, and presentation.” Paper presented at 6th *Digital Games Research Association Conference*, Atlanta, USA, August 26-29, 2013.

Tastet, S. and François Y. 2018. “Comment le pixel est revenu à la mode.” *JV-Culture Jeu Vidéo*. 57 (November), 32-37.

Theophanidis P. and Thibault, G. 2017. “Media Hysteresis: Persistence Through Change.” *Alphaville*. 12. https://doi.org/10.33178/alpha.12.01

Therrien, C., J. Aycock and C. Poremba. 2020. “Remediation of Cinema Images in Video games.” In *Encyclopedia of Film Techniques and Technologies*, edited by A. Gaudreault, L. LeForestier and G. Moüellic. https://encyclo-technes.org/en/parcours/all/remediation-cinema-video-games

Therrien, C. 2019. *The Media Snatcher. PC/CORE/TURBO/ENGINE/GRAFX/16/CDROM2/SUPER/DUO/ARCADE/RX.* Cambridge: The MIT Press. https://doi.org/10.7551/mitpress/10589.001.0001

Therrien, C. 2008. “Graphics in Video Games.” *The Video Game Explosion: A History from PONG to PlayStation and Beyond*, edited by M. J. P. Wolf, 239-250. Bloomsbury Academic.

The Warp Factory. 1992. *Harlequin*. Commodore Amiga game. Gremlin Graphics.

van der Heijden, Tim. 2015. “Technostalgia of the present: From technologies of memory to a memory of technologies.” *NECSUS.* 4 (2), 103-121. Amsterdam University Press. https://doi.org/10.5117/NECSUS2015.2.HEIJ

Vectordean. 1991. *James Pond 2: Codename: RoboCod*. Commodore Amiga game. Millenium.

Victor Musical Industries. 1990. *Toy Shop Boys*. PC Engine game. Victor Musical Industries.

Whalen, Z. and Taylor, L. N. (eds.) 2008. *Playing the Past*. *History and Nostalgia in Video Games.* Nashville: Vanderbilt University Press. https://doi.org/10.2307/j.ctv16759mn

Whittaker, D. 1984. *Lazy Jones*. Commodore 64 game. Terminal Software.

Wolf, M. J. P. 2001. *The Medium of the Video Game*. University of Texas Press. https://doi.org/10.7560/791480

Wulf, T., Bowman, N. D., Rieger, D., Velez, J. A. and Breuer, J. 2018. "Video Games as Time Machines: Video Game Nostalgia and the Success of Retro Gaming." *Media and Communication.* 6 (2), 60-68. https://doi.org/10.17645/mac.v6i2.1317

Zwiezen, Zach. 2021. "The Low-Poly Dog from Modern Warfare is perfect." *Kotaku* (April 25). https://kotaku.com/the-low-poly-dog-from-modern-warfare-is-perfect-1846759963

ENDNOTES

[1] For an early discussion about the importance of screen resolution and pixels in our understanding of video games, see Wolf (2001, chapter 1). It is difficult to associate a specific screen configuration as the threshold for "high resolution" at this point in time, since the expression has been used early in the history of computer and video game marketing, for instance on ColecoVision boxes in the early 1980s.

[2] For a detailed explanation of compression techniques, including FMV in video games, see Aycock (2016). Aycock, Poremba and I proposed simple explanations of these techniques in "Remediation of Cinema Images in Video Games" (Therrien et al., 2020). For a wider discussion about digital glitches and decay, including MPEG pixelation, see Kilker (2009).

[3] It is very common to find this conflation between macroblocking and pixelaton in popular and technical discussions on the topic, and consequently it is difficult to pinpoint exactly when this conflation emerged.

[4] For a detailed explanation of the mathematical principles behind the mapping of texture elements to pixels, see Foley et al. (1995, "Surface detail" section, p. 741-745). More accessible (and imperfect) explanations can also be found in my chapter "Graphics in Video Games" (Therrien, 2008, p. 245-249).

[5] Readers fluent in Portuguese can explore these trends further in Filipe de Alencar's master's thesis *Pixel Art & Low Poly Art : catalisação criativa e a poética da nostalgia?* (2017).

[6] For a deeper understanding of cinema envy at the time, through a survey of paratextual elements (including a periodization), see Andiloro (2025). See also Therrien et al. (2020) for a broader discussion on the phenomenon.

[7] Fuelled by this paradoxical success, many other games were planned in the futuristic retro series; *Defender 2000* and *Breakout 2000* were released before the console's untimely demise.

[8] For a discussion about remakes and reboots of classic franchises in light of nostalgia and romanticism of the past, see Bosman (2023).

[9] To mention but a few important contributions: the long-running Board Game Studies conference, the Analog Game Studies journal (ongoing since 2014), and the recent publication of Adrian Seville's *The Cultural Legacy of the Royal Game of the Goose. 400 Years of Printed Board Games* (2019).

[10] Based on Sterne's etymological account, it is difficult to imagine that traditional games have been presented or marketed as "analog." Since the stated goal of analog game studies is to revalue the contemporary relevance of board games, card games, LARPs and other play instruments, the terminological choice seems counterproductive. However, following the rationale of the editorial team behind *Analog Game Studies* at the time of the journal's inception, it is possible to understand the use of "analog" from the perspective of reappropriation, re-valuing a term that was relegated to the margins by the dominant digital culture.

[11] For a glimpse into this complexity, curious readers can refer to Sol Sherr, *Electronic displays* (1996).
[12] These characteristics and many others, such as the type of phosphor arrays, varied between manufacturers, and consequently it is very difficult to synthesize the CRT "feel" through one effect or image filter. What's more, the type of connector used between a game device and the screen also contributed to the overall feel of the images. In some of the most common video game configurations, all the information was "composited" to fit within a restricted bandwidth, leading to some visible artefacts on the screen. See Therrien (2019, chapter 2) for an exploration of glitches emerging in this context.
[13] As Montfort and Bogost (2009) explain, the creation of levels on the Atari 2600 depended on the programmers' ability to direct the electron beam as the program ran. The system did not have enough memory to assemble complex visual elements in a frame buffer. Background elements such as maze structures or obstacles were drawn by code synchronized with processor cycles, making color changes on the fly at runtime. In effect, coders were "racing the beam."
[14] This program is available to the community for free: https://piratehearts.itch.io/supercrt
[15] Of course, this style existed in printed graphic art and 2D video game graphics. See for instance the box art for *Vectron* (Mattel, 1983) on the Intellivision, and of course the arcade classic *Q*Bert* (Gottlieb, 1983). For an exploration of early 3D techniques used in video games at the turn of the 1990s, see Arsenault (2017).
[16] Space invaders had already been recreated in many titles, most notably in the block breaking arcade game *Arkanoid* (Taito, 1986). Even if the colored bricks that make up each level are not instantly evocative of a pixel shape, the space invader level does create an association between pixels and blocks.
[17] "In sciences, hysteresis refers to various phenomena where effects persist when causes have disappeared. We define "media hysteresis" as the persistence of effects at the cultural level even after the causes have disappeared at the technical level" (2017, p. 9)
[18] Most likely 2xSAI created by Derek Liauw Kie Fa, already found in many emulators over twenty years ago.