

Halcyon and on and on: an exploratory study of online collections of computer games

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Online
collections of
computer
games

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Abstract

Purpose – The purpose of this study is to survey the landscape of online collections of digital games.

Design/methodology/approach – First, the study identifies existing sites hosting collections and criteria that make a collection valuable for research, then it reports on sites that fit the criteria and analyzes trends.

Findings – Most sites provide simple binary downloads, but some choose encapsulation. Common metadata terms consistently include genre, year of release and publisher. Most sites claim the right to provide their collections as “abandonware,” but remove games if they are asked to.

Research limitations/implications – This study was conducted using a very limited subcategory of digital games, which could be expanded in other studies. Future research may require a multilingual team to account for collections based in non-English-speaking countries. Direct communication with sites’ management may be valuable in the future as well, but was not conducted in this study.

Practical implications – The study identifies practices that have developed organically in this field without any guiding standards. Understanding these may aid in Humanities research into digital games, as well as potential collection development in the future.

Social implications – Digital games are increasingly important as cultural artifacts, and there is a growing effort to preserve them for the future, but there are no standards for collecting and providing them. Understanding how this is currently done can help in providing access into the future for both casual and analytical use.

Originality/value – While game preservation is a growing and active field of research, no study has been published in recent years on this particular subject. It will be valuable for the development of future collections and for research using current ones.

Keywords Digital humanities, Digital culture, Information and knowledge organization

Paper type Research paper

Introduction

Digital games have much in common with other topics studied under the humanities. An artifact of the humanities, such as a story, a film or a song, has its own unique content and context. In the case of digital games, content can include its unmediated bitstream, the computer behavior it encodes, as well as its presentation, activities and narrative. Context can include information about a game’s producer or producers, the environment in which they worked, the landscape of existing media and crafts at the time, and the community into which the game was released. Bearing these similarities to other subjects of the humanities in mind, it is clear that digital games are worthy of analysis. Unlike books or films, though, digital games do not have more than a century of research and practice in the field of their preservation, organization and access.

Whether to analyze a digital game or to engage with it according to its original use, access is a vital but little-studied problem. While a game can be analyzed to some extent by a



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description or documentation of it, it must be interacted with to be fully understood. An understanding of the impact of *Pong* or *Doom* at the time of its release would be incomplete without the ability to play it and see what its players were experiencing at the time.

Where a medium such as film must be mediated using a storage and reader device capable of recreating moving images and sound, such as film reel with magnetic strip, optical disc or compressed video file, games require much more complex mediation. The game is made up of a bitstream dependent upon a specific hardware architecture and software environment and cannot be seen without the proper device to run it. This is exacerbated by the especially rapid development of computers, in which both hardware and software is superseded at such a rate that it becomes incompatible with most games within a few years of their release. As a result, it is important for the humanities to develop an understanding of the ways digital games are preserved and distributed online, so that they can be retrieved, played and analyzed efficiently. This study surveys the most prominent means of providing access – via a curated online collection.

This is a descriptive qualitative study of online collections of computer games. The term “computer game” is used to refer to games that are played on a computer or computer terminal. While the term “video game” is often used as an umbrella term for all digital games, in this study it will be used to refer specifically to games played on a television screen, by use of an external console dedicated primarily to playing them. Other distinctions exist, such as “handheld,” “arcade,” and “mobile” games, but are outside the scope of this study. While video games are generally distributed as self-contained packages designed to be run by their designated hardware, computer games often come as a large collection of different files that work together to instruct the computer to create the game behavior, and which may require some familiarity with the emulated computer’s operating system (e.g. MS-DOS, Windows 95, Mac OS, etc.) to properly run. For this reason, sites tend to provide either only video games or only computer games. Computer games require more mediation (e.g. the previously mentioned setup), and therefore require a more all-inclusive approach on the part of the collection to make them available to the average user, making them emblematic of the challenges involved in developing this kind of collection.

Literature review

There is not a significant body of literature on the specific topic of online collections of computer games. A similar study was conducted in 2009 by Winget and Murray, from a different standpoint and in a very different landscape. Still, some related research informs this study and is reviewed here, including three relevant domains: preservation, access and games as information objects.

Preservation refers to concerns with methods of keeping computer games safe and replicable into the future, which is an undeniable necessity if the games are to be available for study. While game preservation is an important and growing field, it is not the focus of this study. Many surveys have been conducted, such as [Barwick, Dearnley, and Muir \(2010\)](#), on preservation practices and shortfalls.

One intersection in the literature between preservation and collection is research on concerns surrounding preserving the context of games, including their associated documentation and development materials. Numerous documents are created during the production of a video game, most of which are not preserved or made publicly available. [Winget and Murray \(2009\)](#) note that these files are important for understanding a game’s context and the intent of its developers. [Kaltman, Wardrip-Fruin, Lowood, and Caldwell \(2014\)](#) issued a white paper following the production of an educational game. Part of their study was to keep track of the production documents and other materials generated during the development process for the purpose of preservation. [Kaltman et al. \(2014\)](#) identified these

documents as software development, active research and self-documentation files (p. xi). [Daiger \(2011\)](#) performed a study of the game development process and listed as many kinds of documents as possible that are created during it. A few of these include studio policies, demos, cash flow schedules, game design documents, art style guides, hiring plans, models, milestone feedback and focus group movies, among many more. [Bachell \(2014\)](#) polled and interviewed independent games developers in the United Kingdom (UK) and found that one third of them would consider transferring their development and business documents to a repository with the stipulation that they only be put to noncommercial use (p. 156). Bachell found that game developers have little interest in contributing their documents to any kind of repository or library, citing apathy toward preservation and a preference for “supersession” of their creations as newer technologies are released. As a result, most preservation is being done by users and noncommercial projects, as [Lowood *et al.* \(2009\)](#) note in their white paper on the topic.

Access is one of the main areas discussed in the literature. What has been written focuses on two subjects: how to replicate a computer program beyond its original lifespan, and how to manage accessibility and discovery, i.e. organization and metadata. There seems to be general agreement that the best way to provide access to earlier games is through emulation, which [Rothenberg \(2002\)](#) describes as “the use of a new computer to ‘impersonate’ an old computer” (p. 40). [Guttenbruner, Becker, and Rauber \(2010\)](#) refers to emulation as one of two main methods of representing video games that do not run on contemporary systems, the other method being migration (rewriting the code to function on newer systems). [Rothenberg \(2002\)](#) sees migration as less viable for true preservation. [Winget and Murray \(2009\)](#) note the additional problem of games requiring network access, and games that are community-oriented; these can never really be accessed beyond their normal lifespan, even if their files can be made to run on a newer computer.

Providing access to digital games may be difficult in other ways as well, specifically in terms of copyright. Whereas it is commonly accepted that public and academic libraries may give access to information objects, fully digital collections, especially those operated by individuals or independent organizations rather than large institutions, may not be afforded that permission. The Digital Millennium Copyright Act (DMCA) of 1998 set forth a number of rules to prevent distribution of digital information without the express permission of its copyright holder. For a Web site that provides access to computer games, this can be a serious obstacle. [Newman \(2012\)](#) discusses the spotty legality of online distribution of old games, and the obstacles to providing legal access, including an antagonistic attitude from the games industry itself.

A key factor identified in the literature is the idea of “abandonware,” a neologism which refers to “software or digital content that does not have an identifiable owner, apparent maintenance or support” ([Klein & Whyte, 2022, p. 198](#)), and thereby acceptable to redistribute. This reflects a concept similar to “orphan works,” as defined in the United States (US) copyright law, but is not explicitly provided for in the DMCA. Orphan works have been extensively discussed, see [U.S. Copyright Office \(2006\)](#), [Pierce and Schwartz \(2009\)](#), [Pallante \(2012\)](#), [Picker \(2012\)](#) and [Loren \(2012\)](#). The [U.S. Copyright Office \(2006\)](#) refers to “orphan works” as “a term used to describe the situation where the owner of a copyrighted work cannot be identified and located by someone who wishes to make use of the work in a manner that requires permission of the copyright owner” (p. 1). This is a very close definition to the one given of abandonware, though without the inclusion of software not being currently maintained or commercially exploited. Orphan works are not a cut-and-dry issue, either; use of a work is not guaranteed legal protection simply because it can be described as an orphan. Many agree, however, “that neither of these points, orphans or market gridlock, are good for the copyright system” ([Pallante, 2012, p. 1252](#)). Film archivist Eric Schwartz ([Pierce & Schwartz, 2009](#)) considers the freeing of orphan works for aggregators and distributors “making certain material available where, after due diligence, a copyright owner cannot be

determined” (p. 130) is an important step for preservation. [Loren \(2012\)](#) goes farther, to call for the metaphor of “orphan” to be changed to “hostage” (p. 1434) to reflect the damage done to users by fear of retribution from unknown copyright holders. [Khong \(2007\)](#) notes that “The key difference between orphan works and abandonware is that the problem of abandonware is the non-availability of a copyrighted work while the problem of orphan works is the non-locatability of the copyright owner” (p. 56). Whether these considerations can be extended to cases in which the copyright holder is known but does not distribute a work for decades, as abandonware’s proponents claim, is unclear. [Khong \(2007\)](#) also posits that the informal online definition of abandonware reflects a practice in trademark law, wherein a trademark becomes deregistered after five years of nonuse (p. 61).

One concept in copyright law that may impact the distribution of old games is that of “fair use.” While not a blanket protection for reusers of existing media, defendants accused of infringing on copyrights may ask the court to consider whether their use of the copyrighted material is fair. However, fair use is “an amorphous. . . regime” ([Sites, 2016, p. 536](#)), and notoriously difficult to adjudicate. At its core, it contains four factors:

- (1) the purpose and character of the use, including whether such use is of a commercial nature or is for nonprofit educational purposes;
- (2) the nature of the copyrighted work;
- (3) the amount and substantiality of the portion used in relation to the copyrighted work as a whole; and
- (4) the effect of the use upon the potential market for or value of the copyrighted work. (US Courts, as cited in [Sites, 2016](#))

Court cases such as those against HathiTrust, West Publishing and Google Books Search by publishers, wherein the defendants created searchable databases containing the full texts of books, which [Picker \(2012\)](#) describes as “Private Digital Libraries,” have been hotly contested, and have required concessions from the defendants. Like the online collections in this study, the defendants in these cases provided the full texts of copyrighted works, but they were deemed fair use because they were essentially “a bucket of text or pixels, and the databases’ primary concerns were enabling users to search the bucket, not convey the expression that the text or pixels communicated” ([Sites, 2016, p. 522](#)).

Along these lines, Supreme Court introduced the concept of “transformativeness” in 1994 ([Adler, 2016, p. 619](#)). Transformative use is an especially murky concept that can affect a court’s interpretation of any of the four main factors. In the cases mentioned above, the databases’ use of the texts (containing and organizing them, and providing them for viewing or download) was considered to be sufficiently different from their copyright holders’ use (generally to sell), thereby constituting a “transformed purpose” ([Sites, p. 519](#)). The defendants were, however, required to ensure that their search engines not “risk. . . supplanting demand for the original” ([Samuelson, 2015](#)), by limiting the amount of text viewable without purchasing a copy, or by disallowing saving or printing.

Several seminal court cases in the past thirty years have been written about extensively, including *Seltzer v. Green Day, Inc.* ([Sites, 2016](#)), *Campbell v. Acuff-Rose Music*, *Cariou v. Prince* and the above book database cases ([Sites, 2016; Liu, 2019; Adler, 2016; Samuelson, 2015](#)). [Sites \(2016\)](#) discuss the history of transformative fair use in the US Supreme Court, and the legacy of these cases. [Adler \(2016\)](#) discusses the dangers of focusing on transformative fair use over market-based factors. [Samuelson \(2015\)](#) extrapolates on the trajectory of fair use cases and proposes reforms to prevent the doctrine from becoming too restrictive or licentious. [Liu \(2019\)](#) examines the nature, strategies and success rates of court cases involving transformative fair use since the doctrine’s inception.

There have been some attempts to create standardized metadata schema for describing video games. A significant project in the past decade has been the development of the video game metadata schema (VGMS) (GAMER, 2020) for use in the Seattle interactive media museum (SIMM), developed by researchers at the University of Washington's GAmE MEdatadata Research Group (GAMER) (Lee, Tennis, Clarke, & Carpenter, 2013). The VGMS is a comprehensive metadata schema based on the functional requirements for bibliographic records (FRBR) principles used in library and information science (LIS), using a modified version of the resource description and access (RDA) model. The researchers at GAMER have written on their goals and challenges (Lee, Tennis *et al.*, 2013), their process, (Lee, Tennis, & Clarke, 2012; Lee, Cho, H., Fox, V., & Perti, 2013; Lee, Clarke, & Perti, 2015) and the conceptual framework they developed (Jett, Sacchi, Lee, & Clarke, 2016).

Lee, Tennis *et al.* (2013) list several challenges they uncovered in the process. They found metadata in existing frameworks to be subjective highly inconsistent. For instance, they note that *Super Mario Bros.* and *Grand Theft Auto* are both generally classified as "action" despite being very different (p. 108), and that the terms "publisher" and "developer" are often used interchangeably (113). Finding information on games is also a challenge. The researchers divide game organization into two areas: schemes originating in LIS, and those from commercial outlets. Their concern with LIS-based organization methods is that they rely on bibliographic metadata sources such as title pages that are not reliably available in video games, and that subject headings have been inefficient (Lee, Tennis *et al.*, 2013, p. 106). Even the LIS-developed FRBR and RDA models were insufficient, because they had been developed primarily to describe books and other traditional materials, and so they lack the conceptual framework, for instance, to adequately distinguish a digital game from a video (Jett *et al.*, 2016, p. 507). Commercial outlets, such as shopping and critical websites, also have no controlled metadata, and are geared toward making purchase decisions rather than organizing and describing (Lee, Tennis *et al.*, 2013, p. 109). Furthermore, as recently as 2012, they found that one of the main sources of information about games is their physical packaging (p. 109), which would be unavailable in an entirely digital environment.

A related project was the game metadata and citation project (GAMECIP). This was a joint project between the libraries and computer science department at the University of California Santa Cruz and the libraries of Stanford University, which aimed at creating "correct and thorough metadata schemas for digital games and related objects" (Kaltman, 2017), especially for libraries and repositories with game collections. Its projects include game citation and linking programs using both metadata and natural language processing (NLP), and a controlled vocabulary.

Chapman (2021) compares metadata schemas developed by "information professionals, fan communities, and commercial websites" (p. 63). Some difficulties and inconsistencies she finds between schemas involve issues such as the need for elements describing franchise (Chapman, 2021, p. 76), country of release (p. 78) and edition (80). She finds that edition is especially challenging to define with regards to digital games, because of the numerous ways games can receive patches, revisions, downloadable content (DLC), ports and so on. Commercial databases, she finds, may also allow users to add "tags" independently of the site's schema (Chapman, 2021, p. 88).

Two chief concerns that arise in the literature relate to the arrangement and description of games and game-related materials, and the functional representation of their code for user access. Arrangement and description will require the ability to describe video games with metadata, which is a major concern for a digital organizational system. Guttenbruner *et al.* (2010) emphasize the necessity of metadata both for access and for representation online. Among metadata terms, genre is especially difficult to specify, because different outlets define them differently (Lee, Tennis *et al.*, 2013, p. 107). Jett *et al.* (2016), in another paper released by GAMER, uses several terms to describe the "Game" entity within the VGMS's

conceptual framework, including “genre, mood, theme, setting, plot, etc.” (p. 508), all of which may be used interchangeably with genre in a nonstandardized schema. [Chapman \(2021\)](#) identifies a similar granularization. [Bobilin and Pagowsky \(2011\)](#), however, recommend Scott Nicholson’s SNAKS model, dividing games into “social...narrative...action...knowledge...[and] strategy” genres (p. 43). [Cho, Moulaison-Sandy, and Hubbles \(2021\)](#) emphasize also that authorship is especially difficult to describe, as well, noting that a simple “Creator” field, even referring to a single corporate body, is insufficient for projects as complex as digital games. [Cho, Donovan, and Lee \(2018\)](#) discuss the difficulty of distilling the visual style of a digital game into metadata terminology.

The study of games as information objects deals with issues surrounding collecting and providing video games, in terms of their value and services associated with them. This is especially relevant when considering the online collection as a kind of library. [Gee \(2012\)](#) emphasizes the benefits of gaming for teaching “21st-century digital media skills” (p. 67) and promoting “out-of-school learning” (p. 66) where possible, making them viable additions to libraries as learning environments. He also refers to the expectation that a library “stock the books that disadvantaged kids [cannot] own” and extrapolates it to other forms of media. [Farmer \(2011\)](#) explains that including video games in library environments promotes equity among players, for similar reasons. [Bobilin and Pagowsky \(2011\)](#) suggest reasons different information institutions may collect video games, including “entertainment and community engagement” in public libraries, “supporting the curriculum” in academic libraries, “education and socialization” in school libraries, and “preservation and cultural significance” in archives and museums (p. 43). Many of these suggestions are more relevant to physical brick-and-mortar libraries, but may hold to different degrees for digital environments.

Method

This study used a content analysis method to analyze online collections of computer games. Sites were found by using search engine queries and following links from known sites. The descriptive study of sites had two stages: first, to identify sites that may be considered viable collections for the needs of humanities study (including, for instance, a large selection, easy access and additional information about each game for comparison and analysis), and second, to examine the characteristics of these sites.

Stage 1. A list of characteristics of online collections of digital games was developed. To restrict the study to sites that are most useful for humanities research, in addition to their stated purposes as collections for public use, it was decided to build this list based on the functions of a digital library. [Borgman \(1999\)](#), describing previous work for the National Science Foundation (NSF), gives two main features of a digital library: as “a set of electronic resources and associated technical capabilities for creating, searching and using information,” and being “constructed, collected and organized, by (and for) a community of users, and their functional capabilities support the information needs and uses of that community” (p. 234). With these goals in mind, a list was made of the following criteria:

- (1) **The site is primarily a collection of information objects stored and accessed electronically.** This study is concerned with sites whose main function is for storing and distributing games. With regards to humanities scholarship, this is important for identifying sites that can be used as databases of computer games as primary sources.
- (2) **The site includes an access mechanism for the games.** The games themselves must be available for the site to be fully functional for research. Outside of scholarship, this is also necessary for preservation and community literacy.

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- (3) **The site provides free access within its target community.** While online storefronts are still useful for research, free access is necessary for research on a wide scale.
 - (4) **The collection is actively maintained.** A database that receives no maintenance is less likely to be reliable and accurate, especially over long periods of time.
 - (5) **The site includes some acknowledgment of copyrights.** Since the site is providing access to complete works, it is important for legal reasons that it not commit outright theft of intellectual property. This is also important for identifying safe practices, so that future collections can be protected from litigation.

(Note: Some leniency is given on this criterion. For instance, sites that only provide access to free games but do not otherwise acknowledge the games' copyrights are not considered to be in violation.)

- (6) **The site includes value-added presentation** (e.g. including more than a simple title and download link). It is important that researchers have access to contextual information about a game in addition to the bitstream itself.

Stage 2. Content analysis was performed on the Web sites identified in Stage 1, with the following list of questions to guide qualitative data collection:

- (1) How do online computer game collections provide access to the games they collect?
 - Do they provide only a download link to the original game files, provide games in precoded wrappers, play them in-browser using an emulator, only provide games that run on current systems, or use other methods?
 - What kind of retrieval methods are available on their site? Searching, browsing or other?
- (2) How do they use metadata?
 - Do they adhere to any standards, use their own schema, use community tags or a combination?
 - How do they obtain the metadata?
 - Does the metadata link items together?
- (3) How do they obtain permission to provide access to copyrighted materials?
 - Do copyrights limit the information the sites can provide?
 - Do they take an active role in seeking permission? Alternatives include providing only games with expired or relinquished copyrights, or addressing copyright claims as they arise.
 - Do they provide copyright information with items retrieved from their database? How well is it sourced?
- (4) Where applicable, what additional materials do they provide and how?
 - Items relating to playing the game: manuals, digitized contextual items

- Items relating to the game as information object: production documents, packaging
- Connected resources: reviews, articles, books

Results

Using search queries, Web rings and catalogs such as The Official Abandonware Ring (<https://www.abandonwarering.com>), dozens of sites offering computer games for download were identified. The goal was not to identify every site, but was intensive to ensure a representative sample. This search included sites from around the world, though research was limited in sites with no English language option. Of the many potential sites found in the search, 28 were met the criteria developed in step 1. 15 of these were then selected to analyze in detail.

Table 1 shows the sites and how the sites were evaluated.

Analysis of selected sites

The following is a report on each site, answering the questions developed in Stage 2. The data gives an impression of the similarities and differences in practices between them, from which can be derived the current state of online collections of computer games, and potentially the groundwork for future development with the humanities in mind. Comparisons and analysis are in the discussion section.

AbandonGames.ru – <https://abandongames.ru>

Because AbandonGames.ru is entirely in Russian, this study has attempted to identify the relevant information using Google Translate.

- (1) Access: Games are downloadable as disc images or as compressed files.
- (2) Metadata includes: Жанр [Genre], Разработчик [Developer], Издатель [Publisher], Год [Year] and ОС [Operating System].
- (3) Copyright: The user agreement (undated) states that the term abandonware is not legally actionable, and that copyrights still belong to their publishers, but predicts little risk of prosecution. It also states:

Все материалы, размещённые на Сайте, взяты из открытых источников и Администрация предпринимает меры обнаружения лиц, являющихся правообладателями данных материалов, в целях предотвращения нарушений законодательства различных стран в области интеллектуальной собственности ([AbandonGames.ru](https://abandongames.ru), undated).

[All materials posted on the site are taken from open sources and the administration is taking measures to identify the persons who are the copyright holders of these materials in order to prevent violations of the laws of various countries in the field of intellectual property.] (automatic translation by Google)

- (4) Additional materials: Most games appear to have screenshots, a description or review and a section for user comments.

Abandonia – <http://www.abandonia.com/>

Abandonia is an “abandonware” site, which provides access to software that is not currently commercially exploited, and therefore considered to be “abandoned” by their publishers, or else their publishers have disbanded. Abandonware is not, however, an official part of any copyright law. The site has been owned by Abovo, which is based in Sweden, since 2010.

	Stored and accessed electronically	Access mechanism	Free access	Actively maintained	Addresses copyright	Value added
100kb Ought to be Enough for Anybody (<a href="http://100kb-games.
heroes3wog.net/">http://100kb-games. heroes3wog.net/)	•	•	•	•		•
AbandonGames.ru* (<a href="https://
abandongames.ru/">https:// abandongames.ru/)	•	•	•	•	?	•
Abandonia* (<a href="http://www.
abandonia.com/">http://www. abandonia.com/)	•	•	•	•	•	•
Abandonware DOS* (<a href="http://
www.abandonwaredos.com/">http:// www.abandonwaredos.com/)	•	•	•	•	•	•
Abandonwaregames.net* (<a href="https://abandonwaregames.
net/">https://abandonwaregames. net/)	•	•	•	•	~	•
Best Old Games* (<a href="https://
www.bestoldgames.net/">https:// www.bestoldgames.net/)	•	•	•	•	~	•
Classic Reload* (<a href="https://
classicreload.com/">https:// classicreload.com/)	•	•	•	•	•	•
Computer Emuzone* (<a href="http://
computeremuzone.com/">http:// computeremuzone.com/)	•	•	•	•	•	•
DOSGames* (<a href="http://www.
dosgames.com/">http://www. dosgames.com/)	•	•	•	•	•	•
DOS Games Archive* (<a href="http://
www.dosgamesarchive.com/">http:// www.dosgamesarchive.com/)	•	•	•	•	~	•
Games Nostalgia* (<a href="http://
gamesnostalgia.com/">http:// gamesnostalgia.com/)	•	•	•	•	•	•
Good Old Games (GOG) (https://www.gog.com/)	•	•		•	•	•
Hall of Light (<a href="http://hol.abime.
net/">http://hol.abime. net/)	•		•	•	•	•
Internet Archive Software Library* (<a href="https://archive.org/
details/softwarelibrary">https://archive.org/ details/softwarelibrary)	•	•	•	•	•	•
Lemon64 (<a href="http://www.
lemon64.com/">http://www. lemon64.com/)	•		•	•	•	•
LemonAmiga (<a href="http://
lemonamiga.com/">http:// lemonamiga.com/)	•		•	•	•	•
Lostgames Abandonware* (https://www.lostgames.net/)	•	•	•	•	?	•
Macintosh Garden* (<a href="http://
macintoshgarden.org/">http:// macintoshgarden.org/)	•	•	•	•	•	•
Macintosh Repository* (<a href="https://macintoshrepository.
org">https://macintoshrepository. org)	•	•	•	•	•	•
My Abandonware* (<a href="http://
www.myabandonware.com/">http:// www.myabandonware.com/)	•	•	•	•	•	•
Old Games* (<a href="http://www.old-
games.ru">http://www.old- games.ru)	•	•	•	•	•	•
Oldgames Download* (<a href="https://
oldgamesdownload.com/">https:// oldgamesdownload.com/)	•	•	•	•	•	•
Play Retro Games Online* (<a href="http://www.playretrogames.
com/">http://www.playretrogames. com/)	•	•	•	•	~	•

(continued)

Table 1.
Games sites and
survey criteria

Table 1.

	Stored and accessed electronically	Access mechanism	Free access	Actively maintained	Addresses copyright	Value added
Reloaded* (http://www.reload.org/)	•	•	•	•	•	•
Software Preservation Society (http://www.softpres.org/)	•		•	•	•	•
Steam (http://store.steampowered.com/)	•	•		•	•	•
World of Spectrum* (http://www.worldofspectrum.org/)	•	•	•	•	•	•
Note(s): *The site has been determined to fit the criteria ?: Site information could not be fully explored due to language differences ~: Site makes a statement about abandonware, but does not explicitly address copyright						
Source(s): Keenan P. Cross						

- (1) Access: This site provides access to games via downloads of the original binary files that make up the game. It has a search bar and the option to browse games by genre.
- (2) Metadata: Terms listed for games includes producer, publisher, year, keywords, size, compatibility, genre, theme and perspective.
- (3) Copyright: Abandonia appears to respond to copyright issues as they come up. It does so mainly by changing “download” links to “buy,” which redirects the user to a place where the game can be purchased. The site has an agreement with the Entertainment Software Association (ESA), which states that it will not make any game available produced by a member of that organization until fifteen years after its release (Dave, 2009). The page for each game lists the producer and publisher for each game.
- (4) Additional materials: In addition to the games themselves, Abandonia collects as much additional information as possible to provide users. Many games have manuals and other documentation available, as well as cover artwork. Some have resources for bypassing the game’s original copy protection scheme, and “extras” such as walkthroughs, hints and save files. There are also community-generated materials, such as comments, message boards, reviews and ratings.

Abandonware DOS - <http://www.abandonwaredos.com/>

- (1) Access: Like Abandonia, this site also provides the original binary files of games that are not currently being commercially distributed. It offers a keyword search function and games can be browsed (though this function is called “searching” on the site) by genre, title, keywords, developer, publisher, designer, release date, operating system and, interestingly, by awards received.
- (2) Metadata: Terms that appear on a game’s page can be browsed. These include genre (or genres), system, year, publisher, developer, themes, keywords and game modes; nonbrowsable metadata under “additional info” include input, distributed on [media] and also published for, as well as popularity statistics.
- (3) Copyright: The site’s frequently asked questions (FAQ) includes a contact link for rights holders to request that access to certain games be removed from the site.

Games claimed by copyright holders and found to be available for purchase elsewhere are given “protected” status and the download link is replaced with a link to the site at which the game can be purchased.

- (4) Additional materials: Items, such as box lists and “feelies” (physical objects included with games) are listed but not scanned. Manuals and walkthroughs may be available, as well as community-generated comments, ratings and information.

Best old games – <https://www.bestoldgames.net/>

Best old games has been operating since 2004, and has a catalog of about 600 games, mostly for MS-DOS and Microsoft Windows, from 1981 to 1997.

- (1) Access: Games are available as original downloadable files, and DOS games are playable in the browser using a java-based emulator.
- (2) Metadata: Terms are genre, year, developer, publisher, perspective and theme.
- (3) Copyright: Best old games has a page describing abandonware, on which the administrator notes that the games may be protected by copyright, but that they are unavailable without distribution.
- (4) Additional materials: The page for each game has a section for extras, but they are not present for every game.

Computer Emuzone – <http://computeremuzone.com>

Computer Emuzone is dedicated to providing access to Spanish-language games for all legacy systems available in Europe.

- (1) Access: The site provides the original binary files for PC (“personal computer,” in this case a catch-all term for computers running Microsoft operating systems) and Macintosh games, and disk, tape or ROM images (e.g. files containing the code stored on the read-only chip within a removable cartridge) for incompatible computers such as the Amstrad CPC or Game Boy Advance. Games can be keyword searched or browsed by name, system, developer, publisher, release date and genre, as well as popularity, community rating and curated lists.
- (2) Metadata: Terms (listed as “info”) include: Idioma/Language, Género/Genre, Tipo/Type, Distribución/Distribution, Prec./Price, Colección/Collection, Motor/Engine, and Juegos relacionados/Related games.
- (3) Copyright: A disclaimer at the bottom of the site says that the site’s maintainers have asked permission to provide each game, and that, only games whose rights holders gave permission or did not respond are provided. Developer and publisher credits are given on game pages.
- (4) Additional materials: Some games include scanned manuals and maps. Scanned cover art is often available. There are also text-only magazine articles, and interviews with developers.

DOSGames - <http://www.dosgames.com/>

DOSGames provides access to freeware and shareware games and demos.

- (1) Access: This site provides downloads of the original binary files. Games can be keyword searched and browsed by genre.
- (2) Metadata: Terms include author, category, license, multiplayer, DOSBox (referring to compatibility), for kids, and resolution. Additional tags are provided for sorting.

- (3) Copyright: The games DOSGames provides are in formats that are intended to be freely distributed and the site gives credit to their authors and publishers. In the case of shareware games, it provides the download but not the license.
- (4) Additional materials: Additional information includes only brief descriptions and reviews by the site's author, and walkthroughs.

Games nostalgia – <http://gamesnostalgia.com/>

Games nostalgia is an Italian site which provides games for MS-DOS, Amiga, Windows, Commodore 64 and Atari ST.

- (1) Access: The games are encapsulated in emulator-based wrappers for download. They can be searched by title or browsed by genre and tags.
- (2) Metadata: Terms include alias (alternative names), year, genre, publisher, developer, OS (operating system) supported and updated, as well as additional tags. Clicking on a metadata term returns a browsable list of games sharing the term in that field.
- (3) Copyright: The site acknowledges that the term abandonware is unofficial, but mentions that famous developers such as Richard Garriott and Tim Schafer support it (Games Nostalgia, 2017). It does not remove games that are monetized, but suggests that users purchase games they have played and enjoyed if they are sold elsewhere.
- (4) Additional materials: Some games include manuals, but most have only a review written by the site and community generated comments.

Internet archive software collection – <https://archive.org/details/softwarelibrary>

The Internet Archive is an enormous project originated in 1996 by Brewster Kahle. Its software collection, launched in 2014 by Jason Scott, is one of the largest and most reputable digital libraries of legacy software, including both games and other applications.

- (1) Access: It provides access via both downloads of the original bitstreams and in-browser encapsulation using java-based emulators. These make it capable of providing games for dozens of platforms, including consoles and computers. The overall software library includes 197,122 applications as of August 2022, but no total number of games is given. Game collections include the Internet arcade (arcade-only titles) the console living room (console-based titles), DOS Haven (for contemporary games programmed for MS-DOS) and software library collections for various computers. Games can be searched or browsed by system or collection.
- (2) Metadata: Both public and system metadata are visible. Public metadata includes published by, developed by, released, also for, genre, perspective, theme and description. System metadata include identifier, mediatype, scanner, publicdate, addeddate, emulator_ext, emulator, creator, date, year, backup_location and language. Terms cannot be clicked on to view games which share the term.
- (3) Copyright: The site includes a general copyright policy, which includes a contact email to which copyright holders may send requests that their games be removed. There does not appear to be any standard procedure for this. The Internet archive was granted an exception from the DMCA in 2003, for preservation purposes.
- (4) Additional materials: Some manuals are provided, but mostly scanned in a separate collection. Another separate collection houses production and promotional materials, discussed later. There is also a large amount of community-generated material, including comments and reviews.

Macintosh Garden - <http://macintoshgarden.org/>

Macintosh Garden was originally hosted at another site called Home of the Underdogs, but since then the site has become a partner with the University of Portsmouth as a software archive.

- (1) Access: The site provides downloads of the original bitstreams, sometimes as disc or disk images. Its downloads are hosted in Sweden, with US-based mirrors. Games and applications can be keyword searched or browsed alphabetically or by genre.
- (2) Metadata: Terms include category, perspective, year released, author, publisher and engine.
- (3) Copyright: The site addresses copyright claims as they arise. A disclaimer at the bottom of the home page states that Macintosh Garden does not own the rights to the games it provides, and offers an email link for rights owners to ask that games be taken down. A notice in the forum explains that this was the case with games published by electronic arts, and at one time the site removed the download link for all games from that publisher, but as of August 2022 those links are active.
- (4) Additional materials: Some manuals are available in PDF format, as well as user-submitted images of packaging.

Macintosh repository - <https://macintoshrepository.org>

Macintosh repository is a robust software collection focusing on the classic Macintosh, but also including Mac OS X software, and other early Apple computers, such as the Apple II, Lisa and Pippin video game console.

- (1) Access: The site provides direct downloads of files in their original formats and structure, usually as compressed archives or as disk images.
- (2) Metadata: Terms include architecture (which hardware it requires), For Mac OS (version; treated as operating system in Table 2), year of release, author, publisher, type and category. Additionally, items may be sorted by the name of the user who submitted them to the site, and by a wide variety of tags.
- (3) Copyright: The site is community-driven, so copyright behavior varies, but it includes authorship with each item.
- (4) Additional materials: Most items have a carousel of screenshots on their download page.

MyAbandonware - <http://www.myabandonware.com/>

MyAbandonware has large catalog of over 21,200 titles, built in 2009 from the remains of an older site called Oldwarez.

- (1) Access: The site provides games from many platforms as binary downloads. These games can be keyword searched with metadata filters or browsed alphabetically or by release date, platform, genre, theme, publisher or developer.
- (2) Metadata: Terms include year, platform, country, theme, genre, publisher and developer. Terms can be clicked on for a list of games sharing the term.
- (3) Copyright: The administrators remove download links from the pages for games that they find to be on sale elsewhere, and replace them with links to sites where the game is sold. There appears to be a partnership with Good Old Games (GOG), which advertises with recommended games throughout the site.

	AddedDate	Age rating	Architecture	Alias	Atmosphere	Author	Availability	Backup Location	Category	Compatibility	Country	Creator	Description	Designers	Date	Developer	Distribution	Emulator	Full title	Genre/Type	Graphics	Identifier	Input	Inspired by	Keywords	Language	Main character	Mediatype	More info	Multiplayer modes
AbandonGames.ru																														
Abandonia																														
Abandonware DOS																														
Best Old Games																														
Computer Emuzone																														
DOSGames																														
Games Nostalgia																														
Internet Archive																														
Macintosh Garden																														
Macintosh Repository																														
My Abandonware																														
Old Games																														
Oldgames Download																														
Reloaded																														
World of Spectrum																														

	Operating System	Original publication	Other systems/Also For	Perspective/View	Platform/OS/Machine type	Player/Number	Popularity	Price	Producer	Protection	Scheme	Public/Done	Publisher	Re-released by	Requirements	Related games	Resolution	Scanner	Series	Sound	System	Size	Tags	Technical details	Theme	Tie-in license	Topic	Updated	Webpage	Year/Released
AbandonGames.ru																														
Abandonia																														
Abandonware DOS																														
Best Old Games																														
Computer Emuzone																														
DOSGames																														
Games Nostalgia																														
Internet Archive																														
Macintosh Garden																														
Macintosh Repository																														
My Abandonware																														
Old Games																														
Oldgames Download																														
Reloaded																														
World of Spectrum																														

Table 2.
Metadata terms used
by each site

Source(s): Keenan P. Cross

- (4) Additional materials: Only community generated extra materials are provided. These include screenshots and reviews.

Old-Games.ru – <http://www.old-games.ru>

Old-Games.ru is a Russian site with a collection of 12352 games as of August 2022.

- (1) Access: The games are made available as binary downloads and disk images. They can be searched by title or browsed by genre, platform, release date and title.
- (2) Metadata: Terms by which games can be browsed includes genre, developer, publisher, released and platform. Other metadata includes technical details, perspective, language, atmosphere, audience, topic, plot, main character and country or region of origin.
- (3) Copyright: The site restricts its collection to games published outside of the russian Federation, and only provides access to games released as late as 2008. Otherwise, the administrators link to sites where monetized games can be purchased.
- (4) Additional materials: These vary by game but often include manuals and other documentation. Production materials are sometimes available for unreleased games,

for example Crack Dot Com's development timeline for Golgotha (Old Games, 2017). Community generated Russian translations are also commonly provided.

Oldgames Download – <https://oldgamesdownload.com>

Oldgames Download is a relatively new site founded in 2018, with a collection of over 2000 games.

- (1) Access: Games are provided as binary downloads, ROM dumps or disc images, depending on the original format. Games are sorted by genre, year and platform, and can be searched by keyword.
- (2) Metadata: Fields include publishers, developers, release date and genre. Games are sorted by tags, such as "Video games released in 1990," and "DOS."
- (3) Copyright: Games' pages list their developers and publishers by name. The downloads are hosted on the Internet Archive, to take advantage of its DMCA exception.
- (4) Additional materials: There are sections on each game's page for "Additional files, patches and fixes" and screenshots. Additional files generally include manuals.

Reloaded – <http://www.reloaded.org/>

Reloaded is an affiliate of Abandonia. Like DOSGames, it provides only freeware games.

- (1) Access: Games are generally provided as binary downloads, but games programmed in flash can be played in-browser. Games can be keyword searched or browsed by genre.
- (2) Metadata: Terms include made by, Website, more info, size, multiplayer modes, age rating, requirements and genre. Some terms are links to agent records.
- (3) Copyright: Reloaded provides only free games and gives credit to games' creators.
- (4) Additional materials: Because these games tend not to have been distributed physically, there are no additional resources aside from site- and community-generated articles and comments.

World of Spectrum – <https://www.worldofspectrum.net> (classic site), <https://www.worldofspectrum.org/> (new site).

World of Spectrum is another of the oldest sites of this kind. It is also one of the best-known, due to its victory in a DMCA case (Van der Heide, 2003). It keeps an exhaustive catalog of games released for the Sinclair ZX Spectrum computer line in the 1980s and 1990s.

- (1) Access: The games are available as cassette tape images (with the file extensions .TAP and .TZX) to be used with emulation or loaded into the original computer. They can be searched or browsed alphabetically.
- (2) Metadata: World of spectrum classic has very rich metadata. Terms include full title, year of release, publisher, rereleased by, author(s), tie-in license, inspired by, machine type, number of players, controls, type, message language, original publication, original price, availability, protection scheme, additional info, series, and other systems. Additional metadata is given for other materials, such as download files, additional materials, magazine references and so on. For instance, metadata for download and play links includes filename, size, type, origin, code, barcode and D. L. encoding scheme. The newer site uses a more streamlined set of terms.
- (3) Copyright: Site administrator Martijn van der Heide dismisses the concept of abandonware as a term "invented by sitemasters to cover up their illegal activities"

(Van der Heide, 2003). Instead, the site actively obtains the rights from as many original publishers and authors as possible. Van der Heide asks for supporters to contact rights holders on the site's behalf as well. A list of permissions is available at <http://www.worldofspectrum.net/permits/>. The site is also officially endorsed by Amstrad, which owns the rights to the ZX Spectrum line's ROMs, so it is legally allowed to distribute emulators and software.

- (4) Additional materials: This library site the most additional information of any included in this paper, such as screenshots, box, manual and cassette insert scans, cheats, advertisement and scans of magazine pages mentioning or reviewing the game. However, many of these are in the form of links to other sites that are no longer available.

Discussion

There are no standards of any kind for online collections of computer games. However, some trends become apparent in comparing sites that may inform the development of future standards.

Access

Providing a download of the original binary files is the simplest and most common means of providing access among the collection sites surveyed. It requires only uploading a game's files to a server and linking to its location on the page. There are a few advantages and disadvantages to this method. For one, the direct download gives the user access to a folder including the game's files (at least in systems such as MS-DOS), which makes it easier for the user to manipulate, fix problems with and generally understand the game. It is also an opportunity for value-added presentation, such as files included in the download that affect gameplay, such as optimization for emulators or customization options. However, downloads require that the user have access to the proper hardware or software required to run the game, and in the case of emulators may still require some knowledge of command-line operation and configuration.

The main alternative to emulation is encapsulation. This is a method by which a "wrapper" is created with instructions to run a program in a different environment, often using an enclosed emulator, usually coded in Javascript. The resulting package is potentially much easier for the user, because it requires no extra software, hardware or expertise. It is more demanding on the site, though, and can create "very large files" (Harvey, 2010, p. 169), limiting the site's ability to provide games if resources are limited. Three of the collection sites (games nostalgia, the Internet archive and my abandonware) present their games using encapsulation. Browser-based encapsulation, such as those offered by the Internet archive and best old games, is perhaps the most convenient for the user, but does not allow the user to access the game's file system and limits flexibility.

Relying on external emulators is necessary for the provision of noncurrent games (as all games will one day be), but it complicates the process, especially given that an emulator is itself yet another piece of software that requires the proper environment to function. Rothenberg (2002) advocates emulation for continued access to computer programs. In terms of digital games, emulation is necessary to recreate the behavior of software for any older computer or console, by recreating older hardware in software form. Sites that provide only binary downloads, such as Abandonia, often also give access to a list of emulators that can run games in different formats. Sites that encapsulate their games package the emulator with the game, such as the Internet archive's use of the Javascript Multi Emulator Super System (JSMESS) emulator, but may also provide direct downloads which require the user to have access to another emulator.

Metadata

Metadata will be vital to retaining access to all games in the future, as it is necessary for organization, arrangement and retrieval. [Guttenbruner et al. \(2010\)](#) emphasize the necessity of metadata both for access and representation. Even so, there are no formal standards for video game metadata. Each of the fourteen sites in this study used a different set of terms to describe the games in their collections. [Table 2](#) shows the list of metadata terms used by each site.

The three terms most commonly used are “Genre” (sometimes labeled “Type”), “Publisher,” and “Year [of release].” These are all very important elements to include, and would be invaluable for searching and sorting. Of all terms found in these sites, only “Genre” is used by every site except one [\[1\]](#), likely for discovery purposes, for users seeking comparable experiences. Other popular terms include “Language,” “Developer,” “Perspective” (or “View”), and “Theme.” The prevalence of “Genre” gives weight to [Bobilin and Pagowsky’s \(2011\)](#) emphasis on the SNAKS model, to give a degree of consistency.

There is disagreement between sites on the term to be used for games’ creators. This term is alternately called “Developer,” “Producer,” “Author,” “Made by,” and “Designers.” Nearly all sites use at least one of these terms, but as their meanings may be different, this study does not take them as identical. “Developer” may refer to the software development company responsible for all the design and code, while “Author” may refer to a specific coder or writer. As [Cho et al. \(2021\)](#) lament, the use of these terms is not even standardized in video game credits themselves (p. 5). Most sites specified both “Publisher” and “Developer” separately.

“Year,” “Released,” and “Date” may be similarly separated, as they may refer to different chronological elements, such as specific release dates or year of completion. Likewise, “Platform,” “Requirements,” “Machine type,” and “Compatibility” could be used in different ways. “Platform” is used by My Abandonware, which collects games for various computer systems and consoles, and by Old Games, which distinguishes between a few platforms. “Requirements” is used by Reloaded, and lists operating system or emulator requirements. “Machine type” is used by World of Spectrum and specifically lists which models of ZX Spectrum computer can run the game. “Compatibility” is used by Abandonia to list required emulation software. These are all similar uses, but could be understood using one standardized term.

The Internet Archive and World of Spectrum have the richest metadata of these sites, with fourteen and sixteen terms, respectively. The former lists its administrative and system metadata in addition to public metadata, exposing games’ identifier and backup location among other features to the user. It was the only site in this analysis to do so. On the opposite extreme, DOSGames does not list metadata.

Addressing challenges noted in developing the VGMS by [Lee, Tennis et al. \(2013\)](#) the present study suggests that unofficial, player- or enthusiast-driven collections such as the sites surveyed here may effectively address some of the issues they found. These sites develop their metadata based on the practical use and acquisition of games by their players, making them more accessible and useful to the public than LIS-oriented frameworks might. Also, unlike commercial outlets, these sites are not primarily concerned with driving purchases, but with helping users navigate a large collection based on their potentially very granular needs. This reflects [Chapman’s \(2021\)](#) observation that “fan communities have led the way in creating systems that effectively capture videogame [sic] metadata for preservation and dissemination; but a few academic schemas have begun to draw level with these fan-developed databases” (p. 64).

Copyright behavior

There is not agreement on the legality of providing copyrighted software. Fair use may protect distribution in some sense, but, in the words of Judge David Nelson, “Fair use is one of the most unsettled areas of the law...so flexible as virtually to defy definition”

(Liu, 2019, p. 165). Therefore, in addition to showing good-faith attempts to avoid infringement on copyrights, the sites in this study also have to avoid other legal statutes. The noncommercial redistribution of software is not specifically prohibited by the DMCA or the World Intellectual Property Organization (WIPO) treaties upon which it is based, only the circumvention of its digital rights management (DRM) technologies ([Digital Millennium Copyright Act, 1998](#)). Material to bypass “Copy protection” (an earlier term for DRM tricks and technologies in computer games) is occasionally provided by these sites, but this study did not reveal any DMCA actions taken for that reason.

Most of these sites operate under the label of “abandonware,” which is a nonlegal but frequently accepted term. As described above, abandonware is software that has been “abandoned” by its publisher, which, according to its proponents, makes it ethically, if not necessarily legally, acceptable to redistribute it. The sites in this study generally operate under good faith principles, including games in their collection but inviting publishers to contact them requesting that they take one down or removing its download link. Of publishers, electronic arts appears to be the most likely publisher to demand their games be removed, having issued a warning to Macintosh Garden ([Maedi, June 10, 2010](#)) and refused World of Spectrum’s request for permission.

World of Spectrum engages in a much more laborious method, actively seeking permission from the developers and publishers of every piece of software in its considerable collection. Because this is such a large task, this site asks its community to assist in it, and keeps meticulous records of whom has been asked. While this is an ideal strategy for an online collection of computer games, it is too labor-intensive. [McDonough \(2011\)](#) gives an example of the process of tracking down the ownership of a game’s copyright, listing nine changes to the name and corporate ownership of Atari. Since the majority of digital games are copyrighted to corporations, this is bound to be a problem faced in most situations in which a distributor tries to license an older game. As [Brito and Dooling \(2005\)](#) note, “Over time, corporations reorganize, file for bankruptcy, and change ownership. . . Additionally, copyrights can be assigned to others, which leads to more confusion as assignments made in private contracts are likely not to be found anywhere in the public record” (p. 79-80). In this way, many older games may reasonably be considered orphan works and their free online distributors more likely to succeed in a copyright case brought against them. It should be noted that World of Spectrum has still been cited for piracy despite these efforts ([Lettice, 2003](#)).

Another strategy is to impose an embargo on games, such as Abandonia’s 15-year embargo on games published by ESA member companies. This way, the games are virtually guaranteed to require obsolete hardware, so distributing them as a means of preservation is allowed under a 2003 ruling by the Copyright Office ([Digital Millennium Copyright Act \(b\), 1998](#)). The Internet archive operates under this provision as well ([Internet Archive, n.d.](#)). World of Spectrum was taken to court under the DMCA in 2003, but the case was dismissed on these grounds ([Van der Heide, 2003](#)). As [Khong \(2007\)](#) notes, the embargo principle does reflect nonuse deregistration in trademark law, if not necessarily copyright law.

Several of these sites are also based outside of the US, where the DMCA is not necessarily law. Abandonia is owned by a Swedish company, Old Games is a Russian domain, and My Abandonware is based in France. These are all United Nations countries and subject to WIPO treaties, but these may not be as strictly enforced as the DMCA. However, as [Bachell \(2014\)](#) points out, every country has its own copyright laws, making it very difficult to research and comply with them all.

Additional materials

Most materials provided additional to games fall under the “value-added” category: Abandonia provides manuals, maps and “box shots” (photographs or scans of packaging),

Macintosh Garden provides manuals, and World of Spectrum provides press, though the links to many of the magazine articles listed are broken. The Internet archive has a separate collection of a large number of manuals and other documentation materials. Nearly all the sites in this study include community-generated material such as comments, reviews, ratings and guides.

Most additional materials would naturally be difficult for Web sites to obtain, given the age and fragility of the games. Production materials would be the most valuable to preserve, but also the most difficult to find. Old Games' press images and demo for Crack dot Com's unreleased *Golgotha* are an example of a well-documented game with significant online production materials that are not as difficult to find as others.

A physical collection of these kinds of items is the Video Game Media Assets Collection at the Video Game History Foundation, which collects press kits, beta documentation and other items from video game development (Cifaldi, 2017). The Internet archive keeps a mirror of this collection. Given time and labor, this would put the Internet archive in a prime position to create a very rich and cross-referenced collection, with many unique assets for a large number of games in its collection. It may even be possible for other sites to collaborate and build stronger multimedia collections between them.

Production materials are very difficult to obtain, as they are often kept private as trade secrets or, as Bachel (2014) found, developers may be disinterested in preserving previous releases in favor of focusing on future ones. A very large number of documents are generated in the production of a video game that may be of interest to digital library users, including game design documents, art style guides and demos among many more (Daiger, 2011). Another study in the materials generated during game production is Kaltman *et al.* (2014).

Providing additional materials also allows a site more protection against copyright claims, as value-added presentation has precedents for courts considering a database of copyrighted materials to be fair use. This was the case in *White v. West Publishing*, wherein a lawyer sued the owners of the Lexis database for providing access to copyrighted legal briefs. The court decided that the database's use was sufficiently transformative, in part because it "added something new by inserting codes and links to these legal documents" (Samuelson, 2015, p. 847).

Further research

Where this study surveyed sites based on their online content, further studies may benefit from interviewing administrators of each site for more in-depth and specific information. This may potentially reveal information unavailable from the site itself, such as the internal metadata used by other sites, such as is only available publicly at the Internet archive, and the process of organizing and creating such a site, including the commonalities and differences in different administrators' experiences. It may also clarify copyright philosophies, such as specific language regarding copyright laws, strategies and actions taken against the site where applicable.

There is much more to be learned with regards to copyright on this subject in general. An in-depth comparison between the concept of abandonware and accepted legal terms such as orphan works, similar to Khong (2007), but with an emphasis on practices of preservation and free access could reveal strategies for use and protection. Similarly, a study specifically on the measures these sites take to keep themselves safe from a copyright suit on fair use grounds could also be informative. What makes a catalog entry that includes a full download of a copyrighted computer game considered transformative? Especially with regards to Humanities scholarship, how does access to computer games differ from the games' original intended purpose? Research is warranted into comparative copyright practices, including

more intensive legal study and evaluations of past court case. Comparisons between the copyright laws in the home countries of different sites, and how they affect availability and practices, may also be a fruitful avenue for research.

A detailed comparison between these sites' metadata schemas and the ones developed by scholars, such as the VGMS and GameCIP, could also help refine future practices, both for scholars and for future game databases.

This study primarily surveyed the selected sites in a vacuum; future research could position them in their wider contexts as well, to understand their respective user bases, audiences, contributors and histories. Another similar study may compare community-generated material and other social functions with regards to humanities practices.

As mentioned in the introduction, this study was restricted to a very limited category of digital games. Further studies on sites that collect and distribute console, arcade, mobile and other categories of games may have widely varied results. Console games, often distributed as raw dumps of the code on a cartridge's ROM chip, have been especially vulnerable to litigation on copyright grounds, as in the case of *Nintendo v. ROMUniverse* (Van der Sar, 2021), and a survey of them may find very different results involving copyright and fair use. A study of the distribution of emulated arcade games, which are generally tied to standalone machines accessible only in certain physical locations in their original uses, may find helpful examples of transformative reuse. All of this information may be different when collecting games intended for virtual reality (VR), as well.

Conclusion

This study has explored the state of online collections of computer games, and determined patterns in their approaches. It examined the sites according to their access provision, metadata usage, copyright behavior and additional materials. No standards were found in any of these areas, but a few trends emerged. The two access mechanisms were binary downloads and encapsulation, with preference for the former. Metadata was found to be highly inconsistent, but terms for genre, publisher, developer and release date were found in nearly all the sites. Each site surveyed operated under the claim that they are preserving games released for obsolete hardware, which ostensibly protects them from prosecution under the DMCA. Many, however, employ strategies to avoid infringement on copyrights still enforced, such as removing listings for games that are still being sold by their publishers or inviting publishers to contact them regarding games they wish removed. Still others are based outside of the US, in locations where the law is less strict. Few provide additional materials beyond manuals and community-generated content. It is possible that partnering with physical collections, such as the Internet archive mirroring the Video Game History Foundation's Video Game Media Assets Collection, may be a useful strategy for providing the best quality collections. Online collections of computer games can benefit from greater standardization for interoperability, codification of legal practices and collaboration for added value.

Note

1. DOSGames, which designated genres in the Category field, as well as tags.

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