Extending Capacities in Digital Archaeology

Study Leave Report, March 15 - September 15, 2021

John Durno

October 22, 2021

Contents

1 INTRODUCTION

In my application for study leave I indicated I would be working in the area of digital archaeology, focussing on the recovery and restoration of early Canadian Telidon artworks, and on enhancing our Historic Computing inventory and web site. I am pleased to report that although my primary focus was on Telidon, I was able to make significant progress in both project areas during my leave. I also had the opportunity to work on a number of related initiatives not explicitly identified in my application, but which contributed to its overall objectives.

A considerable part of my leave was given over to software development, as described below. It is important to note that this work is part of my research programme. I am not just building infrastructure. The development work I am doing here contributes constructively to conversations happening currently in the digital preservation space. In particular, retrofitting the affordances of the modern web onto software emulations of media art from earlier eras in order to enhance accessibility is only now beginning to be seriously considered in venues focussed on this kind of work.

2 TELIDON DEVELOPMENT

2.1 Background

Telidon was a vector graphics encoding protocol developed in Canada from 1978 through 1985, eventually standardized as the North American Presentation Level Protocol Syntax (NAPLPS) after various US-based entities (notably AT&T) became involved.[1] It was used primarily in conjunction with a variety of public and commercial online information services in the pre-web era.

The recovery and restoration of Telidon art has been a major focus of my research since 2015. I became interested in Telidon art when I was asked to undertake the restoration of several Telidon works made by Victoria artist Glenn Howarth, in the collection of our University Archives. That project concluded successfully in 2016.

While researching the technologies Howarth had used to create his artworks I became aware there had been dozens of other artists from across Canada working in Telidon in the early-mid 1980s. Unfortunately almost all

[1] Canadian Standards Association/American National Standards Institute, "CSA T500-1983/ANSI X3.110-1983. Videotex/Teletext Presentation Level Protocol Syntax: North American PLPS," 1983.

of their work had long been thought 'lost' due to the extreme obsolescence of the specialized and rather obscure hardware and software required to display it.[2] Given the significance of Telidon art as some of the very earliest networked digital art in Canada, it was well worth exploring how much of it still existed in its original form, and whether the approach I had developed for restoring Glenn Howarth's artworks could be applied to recovering the works of other artists.

In the years following I made contact with a number of original Telidon artists and curators, as well as others seeking to recover and restore Telidon art. A core group of collaborators emerged out of those initial contacts, centred on InterAccess, a Toronto based media arts centre that (as Toronto Community Videotex) had been the centre of Telidon art production in Canada in the 1980s. A large collection of floppy disks and tapes containing Telidon files and videos was found in a storage room at InterAccess, and smaller collections were found in other public and private repositories.

Data recovery efforts were funded by an ICRPG grant (awarded to me) and a Canada Council grant, awarded to our curator, Shauna Jean Doherty. I also did some data recovery work myself. Well over 10,000 files were recovered from floppy disks and dozens of videotapes were digitized in this initial stage of the project. I developed a web emulator and workflow for reviewing the contents of the disks, and made the contents accessible to my collaborators on a server provided by Compute Canada, which I maintain.[3]

With InterAccess as the lead organization, we applied to Digital Museums Canada (DMC) for funding to create a web exhibition of Telidon art to launch in 2023, marking InterAccess' 40^{th} anniversary. The application was successful, as was an application to the Canada Council to fund a gallery exhibition at InterAccess the same year. UVic Libraries has committed to providing significant in-kind resourcing for both projects, primarily in the form of work performed during my leave.

Finally, I will note that just prior the start of my leave the Art Gallery of Ontario expressed an interest in acquiring InterAccess' collection of Telidon materials for their Archives. I participated in preliminary discussions during my leave and will continue to advise and assist in a technical capacity as this initiative moves forward.

[2] J.Pearson, "The Original Net Artists: The Lost Art of Canada's Doomed Pre-Internet Web," Jul. 21, 2015. Motherboard. Available: https://www.vice.com/en/article/ezveak/the-original-net-artists (Accessed: Oct. 15, 2021).

[3] The server is hosted at https://telidonart.ca, and is private as we do not have the rights to exhibit the works publicly. Credentials available on request

2.2 Telidon Web Exhibition

My study leave began just as InterAccess initiated the process of hiring a web development agency, to resource the creation of the Telidon web exhibition site. I acted as a technical resource, developing interview questions, participating in interviews, and helping to select the winning proposal. I have continued to work with the web agency (Tennis) throughout my leave. It has been a productive working relationship, particularly given that we are using non-standard and relatively new web technologies to showcase the artworks. Tennis has worked with us to overcome the interesting challenges this has sometimes presented.

The working relationship with Digital Museums Canada has also been quite productive. Unlike many granting agencies in the academic sector, DMC takes a hands-on approach to working with the projects they fund. This has necessitated regular check-in meetings and reporting back to ensure our project is on track and meeting their requirements. I participate in meetings as required, generally when there are technical matters to clarify or resolve.

I am of course also in regular communication with the rest of the exhibitions project team, via bi-weekly Zoom meetings and email.

2.2.1 Web Emulator

A significant technical challenge emerged very early on in my leave. Core DMC technical requirements include descriptive text for all visual content, a mobile-friendly interface, and text in both official languages. It was by no means clear at the outset of my leave how this could be achieved in the context of presenting 35 year old interactive artworks running under web emulation.

Prior to my leave I had successfully developed a Telidon web emulation software stack based on DOSBox, the same platform used by the Internet Archive to make DOS games playable on the web. However, it was missing key functionality that would need to be developed to meet the DMC requirements and address basic usability issues. Fundamentally, the central limitation was that the emulator existed as an isolated element on the web page, unable to interact with anything on the page outside its own limited window. Working within the emulator was very like working with an MS DOS operating system circa 1988.

In order to address this limitation I began working with a javascript API called JS-DOS. JS-DOS is an open source project in active development,

Figure 1: Telidon Web Emulator

focussed on a similar problem space: how to make DOS games playable on mobile devices on the web. Out of the box, JS-DOS enabled me to create simple control widgets on page outside the DOSBox window. That went a long way toward addressing the mobile requirement, as it meant the user no longer needs to have an attached keyboard to interact with the emulation.

However, out of the box JS-DOS did not offer an avenue for addressing the funder's requirements for descriptive text and translation. The core problem had to do with communicating state between the application running in the emulator, and web page that frames it. The framing descriptive text and translation had somehow to be linked to the user's current place within the emulation. Since the emulated artworks could change in response to user input, that meant the application running within the emulation needed some way of telling its external environment which text and translation to display at any given moment. However, the JS-DOS API provided no way to do this, as it is solely concerned with sending input into the emulation, not with responding to changes within the emulation itself.

My solution was successful, but I have to note that it is probably unique to our particular use case. Part of my Telidon emulation software stack consists of a display controller I programmed myself, that runs inside the

DOSBox emulator. I was able to modify the display controller to write its current status to a 'file' in the emulated 'filesystem' inside the DOSBox emulator.[4] A function was then added to the JS-DOS API to enable the environment to read the current state of the artwork from the status file.

With that in place, it was fairly straightforward to keep the contextual display (descriptive text/translation) in sync with whatever was showing inside the emulator.[5]

2.2.2 Microstar Graphics Editor

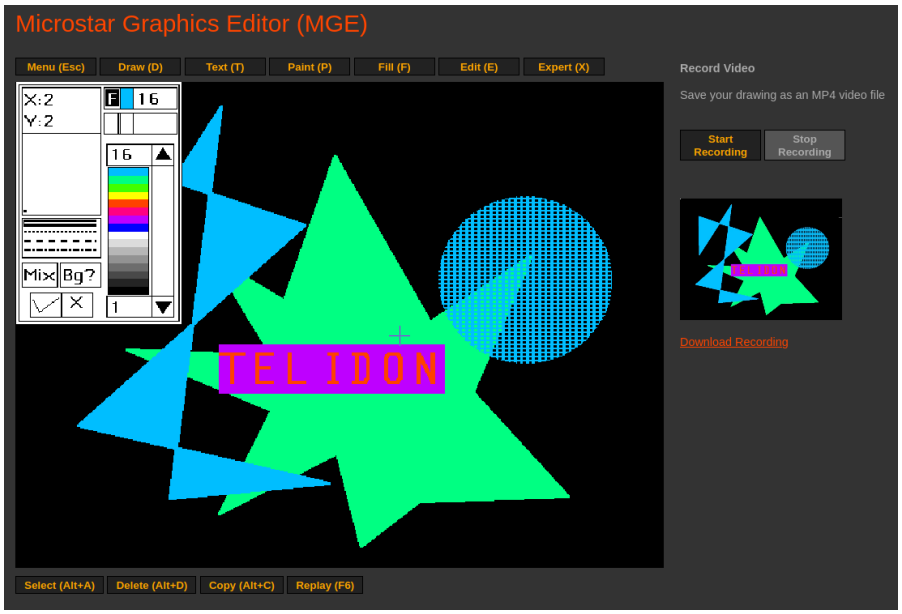

Figure 2: MGE Editor (Web version)

On the initiative of our curator, the proposal to DMC included a commitment to add audience participation features to the exhibit. From a technical standpoint, the most challenging feature we included in our proposal was to make a Telidon drawing program available on the web, enabling visitors to create their own Telidon graphics and post them to an online forum.

[4] 'File' and 'filesystem' are in quotes because they exist entirely inside volatile browser memory, they are not actually written to disk

[5] A draft version of the Telidon emulator is available at: https://webapp.library.uvic.ca/jdurno/vtdemo6/

It was not immediately clear to me how we would meet this requirement. As noted above, Telidon was basically a vector graphics encoding format. What made it unique was its extremely compressed file format (optimized for the storage capacities and bandwidth of 1980s computing hardware) as well as some of the specific affordances of the Telidon protocol with regard to colours, textures, text formatting, display timings and so forth. While we could have made a simple, generic vector graphics drawing program available on the web easily enough, it was hard to see how that would constitute an authentic Telidon graphics creation experience for exhibition visitors. Nor would time and resource constraints allow us to code a Telidon drawing program from scratch, in javascript. I decided the only really viable approach would be web emulation, similar to the approach we were taking for displaying the artworks.

Parenthetically, I will note that the DMC project, and indeed most of my Telidon recovery work to date, has been highly dependent on software created by Microstar, a Telidon/NAPLPS focussed company based in Nepean Ontario in the 1980s and 90s. Microstar created MVDI (the Microstar Virtual Device Interface), one of the few feature-complete NAPLPS rendering engines that could run on a standard PC of the era. MVDI is what I am using to render Telidon/NAPLPS graphics inside the DOSBox emulator.

Microstar developed a number of products on top of MVDI, including Microstar Graphics Editor (MGE), a very capable NAPLPS drawing program. Although MGE initially retailed for a significant sum, it was eventually released as shareware back in 1992, just as NAPLPS was on the cusp of going fully obsolete. It has been available in various shareware repositories (notably Simtel and its mirrors) for the past 30 years. Consequently it is legal to make it publicly available under web emulation for the purposes of our exhibition, since one of the provisions of the shareware license is that the program may be redistributed by anyone.

There were several technical hurdles that needed to be overcome in order for the MGE emulation to work. For brevity's sake, I won't itemize them here. However there was one major issue that is worthy of more discussion, namely giving visitors a means of saving their drawings.

Of course, MGE has a built-in means of saving drawings: they are saved as NAPLPS code. In emulation, this means they would be saved either to volatile browser memory (and vanish when the user closed their browser window) or to storage within the browser cache. While the latter option would have the benefit of persisting (for a time), files saved by that method would only be viewable within MGE itself, and could not be shared outside the emulation. An alternative means of saving drawings was necessary.

Complicating the problem yet further, Telidon drawings were not static. A key feature of Telidon was that when they were played back, the drawings rendered themselves in real time, and could include crude animation effects. A simple static screen capture would fail to authentically represent the nature of Telidon, although it was one of the options I considered.

The solution I eventually arrived at was to use a javascript canvas method to enable visitors to record their drawings as mp4 videos, entirely within the browser. Currently videos can be downloaded and saved locally. In future we should be able to add a feature to enable uploading videos to a web forum, as envisioned by our curator.

Constructing this feature required significant research and testing, as I was not even aware it was possible to do this when I first approached this problem. It offers another example of how older software can be better integrated into modern computing environments through the use of emulation environments adapted for the web.[6]

2.3 Art Recovery and Restoration

In addition to developing the software needed to view and create Telidon artwork on the web, I spent much of my study leave recovering and restoring significant Telidon artworks.

2.3.1 Data Recovery

Recovering Telidon data is of course a necessary precondition to recovering artworks, although effecting a full restoration always involves more than simply recovering the files of which the artworks are comprised.

Telidon files were typically stored on floppy disks, in two different formats. The earliest works (dating from approximately 1981-1983) were stored on 8 inch DEC RX01/RX02 formatted disks, whereas later works were kept on 5.25 inch disks formatted for the IBM PC. This reflects a generational shift in the technologies used to create Telidon graphics. First generation works were created with a drawing program running on an elaborate workstation built around a DEC PDP-11, while later works were often created with a program called Createx, that ran on a specially configured IBM PC.

As noted in my introduction, most of the data recovery phase of this project took place prior to the beginning of my study leave. However, more Telidon floppies turned up during my study leave, requiring further data

[6] A draft version of this application is available at https://webapp.library.uvic.ca/jdurno/mge4/

recovery work. An additional twenty five 5.25 inch disks were found at InterAccess. I was able to recover the data from all of them using our Kryoflux disk imaging device. Four more 8 inch disks from the personal collection of Toronto curator Paul Petro were sent to a commercial service (RetroFloppy) for data recovery. I reviewed the contents of all of the disks and added entries to our inventory.

2.3.2 LAC materials

Telidon was created in the 1970s by a team at the Communications Research Centre (CRC), a Canadian government scientific laboratory. In an email discussion with one of the original members of that team, Douglas O'Brien, we learned that a collection of Telidon data files had been given to Library and Archives Canada in the mid-late 1980s. As these data files contained material from some of the earliest Telidon field trials we considered it possible they might include files for some of the artworks we had not yet been able to locate. I sent an inquiry to LAC in May, however their backlog is such that they were unable to respond to my inquiry until September. They were then able to provide us with copies of the data files, along with documentation detailing how the files had been created.

Unfortunately, I have not yet been able to make much sense of the data to this point. Much of it appears to be encoded in an as-yet unidentified database backup format. The data that is not so encoded is merged with control sequences that make it difficult to extract the Telidon/NAPLPS code in such a way that it could display cleanly in an emulator.

Close examination of the data reveals that there are indeed artworks included in the data set, intermixed with the more informational sequences common to Telidon systems of the day. Most of the artworks I have so far located in the LAC data set appear to be duplicates of works already recovered from InterAccess' collection.

It is interesting to note that files stored on floppy disks kept in the storage closet of a community arts organization have proven to be more accessible, thirty five years on, than files contained in data sets preserved by our national Library and Archives. This observation is not intended as a criticism of LAC, but rather as a reminder that we should be cautious in our assumptions of which digital formats and preservation techniques will be of most benefit to those who encounter them decades from now. Every attempt to define best practices for digital preservation is an attempt to predict the future, and we would do well to remember the wisdom of the well-known Danish proverb.[7]

[7] "It is difficult to make predictions, especially about the future"

As I obtained the LAC materials toward the end of my research leave, I have not been able to do much more than a preliminary review up to this point. I intend to subject them to a more thorough examination in future.

2.3.3 Art restoration

Over the course of my study leave, I restored 64 Telidon artworks created by 30 different artists. (See Appendix A for a list). The level of complexity varies significantly from one work to the next. Some works consist of one or two files, that can be integrated into a web emulator in an hour or two. At the other end of the spectrum, there are works consisting of well over a hundred files, that have taken me anywhere up to two full time weeks to restore. Most works fall somewhere in between.

There are a number of factors in play that can complicate the restoration process. These include:

1. **Interactivity**. Some Telidon works were interactive, with a display that could change in response to user input, as the user navigated through an inverted tree-style hierarchy. These works typically depended on a database to track the relationships between the files. In these cases it is not only necessary to recover the files, but also to recover and reconstruct the database. In at least one case, this involved emulating the database software and the DOS environment in which it ran, in order to generate a textual representation of the database contents.

   Regardless of whether a work was interactive, it is necessary to create a playlist for every work, so the emulator knows the order in which to display the files, timings of the pauses between files, and the kind of user input to expect, if any.

2. **File format conversion**. The Telidon encoding protocol existed in two versions, the second of which (NAPLPS) was not fully backwards compatible with the first. The MVDI software that renders the images within the emulator can only display the second version. I do not have software that can display the first version, because as far as I know there was never any install-able software developed for that purpose. The first version of Telidon relied entirely on special purpose hardware.

   It is possible to convert the first version of Telidon so that it can be rendered by MVDI. I developed a conversion script for the purpose.[8]

[8] Available at: https://github.com/jdurno/Telidon699toNAPLPS

However due to the manner in which the encoding differed between the two versions it would be extremely challenging to develop a converter that could be relied upon to work perfectly.[9] Consequently restoring first-version Telidon is a multi-step process:

(a) Extract the files from the disk image

(b) Separate the first and second generation Telidon files. Telidon files of both generations often appear on the same disk, mixed together.

(c) Convert the first generation Telidon files to second generation files using the conversion script

(d) Create a playlist in alphabetical order by file name, and set up the files to run in the emulator

(e) Review the files, and evaluate whether further restoration work is required. (Further restoration may not be required if the files are deemed uninteresting, are clearly unfinished drafts, or if they are duplicates of a work that has already been restored).

(f) If further restoration is required, create a playlist to display the files in the correct order. This is necessary as Telidon files are not discrete entities. Settings from one file (colours, font sizes, etc) may carry over to the next. Consequently files may not render properly if they are displayed out of sequence.

(g) Compare the converted files to the unconverted files displaying on a vintage 1983 Telidon Terminal in our collection.

(h) Manually intervene to change the encoding of the converted files, in cases where the automated conversion was imperfect. This can be extremely time consuming, as the Telidon encoding is not easy to interpret, and changes can have unexpected effects.

Restoring second generation Telidon is usually far less time consuming, but this is not always the case. Due to differences in the way Telidon output varied across devices and software made by different manufacturers there are some instances in which it is necessary to change the encoding of second generation Telidon also.

Given the labour involved, it was necessary to prioritize the selection of artworks for restoration. I employed the following criteria:

[9] This was also true of conversion tools that were developed back in the Telidon era. Douglas O'Brien confirmed that a manual review of converted files was considered necessary in the 1980s

1. If our curator identified the artwork as a candidate for possible inclusion in our exhibitions

2. If the artwork was known to have been exhibited publicly in the 1980s. For example, Telidon artworks were exhibited in the original Telidon field trials in 1981/82, at the 1983 Bienal de São Paulo, at the 1986 Venice Biennale, at Expo '86 in Vancouver, etc. Clearly these works have some historical significance, in addition to their artistic merit.

3. If the artwork had some other cultural significance. For example, one Indigenous Telidon work is known to exist (a drawing by Tony Hunt, Sr.) and there is another work done in style of the Woodlands school that is likely to be of Indigenous origin, though its provenance is less certain.

4. If the artwork was by a well-known artist. For example, I restored an early work by Gisèle Trudel, who is an artist and professor at UQAM, and is currently MÉDIANE Canada Research Chair in Arts, Ecotechnologies of practice and Climate Change (2020-2025)

2.3.4 Consultations With Artists

In all my restoration work I endeavour to hew closely to the original manifestation of the artwork in question, in so far as I am able to ascertain what that was. Nevertheless, it is simply not possible to reproduce the works exactly as they would have appeared on a Telidon terminal back in the 1980s. The reasons for this are sometimes obvious (for example, modern LCD displays differ from CRT displays), but sometimes the differences are more subtle.

Telidon was a specification (or rather, two different specifications) that were implemented by multiple companies. Some of the implementation details were left up to each manufacturer. Consequently, the display of Telidon images differs in various ways from one device or software engine to the next, even when all of them conform to the letter of the specification. In addition Telidon could be transmitted at different speeds. A Telidon work transmitted at 1200 baud would render at half the speed of one transmitted at 2400 baud. It would also display differently at different screen resolutions. The 640x480 resolution that is optimal for the DOSBox emulation is twice the resolution typically seen on Telidon terminals in early 1980s.

Thus an artwork could be made to render in the emulator and yet still not fully reflect the artist's intentions for the piece. In many cases (hopefully most) the variances would be within the acceptable range, however one

should not simply assume they are.

Where possible, then, it is necessary to consult with the artists who made the works. As more restorations have been completed I have reached out to several artists seeking their feedback and approval of the works in their current form. Responses received to date have been favourable. Several outright approvals have been obtained, along with provisional approvals if certain changes can be made. None of the artists consulted have withheld their approval, and most expressed considerable appreciation.

To enable artists to review the restorations, I created a simple web application that provides password-protected access for each artist to their own artworks. In addition to being more convenient for the artist, I felt it would not be appropriate to share their works more widely without their permission (for example, by giving all of them access to all of the works currently undergoing restoration).

Regrettably, such consultations are not always possible. Sometimes the whereabouts of the artist is uncertain, and in some cases the artist is no longer with us. In these cases it is necessary to rely on my own judgment and experience, as well as on whatever documentary materials exist, for validation of the final result. In a number of cases we have video-recordings of Telidon artworks made in the 1980s. These have been invaluable points of reference.

3 HISTORIC COMPUTERS

Telidon was the primary focus of my study leave, but I also found some time to work with our historic computing collection.

3.1 Presentations

The Obsolete Computing and Media Lab was featured in three virtual tours given at the Endings Symposium, DHSI, and a COPPUL Webinar, each described elsewhere in this report.

3.2 Web site / Inventory updates

I photographed, bar-coded, and catalogued a number of new additions to the collection. I will continue this work after my study leave, as I was not able to bring the inventory fully up to date.

I added a field for donor names to the database, and corresponding fields on the admin and public sides of the web site.

3.3 Equipment repair

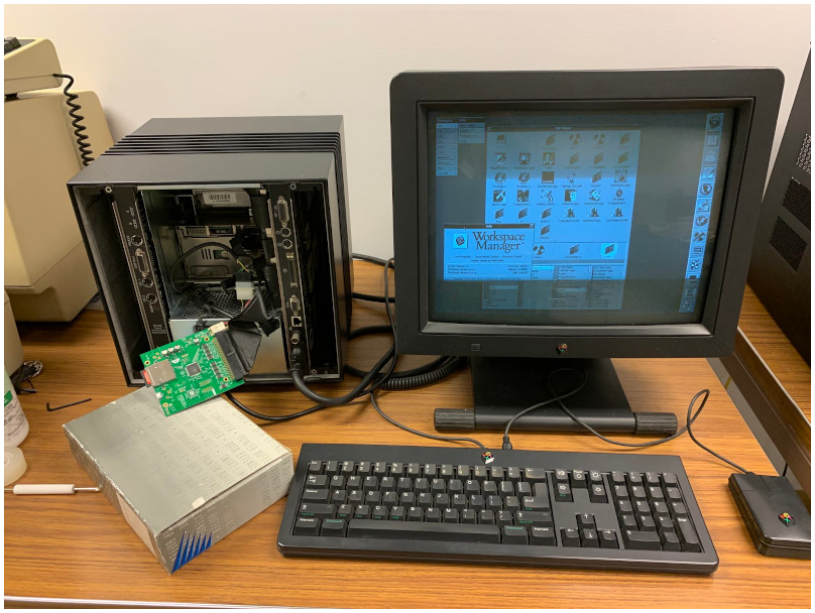

Figure 3: NeXTCube with SCSI2SD Hard Drive Replacement

NeXTCube: manufactured by NeXT, a company founded by Steve Jobs after his ouster from Apple in the mid-1980s, the NeXTCube holds an important place in computing history: The first web server was a NeXTCube, and the NeXTStep operating system formed the basis for Mac OS X after Apple acquired NeXT in the late 1990s. NeXT computers were fairly common at UVic; this particular NeXTCube belonged to the Music Department before it came our way 2018. Unfortunately it was not fully operational at time of acquisition, failing to find an operating system at startup. It was not simply a matter of re-installing the operating system as we had no installation media and even if we had, it was highly probable that the NeXTCube's magneto-optical drive would be inoperable, since few have survived to the present in working condition. Instead I replaced the hard drive with a SCSI2SD card, a device that bridges a modern SD card with the SCSI controller on the motherboard. The SD card contains a disk image of a NeXTStep operating system and many common applications of the era. A copy of the disk image has been saved to Library

Systems' unit storage in case the SD card ever needs to be replaced.

Teleray Terminal: In the fall of 2019 an ASCII/APL terminal was transferred from the UVic Observatory to the collection in 080. Although the terminal dates from 1976, it appeared to be in good condition after cleaning. However, equipment of that vintage requires a thorough inspection before being powered up, and also required some repair work to be fully functional. As the work required exceeded my level of competence, I enlisted the services of a highly capable subject matter expert, Brent Hilpert, with whom I have worked in the past. Brent was contracted to inspect, repair and document the terminal. Brent prepared thorough documentation and replied to questions from the Computing History Museum, who expressed interest as information on the terminal was heretofore somewhat scanty.[10] Brent is currently contracted to repair two Altair computers in the collection.

Dot Matrix Printer Another Surplus acquisition, our Roland DG PR-1012 dot matrix printer dates from the early 1990s. Somewhat surprisingly, replacement printer ribbons are still available. I cleaned the unit, replaced the ribbon and successfully printed a test page. The required Centronics parallel cable was located and the unit was attached to a Dell PC of approximately the same vintage as the printer. It is currently possible to print plain text but not formatted documents due, I believe, to driver issues. The goal is to enable users to print custom banners using Print Shop Pro or the equivalent, as an attraction for open house events. I will continue to work on this, time permitting, after my leave has ended.

Pentium PCs: I performed hard drive replacements and installed Windows 98 on two Pentium PCs from the late 1990s.

Apple IIe DuoDisk: As the individual floppy drives on the Apple IIe were failing, I sourced the appropriate controller card for a DuoDisk drive already in the collection, and installed the card and drive.

[10] Documentation available at http://madrona.ca/e/teleray3931/log.html

4 PRESENTATIONS AND WORKSHOPS

4.1 Endings Symposium (April 15/19/22/26, 2021)

As a collaborator on HCMC's Endings Project, I attended the Endings Symposium and helped to facilitate two sessions:

- Sara Diamond: The Danger of Disappearance
- Clare Battershill: The Preservation of Critical Digital Archives: Obstacles and Affordances

I also presented a virtual tour of the Obsolete Computing and Media Lab for symposium participants

4.2 DHSI - Retro Machines and Media (June 7-11, 2021)

In 2019 I had the honour and privilege of co-teaching a 5 day workshop on "Retro Machines & Media" with Dr Dene Grigar, WSU, at the Digital Humanities Summer Institute. We had planned to give the workshop again in 2020, but circumstances did not permit. Fortunately we were able to regroup in June 2021 and offer the session in a somewhat shortened and wholly virtual form.

I prepared four sessions for the workshop:

- A tour of the Obsolete Computing and Media Lab
- An overview of the Telidon Art recovery project
- A digital forensics demo using the Kryoflux
- An introduction to software emulation

The session was well attended and received. We plan to offer it again in person in 2022. Should that come to pass, it will be the first time it will be given in the Obsolete Computing and Media lab.

4.3 CDSN Webinar: Working with Retro Media (July 6, 2021)

As an outcome of our DHSI session, Dr. Grigar and I were invited to co-present a talk, *Working With Retro Media*, for the COPPUL Digital Stewardship Network. As with the DHSI session, it was well attended and feedback was positive.

4.4 Access 2021 (October 18, 2021)

In July I applied to present on my web emulator work at Access 2021, which will again be held virtually this year. My application was accepted and I am scheduled to present on my first day back from leave. As I prepared the presentation while still on leave, it qualifies for inclusion here.[11]

5 MISCELLANEOUS

5.1 Data Recovery for Norman White

In addition to Telidon materials, the InterAccess archives contained three floppy disks belonging to Norman White, an artist Wikipedia describes as "a pioneer in the use of electronic technology and robotics in art."[12] As a courtesy to the artist, I recovered his data files, decompressed them in an emulator, and advised him on software suitable for accessing the contents on a modern PC. The files were related to three artworks: *Hearsay (1985)*, *Ubiqua (1986)*, and *Plissure de Texte (1983)*.[13]

5.2 Other Items

Peer review: Early in my study leave, I was asked to review an article for the journal *Archivaria*. The article proved to be quite interesting. I recommended it for publication with minimal alterations.

Ring story: I provided background information for an article written by Lisa Abram on the Telidon Art project, that appeared in the Ring in June[14]

Re-collection: To better familiarize myself with the issues surrounding digital art preservation, I read a fascinating book on the topic: *Re-collection: Art, New Media, and Social Memory*.[15] In part, the book

[11] A recording of the presentation is available at: https://webapp.library.uvic.ca/jdurno/talks.php

[12] Wikipedia, https://en.wikipedia.org/wiki/Norman_White

[13] More information about all three works available at: http://www.normill.ca/artpage.html

[14] L. Abram, "Digital Archaeology Frames National Exhibition." Jun. 3, 2021. The Ring. Available: https://www.uvic.ca/news/topics/2021+telidon-durno-howarth+news (Accessed: Oct. 15, 2021)

[15] R. Rinehart and J. Ippolito, "Re-collection: Art, New Media, and Social Memory". Cambridge: The MIT Press, 2014.

explores the challenges of preserving artworks dependent on rapidly obsolescing hardware and software, and argues convincingly that it will in many cases be necessary to embrace change and let go the idea that one may preserve the original experience of the artwork in its entirety.

Rhizome sessions: I attended a three part session, *From Black Boxes to Open Systems*, presented by Rhizome, an organization which both exhibits and preserves born-digital art and culture. All the sessions were informative; the second, "Software and Net Art Preservation," was directly relevant to my research.

Decentralized IT Committee: By prior arrangement, I continued to participate in meetings of the Decentralized IT Committee during my leave.

6 SKILLS DEVELOPMENT

My work during this period provided opportunities to develop my technical skills and knowledge in the following areas:

6.1 Commercial Web Development

Although I have been involved with a great many web development projects throughout my career, most of them were done with internal resources, either entirely separate from the sphere of commercial web design, or with the contracted designers clearly in a subordinate role. The DMC-funded Telidon Web Exhibition project is the first project I have participated in that is being managed by a team of commercial web developers. It was informative to take note of their project management processes and software toolkit, particularly the Webflow CMS which takes a much more visual approach to creating web content than other content management systems I have used in the past.

6.2 Web emulation

Prior to my study leave I developed a Telidon web emulator that was usable, but not too far beyond the proof of concept stage. During the course of my leave I had the opportunity to become much more familiar with the details of web emulation, as I added the functionality required to make the emulator usable for a public exhibition. Based on my brief experience working

with Flash emulation at DHSI, I believe my knowledge has wider applicability than DOS emulation, should the Libraries take on other web emulation projects in future.

6.3 Javascript programming

I first honed my skills as a web developer in my previous position at the British Columbia Library Network, where at various times programming was over 50% of my job. At the time, I was focussed on back end, server-side programming in PHP/MySQL. My use of javascript was quite limited, as javascript was in those days more targeted at enhancements to the user-facing side of web applications, that were mostly not needed for the projects I was working on. Since taking on my current role at UVic I have continued to do web development from time to time, but my skill set remained largely rooted in the first decade of the millennium. Fifteen years on, javascript has become remarkably powerful, supporting a general trend in web development toward minimizing server load by shifting more and more of the processing work to the client (i.e., the user's web browser). As my Telidon emulator operates mostly on the client side it was necessary to further develop my knowledge of javascript and related tools such as the node package manager. I am still a relative novice at javascript programming, but I am certainly better able to work with the language, and (arguably more important for my managerial role at UVic) understand its capabilities, than I was six months ago.

6.4 Reveal.js

Over the years I have primarily used PowerPoint and LibreOffice Impress as my presentation applications of choice. I have not been entirely happy with either of them, in large part because neither handles embedded video particularly well. As I had a number of presentations to create during my study leave, I turned to a javascript framework called reveal.js, that turns a web browser into a presentation platform. Although I would not recommend it for non-technical users, reveal.js is ideal for users capable of writing simple HTML and CSS. It not only allows me to embed video seamlessly, it also allows me to embed samples of my web emulation work within the presentation itself. And of course, allows me to put my presentations on the web simply by uploading them to a web server. I intend to make it my primary presentation software going forward.

6.5 Emacs Org Mode

Emacs is a powerful text editor that dates back to the 1970s, one of the oldest free software projects still in active development. I have made use of Emacs on and off for the past 20 years or so, primarily as a coding editor. However, some time ago I became aware of an alternative operating mode called Org Mode. This mode optimizes Emacs as a personal organization and project management tool, streamlining the creation of task lists and reports. I began using it during my leave, to track the progress of my various projects and deliverables. I found it worked quite well, so Org Mode too is a tool I will continue to make use of in my day to day work. For example, this report was written in Emacs Org Mode using a simple markup language, that was then automatically converted to LaTeX and output as PDF. It is far more efficient than formatting the report by hand, as would have been necessary had this report been created in MS Office or Libre Office.

6.6 Git Code Repository

It has been close to 20 years since I regularly made use of code versioning software in my day to day work, and the software I used back then (CVS) has long been superseded by more modern alternatives, such as git. Although I have been an occasional user of GitHub for almost a decade, I have mostly used it as a convenient place to share finished code rather than a tool to use in active development. Put simply, my coding projects have been simple enough that I felt a version control system would not be worth the overhead it imposes. However, as coding was to occupy a major part of my leave, I took the opportunity to install git repository software on the Telidon project server I maintain, in order to better manage the source code of the applications I was developing. As git is not trivial to learn, I spent some time reading the documentation, including an entire book on the topic.[16] At the end of six months, I have a much better understanding of git, as well as greater confidence in my initial assessment of it: that for my projects, it does not appear to be worth the overhead. However, there is no question that in other contexts (particularly in cases where more than one developer is working on the same code base at the same time), git or something like it would be absolutely necessary.

[16] S. Chacon and B. Straub, "Pro Git". 2nd. ed. Berkeley:Apress, 2014. Available: https://git-scm.com/book/en/v2 (Accessed: Oct. 15, 2021).

7 NEXT STEPS

- I will give a talk on my web emulation work at Access 2021 (October 18th)
- A considerable amount of work remains to be done before the Telidon web and gallery exhibitions launch in 2023. I will continue working with my collaborators to ensure we are well positioned to meet our timelines.
- I will continue to act in an advisory capacity on technical matters relating to the acquisition of the InterAccess Telidon Archives by the Art Gallery of Ontario.
- I will continue to curate and promote our collection of historic computing artifacts.

A Appendix: Artworks Restored

Artist	Artwork	Year	Disk
Nina Beveridge	Untitled Graphic	1981	IA 154
Weldon Bona	From Eastern Electric Art	1983	UVic SP 3
Elaine Cohen	City	1984	IA 017
Elaine Cohen	Moving Painting	1984	IA 017
Elaine Cohen	Sleeping Beauty	1984	IA 017
Robin Collyer	Graphics	1981	IA 154
Alex (Runt) Currie	Robot Walking Dog	1986	IA 36B
Adele D'Arcy	Electronic Brochure	1987	IA 001
Joanne Daoust	Figures	1983	IA 136A/017
Joanne Daoust	Baggy Shorts	1983	IA 073
Dennis Day	Democracy the Movie	1985	IA 027
Stephen Dennis	Telidon Awareness Project	1984	187,188,190
Dean Oswald Eyford	Niagara Strip	1985	IA 036B
Robert Fisher	Graphics	1985	IA 022
Robert Flack	By the Strings	1984	IA 145
Robert Flack	Focus	1984	PP 127
Robert Flack	Oh Baby	1984	IA 145
Robert Flack	U Follow Me	1984	PP 127
Robert Flack	Web	1984	IA 145
Nancy Godin	Cocoon	1982	IA 096A
John Gurrin	Here is an Office	1983	IA 078
John Gurrin	I Hold My Life in My Hands	1983	IA 048
John Gurrin	The Man Child	1983	IA 048
John Gurrin	Nadia's Crime	1983	IA 078
John Gurrin	One Hour of Love	1986	GS 002
John Gurrin	Yeah!	1983	IA 048
Glenn Howarth	The Red River Valley	1983	UVic GH
Tony Hunt Sr.	Raven	1983	UVic SP 3
Lana Lovell	The Knowledge of Jour Torys	1985	IA 194
Anat Matri	C Series	1984	IA 010
Anat Matri	Dope	1984	IA 010
Anat Matri	Face	1984	IA 010
Anat Matri	From 3D Series	1983	UVic SP 3
Anat Matri	Mummy	1984	IA 010/136A
Anat Matri	The Telidon Fly	1983	IA 129

Continued on next page

Continued from previous page

Artist	Artwork	Year	Disk
Andrew Owens	Renaissance Woman	1983	IA 129
Andrew Owens	Graphics [São Paulo]	1983	UVic SP 3
Andrew Owens	Graphics [Venice]	1986	GS 002
Lisa Particelli	The Art	1985	IA 089
Lisa Particelli	Ineternal Imbalance	1985	IA 089
Valya Pavluk	Abstracts	1983	IA 061
Valya Pavluk	Axis	1984	IA 043
Valya Pavluk	Visual Ideas	1984	IA 043
Bill Perry	Computerese	1981	IA 017
Paul Petro	His 'N Hers	1985	PP 136E
Paul Petro	My Media My Self	1984	PP 136A
Paul Petro	Robin	1986	IA 061
Paul Petro	State of Being	1986	PP 136E
Douglas Porter	Application	1987	IA 037
Douglas Porter	Empty Objects	1983	IA 039
Douglas Porter	(How to Avoid) Cold Toast	1985	IA 195
Douglas Porter	Information Free Toronto	1985	IA 036B
Douglas Porter	Who's Afraid of Red Green Blue?	1986	IA 195
Pierre Rovere	To	1983	UVic SP 3
Geoffrey Shea	Democracy at Work	1985	GS 002
Geoffrey Shea	From Proposal 30	1983	UVic SP 3
Nell Tenhaaf	Believable if Not Always True	1986	IA 099
Nell Tenhaaf	The Information Gap	1985	IA 103
Nell Tenhaaf	Us and/or Them	1983	IA 121A
Gisèle Trudel	A Field Study	1985	IA 036B
Woodlands School	Man Changing Into Thunderbird	1983	IA 138
Peter Zmudski	Graphics	1982	GS 002