Like a Wave Upon the Sand:
Digital Preservation of Variable Media Art

Introduction to the Problem

There are as many different kinds of new media art as there are artists. New media art differs from traditional art in its non-physicality: instead of using paint and canvas to convey ideas, new media artists might use databases and CRT monitors; instead of modeling their subjects in clay, they might use computer programs to model data; and instead of being architects of physical spaces, they might build virtual spaces that house fantastical creatures, institutions, concepts or ideas. It also differs in its temporal quality. Unlike paintings, sculpture or buildings, new media art is always changing and shifting – viewers can't be confident that they'll see the same thing twice. Conventionally, preservation is seen as a way to fix an object's physicality, to keep it safe from injury, destruction, and decay. When an object is neither physical nor fixable, however, this conventional view must itself change.

There are a number of cultural organizations that specifically collect and archive new media art, and there are numerous digital libraries that focus on the related form of interactive video, including performing arts libraries and news organizations. These organizations recognize preservation as one of their primary responsibilities as regards these artifacts, but affordable, viable and robust methods have not yet been developed. The main problem in this case is that these are not simple digital objects (if there is such a thing), but are artistic in nature, and are therefore signify something not easily communicable or translatable. Digital preservation methods typically focus on developing documentation for the systems and programs that run behind the scenes, technical metadata necessary for re-creating digital objects, and architectures to organize and store the objects most reliably. These methods do not, and cannot capture the "essence" of a digital object; and in most cases, it would be inappropriate to do so. However, in the case of new media and interactive art, where meaning is conveyed through software, system,

data, and user interactions; the technology will have to document the essential characteristics of a piece, if there is a desire to provide meaningful access to these objects even in the near future.

Before delving into the specifics of variable media art preservation, it might be useful to illustrate the problem with an example. Imagine that you're working in a state-of-the-art new media art institution as the resident curator/archivist. Your institution has developed a collection of interactive digital art, and one of the works for which you're responsible is a work called 'Loops,' a digital portrait of Merce Cunningham by Paul Kaiser, Shelly Eshkar, and Marc Downie. Because of debilitating arthritis, Cunningham, one of the great dancers of the twentieth century, is no longer able to dance but can still move his hands. Kaiser and Eshkar attached sensors to Cunningham's hands, and, using a combination of motion-capture software and 3D modeling techniques, recorded his solo dance for hands and fingers. Marc Downie, a doctoral student in the Synthetic Characters research group of M.I.T.'s Media Lab, developed an artificial intelligence algorithm, which would let each sensor-node "make their own decisions about how to appear graphically, how to move in relation to their underlying motion-capture data, and how to connect to each other" (Kaiser, 2004b). 'Loops' consists of a basic vocabulary of forms, movements, topologies, and interactions for each sensor node, or "creature," eleven minutes of "script," fifteen minutes of recorded narration by Cunningham, and ten minutes of music by Takehisa Kosugi, which are looped indefinitely. One of the main underlying ideas in this work is the quality of interaction. Not only is there interaction taking place internally: the sensor nodes are interacting with each other and with the underlying programming, but the artists wanted the presence of viewers in the gallery space to register within the visualization as well. Hence, the motion of the nodes in the visualization is slightly disturbed by the motion of people in the gallery space, and although these disturbances are not taking place on the main screen, but on

synchronized secondary screens, they succeed in strengthening the viewers' association to and interaction with the piece.

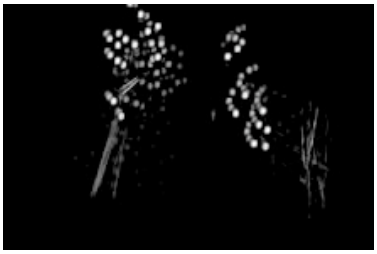

Figure 1. Loops. Digital Portrait of Merce Cunningham. Paul Kaiser, Shelley Eshkar, Marc Downie. 2000-2004.

Because of the generative quality of these "autonomous creatures" (the AI enabled sensor-nodes), and their randomized reactions to each other and the world around them, Kaiser considers 'Loops' a live performance, even though the sensor-data is stable and stored. Although the piece loops back to it's beginning every ten minutes, it's never the same piece twice. "Manifesting itself through the probabilistic interaction of its distinct parts, it has what is called an emergent structure, which means that it was grown as much as it was designed" (Kaiser, 2004a).

Now, imagine how you would preserve such a system of interactions. Because this work changes with every performance, videotaping any given instance will at best be incomplete. If you decide to preserve the underlying code for later performance, there are a number of issues to take into consideration. First, there's the data and programs that generate the work: the sensor-data created by Cunningham, the modeling program which generates the visualization, and the AI program that adds a transformative aspect to the data – all need to be kept intact. Second, you'll need to make some decisions about presentation; can the work run on any kind of

computer, or will you need a specific setup? What kind of sensors and recording devices do you need to record data from visitors in the gallery space? What kinds of projectors does the work use? What kind of screens? Are the screens and projectors important to the overall meaning of the work? How should the projectors be set up? Is the exact set-up important? Truly cutting edge technology is being used to generate this piece. What happens when this technology is no longer cutting edge? Should your institution consider updating the piece? Perhaps making the projected image a hologram? Finally, in addition to the technology and the presentation challenges, there are the issues surrounding interactions and chance, which are built into the system, and play an integral role. There are many complex relationships in this piece, both internal and external, and authentic representation will require a series of decisions about the quality of each. How will you do that?

In taking on this preservation responsibility, the variable media art community faces two challenges: the strategies themselves, and the representational frameworks used to describe the digital objects.

Digital Preservation Strategies

There are currently four preservation strategies commonly in use. The first three have technical origins, and should be familiar to the general digital preservation community. Related to "the viewing problem," they are: *refreshing*, the upgrade of storage mechanisms; *migration*, the premeditated upgrade of file formats; and *emulation*, which focuses on development of ur-operating systems able to run obsolete media. The fourth option, more radical, and developed by and for the new media art community, is *re-interpretation* (Depocas, 2003); a method intimately related to the presentation, exhibition, and performance of an interactive variable media art object.

The Viewing Problem

The primary problem with the longevity of digital documents is the "viewing problem" (Besser, 2000a). Unlike analog or physical information, which tends to exist independent of human involvement, digital information needs constant intervention in order to survive. History has shown that digital documents are problematic by default. Whereas we can look at the Great Pyramids, created two thousand years ago, it is difficult if not impossible to view simple documents on 8-inch floppy disks created in the last twenty years, even if someone has taken an immediate, proactive role in preserving them. Without concerted effort on the part of archivists and preservationists, digital objects become obsolete or inaccessible due to unforeseen advances in information technology.

Refreshing

There are two fundamental issues related to the "viewing problem." The first is the obsolescence of physical storage formats, and the second is the obsolescence of software systems. Physical storage formats are forever being replaced by newer mechanisms: 8-inch floppy disks became 5.25-inch floppy disks, which morphed into 3-inch diskettes, which became CD-ROMs, which are now turning into DVDs. While it may be possible to extract information from two iterations before (for example, it's possible for me to view files saved on a 3-inch diskette), we cannot depend on the ability to view documents stored in older formats (it's very difficult for me to view files on 5-inch floppies). The solution to this changing storage format issue is the concept of "refreshing" (Task Force on Archiving of Digital Information, 1996) which involves periodically transferring a file from one physical storage mechanism to another. This is a solution that will probably persist for many years (Besser, 2000b), although it is not elegant, and does not address the problems of authenticity or file format obsolescence.

Migration

Migration and *emulation* are the two primary methods in managing the problem of obsolete file formats (Information, 1996; Task Force on Archiving of Digital Information, 1996). *Migration* focuses on the files themselves, periodically updating files in new software formats. For example: we could migrate a file created in ProCite 5 to EndNote 8 to BibTeX 1.0. This is a process by which we can consolidate numerous historical file formats into limited numbers of contemporary programs, thereby simplifying the process of access in the future. However, there are monetary, organizational and authenticity issues involved with migration that make it an imperfect option (Besser, 2000a). These somewhat obvious issues don't even address the subtler problem of the artistic choice of one format over another. If a writer chose to write hypertext fiction in hypercard, and it eventually got migrated to Word XP or Flash, is the work being honestly represented? To take a more strident example: would the Sistine ceiling convey the same meaning if the fresco layer were separated from the wall, transferred to canvas or wood, and hung in a museum? The technology is certainly there, but it would be a fundamentally different experience. Again, it becomes a question of whether the conservation/preservation community is trying to preserve access to the physical content of a work, or if they're trying to preserve access to its deeper meaning. It becomes a very sticky business wherein the conservator is making major artistic choices traditionally left to the artist.

System Emulation

The second method of file format preservation is *emulation*. Instead of endlessly transferring files from one format to another like proposed in *migration*; *emulation* focuses on developing systems that mimic the application software used to create the original document. For example, if we wanted to run a piece of software created in 2001 on a computer in 2101, we

could write a piece of software called an "emulator" which would make the 2101 computer appear, for all intents and purposes, to be a computer from 2001. Once the emulation software is in place, we could run all of the original software from 2001, including the operating system, the application program and all the document files. Some emulation proponents want to develop systems that mimic every application ever used for every file format, then make those systems operate in contemporary computing environments, whatever those might be (Besser, 2001), but the researcher most closely allied with emulation, Jeff Rothenberg, makes a pretty strong case for emulating only at the hardware level, and running the original OS, application, and document within that hardware emulator. He argues that hardware is well documented on a technical level, and hence can be re-created with the most ease; and that this approach gives the most "bang for the buck." By writing just a few hardware emulators, we could run dozens of operating systems, thousands of applications, and millions of documents (Rothenburg, 1999). As evidenced by the numerous articles, institutes, and recent breakthroughs, emulation is currently the preferred method of digital preservation and access (Anon., 2002), (Granger, 2000), (Rothenburg, 1999).

Emulation isn't only gaining importance in providing access to documentary content. Rhizome, one of the premiere venues for digital variable media art, in 2002 released the white paper "Preserving the Rhizome ArtBase" (Rinehart, 2002), recommending the support, development and use of emulation software. One of Rhizome's primary functions is the maintenance of the ArtBase, an archive of new media art. As initially conceived, in 1994, the ArtBase was an archive of exclusively net art projects, but has expanded to include other forms of new media art such as software, games, and web-based documentation of installation and performance works. The ArtBase is maintained and developed by Rhizome members, and includes works of historical significance that are either submitted by the owners of

commissioned artworks, or by the artists themselves. Information is collected through an online submission process (Rhizome.org), which includes an artist questionnaire, and user-defined metadata entry. The white paper deals specifically with Rhizome, but also serves as a general research agenda for long-term new media art preservation.

One of the major drawbacks of current emulation strategy in relation to Internet art is the focus on stand-alone computers rather than the network. Much of new media art integrates the Internet into the work – for example the *Listening Post* (Rubin & Hansen, 2001) is a project that collects data in real time from tens of thousands of newsgroups, chat rooms, bulletin boards, forums, and other online public communication channels and statistically analyzes those messages into topic clusters based on their content. This data is then translated into a "tonal soundscape" with spoken text responding to the changes in the flow and content of the messages (Hansen & Rubin, 2001).

Emulation will never be able to reproduce the entire Internet environment needed for this type of work, although one might be able to mitigate this problem through collection of very specific information about the functionality of the artwork. For example, some of the *Listening Post's* underlying technologies are the pinging of IP addresses and the use of "Carnivore"-like software to monitor online discussions. We don't know what the Internet will be like in the future, though. If "ping" and "IP" become obsolete protocols (unlikely, but possible in the distant future), how will the system gather the data? How will the data be generated if there are no public chat rooms? It would be possible to preserve the work with an IP-style number generator and a simulated discussion environment to which the system could listen, but even if this sort of very intelligent preservation happens, in many cases the emulated artwork will only preserve *some* of the original work's features. It will serve as a simulation of the original experience, and

will therefore serve primarily as a snapshot or fragment to preserve some critical historical evidence of the original. For example, a major part of the *Listening Post* experience is the knowledge that you are "listening to" and experiencing "the Internet" in real time. Emulation, in the terms described above, would diminish the immediacy of that experience. Whether that diminution was significant would depend on the presence of a comprehensive representation of that object/experience, able to describe the artists' intent when creating the work.

Software Emulation

In art, every difference makes a difference (Goodman, 1976), and because software emulation disrupts formal elements of a work like pacing, aspect rations, and format, it presents even more profound artistic problems than does system emulation. The related problems of accountability and authenticity leads to the very complex issue of defining the nuances in individual art works. What is the work, really? What parts of new media art are important to preserve, and why? Who decides what's important? The artist? The critic? The viewers? Because change is inevitable, particularly in variable media art, how can we track those changes? These are not new questions, and have been plaguing art conservators since the beginning of the profession over a hundred years ago (Glueck, 1980). The dilemma really came to a head in the post-war era, with the dual emergence of "modern" art, which tended to have more ephemeral qualities than the art of the old masters (Wyer, 1988), and "modern" science, which was able to take advantage of new chemical techniques to halt or repair the progress of time on works of art. Specifically, there are two issues in traditional art conservation that are particularly germane to the discussion of digital art preservation: the reliability and/or appropriateness of seeking out artistic intent; and the reality of ageing itself – should conservators try to keep the work in pristine condition, or is it more honest to allow for some ageing?

The first problem, that of artistic intent, is particularly notable, because much of the current thinking on digital art preservation has an artist questionnaire as one of the first and central means of defense (Ippolito, 2003), (Rinehart, 2002), (Besser, 2001). However, for the last fifty years, conservators have been debating the appropriateness of seeking out artistic intent (Wimsatt & Beardsley, 1948) (Lyas, 1983). Comprehension of intent is a very complex process, sometimes not fully understood even by the artist him/herself (Sloggett, 1998); it is often ancillary to received wisdom about the piece (Dykstra, 1996); and more often than not, conflicts with what a conservator is, or should be, willing to do (van de Wetering, 1989). For example, Vincent van Gogh would have had his brother Theo shave off the peaks and valleys of his paintings, saying he only painted thickly to guarantee the "solidity of color." What we currently see – the rich texture that hints of van Gogh's "famous" madness, is in fact only a side effect of his painting technique, and was meant to be "erased" by shaving (van Gogh, 1996). However, the impasto of his paintings, whether he intended it to persist or not, has gained historical value as an essential element of his style, and it would be impossible to find a conservator willing to shave a van Gogh. This is not to say that conservators should ignore completely what an artist has to say – they are a valuable resource. However, there ought to be some recognition of the limits of the artist's ability to define the importance or poetry of his or her work.

But because the "artist questionnaire" is such a major component of the current preservation strategies within the art community, it should be addressed here in a little more detail. In March 2001, the Solomon R. Guggenheim Museum in New York City held a conference, "Preserving the Immaterial," which dealt with variable art forms (Depocas, Ippolito, & Jones, 2003). This included not only new media and net art, but also performative, reproducible, interactive, and duplicable artworks. Specifically, it was a chance for the curators

and conservators of collecting institutions to test out the "variable media questionnaire" that had recently been developed. They brought artists on stage, and asked them questions relating to works that had previously been collected by the institution. There were two particularly notable lessons to bring away from this conference. First, and this should come as a surprise to no one; the artist questionnaire is difficult and complicated. The artists had a hard time answering the written questionnaire, and when being orally questioned (on stage), their answers were not simple – there were almost always qualifications, and "you'd have to ask me if that situation arose," sorts of answers; precisely the kind of answers that the questionnaire is trying to get away from. The second notable idea is that the artists were almost universally appalled at the technology available for preserving and reproducing artwork. At many times throughout the conference, the artists, particularly the older ones, whose art is ageing, would assert that the thing being displayed was merely a "record" of the art, not the art itself (Gartenburg, 2003), (Ludwig, 2003). If the art presented in an institution is only a "record of" the original work, what kind of record is it? Is it possible to know certain things about the original artifact, or has that information been lost forever?

The matter of ageing gracefully is also relevant to the discussion of digital art preservation, although there are considerable differences between physical works, which deteriorate slowly over time; and digital works, which tend to simply disappear. In his keynote address to the "Preserving the Immaterial" Conference in 2001, science fiction writer Bruce Sterling put it nicely when he said, "entropy requires no maintenance. Entropy has its own poetry: it's all about delamination, disintegration, deterioration, degeneration, decomposition, and doddering decline" (Sterling, 2003). To make matters even more complicated, much new media art uses chance as an integral characteristic. Should that mechanism be overridden in the

name of technical possibilities or aesthetics? Again, problem of ageing has also been a major issue for traditional art conservators. Picasso and Braque "would rather have had a painting disintegrate than see it undergo plastic surgery" (Richardson, 1983). However, not all people see the problem in those black and white terms, and there is a question of whether the will of those conservators, who define themselves as "restoration minimalists," might take precedence over the creative process of the artist. By refusing to repair decaying art works, even if the technology is available, is the conservator then locking the artwork into a single moment in time (Albano, 1988)? If it's possible to fix something, and that action does not change the inherent nature of the original work, isn't it the conservator's responsibility to keep the work "alive," relevant, and accessible as long as possible? The real question, then, becomes: is it possible to discover and define a variable media art object's inherent nature or its essential characteristics?

Stability Through Change: Re-Interpretation

I have tried to demonstrate that the technical approaches to digital preservation are not without problems. They subtly and invisibly alter those digital works they are seeking to preserve, and these alterations, particularly if they're not recognized and referenced within some representation of the original object, are unacceptable from an artistic point of view. The new media art community, in an effort to take control of the situation, is formulating a new tactic, "re-interpretation," which basically allows museum and archives professionals to make decisions about the characteristics of a variable media object's presentation or performance within some pre-defined boundaries. Currently, the artist questionnaire (discussed above) is the primary means of developing a representation of a variable media artwork with an eye towards re-interpretation.

In mid-2004 Richard Rinehart, reflecting on these problems of artistic intent and the variability of this art form, delivered a paper arguing that new media art is more like a musical performance than it is like a painting or a book, and therefore more appropriately represented by a scoring system than the text-centric methods used today (Rinehart, 2004). His proposal of the Media Art Notation System (MANS), based on the MPEG-21 framework, is a welcome step forward in the development of a viable preservation schema for these highly variable and ephemeral objects. Rinehart's system, however, is more of a metadata framework or ontology than a scoring system, and therefore runs into the same general problems inherent in any text-based representational framework that attempts to describe or define a non-textual entity (Svenonius, 1994), and is based on the pervasive 'conduit-metaphor' model of communication (Reddy, 1979). Specifically, the success of a MANS representation depends on two things, both problematic: First, artists must understand and be able to meaningfully describe the important elements of their work; and artists' must be able to relate the importance of those often non-textual elements using…text.

In order for digital preservation of variable media to move to the next level, the community must begin, again, to think outside the box. Perhaps it would be useful to use the preservation and performance means of other variable media as models upon which to build, or look at the use patterns, needs, and behaviors of people who typically interact with variable media systems, both digital and analog. Existing preservation methods, while prevalent, are simply not appropriate any more. New methods, theories, and approaches must be defined, if we are to preserve the output of our most outstanding contemporary artists.

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