Conservation Assessment and Recommendations

***CPU* (John F. Simon, Jr., 1999)**

For the Museum of Modern Art

By

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Moving Image Archiving and Preservation Program,

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June 2008

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Introduction

This report was prepared by the students of the Handling New Media class instructed by Professor Mona Jimenez in the Moving Image Archiving and Preservation program at New York University. The findings are based on research from published resources, MoMA conservation files, and a recorded interview conducted with the artist on Thursday April 10, 2008 at MoMA. The class gratefully acknowledges MoMA Conservator Glenn Wharton for his assistance in facilitating this project. We would also like to thank MoMA Curator Barbara London and MoMA Registrar Sydney Briggs for their participation in the artist interview.

I. Artist's Biography

John F. Simon, Jr. is a New York-based digital artist born in Louisiana in 1963. His work integrates the disciplines of art history and computer programming. Simon received a Master of Arts in Earth and Planetary Science from Washington University in St. Louis in 1987. Next, he completed a Master of Fine Arts in Computer Art at the School of Visual Arts (SVA) in New York City. At SVA, he took a teaching position in the MFA program in Computer Art, and combined programming languages with theory in his courses. He has exhibited work at MoMA, the Guggenheim Museum, the Whitney Museum, SFMoMA, and the Los Angeles County Museum of Art. At the Guggenheim he has also appeared for speaking engagements, including a lecture in May 2002 titled "Coding as Creative Writing," and as part of a panel discussion titled "Collecting the Uncollectable" in April 2004. He first exhibited the work *CPU* at Sandra Gering Gallery in New York.

II. Artist's Working Method

When creating a new artwork, John F. Simon Jr. begins by looking at the cards from his daily drawing session. He picks out the persistent idea that emerges and then moves to render it in code.[i] Simon approaches the code as an organic process. He begins by writing an action he would like to see, and as he sees what is emerging he will change and manipulate the code until he likes the result. He normally sets out twenty to thirty parameters for a piece.[ii] With CPU, Simon began with the boxes and wrote paths for them to follow; as it emerged he noticed the crossover paths created a heart shape, which mimicked the circulation patterns of the human heart.

CPU runs on code that was created using Symantec C language and the Apple Quickdraw Toolbox in Mac OS 8.3. Simon constructed the physical object from a used Macintosh computer purchased in 1999 (for his newer works, he purchases Mac Minis). The artist uses Macs because he feels that they are robust and reliable machines and because commercially available replacement parts are easier to acquire.

To create the piece, Simon begins by removing the casing from the laptop. Next, the batteries are removed and the power is drained (this allows the piece to be turned on by a switch as opposed to the button on the laptop). The acrylic housing for the artwork was designed in-house and was originally sent to an outside vendor for creation, although Simon now also creates the housings in-house. Simon uses industrial strength peel-and-stick Velcro to attach the laptop elements to the housing. This makes the repair and replacement of the piece much simpler and helps the acrylic housing retain its full strength. The name and edition number of the artwork is placed on the back of the piece and on the software. Once the piece is finished, Simon's wife cleans and handles it from that point on.

When a piece has a problem, it is sent back to the studio. Simon will replace the hard drive, motherboard, or whichever part is broken. Simon also maintains a Mac 280c with the top popped off in his studio; if he needs to repair a hard drive on a returned piece, he will work on it on this machine, then install it into in the piece.

III. Composition and Display

In CPU, the primary hardware components, all from a deconstructed Macintosh 280c PowerBook, have been attached with industrial velcro to a rectangle of plastic acrylic; white on the front, with black backing and wall mounting brackets. The central visual element of the artwork is the PowerBook's 8.4-inch screen, rotated 90 degrees from the traditional viewing position, with its original operational control panel (with two operable buttons for brightness adjustment) attached below. Both the screen and the control panel have been stripped of their original black plastic casing, making visible some of the metal framework, electrical cords and circuit boards beneath.

The screen and the acrylic have been intentionally positioned to cover the majority of the hardware from frontal view; underneath, the motherboard, hard drive, and the rest of the components are exposed to the air, but are not visible unless viewed from the side or behind. The laptop's original power cord hangs from the bottom of the piece (to be plugged in nearby), intended to draw attention to the physical presence of the computer in the artwork. The power switch for the piece, however, has been positioned out of view, in part to discourage unwanted use. By plugging the cord into a surge protector with an on/off switch, the curator has the means to easily operate the piece as necessary.

IV. Display Method

CPU hangs from a plastic bar using one screw and two nails. The hole for the screw should be properly anchored. The bar should be leveled after the screw is almost completely inserted. The nails should then be driven in to hold the bar in place while the screw is completely tightened. The two holes on the top of the artwork fit over the nylon posts in the plastic bar. The artwork should be hung at approximately eye-level on a white wall.

MoMA may turn the computer off when the museum is closed, but the system should be left plugged-in after installation. The AC adaptor will plug into the wall socket or power strip. Simon recommends the use of a surge-protected power strip, and suggested that MoMA may wish to connect the power to a switch for easy powering up and down.

CPU should be displayed in a location free from dust, moisture and extreme temperatures, not below 40 degrees (F) nor above 90 degrees (F). The area surrounding the work should also be free of fire hazards, and should allow for air circulation so that the artwork remains properly cooled.

V. Technological Elements

The artwork is largely composed of an Apple PowerBook 280c, which was originally released in 1993. One of Apple's earliest "subnotebooks," the 280c made use of a dock for connectivity to other devices and peripherals. Four compatible docks were manufactured to pair with Apple's 200 series PowerBooks: the Duo Dock, the Duo Dock II, The Duo Dock Plus, and the MiniDock. The 280c, however, is only compatible with the Dock II or Dock Plus. One of the features of the model is its 8.4-inch 16-bit active-matrix color screen, the most advanced of the 200 series, making it unique as compared to other models' displays whose screens and parts are interchangeable.

The 280c's display cable is exposed in this artwork and routed in a way that may compromise its durability. A replacement part (Apple part number 922-0577) can be obtained for about $30. Other parts that may require replacement and their corresponding Apple repair service part numbers include the inverter board (922-0431), main logic board (661-0051), bottom case (076-0419), LCD display (661-1734), 8MB RAM chip (661-1658). The unit's backup battery (630-6546), which is responsible for managing power while the machine is turned off, has been removed and is therefore not a concern.

Helpful key commands specific to the 280c:
• Restart Computer Externally: Press <Command>, <Control>, and <Power On>.
• Power Manager Chip Reset: Press rear power switch for 30-45 seconds.
• Power Manager Code Reset: Remove power supply, system batter, and backup battery. Wait 10 minutes. Reconnect power sources and attempt to power on.

VI. Key Components

John F. Simon Jr. considers the code used in *CPU* to be the central component of the artwork. He notes that when creating a new piece, if the source code remains the same, he calls the work an 'upgrade' and not a new work. Thus, in his oeuvre, a new source code becomes the mark of a new work.

The image is created when the code executes instructions for the movement and placement of basic graphical elements in a dynamic way. The results of the instructions are stored, or accumulated, on the hard drive, representing in data the changes occurring over time. CPU's source code is written in the C programming language. Simon is particularly fond of this language due to its simplicity as well as its broad range of functions. C is said to "provide low-level access to memory, provide language constructs that map efficiently to machine instructions, and require minimal run-time support."[iii] It is an imperative (procedural) systems implementation language. Different from assembly languages, a procedural language supplies the computer with a continuing set of basic commands that it then executes.

Although Simon has not yet revealed the code to owners of the piece nor made it open-source to a wider audience, it is available on a floppy disc. Simon also maintains copies, presumably on hard drives. The C language is one of the most basic programming options available. It is human readable, which is helpful in assisting future conservators in gaining a basic understanding of the how the code is written. Should there be a problem with the code and neither Simon nor the back-up copies are available, there are hundreds of internet sources that can be consulted in order to determine the structure of the language. Furthermore, should these online resources be unavailable there are also countless print sources that outline the structure of the language. Such resources could be helpful in fixing breaks in the code.

Due to its simplicity, the C programming language is often used in conjunction with other more complex languages. Simon, however, says that the *CPU* code is written purely in C and was written in MacWrite, the Mac equivalent to Microsoft Word. Considering the time that the piece was made, Simon was likely using MacWrite Pro, the final release of MacWrite prior to Apple's complete redesign and rewrite of the program, which was then released as Apple Works. Since he was probably using a later version of MacWrite Pro, there are early versions of Apple Works that could read the file.[iv] Reading the file should not be a problem. In the event of a failure, the Museum should, for as long as possible, attempt to copy the information onto another Powerbook 280c, which would hopefully have the proper OS in place. Should copying onto a computer with the proper system no longer be an option, Simon still works with and maintains the code for his pieces, including *CPU.* For this reason, it can be expected that he has already migrated the source code into a newer word processing program that would be easily readable from a modern computer.

As his work has progressed, Simon has become increasingly interested in the function of the screen in the work. In the case of *CPU*, he notes that his positioning of the screen was essentially akin to literally putting a frame around a computer screen. Over time, he has incorporated the screen into a larger purpose that considers the aesthetic relationship between the screen and the displayed code as a central to the meaning of his work. Despite the simplicity of the screen in *CPU*, Simon still does consider the overall look to be a seminal aspect of the work that must be maintained.

Despite this, Simon is very open to the light source in the screen used in *CPU* being converted from its original fluorescent bulb to an LED bulb. He feels that the two light sources are comparable. Furthermore, a fluorescent light source changes during its lifespan causing slight shifts in the appearance of the work. Contrastingly, an LED bulb offers a stable light source over its lifespan. Overall, however, he identifies the process of bulb-switching as too time consuming to be a reasonable option. Thus, he feels it is perfectly acceptable to simply replace the entire screen. Simon keeps the brightness adjustment dial for the monitor open and accessible. He expresses little concern about the specific brightness of the image when the work is on display and suggests that MoMA should feel free to adjust the brightness if they feel that the display is either too dark or too bright.

In his interview with the authors, Simon outlines two specifications for screen replacement. First, the size of the screen used in the piece must be maintained. In the past, he has had collectors request that their version of a piece have a 'big sized' screen. Simon feels changing the screen size disturbs his original intentions and causes significant changes to his artwork. Secondly, Simon wants the inverter board (a component that controls the voltage to the screen and thus its brightness) associated with the original piece to be maintained. Newer screens do not require an inverter board in the front, so this may require salvaging the inverter board from the original screen and attaching that to the front. The look of the front of the work should be maintained. He cites an example of another work in which he replaced a screen with another that did not have an inverter board. He did not initially expect the absence of the inverter board to be an issue, but upon seeing this piece he realized that the presence of the inverter board was in fact important for aesthetic purposes as well as to maintain a tangible association with it computer components.

Simon prefers to have the power source showing or to have the work placed sufficiently away from the wall to allow the viewer to see the back. He feels that this is an important means of ensuring that the viewer understands that the work involves a simple laptop and that there is no further machinery powering the piece behind the museum wall. During the initial period he was making works, he notes there was some misunderstanding on the part of the viewers regarding how to interpret the work. Simon found that some viewers would identify the works as video art or simply not know how to define them. Simon is also attached to the slimness of the work. For these reasons, in the event that problems occur with the piece related to this casing, it should be replaced by another Powerbook 280c.

In the event of a failure, he has tried to program the code so that it would, upon rebooting, return to the same point in the code at which it failed. Simon considers this a salient component of the work because the pattern displayed by the code does not repeat until an immense amount of time has passed. Tracking of the code's position over time is maintained by an accumulator; the code and the accumulator are the critical contents of the computer's hard drive. He notes that he has programmed a specific event to occur fifteen years into the piece. This event is an important aspect of the work.

Simon is not concerned with replacing internal parts with the exact same parts. As long as the source code and accumulator are correctly copied to the new hard drive, Simon feels the integrity of the work is properly maintained.

VII. Condition Assessment

MoMA's edition of *CPU* is in excellent condition. The "computer" portion of the work is in perfect working order, and shows no signs of physical degradation. The acrylic housing is also in perfect or near-perfect condition, and has not yellowed, cracked, or become warped.

VIII. Risks

Due to relatively fragile nature of the technology, *CPU* faces significant long-term risk of hardware failure, which should be addressed before any concerns regarding the failure of its base materials (acrylics, metals, silicon, velcro etc.). The artist has stated that he chose the Macintosh 280c in part due its reliability, but even the most sturdy computer is at risk within a relatively short time frame compared to non-digital artworks. These risks are compounded with those a traditional sculpture might face.

By far, the most likely points of failure are the PowerBook's screen and hard drive. These faults are not specifically attributable to this model of computer, but are common problem sites in all commercial, industrial, and personal computers. The recent development of this technology makes it difficult to draw an exact timetable of component failure, but as the computer used in this edition of *CPU* has parts dating back to 1992, the system is nearing the end of the typical laptop life cycle, if it hasn't already far exceeded it. [v]

The age of the computer, when combined with the type of heavy usage necessary for typical museum viewing, makes the eventual failure of the hardware an inevitability, not just an archival concern. As such, the primary attention should not focus on absolute preservation, but rather on the management of the distinct risks faced by the computer, and on the accumulation of replacement components. However, the artwork was created with these risks partly in mind, and the modular nature of the technology allows the museum to directly confront any possibility of the piece's complete failure.

Returning to the specific problem of hard drive failure, the memory systems used in *CPU* are likely to be the first site of hardware deterioration. Hard drives stand at a crucial intersection of mechanical and digital technology, and the combination of high-speed motors and flimsy, magnetically encoded information leaves the system particularly vulnerable. Additionally, as computers are employed beyond typical schedules of obsolescence and replacement, complications arise in unexpected areas, such as the eventual break down of the polymer (Perfluoropolyether) used as lubricant.[vi] More common short-term risks include prolonged exposure to humid environments (as well as the obvious risk, direct contact with liquid), excessive buildup of dust and foreign particles, any contact with magnets or magnetized objects, overheating, and electrical shock (static or otherwise).

Hard drive failure is often preceded by warning signs that should be attended to.[vii] Excessive or abnormal noises emanating from the drive can possibly indicate emergent problems, whereas the appearance of bits of thin metallic foil in the vents suggests permanent failure within a matter of hours. The curator overseeing the artwork should also be aware of the operating speed of the software; should the program slow down, this might indicate a less immediate problem with the hard drive's functionality.

Aside from the hard drive, other weak spots in the technology include the screen and, to a lesser extent, the motherboard. The 280c was the first Macintosh laptop with a color screen that, while not particularly prone to failure, is more likely to burn out then current LCD models. The fluorescent bulb that lights the screen will eventually need to be replaced, as it will grow increasingly dimmer over time, eventually failing.[viii] While the screen in this edition of *CPU* appears to be free of dead pixels or other flaws in the construction process, these visual defects might also appear as the system ages. Fortunately, the screen can be removed from the mounting, and replaced if necessary. The motherboard is similarly replaceable, and is unlikely to fail before the hard drive or screen.

The unique architecture of *CPU* actually helps protect it from some of the dangers mentioned above, and yet also exacerbates others. The open-air system facilitates airflow over the hard drive and other components, reducing the threat of overheating provided that the artwork is in a well-ventilated area. The batteries have also been removed, making the system slightly less vulnerable to power surges. However, the open framework increases the risk of moisture condensation and dust accumulation, and leaves the interior systems vulnerable to the introduction of foreign objects and the disconnection of necessary wires. In particular, the wires attaching the screen to the motherboard are prone to separation, through vibration or human interference.

Special precautions must also be taken in the storage and transportation of *CPU*. The frame is rather physically fragile, and prolonged periods of dormancy are potentially disruptive to the system itself. Care must be taken to avoid extreme heat or cold, and that the room humidity remains within reasonable levels. Dust should be cleaned out occasionally (using compressed air) to prevent later complications with restarting the computer.

While these risks may seem daunting, they are mostly linked to the enduring functionality of the computer. The artist has stated that he has come to accept the inevitable failure of the technological components in his artworks, and the necessity for their eventual replacement. In the long term, the greatest attention should be paid to the continued migration and refreshment of the source code, which is much less fallible, but significantly less replaceable.[ix] Periodic updates should be arranged to ensure that the source code does not become obsolete and irretrievable due to the continued evolution of technology.

IX. Exhibition History

2004: Knoxville Museum of Art, Knoxville, TN

2002: SITE Santa Fe, Santa Fe, NM

Digital Louisiana, Contemporary Arts Center, New Orleans, LA

University of Iowa Museum of Art, Iowa City, IA

2001: Glee Painting Now, Palm Beach Institute for Contemporary Art, Ridgefield, CT

1999: Cyber Cypher Either End, Mario Diacono Gallery, Boston[x]

MoMA purchased the 6th of 12 editions of *CPU*. The edition purchased by MoMA was owned by a private collector in Boston prior to MoMA.[xi] MoMA's edition was not exhibited in the shows above; an exhibition edition was used for the public shows listed above. The other eleven editions of *CPU* are held in private collection.

X. Recommendations

<u>Maintenance and Display</u>

- MoMA should plug the artwork into a surge protected power strip, and use the strip to turn the piece on and off. MoMA may wish to connect the power to a switch for easy powering up and down.

- *CPU* should be displayed in a location free from dust, moisture and extreme temperatures, not below 40 degrees (F) nor above 90 degrees (F). The area surrounding the work should also be free of fire hazards, and should allow for air circulation so that the artwork remains properly cooled.

- Ultraviolet light will damage the acrylic housing. Exposure to UV light should be limited.

Storage and Handling

- For safety, those handling the artwork should wear a static strap.
- The artwork should be handled with gloves.
- The artwork should be cleaned with compressed air.
- For storage, wrap the piece in static free plastic, styrofoam, and/or Tyvek. Do not wrap the piece in bubblewrap.

Maintenance and Repair or Repair/Replacement

- MoMA should be aware of the most common warning signs of failure:
    - Striping on screen = motherboard problem
    - Clicking sound= hard drive
    - No display = ribbon cable is not attached or is no longer functional
- MoMA should be aware of key commands for restart (see Section V).
- In the event of failure, the first action MoMA should take is to contact the artist to consult with the conservators in any repairs.
- Stockpile Powerbook 280c computers. These are currently widely available. The computers need not be fully functional, as only certain parts may need to be used from them, and other parts only serve aesthetic purposes.
- MoMA may also consider purchasing one or two legacy screens with inverter boards intact. These could be used in the event that the screen needs to be replaced and the current inverter board is somehow damaged during the process and rendered unusable. If a new screen is used and does not require the inverter panel, the old inverter panel can be utilized and left visible on the front for aesthetic purposes (keeping the rectangle shape).
- When fluorescent bulb gets too dim, replace entire screen instead of replacing bulb. Otherwise it is OK to replace fluorescent bulb with an LED one.
- MoMA should purchase a compatible dock for the Powerbook 280c (Dock II or Dock Plus).
- MoMA should also be prepared to substitute compatible hard drives in the case of hard drive failure. The most current backup files (from the last time the drive was put in storage) should be copied to the new hard drive before it is installed to restore the piece to its last known position. Replacement drives could have *CPU* software pre-installed, although adjustments will still need to be made to the accumulator.
- MoMA will also need a hard drive sled.

- To restore accumulator, MoMA should contact the artist. If the artist is unavailable, MoMA should reference the most recent documentation to restore the piece to its last known position.

- MoMA should purchase a compatible dock for the Powerbook 280c (Dock II or Dock Plus).

- A good source for spare parts is the Oakland Powerbook Guy: http://www.powerbookguy.com

Documentation

- MoMA should fully document the measurements of the housing in case it needs to be reconstructed.

- MoMA should videotape *CPU*'s screen to record the artwork's pacing and timing. This document can also be used if MoMA needs to restore the accumulator file.

- Immediately backup the floppy disk with the source code and make redundant copies of software. If using removable media, migrate to newer media as needed.

- Backup the code and the accumulator file each time the piece is put into storage.

- MoMA should remain aware of Simon's intentions in regards to the code. He implied that he would eventually make the code open source. When this happens MoMA should immediately gather the code and keep multiple hard (print) copies, as well as file-based copies for future reference.

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[i] Interview with John F. Simon Jr. Youtube. http://www.youtube.com/watch?v=bsLUxM_MGQ. Accessed April 2008.
[ii] Ibid.
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[vi] Sinha, S. K., M. Kawaguchi, T. Kato, and F. E. Kennedy. 2003. "Wear durability studies of ultra-thin perfluoropolyether lubricant on magnetic hard disks". Tribology International. 36 (4-6): 217-225.
[vii] Longbottom, Roy. 1980. Computer system reliability. Wiley series in computing. Chichester, [Eng.]: Wiley.
[viii] Hennessy, John L., and David A. Patterson. 1998. Computer Organization and Design: The Hardware/Software Interface. San Francisco, Calif: Morgan Kaufmann Publishers.
[ix] National Research Council (U.S.). 2000. The Digital Dilemma: Intellectual Property in the Information Age. Washington, D.C.: National Academy Press.
[x] Artist's website, http://www.numeral.com/panels/cpu.html. Accessed April 2008.
[xi] Personal interview, Gering Lopez Gallery, April 25, 2008.