Virtualisation as conservation measure

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Abstract

The subject of this paper is dedicated to questions on archiving and preservation of born digital media art. It investigates to what extent virtualisation is suitable as an increasingly accepted method for conserving especially computer- and internet-based media artworks. Summarising interim conclusions of AktiveArchive [1], the empirical basis is formed by case studies. The handling system failure examines possible preservation approaches. As the research is embedded in a broader context it devotes conclusions on a more theoretical level. Considerations on sustainability are discussed implicit. Action-oriented electronic works of cultural value provide the center of our research. The focus on media art projects accounts for an art-technological approach.

Introduction

Apart from technical documentation the physical maintenance, archiving and preservation of born digital artworks presents a particular challenge within the cultural context. On the one hand this examination is related to the resolving character of the analysed artworks themselves. As opposed to many other art forms it is difficult to give a tangible form to those artworks. The kind of digital assets examined here is naturally shaped by (im)materiality while being processed. A basic question is: How to preserve the dynamics or course of action of an interactive, distributed artwork? Observing Internet based art forms presents a basic constellation where the appearance of the artwork – a browser or player on the client machine – and its physical anchorage of the server engine are located on different machines. There is no single entity that can be identified as *the artwork* (objecthood).

On the other hand the overall saturation of media technology - in our computerised surroundings - tempts us to underestimate the problem of preserving digital cultural heritage. Digital objects seem so easy to copy and store on CDs/DVDs, external hard drives or a running server unit. This aspect leads over to another conflict related to our subject: While scientists and researchers in the field of long term archiving and preservation insist on relocating and transcoding content for sustainability reasons, conservators facing artworks emphasis on maintaining *the original*. Transferred or copied usage of any element – be it software or hardware - appears as replica and seems of minor interest. The coupling of hardware and artwork tightens the conflict. Very often computers are determined as artwork if artistic software is installed on them.

Field of research

Against this background the following text asks how far virtualisation might relieve the situation. As opposed to the industrial usage, virtualisation is discussed as transferring method. Beyond current market trends we adapt the software products to cultural requirements. This means to enhance the technological knowledge by inducing parameters for lasting valences. Or more precisely: we use aspects of virtualisation, which are marginal to the commercial distribution (see below).

Whereas in former time the (in)visible processes or rather immaterial components of the computerised artwork where often observed only as an generator of surface effects, we want to stick up for a preservation philosophy, which concedes special impact to the digital components. As far as possible they should not simply be replaced by one another. Software elements, scripting and specific configurations often contain important information about a technological developments. They so far keep historical inscriptions and might be considered as specific to a particular digital epoch. Maintaining the functionality and cultural values, which are inscribed in the technology, implies a sustainable form of archiving, conserving and restoring. In order to perceive different layers of historical appearance, the artworks shall be preserved as a whole. This means to include real-time performance and interactive processes while preserving. In this context a theoretical entity described as *digital environment* gains special importance.

The digital environment contains both: the core elements of the artistic software as well as the operating system and modules required by the artistic software. The latter enable the possibility of executing the. Technically fragile work components are encapsulated in an artificial safety zone.

In our case the digital environment is migrated to a so-called virtual machine and stored. Figure 1 shows the modular view on a computer system, where the digital environment of an artwork, including the original artistic application is marked red. This module will later be transferred to the VM.

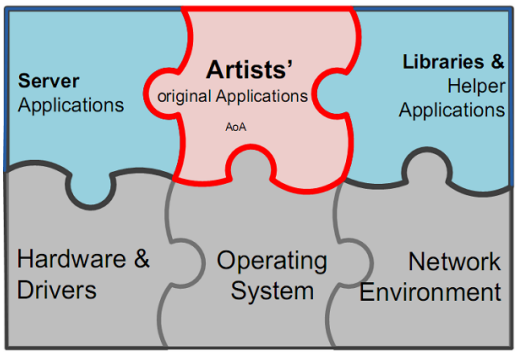

Figure 1: *Modular view of the digital environment of an artwork.*

The approach to preserving a digital (system) environment goes further than the previously practised forms of *static preservation* (see below). Within the digital environment of the VM certain failures and bugs of the artwork become manageable. Evacuated in the VM they can be considered as coherent effect of technological innovations. They appear as a kind of media imposition (*Medienumbruch*) [2]. As remains to be shown in this text visualisation is a non-immersive conserving method, which allows in some cases to get a dysfunctional artwork executable again without, at the same time, destroying the historical connotations.

State of the art

Our research queues in the context of data transfer, emulation, migration and related forms of preservation. While the gaming community has breed out a remarkable amount of specified emulators and generates continuingly vast knowledge on emulation [3], within the art context we are still looking for standardised routines and ways of handling computer- und internet-based art forms. Experience based findings are disseminated through conferences and on websites [4].

Apart from the Howard Bessers's Theories of Longevity [5] Jon Ippolitos *variable media approach* [6] defines a status quo. In addition case study like 'Preserving the Rhizome Artbase' [7] and the survey of restored computer artworks moot in the exhibition 'Seeing Double. Emulation in Theory and Practice' [8] are essential up to the present. Facing European research programs, organisations like the Netherlands Institute Montevideo/ Time Based Art [9], V2 in Rotterdam [10] and the INCCA-Network [11] as well as the Nestor Network in Germany [12], AktiveArchive in Switzerland [13] and many others are to be mentioned.

Coming back to our subject Jon Ippolitos classification of *emulation, migration* and *re-interpretation* is to be referred. Completed by Richard Rinehart term of *static preservation* [14] both schemas offer useful attempts for outlining the function of virtualisation. Whereas *static preservation* strives on an appropriate storage and maintenance of the artwork's original components (and therefore primarily the hardware), *migration* means the update onto the newer system – "simply copying digital information from outdated to new, fresh and current forms of media" [15]. The *emulation* however simulates a computer system that differs from its host. The mimetic behaviour of emulation concerns specific hardware conditions, which are decisively responsible for the compatibility of the software.

The Virtualisation procedure

The *virtualisation* of a computer system mediates between the preservation approaches that have been sketched so far. Whilst this technology was already used in the 60ies for optimising meagre hardware and memory resources (ref. the time-sharing system VM/370 of IBM), we use this technology in order to preserve current or superannuated but still accessible operating systems.

Virtualisations allows isolating the digital art piece and ports the work relevant components to the virtual machine (Figure 2) [16]. Applications, software libraries, browser, players, plug-in, helpers, specific drivers and hardware configurations, and even system environments (assembles of software elements) are kept executable.

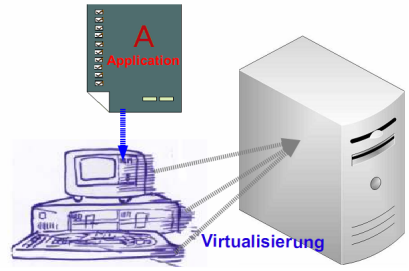

Figure 2: *Schematic view of virtualisation.*

Virtualisation uses a set of hardware emulators and is in this way naturally related to the subject of emulation. Whereas emulation normally reconstructs the target operating system, virtualisation combines emulated hardware with the direct use of hardware and system components its host machine. This means that the VM is in certain areas compatible to its host. It accesses interfaces like e.g. the USB Port or Network adapters immediately. Single executing processes are carried out directly on the host computer. To speak literally: the surface of the VM is partially semi permeable. This ability for controlled interchange with the host improves the performance of the VM. At the same time this could cause a need for further action in future: The VM requires itself specific hardware conditions, like e.g. the X-86 processor, which has to be provided by the host. Figure 3 outlines forthcoming migration processes introducing emulators or even replacing the VM. One of the most important aspects at this point is, that again the digital environment won't be touched at this stadium any more.

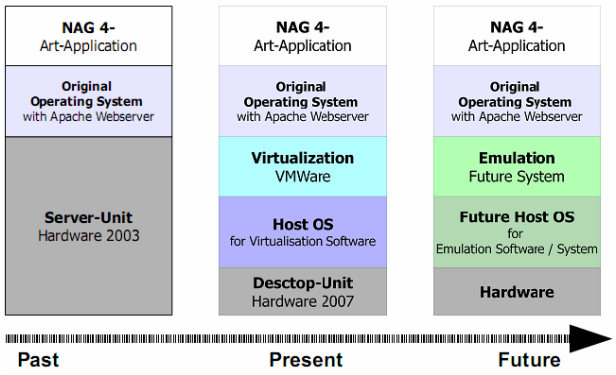

Figure 3: *Migration procedure of an artwork: from left to right: original art environment, VM, Emulation.*

In general we distinguish between the virtualisation of server systems and that of desktop machines. In our context desktop VMs serve an authentic re- and display of data in different formats, historically more and more outdated browsers, players, plug-in etc. They keep operating systems, specific software packages and libraries, which are not supported by their (commercial) distributors any longer or have disappeared the market already. In this way desktop-virtualisation technically enlarges the scope of storing vintage reference equipment.

The virtualisation of server systems however counteract side actions like security bugs caused by technological improvements, run-time software developments or breakdowns through server updates. Additionally significant problems arise by interfacing the communication process and whilst data exchange. Especially in the past decade, between 1995 and about 2005 external factors caused a grate many of failures. Quite a lot of internet-based artworks disappeared without a trace. Today quite a number of artistic software functions on current web servers only restrictedly or even not at all. However many artists update their websites and applications regularly. We have no objections as long as specific, historically informed procedures are deliberately attended.

While for artists it is a common practise to improve their artworks while removing bugs or after having migrated their pieces to an updated server / operating system, restorers would consider

many exchanges in a strict sense as creation of a new version of the work. At this point we want to emphasise that the original version of the work very often gets lost in the course of modernising. There is no necessary conflict between the artist's interest in keeping the artwork just accessible and running, and the conservators charge in preserving authenticity and historical implications, as mentioned before. In this context virtualisation becomes especially interesting.

Course of Action

In order to analyse specific networked artworks and for evaluating their actual state (functionality) AktiveArchive has virtualised their server engines. The VMs maintain the digital environment and work in this context as technological tool. They offer an isolated, secure environment for examining all work-relevant software and system components in terms of

- required technological infrastructure,
- completeness,
- data-exchange and communication-process and
- additional internal operations.

The possibility to replicate certain operations and to recur on a secured (frozen) status of the artwork by restoring a previously done snapshot can be considered as special feature in the context of scientific research.

During the test installation we came up with quite some problems, which can be described as typical. The following summary tries to assign recurrent shortcomings of computer- and internet-based artworks related to different modes of preservation. In general one distinguishes between *preventative conservation, classical conservation* and *restorative engagements*.

Preventative conservation carries out foresightedly actions like gathering run-time software products, players, plug-in and software libraries etc. *Classical conservation* is more concerned with stabilisation of the current state of an artwork in a moment where seemingly or even obvious degradations arise. Additionally *restorative engagements* try to reconstruct the original functionally with as little interventions as possible. This become mandatory after the artwork has stopped proceeding caused by internal or external damage.

Preventative conservation

An example for preventative conservation is given by Cornelia Sollfranks artwork 'Net.Art Generator' (1999-2004) – a series of server based web applications [17]. The artwork 'Net.Art Generator. No. 4' adopts e.g. the software library ImageMagick for resizing, re-structuring and re-assembling images from the Internet [18].

Like in many other cases the software library is used to render the (audio-)visual display of the artwork. Beside images many artists, including Cornelia Sollfrank, utilise additional sources like text, sound or even video material in order to recycle them conceptually. Graphical patterns are generated real-time, text material is re-assembled, images, audio and video material as well as the content of RSS-feeds is gathered and modified. The artists' software packages and applications are very often assigned to open source licences and available through freeware supply. Some of them are even contained in the basic installation package e.g. of the web servers' operating system [19].

As specific software-components contribute at last instance to the aesthetical appearance of the artwork, we consider it appropriate to save the original version of this very components. The identification of indispensable elements occurs while ascertaining the source code and especially by tracing related software components or the application interfaces. If the artwork is transferred to a recent server systems updated versions of software libraries are automatically offered. In case of Cornelia Sollfranks 'Net.Art Generator. No4' the ImageMagick Version 6.2.5. (2003) is needed instead of the current version 6.3.9-9 (2008).

For preservation purpose in this case single modules should be exchanged manually. Whereas recent versions of the same software library keep naming the core functions and commands identically, the internal algorithms might differ. Within the art context it is ought to exercise reasonable care.

Classical conservation

It is hard to draw a strict line between classical conservation and restorative engagement if the interventions occur at the level of the artistic scripts and pre-programmed code. Wide ranges of internet-based artworks offer not only a specifically designed websites, but also provide executable scripts as artistic application. They can be downloaded and installed by any user on his/her own web server.

Within our case studies we have examined a series of Andrew Bulhak's so called 'Dada Engine' (1995). The piece exists embedded in special websites [20] as well as in the format of executable scripts. The artist offers a number of scripts for text-based operations. As the code obtains unmistakable a central part of the concept, we tried to figure out why several art-scripts are not executable any more. By analysing the script code we noticed a number of syntactical errors, which seemingly have been ignored by old server systems, and become now obvious due to changed network and especially software conditions.

Pertaining certain characters, syntactical elements or punctuation allow fixing these sorts of bugs according to conservation guidelines. Corrected lines are commented immediately in the source code. Whereas adjusting faulty chains of characters is plain sailing, an actual reprogramming leads to a different category of preservation, discussed under the subject of emulation. At this moment we do not deal with the sweeping transcoding of the artwork but rather maintaining of artworks within VMs.

Restorative engagement

A third category of problems is caused by the fact that a remarkable amount of Internet based artworks require on public web services. Service-providers like Google, Wikipedia, Technorati and others allocate content, which is processed dynamically through the course of the artwork. The dependency on external resources becomes complex in case of changes: e.g. when the web service modifies its access protocol, the communicating format or additional functionalities, which are anticipated by the artwork. Artists use to accomplish their works by line-by-line corrections of the source code. For us it is furthermore challenging to maintain authenticity. Sustainable, non-invasive solutions shall be investigated, which do not touch the source code each time a services changes its access. Specific network components are used to proxy inconsistencies within the communication interchange. They are located in-between the digital environment of the artwork

and the Internet. As the latter potentially continues changing the network component can be modified according to request.

Whereas in some cases a problem can be solved by pittipaling certain conditions to the web service, more complex art works require a proxy-like bridge solution or even firewalls or routers.

The interactive net-based installation 'Breaking the News. Be A New-Jockey' (2006/07) by Marc Lee retrieves e.g. data from 16 different web and news services [21]. Facing the fact that significant improvements in the communication format are echoed by different web services at one time, it becomes obvious that clearly arranged solutions are necessary. In this case the network component might be a proxy-like module. Other artworks require specific router solutions or configurations of the firewall, in order to support the maintenance. And the list of additional scenarios might be continued on and on.

Conclusion

This short survey indicates that archiving and preserving computer- and internet-based artworks cannot fall back on a technical ready-made solution. Investigating an appropriate set of operations requires a careful analysis of the technical conditions of the artwork, detecting any immediate addressed system component, and a profound understanding of the artist's concept. In this process metadata retrieval and adjustment of the aesthetic implications are essential in order to determine the relevance of each related element. The internal communication process frames the logic of operations and is inherent to the artworks' intention. This is why the digital environment is so important.

Gathering technical metadata includes detecting internal and external interfaces, communication flow and displaying mode. In addition context-formulating elements shall be traced and described. Basic information is denoted within the source code.

While balance reasons for different conserving measure criteria for identifying the artwork logics appear, which enabled in a next step the definition of the virtualisation line.

Besides static conservation virtualisation offers the maintenance of an authentic digital environment. Is retains the original functionality of an artwork and stores cultural information. An authentic environment is of high importance, because it emphasis the artistic intention. Did the artist recur on up to date programming or did he/she rather stage out-of-date components. Both are common strategies and are used in order to advert e.g. the velocity of technological improvements.

Encapsulated within the VM different developments of the artwork can be traced by storing regularly done snapshots. The VM stores the inner core of the artwork and at the same time prepares the artwork for future improvements. The VM offers an important, transitory tool, which guarantees the seamless migration of the artwork into an authentic emulated surrounding. Continuing updated keep the comparability and can so far operate in a sustainable way.

The VM enables backups and transfers to different operating systems. Depending on the software product used for virtualisation the VMs are executable on different platforms.

Virtualisation is a lossless transferring measure that does not touch any software components by its own. Shrouded in an up to date software environment – which is the VM -, old systems, programs and applications are kept alive in an artificial biotope.

References

[1] AktiveArchive is founded by the Suisse Department of Cultural Affairs within the framework of sitemapping.ch. It focuses on strategies for documenting and preserving electronic media art. Beyond stabilising the current status of an artwork, an active form of archiving is intended. Ideally this working process leads to a historically informed re-construction and re-play (*Wiederaufführung*, Johannes Gfeller).

[2] G. Tholen, Die Zäsur der Medien. Kulturphilosophische Konturen, Frankfurt 2002.

[3] An introduction is given at Wikipedia at: http://de.wikipedia.org/wiki/Emulation as well as on http://en.wikipedia.org/wiki/Emulator.

[4] Important compilations of essays are accessible through the following websites:
CoOL Conservation Online: http://palimpsest.stanford.edu/
PAID preservation access to digital information: http://www.nla.gov.au/padi/
IMAP Independent Media Arts Preservation: http://www.imappreserve.org/.

[5] H. Besser, "Longevity of Electronic Art", in ICHIM 2001, p. 263-275 and additional essays.

[6] J. Ipolitto, "Method, Accommodating the Unpredictable: The Variable Media Questionnaire", in: Permanence Through Change: The Variable Media Approach, New York, 2003 and J.G. Hanhardt, "The Challenge of Variable Media", in ebda. p. 7-9.

[7] R. Rinehart, Preserving the Rhizome ArtBase. New York, 2002, see: http://rhizome.org/artbase/report.htm.

[8] Seeing Double: Emulation In Theory And Practice, Guggenheim Museum New York City, 2004, see: http://variablemedia.net/e/seeingdouble/.

[9] Netherlands Media Art Institute (Montevideo/Time Based Arts), http://www.montevideo.nl.

[10] Institute for the Unstable Media (V2_), http://www.v2.nl.

[11] International Network for the Conservation of Contemporary Art (INCCA), http://www.incca.org/Dir003/INCCA/CMT/text.nsf/0/76A86ECC5585CCEEC1256B0200384B58?opendocument.

[12] Nestor Kompetenznetzwerk Langzeitarchivierung, http://www.langzeitarchivierung.de/.

[13] AktiveArchive, http://www.aktivearchive.ch.

[14] R. Rinehart, The Straw that Broke the Museum's Back? Collecting and Preserving Digital Media Art Works for the Next Century, http://switch.sjsu.edu/nextswitch/switch_engine/front/front.php?artc=233.

[15] R. Rinehart, The Straw that Broke the Museum's Back? Collecting and Preserving Digital Media Art Works for the Next Century, http://switch.sjsu.edu/nextswitch/switch_engine/front/front.php?artc=233.

[16] A VM is a fully operative computer system which exists independently from any specific hard ware. In the shut-down status it can be saved as a file and is portable.

[17] C.Sollfrank, net.art generator, http://net.art-generator.com/.

[18] ImageMagick, http://www.imagemagick.org.

[19] In this case we refer so server operating systems like Ubuntu, Debian Linux, Suse/ Open Suse and Readhead / Fedora which are frequently used in the current field of net art works.

[20] Andrew Bulhaks source code can be downloaded from http://contraintes.inria.fr/bin/dada. See also http://contraintes.inria.fr/bin/dada?pomo.pb;m=SRC.

[21] See the documentation and reference material on: http://www.1go1.net/index.php/Main/News-Jockey.

Author Biography

Tabea Lurk studies at Karlsruhe, Leipzig and Osnabrueck and received her MA in art history (Kunstwissenschaft) and media theory at Karlsruhe University of Arts and Design (2003). She completed her scientific internship ZKM – Center for Art and Media Karlsruhe (2006) and has worked since then for AktiveArchive at BUA Bern, where she researches on preservation strategies for computer and internet based media art works