(How) It Works!

A manifesto .. towards establishing a functional software collection at the Vienna museum of science and technology

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Abstract -

This paper presents the decision making process involved in establishing a software collection at the Vienna Museum of Science and Technology. The museum's collecting activities have been limited to the collection of tangible heritage. The current collection strategy defines the functionality of a museum object solely as its own material manifestation. That is why the museum keeps its physical collection in a "powered-off" state to preserve its integrity and functionality for the future.

To integrate a functional software collection into this theoretical frame we are discussing applied terminology and have developed a manifesto to build on a solid theoretical foundation.

Keywords – software collection, strategy, manifest, open source, embedded community

Conference Topics – Digital Accessibility; From theory to practice

1. Introduction

The Vienna Museum of Science and Technology houses one of the largest and oldest collections of technical objects, inventions, designs and research projects from various fields who have contributed to the advance of science, art and daily life of Austrian people. The largest part of the museum collection consists of commercial objects that were mass produced. However, the museum also preserves individual objects, art, innovations and technical inventions that were never mass-produced but are of particular value to Austria's scientific and cultural heritage. The various objects are collected and divided into five collection groups, each with its own individual collection strategy and research focus. The recent collection strategy for tangible cultural heritage protects the collected objects in the museum and prohibits any functional use of them to preserve their integrity.

Despite the diversity and historicity of the museum, which took on the task of preserving the physical integrity of the objects – keeping them in a "conservatorial resting state", its role as a collector of modern technologies and intangible cultural heritage in Austria was unclear. Due to the threat of technical obsolescence and the associated loss of the logical counter-part of the objects that were still undiscovered within the collection, as well as the growing need to digitally expand the museum's collection, the museum established a new collection department for the intangible cultural heritage as part of the research institute in 2022: The software collection.[1]

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In addition to the obvious question: how to adapt the museum's existing infrastructure and collection strategy to meaningfully collect, catalog, document, preserve and restore the logical, the contextual and physical layers as a whole; there was also a conceptual issue. How to expand the internal methods and infrastructure with novel tools, technology and platforms to apply preservation actions on all described levels of threat. Does it make sense to build a software collection without planning the functional preservation of the original hardware to interpret?

II. Scope of the research

At the beginning of this research project, the museum successfully applied for funding from the Vienna Business Agency and set a time frame of two years (12/22-12/24) to develop a concept for collecting, archiving, documenting and the dissemination of software-based objects, focused on two different groups: 1. complex software objects, 2. industrial everyday technologies with embedded software. The first group lays a focus on experimental games, design and computer graphical methods from the 1980s, 1990s and 2000s. The second group focuses on contemporary everyday machines from the museum such as the ATM machine [2].

First objective was to understand how we can utilize the existing physical collection, to preserve and extract the original source code, the executable binary and other functional software and hardware dependencies that in order to document their authentic performance, such as: applications, compilers, software libraries, operating systems, device drivers, firmware, hardware embedded software, etc.

II.A Focus

Since this project is right at the beginning this paper tends to openly discusses terminology used and the results of the ongoing inventory analysis of the existent collection and the associated decision making processes within the museum transformation. First step was: finding out what the profile of the collection is and how to logically expand it with device, resp. object relevant software and cultural-historical digital artifacts to *"reflect upon the development of technology and science*"[1].

II.B Goals

At the end of this research the following goals should be accomplished:

> Enhance the existing collection strategy with modified definitions and unify vocabulary and terminology.

> Integrate the new objects logically and conceptually into the collection;

> Establish a common understanding within the museum what "function" means to consequently preserve it properly.

> Build and integrate a sustainable, functional, and long-term software archive.

> Build a dedicated workspace with an emulation framework for hardware embedded software and data extraction, migration and rendering.

> Make this acquired knowledge accessible to other researchers, institutions, collection, archives and museums following the open source, open data, and participatory collaboration policy of the museum.

II.C Research Questions

? What kind of objects are already part of the collection (technical and historical)?
? How many of them are unique?
? Can a specific focus be deduced? (office, art, game culture, ...) and shall this focus be followed?
? What are the consequences for the software collection?
? What general strategy and focus can be derived and defined?
? What gaps need to be filled based on the developed strategy?
? How to define and apply the terms *software, information, digital entities, complex digital objects and their interrelations*?
? How to define this new group of objects within the context of this specific collection?
? How to re-enact the historical context of the

object with its digital (virtual) twin?
? How to identify valuable content?
? What virtualized existence should we preserve?
? How to identify cultural heritage institutions with similar collection profiles and compare their existent content?

2. Related Work

Through an environment analysis we defined the following types of cultural heritage institutions, to engage within the international trans-disciplinary collaborative network: Technical museums, Computer (game) museums, Archives / Libraries and Art Collections. This pool of diverse scientific disciplines frames our field of interest. As we tend to understand a museum artifact as complex entity which needs to be re-interpreted again and again to be perceived. This is caused by the inherent dynamic existence of the digital object itself and its rendering environment. In the case of the Technical Museum Vienna this rendering environment changes depending on the target group, stakeholders and use case (e. g. exhibition in the museum space, virtual access through online collection, etc.).

3. INVENTORY ANALYSIS

To comprehensively understand the physical collection: 199.338 objects / data sets (counted by inventory number) from the collection management system have been extracted, structured and classified, to:

- Understand and describe the technical and conceptual profile of the already existent software (either stored on information carriers or device embedded).

- Discuss this profile within internal and external stakeholders to enable a gap analysis and the potential expansion of the collection.

- Derive and define object groups of expansion considering technical and conceptual aspects (e. g. Austrian developed software, application software, games, art, external drives, …).

- Identify and Execute risk assessment.

The following conclusions were drawn from the initial collection analysis: Interestingly, no focus on software (or its hardware environment) produced in Austria could be identified. The reason for this could be that the collection departments place a stronger focus on collecting objects with a cultural and technical connection to Austria (e. g. a series of generic desktop computers used in an Austrian bank branch). Furthermore we discovered that the found software was mostly hardware related (e. g. drivers and applications for an office printer) or were embedded in the collected hardware (e. g. an ATM machine). Based on the analysis, the historical context of the object as well as the context of their use along with its physical integrity are the main interest of the collection strategy.

Around 27% percent of the identified relevant objects are saved on different information carriers and embedded in dedicated devices. The rest constitutes itself as diverse hardware devices (personal computers, workstations, game consoles , digital music instruments, external reading devices). Most of the identified software objects are common computer and video games. We expect the 58% of unknown software (saved on different carriers) as mainly empty (~ useless), since the focus was to study the physical characteristics, rather than its intangible content. (see TABLE I)

TABLE I
classification of expecting software types

Type of software	%
Software Objects (Game, Doc, …)	32
Supporting Software (Application)	3
Operating System	~ 1
Device Driver	~ 3
Hardware embedded	~ 1
unknown	58

4. Terminology: Information, software, Complex Objects, Function and Performance

After the inventory analysis was completed, a general classification of the object groups was created and relevant keywords were identified. This made it possible to develop a more detailed description of the role of each object type and describe them based on their level of existence: the physical, logical and conceptual.[3]

> Definition on the physical level of existence (binary): All physical objects that contain transferable information or the logical part can be separated from the physical carrier and migrated into a virtual format. These binary images will form the basis of the software-archiv [4]: a passive, non curatorial selected collection of software objects to built up a functional infrastructure. Which means that they can be used in combination with other virtual binaries and environments. Their content should be extracted to allow precise interpretation. Based on the inventory analysis, we consider the following terminology to describe these types of software-objects: device-embedded software, hardware image, extracted virtual image, base image, imaged medium, imaged system, synthetic image.[5]

> **Definition on the logical level of existence:** single binary or textual file, collection of binary or textual files, complex object with just internal dependencies, complex object with external dependencies or source code.

> **Definition on the conceptual level of existence**: software objects and supporting software (games and applications) operating systems, device driver, source code.

> **Definition of software-based objects**: targets are by definition digital born and digital transferred data objects [6] (binary and textual) as singular file or complex organization of files (dependencies).

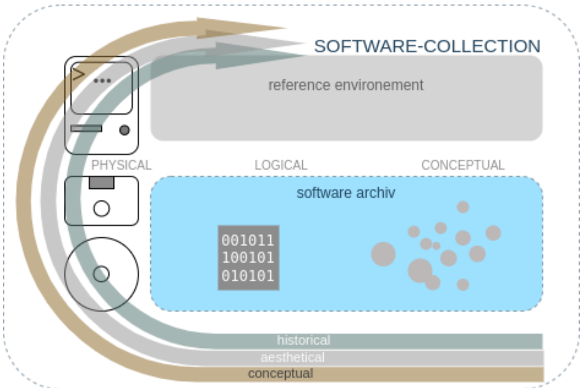

Figure 1 visualization of the structure of the software collection, consisting of the software archive, interpreted by the reference environment and representing historical, aesthetically and conceptual information.

> **Restructuring the existing tangible collection:** The primary objective is to first separate the physical and logical parts of the software-based objects in the Museum. We need to document the technical information, render them in the native environment, document their performance, and keep them in a stable, virtual form and archival formats. The second goal is to find a platform on which the separated virtual images can be merged into a working entity. The third goal is to permanently make the software archive accessible to researchers and the public.

We plan to build a software archive, that will contain the binary images and their extracted content. Re-interpretation and re-execution will be enabled by a reference environment, both in physical and virtual form (EaaS). While the virtual environment will provide access to the transferred software objects the physical environment will enable precise comparison with the originated hardware. Facing the museums politics the collections strategy has been modified to include the term “everyday objects” [14]: this excludes objects which are mass-produced, not older than 100 years, without any unique value from the restriction to “turn it on”. To substitute this collection donations will conclude the hardware environment and integrate the conceptual information (oral history) to the software collection.

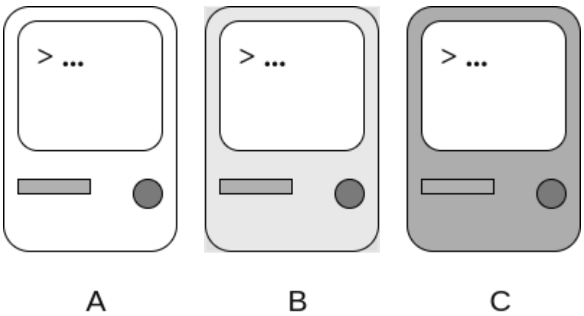

Figure 2 visualization of the different object/collection groups, resp. the defined environments and their associated use within the museum context. A: Objects (traditional museum objects). B: Functional Collection (non cultural heritage objects), C: Software collection (with software archive)

5. MANIFESTO

To create a profound understanding and clear communication of the software collection and its implications we drafted a manifesto resulting from the discussion described above. Considering the mission statement : "here technology becomes experience" we do state:

FUNCTION REFLECTS THE ABILITY OF A SIGNIFICANT PERFORMANCE: time is crucial for an authentic experience. The rhythm of processing and interaction explains the fundamental design and programming structure. Functional long-term archiving is focused on permanent access to digital objects and their interactive perception through a rendering environment. So we do understand the function of a rendering digital environment as a performative act revealing the truth of the object itself. This digital calculating space embodies more the dynamic structural relations than static hard coded numbers.[13]

NO INTEGRITY WITHOUT FUNCTION: This inherent functionality is key to the software object integrity. The significance of performing is just possible through dynamically preserving the object, view path and interfaces to render (interpret) embedded instructions manifested in algorithms.

THE RENDERING ENVIRONMENT FORMS THE IDENTITY AND IS KEY TO DOCUMENTATION: As above stated software-based media objects need adequate environment to render it, not just for perception but also to document. Preservation implies documentation which requires just as much dynamism. The applied documentation methods are demanding permanent transformation otherwise they will get obsolete. So the primary operation of the archive is shifting from the content of one singular object to a logistical interlinking of object and layers.

DIGITAL OBJECTS DEGRADE INEVITABLE: Even though digital copies are identical, real life and endless (format) migrations disprove the myth of the digital ... [8]. The Copying of data in the digital realm is questioning the meaning of the original but also blurs its boundaries. Lots of copies keeps stuff save but what is the difference between them? How to describe the different rendering environments and their significant properties? And even physical realities transform in time which might makes the concept of the static archival storage obsolete itself.

TECHNOLOGY IS CULTURE: The holistic claim of the historical museum object demands comprehensive investigation and documentation of the semantic level as well. The culture production from the 70s on has been especially driven by the development of these computing machines. The creation of video games is just one part. The computer as performing complex creates, embodies and transforms culture. The active protagonists of this scene are urged to research themselves to adopt documentation as cultural technique [7]. . . and preserve the process of the process of the process as permanent performance.

6. ACKNOWLEDGMENTS

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