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Application of Digital Information in Prevention and Reconstruction of Monuments, Architecture and Urbanization – Specific Application of BIS Machine

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Summary

The new information technologies imply new understanding of access to cultural and scientific heritage materials. The preservation and reuse of these digital assets forms both the cornerstone of future civilization growth and development.

The cultural and scientific heritage consists of treasured values, accumulated during the centuries. They are the foundation for the future of human being memory. These can remain beyond time only if we take now the responsibility for their preservation or reconstruction using digital methods. It is necessary to prepare before hand physical copies of the most valuable products of human intellect, in order to save them for the future generations. Increasing amounts of cultural, natural and scientific heritage are being created or represented in digital forms, as we are living in the digital ages.

These digital materials represent our heritage in order to monuments, architecture and urbanization and are our future intellectual capital. The fast pace of change in the technological landscape makes ensuring long-term access to these materials as a challenge.

The paper presents some specific theoretical and practical aspects of preservation of cultural assets in digital form in long-term aspects and practical issues in information digitisation through the practical example of some part of BIS Machine related to Apoksiomen, as a connection of digitisation and production of monuments.

Key words: monuments, architecture, threats, digital information, digital preservation, reconstruction

Introduction

The cultural and scientific heritage consists of treasured values, accumulated during the centuries. They are the foundation for the future of human being memory. These can remain beyond time only if we take now the responsibility for their preservation or reconstruction using digital methods. It is necessary to prepare before hand physical copies of the most valuable products of human intellect, in order to save them for the future generations.

The digital world is still relatively young and immature in relation to the larger information universe, parts of which have been under development for centuries. Therefore nowadays information is being generated in greater quantities and at higher frequency than at any time in human history. Such information is penetrating and transforming nearly every aspect of our culture and life. Increasing amounts cultural, natural and scientific heritage is being created or represented in digital form.

In recent years, rapid advances in digital technologies, from 3D graphics, CAD systems, etc. to multimedia, and virtual reality, have given heritage new hope: from archaeology to architecture, emerging digital tools offer promise in documenting, analysing, and disseminating culture. From the now obliterated treasures as Buddhist statues at Bamiyan, Afghanistan, to Minoru Yamasaki's, Twin Towers' in New York, Croatian sculptures and monuments laying on the deep end of the Adriatic, and so on, we owe it to future generations to harness our digital tools to preserve and protect the world's cultural legacy.

Cultural Transformations and Digital Dependence.

The increasing dependence upon digital information is having several dramatic effects. It is changing the way in which our culture is recorded and our culture itself is being transformed. If we think of physical products of culture as artefacts, we should also be thinking of digital and electronic products as digital-facts (d-facts) or e-facts. However digital-facts are very fragile, cause digital technology is very fragile also. Digital information is inherently more fragile than traditional technologies – more easily corrupted or altered, without recognition. Digital storage media have shorter life spans and require access technologies that are changing at an ever-increasing pace. If we think of technologi-

cal advances, need to consider the time frame in which we archiving become much shorter.

The cultural heritage reflects the way of life, the history and identity, provides the link between the past, the present and the future, and contributes also the economic sustainability and welfare. People, a community cannot function effectively in the larger societal context if deprived of its identity through the loss of its cultural heritage. "The digital heritage is inherently unlimited by time, geography, culture or format. It is culture specific, but potentially accessible to every person in the world. Minorities may speak to majorities, the individual to a global audience. The digital heritage of all regions, countries and communities should be preserved and made accessible, so as to assure over time representation of all peoples, nations, cultures and languages" [19].

Definition of the architectural heritage

For the purposes of Convention for the Protection of the Architectural Heritage of Europe [7] (Granada, 3.X.1985), the expression "architectural heritage" shall be considered to comprise the following permanent properties (art. 1):

1. Monuments: all buildings and structures of conspicuous historical, archaeological, artistic, scientific, social or technical interest, including their fixtures and fittings;
2. Groups of buildings: homogeneous groups of urban or rural buildings conspicuous for their historical, archaeological, artistic, scientific, social or technical interest which are sufficiently coherent to form topographically definable units;
3. Sites: the combined works of man and nature, being areas, which are partially built upon and sufficiently distinctive and homogeneous to be topographically definable and are of conspicuous historical, archaeological, artistic, scientific, social or technical interest.

The architectural heritage constitutes an irreplaceable expression of the richness and diversity of cultural heritage, bears inestimable witness to the past and is a common heritage.

Treats and responsibility

Our ability and commitment as a society to preserve cultural memory, and natural and science heritage are far from secure. It is so easy to damaged and lost all these in dramatic immediately, only if remind hurricanes (lately Katherine), tsunami, terrorist's attacks (11 September 2001), fires or floods

Threat – be called out phenomenon the working the strengths of nature man, which cause that the feeling of safety, are diminishes completely it disappears. We distribute the threats on natural (e.g. the impulsive defeats) and connected from activity of man (distribute these on: treats of the civilisation, e.g. the mass events of, disease; destructive treats, e.g. the terrorism, crime, sabotage; economic treats, e.g. the dirt of environment, defective constructions). Treats can

be divided from regard on sizes (territory) on which it sets – global treats, regional and local [2].

Examples of threats depending of monumental, sculptural and architectural heritage [12], besides mentioned before:

- conditions of settled;
- the working the moisture and water;
- the atmospheric factors;
- the chemical aggression of environment;
- the biological processes;
- the strain corrosion of materials;
- the influence of constructional defects and execution;
- the influence of underground excavations;
- kinematics of geological movements;
- decay and inappropriate using of relics, their thefts, disappearances; illegal transportation for border;
- lack or inappropriate devolution of protective heritage legislation;
- lack of awareness of their heritage values;
- lack of expertise for specific materials repairs;
- pressure from urban growth and redevelopment;
- pressure from application of uniform building codes.

The Limits of Digital Technology and the Technological Obsolescence

However digital technology poses also new threats and problems as well as new opportunities. Its functionality comes with complexity. Reading and understanding information in digital form requires equipment and software, which is changing constantly and may not be available within a decade of its introduction. Digital information today is produced in highly varying degrees of dependence on particular hardware and software.

The digital world is still too new for us to describe fully the life cycle of the information objects that do now or will in the future reside there, but what surely unites the community of actors in their various information-based activities is their common purpose in support of the pursuit of knowledge.

Knowledge cannot advance without consistent and reliable access to information sources, past and present. The application of computer hardware and software has also generated other new kinds of information objects, including the products of simulation, remote sensing, computer-aided design (CAD) and information systems (IS). These objects come into being and exist as creatures of the digital environment; if nurtured well, digital technologies will certainly get still other kinds of information objects, which we can now only anticipate.

Preservation requirements

In the digital world, to succeed in the preservation of digital objects, preservation measures must ensure that as many of these aspects as possible persist over time. In preserving a digital object, we aim to:

- Fix the object as a discrete whole – the boundaries of digital objects are less clear, especially if they are compound objects created by assembling different media or by linking to resources from around a network.
- Preserve the physical presence – preserving the physical file does not mean that the object will remain accessible.
- Preserve content – refers to maintaining the ability to access the content at its lowest level, such as ASCII text, without the embellishments of font variations and layout features.
- Preserve the presentation – content is typically rendered in some presentation, format or layout. To retain the original look of a document, these layout specifications must also be preserved, especially when they contribute significantly to the understanding and interpretation of the content.
- Preserve functionality – digital objects can contain multimedia components (i.e. text, graphics, audio, and video), exist in hypertext format, contain dynamic content generated automatically from data stores, or have navigation functions, such as toolbars, keyword search, or interactive tables of contents. Special efforts must be made to preserve the functionality.
- Preserve authenticity – activities to guard authenticity include securing digital objects against unauthorized changes and monitoring digital objects through multiple "copying" cycles to ensure that each copy is an acceptable rendition of the original.

Locate and refer to the digital object over time – objects can be readily altered, copied or moved. An individual must be able to match a citation to a digital object, and to distinguish it from other versions or editions.

- Preserve provenance – provenance is an archival concept that asserts the origin and chain of custody of an object and contributes to defining it as a whole. Imprint statements and bookplates. Establishing an object's origin and history help confirm that the work is authentic and its content is intact.
- Preserve context – digital objects are partly defined by their hardware and software dependencies, their mode of distribution and linkages to other digital objects. Preserving digital objects may mean weaning them from some technical dependencies, changing the mode of distribution, and deactivating links. In these circumstances, preserving context is a particular challenge.

Digital Preservation

The term "digital preservation" refers to both preservation of materials that are created originally in digital form and never exist in print or analogue form (also called "born-digital" and "electronic records") and the use of imaging and recording technologies to create digital surrogates of analogue materials for access and preservation purposes.

Preservation must allow future users to retrieve, access, decipher, view, interpret, understand, appreciate, and experience informational entities in meaningful and valid ways. It is required specifically exclude the potential use of digital technology to preserve the original artefacts through digitisation.

Digital preservation strategies are:

I. Technology preservation – means of overcoming technological obsolescence by retaining the hardware and software used to access the digital resource.

II. Migration of Digital Information – refreshing digital information by copying it from medium to another medium and the possibility of maintaining a complex set of emulators describe two distinct points on a continuum of approaches to preserving digital information. Data migration includes: medium refreshing, medium conversion, format conversion, version upgrade and migration of technical environment.

III. Change Media – transfer digital materials from less stable to more stable media. Copying from one medium to another has the distinct advantage of being universally available and easy to implement.

IV. Change Format – the migration strategy for digital archives with large, complex, and diverse collections of digital materials is to migrate digital objects from the great multiplicity of formats used to create digital materials to a smaller, more manageable number of standard formats that can still encode the complexity of structure and form of the original.

V. Emulation – refers to the process of mimicking, in software, a piece of hardware or software so that other processes think the original equipment/function is still available in its original form. The essential idea behind emulation is to be able to access or run original data/software on a new/current platform by running software on the new/current platform that emulates the original platform. Emulation means technological obsolescence of hardware and software by developing techniques for imitating obsolete systems on future generations of computers. Three options are: emulate applications, emulate operating systems, and emulate hardware platforms.

VI. Adherence to standards – adhering to stable and widely adopted open standards when creating and archiving digital resources.

VII. Backwards compatibility – being able to retain accessibility to a digital resource following upgrade to new software and/or operating systems.

VIII. Encapsulation – grouping together a digital resource and whatever is necessary to maintain access to it. This can include metadata, software viewers, and discrete files forming the digital resource.

IX. Converting to stable analogue format – converting certain valuable digital resources to a stable analogue medium.

X. Digital archaeology – rescuing digital resources, which have become inaccessible as a result of technological obsolescence and/or media degradation. Museums of hardware and software where ancient versions of hardware, operating systems, and applications software would be lovingly preserved so that people could read old data. This idea born some obstacles, but is sounding very nostalgic.

Implementations of New Technologies

The new technology has brought some new possibilities enabled to give effect through original copies production and the databases for valuable cultural heritage objects. One of a known method and methodology of an implementation of new technologies (IT, mechanical and other) is a "BIS Machine" – authors Kresimir Buntak and Davorin Kerekovic, which have been presented in Warsaw at 2004 year.

"BIS Machine" system could be described in flow diagram of work process. The diagram shows step by step every work process and check points necessary to evaluate all production steps during replica production.

Phase I

1. Object selection
2. Object imaging harmonized with requirements and possibilities (boundaries) by measuring, D scanning, photo-grammatically, digitally analogically or using combination of the aforesaid data entry methods
3. Processing of the imaged (quantified) data processing
4. Developing of imaging (quantifying) reports
5. Formation of the virtual object i.e. digital file etalon pattern
6. Data direction and harmonization

Phase II

7. CAD preparation
8. CAD model design
9. Validation and -pattern (etalon) calibration
10. Re-design – if necessary
11. Prototyped model design (rapid prototyping – 3D printing and the like)

Phase III

12. Material selection
13. Selection of machine and tool
14. CAM program development
15. Computer development simulation

16. Machine or device-developed production
17. Validation of the developed object
18. CAM program redesign – if needed
19. Sorting and saving all data systematized for data base
20. Object delivery and fitting

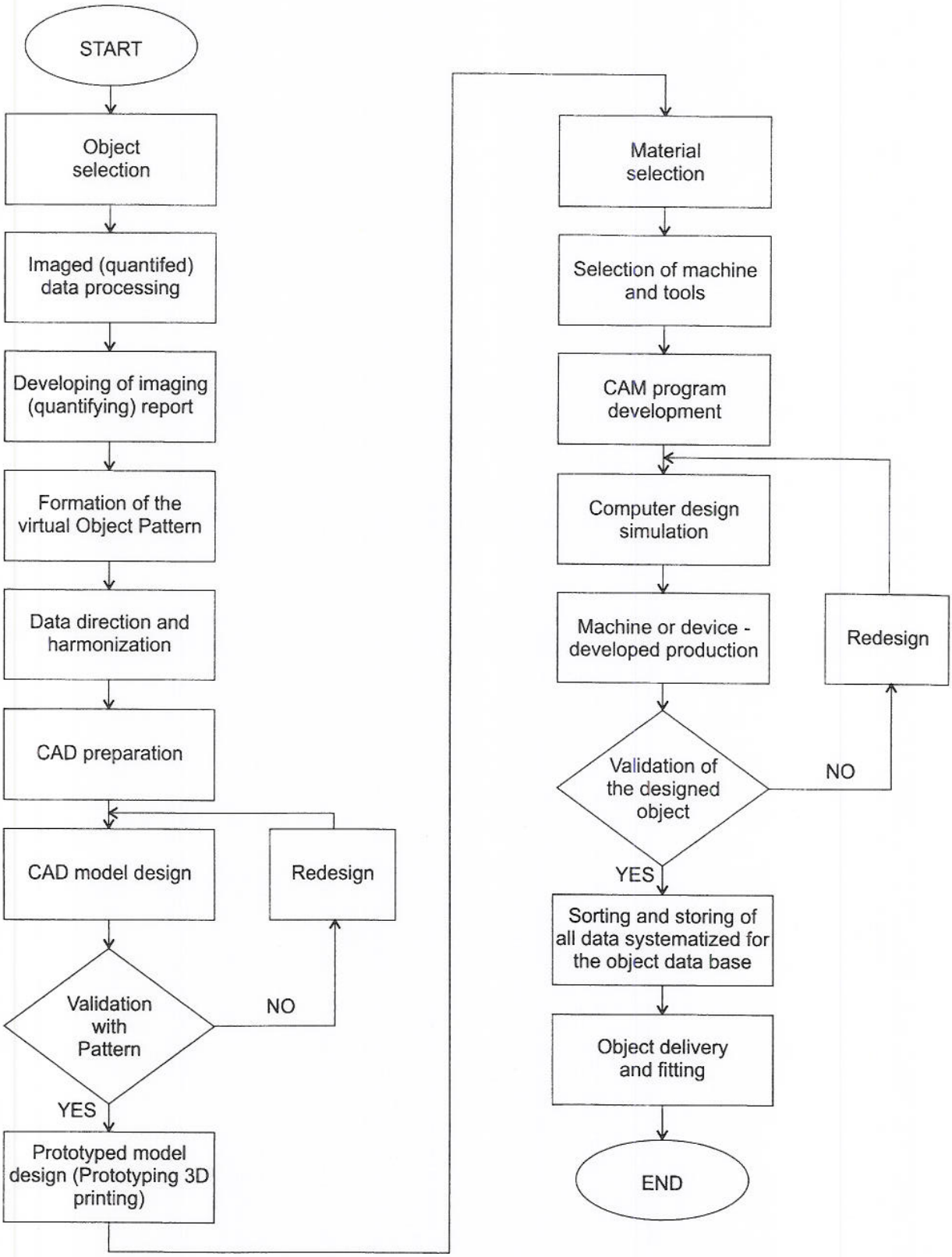

Figure1. Diagram of process flow of the BIS Machine's method.

"BIS machine" is the method composed of three phases enables of the documenting and makes virtual " the solid "the CAD of model over selections of materials and technologies

Main part of "BIS machine method" is

1. Stereophotogrametric survey of object
2. 3D modelling of received graphic data
3. Production of replica with one of several solutions able to give result

This process flow is prepared according with ISO standards and demands and represents step foreword in the sense of methodology and quality in project preparation and realisation.

Beside replica application of BIS Machine method gives database of targeted object as a very important aim of project. "BIS machine" it is the method composed of three phases enables of the documenting and makes virtual " the solid " the CAD of model (the virtual standard), over selections of materials and technologies, to the creation of replication or the original copy of very large precision (to 1 μm) (Figure 2).

Figure 2. The Replica of the head

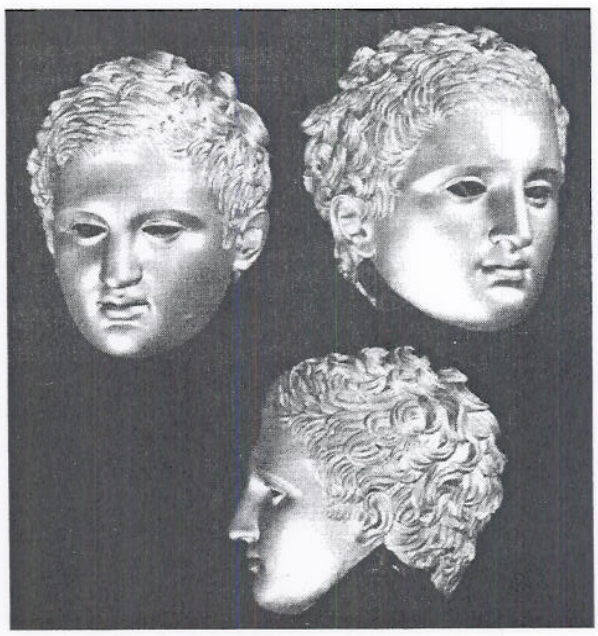

Figure 3. The 3D virtual model of Apoxiomenos

Antique sculpture entitled "Apoxyomenos, il Bronzo della Croazia" excavated from the sea in 1999 near Losinj island, in the northern Adriatic. The sculpture of 192 cm height originated from the period between Classical Greece and Hellenism in the 4th century BC and represents one of the masterpieces of world cultural heritage.

Applying that method it is possible to displace and safe valuables sculpture, parts of rare architecture masterpiece or other object in a way that the original copy will occupy the place of original (Figure 3).

Conclusion

Increasing amounts of cultural, natural and scientific heritage are being created or represented in digital forms, as we are living in the digital ages. Human being will need to develop a range of strategies to ensure the preservation of and access to various categories of digital objects. Custodial and non-custodial arrangements will need to be considered both from preservation and an access perspective. One of the methods of preserving real world to digital one it is a BIS Machine. One of the final goals of this method it is the creation of virtual museums.

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