Research Methodologies for Digital Holistic Documentation of Cultural Heritage

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1. INTRODUCTION

The paper presents the remarkable results of the Horizon 2020 ERA Chair in Digital Cultural Heritage: 'Mnemosyne' project at the Cyprus University of Technology (CUT), and is funded under the programme 'Establishing ERA Chairs'. The research outputs concerning the implementation of 17en selected case studies together with the developed methodologies are summarised in this paper. Their holistic documentation is based on the outstanding results of the EU Study VIGIE2020/654 (Commission et al. 2022). The proposed holistic documentation lifecycle includes the following three broad thematic areas: (1) Data acquisition and data processing; (2) Semantic data modelling and Knowledge management, (3) Data long-term preservation and Data use and reuse.

2. SELECTION OF CASE STUDIES

The Mnemosyne project has chosen several representative historical sites, monuments and artefacts to study and digitise, from various timelines, such as Classical 8th-4th c. B.C; Hellenistic Period 4th-1st c. B.C; Roman Period 1st – 4th c. A.D.; Byzantine Period/ Middle Ages 4th-15th c. A.D; Renaissance 15th – 17th c. A.D and

Ottoman, Modern and Contemporary period 17th – 20th c. A.D.

All the studies were selected based on their complexity and uniqueness. The selection criteria for the case studies took several parameters into consideration. Some of those considerations were their use and the materials that they were made of, if they were tangible or intangible and mobile or immobile, as this affects the digitisation process and documentation. They have different sizes ranging from the scale of millimetres to tens of meters, such as instruments, wooden panel icons, paper documents, liturgical vessels from precious metals, gold and silver coins, a castle in the UNESCO WHL, and a medieval village in the tentative list of UNESCO etc.

3. CREATION OF A USER CLASSIFICATION

One of the primary goals and challenges of the paper is the illustration of the newly developed user classification and the resulted diagrams with the main purpose being to categorise the users based on their needs and knowledge regarding the Cultural Heritage assets and digitisation process (Achille et al. 2019).
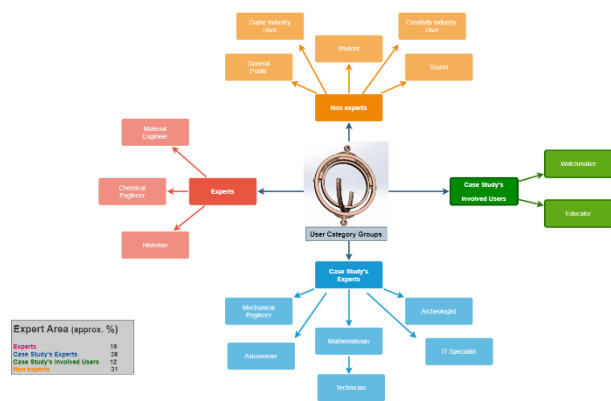
Figure 1: The multidisciplinary community of experts and users involved in the documentation of the Horologion of Philippi: A Portable Sundial (250-350 CE)*

Figure 1 presents the multidisciplinary community of experts and users involved in the holistic documentation and knowledge of the Horologion of Philippi, which is one of the case studies of the Mnemosyne project. The Philippi sundial is one of the most stunning and elegant technological artefacts and measurement tools of the Hellenic epoch (Gibbs, 1975; Jones, n.d.; Sawyer et al., 1978). The proposed user classification system includes four main categories with their corresponding sub-categories as illustrated in Figure 1.

The main criteria for the users classification are based on their needs such as general, educational, specialist visitors, their expertise (domain expertise and technical expertise), and motivation (curiosity, work, plan visit, pleasure, learn captive, learn non-captive).

4. DATA ACQUISITION AND DIGITISATION PIPELINES

The development of the Data Acquisition and Digitisation pipelines is another important issue of our research methodology. The complexity and quality of the data acquisition process, are fundamental parameters in determining the necessary and required effort for the digitisation project. Therefore, an extensive work has been carried out for the establishment of criteria for measuring in a very simple way the quality of the data acquisition results.

This work took into account the research results obtained from the questionnaire conducted in the context of EU Study VIGIE2020/654 (Commission et al. 2022). The survey was based on techniques and technologies used for the digitisation process, insights from the project and information on quality and complexity.

The complexity of 3D digitisation of cultural heritage can be defined after the stakeholder requirements are determined, the project specifications are set, the object's location and environmental conditions are known, and the object is defined (Figure 2). Furthermore, a very important part for the determination of the complexity parameters is the collection of paradata (technical specifications of the equipment used) and specific information regarding the digitised objects.
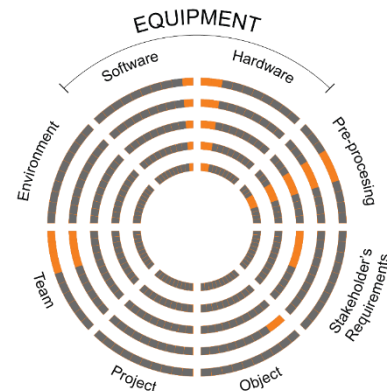

Figure 2:The Radial-Pie-Chart for the estimation of complexity for a 2D & 3D digitisation*

Quality is a fundamental component of the 3D digitisation in cultural heritage. It may comprise different parameters such as the degree of detail, the geometric accuracy of the 2D and 3D shape, the spectral, scale and texture, material properties and chemical composition, and structural health monitoring status (Figure 3). These parameters can be combined into the following categories: a) Geometry, b) Image, c) Material, d) Structural Health Monitoring as shown in Figure 3.
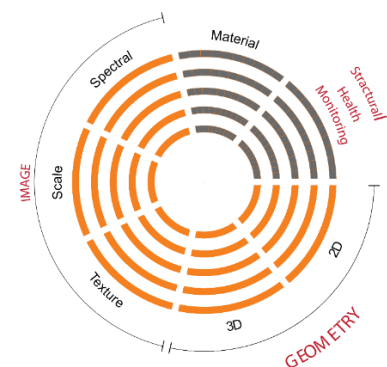

Figure 3: The Radial Pie Chart for the estimation of quality in the digital documentation of 3D objects*

5. CREATION OF KNOWLEDGE

Another essential part of our research methodology is the development of an integrated taxonomy of tangible Cultural Heritage assets for the representation of movable and immovable heritage complex nature and their embedded intangible heritage (Figure **4**). This object's taxonomy classification is based on the Getty architectural thesaurus that provide a structure which contribute in the holistic documentation process of the cultural heritage objects (Getty Vocabularies, n.d.). The proposed taxonomy separates tangible and intangible

heritage, with the focus on developing the specific knowledge classes. By separating them, the intention is to identify where intangible heritage can be recognised, how it intersects with the tangible and how this comprehensive information can then be integrated into this system.

Movable and immovable heritage make up the tangible heritage class. The object's classification, by determining how to develop this specific terminology, is another key challenge of the project. These two categories are distinguished by different levels of complexity that have been recognised. They might overlap, but they should be taken into consideration separately before expanding the wider knowledge system that is available for each object, monument, and site. The following criteria are used to categorise movable objects: (i) *function*, which refers to an asset's technical capabilities; (ii) *form*, which refers to the typological categories of an asset; (iii*) subject type*, which describes a particular use or purpose of an asset that distinguishes it from another physical form with a similar physical quality, (iv) *material/technique*, which covers the physical attributes of the asset revolving around its manufacture/creation, including its material(s) and production technique(s), (v) *location or context*, which serves as a vital link between tangible and intangible heritage, as well as between movable and immovable heritage, and it focuses on documenting the physical and temporal provenance of the asset, (vi) state/condition, that covers the asset's lifecycle, including its pre- and post-depositional stages.

An example of the proposed taxonomy classification can be seen in **Figure 4**, which describes the holistic documentation of the Horologion of Philippi. The presented graph (**Figure 4**) can be further expanded by adding the "State Condition", "Form", and "Context" classification taxonomies.

Furthermore, a classification scheme has been developed for immovable heritage assets in a similar manner. Additionally, monuments can be categorised based on: (i) *feature,* that depends on spatial and temporal variables and is rooted in the general environment; (ii) *significance*, which refers to the monument's primary purpose in relation to the human social and economic context (such as storage or cultic purposes); (iii) *Components*, divided into two categories: *built elements*, which refer to the parts of a particular structure constituting a specific structure depending on the segmentation of the space they provide, and *space*, which can be delimited (indoor) or not (outdoor).

6. CONCLUSIONS

Our paper exemplifies the results of the newly developed methodology for the holistic documentation of the past, by embedding the Intangible (memory) in the 3D geometrical structural

approach, which is based on the outstanding results of the EU Study VIGIE2020/654, and has been developed by the UNESCO Chair on Digital Cultural Heritage in the last three years.
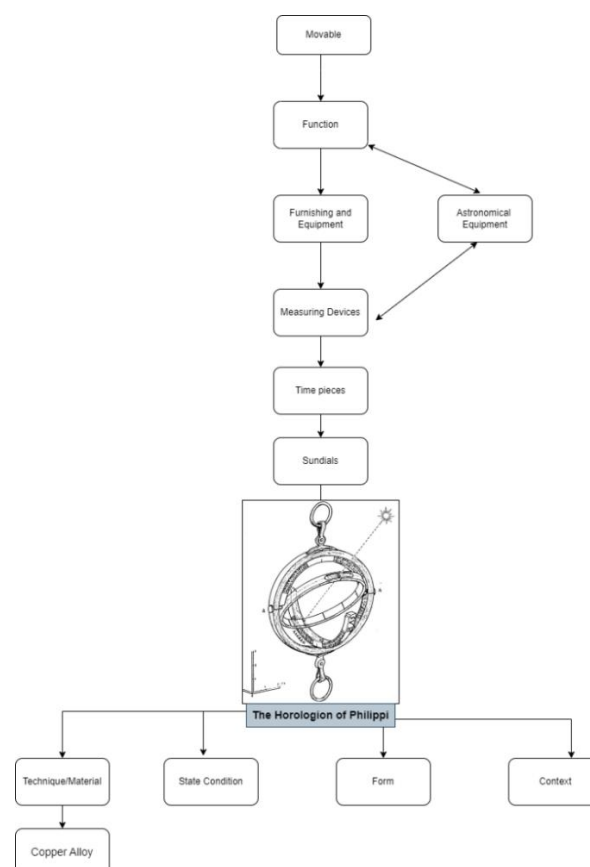

Figure 4:*Conceptualization of holistic documentation regarding the Horologion of Philippi*

7. ACKNOWLEDGMENTS

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