

# Digital technologies as a basis for building a museum of geodesy, photogrammetry and cartography

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## Abstract:

Geosciences are developing and changing at a rapid pace. In recent times, the presence of an increasing variety of new technologies and the excessive use of electronic devices reinforce the need to build a bridge between history and the foundations of the profession in applying long-established scientific principles and research practices. One of the directions in which geosciences and digital technologies contribute to the preservation of historical heritage is the creation of museums of scientific and technological equipment, textual documents and other materials through digitization and their preservation as valuable archives for generations. Modern technologies are transforming museums from viewing and learning exhibits into interactive spaces through visualized 3D models and information about exhibits accessible via QR codes, presented as their digital twins. Pointing a mobile device with relevant apps installed to specific exhibits provides more information with rich content about the digitized objects, such as detailed descriptions, pop-up snippets, additional photos and other visual effects.

Digital transformation initiatives and projects regarding the cultural and historical heritage sectors come from European and global organizations. Digitization and providing access to the created digital information are of utmost importance for the construction, documentation, maintenance and promotion of the geodetic, photogrammetric and cartographic heritage. An excellent example in this direction is the celebration of 100 years of innovation in surveying and photogrammetry by 3D-digitizing the iconic and innovative WILD T2 theodolite from the 1927 series of the now-famous company Leica Geosystems, part of Hexagon, and developing an Android application, iOS and Windows (Fritsch et al., 2021).

At the end of 2022, the preparation of a research project titled "Digital Geodetic Twins at UACEG" aimed at the creation of a new "geo-museum" at the Faculty of Geodesy at the University of Architecture, Civil Engineering and Geodesy (UACEG), Sofia has been initiated. The project aims to be a bridge for students and teachers to experiment and analyze different geosciences while preserving the geodetic, photogrammetric and cartographic material and non-material heritage, providing an opportunity to experiment with new visual techniques to add content and information to the exhibits. The project envisages studying the geodetic heritage of the UACEG and the creation of a physical museum exhibition with digital information organized in a geodatabase. Digitization and providing access to the created digital information are of utmost importance for geo-heritage construction, documentation, maintenance and promotion of valuable historical exhibits. For each UACEG heritage exhibit available in the physical museum, its digital twin will be presented on the project website with digital information such as description, digital image, 3D model, animation, and visualization via the project website. In addition to directly accessing the virtual museum, additional information will also be available through QR codes located in the modular systems of the physical exhibits.

The physical exhibits will be a base that will be digitally captured and enriched with information through modern means of visualization such as 3D scanning and modeling, interactive modeling, virtual modeling and visualization through augmented reality. This way, digital geodetic counterparts will be built, which is the primary goal of the research project. Providing access to the exhibits in a digital environment will ensure a better understanding and promotion of the geodetic heritage. In addition to the digitized types of equipment, the written geodetic heritage (see, e.g. Sankar et al. 2006) will be included in the museum content utilizing the upgraded results of the Erasmus + Program Project (MobiDig, No 2017-1-BG01-KA202-036350). Textual materials: books, textbooks and first theses in the Geodetic Faculty will be digitized, visualized, animated and presented through the project website. The first moving picture book appeared in September

1868. It was created by John Barnes Linnett, who called the technology a kineograph (McDonough and Egolf, 2015). These first steps towards animation have many progressively developed variants nowadays which will be used.

Each digitized object will consist of an identifier, data and metadata. Correctly set metadata is essential for organized digital content. Variants of schemes for a digital description of objects will be considered and analyzed using the Lightweight Information Describing Objects (LIDO), established in 2010 and updated (v1.1) in December 2021 by the Data Collection and Exchange Working Group of the International Council of Museums (ICOM 2023), Spectrum collection management standard, developed in the UK (Collections Trust 2023), DublinCore, developed by the Dublin Core Metadata Initiative (DCMI) (DublinCore 2023) and others. In the development of specialized digital content, the main features and characteristics of the heritage objects in the UACEG will be studied, and on this basis, a scheme for collecting metadata for the exhibits will be developed. The cartographic heritage has a good foundation in the already completed project under the UACEG scientific project for digitizing maps and atlases. The research team will benefit from the experience and knowledge of the International Cartographic Association and the Digital Cartographic Heritage Commission on collecting and using data from old maps and atlases. Working with information about different types of objects: geodetic, photogrammetric instruments, textual materials, and maps is a new and unexplored area in the scientific literature that makes the project original and innovative.

The digitization of the exhibits envisages the use of Augmented Reality (AR) technology, in which additional computer-generated images and video materials based on markers will be displayed to physical objects through interaction with the surrounding environment. The PhD theses developed in recent years at the Laboratory of Cartography and GIS show that the "Augmented reality" technology can be used without any problems on 2D objects and with a little difficulty on 3D ones. Therefore, the aim is to find the most suitable exhibits to apply one of the most current technologies of a mix between real and virtual modeling "Augmented reality". The methods of classic close-range photogrammetry using a digital camera and a handheld scanner Einscan H will be used for the creation of 3D models of the exhibits. It is also planned to conduct experiments to study the possibilities of combining technologies, analyze the obtained results and prepare a technological scheme for documentation depending on the features of the objects (color, material, texture, etc.).

The study and archiving of the geodetic, photogrammetric and cartographic heritage, the construction of a museum-historical center and the implementation of exhibits in the internal space of the UACEG can provide a sense of community to the guild and motivate students by providing them with an opportunity to get to know and understand the roots of the profession. The project research staff will use the latest visualization techniques to build digital geodetic, photogrammetric and cartographic twins. The research project is unique for Bulgarian conditions, as it combines the construction of a real and virtual museum of specialized tools and valuable archival materials from the heritage of the Faculty of Geodesy of the UACEG. Using the advantages of modern digital technologies, the scientific team also aims to support the daily scientific work of the teachers and students at UACEG by introducing the concept of digital geo-heritage. As technology and digitization make us increasingly globalized, a project like this offers a welcome reminder of achievements and discoveries closer to home and an opportunity to present our past to the international community by building digital twins, an online gallery of exhibits, public events, seminars and lectures.

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