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Digital Technologies for the Conservation and Enhancement of the Castle of Gaeta: An Inclusive and Participatory Approach

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Abstract

The Angevin Castle of Gaeta, located in southern Lazio, represents a unique architectural complex and preserves a rich cultural heritage, both tangible and intangible. With a history spanning from the 13th century to the present day, the Castle has long served as a vital point of reference for the local community. State-owned, since 1995 it has been granted in "free and perpetual use" to the University of Cassino and Southern Lazio, which employs it as a venue for higher education, seminars, conferences, and cultural initiatives. These initiatives are promoted and coordinated by the Rector's Delegate for the Dissemination of Culture and Knowledge, Professor Ivana Bruno.

This paper outlines the objectives and operational methods of the project "The Castle of Gaeta: Virtual Technologies and New Communicative Languages of Public History for the Narration and Musealization of Memory," developed within the framework of the program CHANGES – Cultural Heritage Active Innovation for Sustainable Society. This initiative involves a partnership of 11 universities, 4 research institutions, 3 advanced studies schools, 6 enterprises, and the Center of Excellence of the Technological District for Cultural Heritage and Activities in the Lazio Region (DTC Lazio).

Aiming to safeguard, enhance, and disseminate knowledge of the monument's tangible and intangible heritage, the project adopts an innovative approach centered on accessibility and broad public engagement. This is achieved through the use of advanced digital technologies and new communicative methods designed to narrate memory within its original historical context.

CCS Concepts

• ***Human centered computing*** → *Accessibility* → *Accessibility design and evaluation methods*

1. Introduction

The project "Il Castello di Gaeta: tecnologie virtuali e nuovi linguaggi comunicativi di public history per il racconto e la musealizzazione della memoria" (The Castle of Gaeta: virtual technologies and new communicative languages of public history for the narration and musealization of memory) seeks to safeguard and valorize the monument's tangible and intangible heritage and to promote broader knowledge of it. This initiative is part of the broader framework "CHANGES – Cultural Heritage Active Innovation for Sustainable Society", a partnership comprising 11 universities, 4 research institutions, 3 schools of advanced studies, 6 enterprises, and the Center of Excellence of the Technological District for Cultural Heritage and Activities in the Lazio Region (DTC Lazio).

2. Context

Located in the medieval part of Gaeta (Latina, Italy) and perched on a rocky hill of the Monte Orlando promontory, the Angevin Castle forms part of a larger fortified structure known as the Angevin-Aragonese Castle. Although the earliest nucleus of the building likely dates back to an earlier period, reliable records of its existence link it to coastal fortification campaigns promoted by Frederick II of Swabia (1194–1250), King of Sicily. The dynasties that subsequently ruled over the city, the Angevins, the Aragonese, and the Bourbons, modified the castle through the centuries. Comprising two interconnected buildings from different periods, the Castle spans over 14,000 square meters. Under Bourbon rule in the eighteenth century, the two structures were unified to form a single, impregnable fortress [PMS23]. In the centuries, the complex became the site of major historical events and was repurposed as a detention facility: initially as a penal bathhouse and later as a military prison, which was permanently closed in 1990.

3. Methodology

The project leverages advanced digital technologies, communication strategies, and new communicative languages to narrate the Castle's long memory, in a multidisciplinary perspective based on accessibility and broad public engagement.

3.1 Web GIS

One of the main objectives is the realization of an interactive WebGIS of the Castle, integrating digital maps, 3D models, and historical documentation. The WebGIS will serve as an online extension of the open-source GIS (under development), which will be the environment for data processing, verification, and ongoing updates. The WebGIS will ensure the dissemination, consultation, and usability of the data. Studies show that WebGIS in combination with GIS, is highly effective for data visualization and support of decision-making processes [BB13]. The GIS database is the result of a photogrammetric survey campaign of the Angevin Castle. Instruments used include: UAS Dji Mini 3 Combo (external architectural features, about 940 pictures acquired), digital camera Nikon D3100 (walkable internal areas, partial count over 65000 pictures acquired). The

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images were processed using the Structure from Motion (SfM) technique (Agisoft Metashape), to generate dense point clouds, orthophotos, meshes, and 3D models, which were then integrated into an HBIM (Heritage Building Information Modeling) environment (Autodesk Revit), crucial for the management, conservation, and enhancement of historical heritage [Ban23]. The WebGIS platform will be a fundamental tool for planning conservation measures and research and dissemination projects, contributing to the promotion and protection of the monument [Boz10].

3.2 Audience analysis

Audience analysis is ongoing, conducted through questionnaires accessible via QR codes, administered to visitors starting July 2024 (144 respondents so far). Results showed balanced gender demographics with opportunities for improvement regarding the attendance by age groups 0-17 y.o. and 65 y.o. and over. The visit experience ratings show broad appreciation throughout the results. These fundamental preliminary outcomes, also show a bias as they do not represent people with disabilities, hence highlighting the importance of the removal of both architectural and cognitive barriers at the Castle (currently headed towards completion) to ensure universal access. The project emphasizes the active involvement of new audiences through co-design processes, with strong attention to the quality of the experiences offered [Bru19]. In this regard a qualitative data collection is currently underway, through narrative interviews and participant observation among diverse visitor groups, including deaf people, blind people and schools, aimed at exploring cultural expectations and patterns of use. This data will be subsequently interpreted in an integrated manner adopting Cultural Mapping, an interdisciplinary tool that enables the mapping of the symbolic and relational resources of places, fostering active territorial participation and promoting cultural engagement and sustainable accessibility [Ber24].

3.3 Accessibility focus

A central aspect of the project lays in its inclusive approach to cultural access, hence bespoke solutions have been introduced, such as 3D interactive tactile maps and multimedia content accessible in both Italian Sign Language (LIS) and International Sign (IS). In producing the videos in Sign Language, to ensure the highest quality and empower the Deaf community, only deaf signing actors were employed [Bia21]. A wide range of technologies for accessibility has been used, such as panels with Braille text, tactile orientation maps, tactile QR codes linked to audio descriptions and multimedia content accessible and subtitled. A bespoke 3D model of the Castle designed for tactile exploration, features haptic sensors that activate thematic audio descriptions and – on the monitor in front – play multimedia content paired with LIS/IS interpreting. A fully accessible website is under development. Digital storytelling initiatives have been employed to stimulate strong emotional and consociative engagement in visitors, in line with the potential of storytelling in the museum and cultural context [Dal18]. Digital personifications of historical figures have been designed to guide visitors providing engaging multimedia contents rigorously based on historical sources and available in Italian, English, and LI**S.**

3.4 Communication

Thorough and attentive communication strategy and design care have accompanied the research. Outcomes include the development of a coherent visual identity, to make contents accessible and informative for all visitors, the employment of a range of multimedia languages such as photographic reporting, multimedia video editing, creation of editorial plans supporting a contemporary communication campaign, aptly reflect the notion that media are extensions of the senses [Dea00].

4. Preliminary results

Preliminary findings that emerge from visitor surveys and interviews signal that the integration of digital technologies, and a participatory approach can significantly enhance visitor experience and contribute to the long-term preservation of cultural heritage. Furthermore, co-design not only enhances accessibility but also fosters the development of a lasting dialogue between cultural institutions and local communities.

5. Conclusions

This study aspires to serve as a replicable model for other historical sites that could derive similar solutions for their development, and it emphasizes the importance of sustained dialogue between scientific research, technological innovation, and community engagement.

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