Final dissertation: Master of Science in Geotechnologies for Archaeology

A.Y. 2023/2024

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Dr. Rachele Budelli

Architectural survey and consolidation and restoration project of the Santa Maria d'Ancaelle's church in Magione (PG)

Internship at LS Rilievi snc

The project utilized modern technologies, including topographic surveying, laser scanning, terrestrial photogrammetry, and UAS (Unmanned Aerial System) to collect data and subsequently produce graphics in 2D and 3D CAD. During the internship, a survey of the Church and the adjacent building was conducted with the aim of acquiring a detailed understanding of the dimensions and construction relationships of the complex. The main activities included photogrammetric surveying of the exterior and interior walls, graphical representation of the plans at different


levels, and external elevations, focusing on exposed masonry and decorations. Additionally, an orthophotomap was created to represent the elevations and decorated internal walls. This report emphasizes the importance of combining these modern technologies, as each has its own limitations. Their integration is essential for achieving precise and comprehensive design results, compensating for the individual shortcomings of each tool.

Dr. Federico Ciani

GIS technologies for archaeology: development of an integrated system for the management of archaeological data

Internship at Archetipo srl
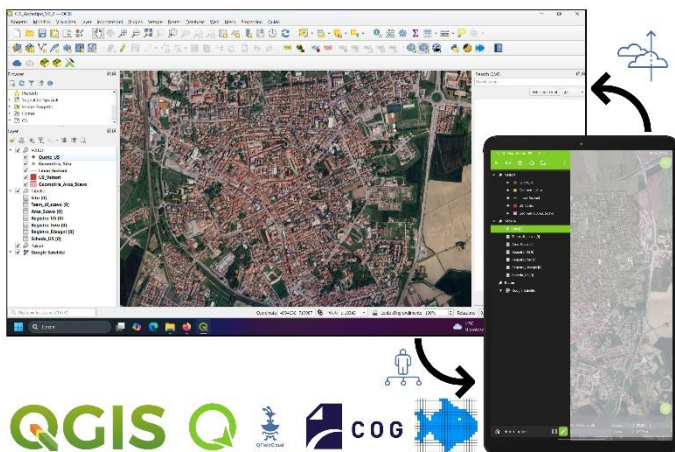
This technical report presents the development of a GIS-based system designed to streamline archaeological data management for Archetipo S.R.L. – Drone Services. The project, implemented during an internship, addresses the need for efficient documentation workflows (from field surveys to post-excavation analysis), by integrating spatial and tabular data into a unified, user-friendly platform.

Key Features:

- GeoDatabase Structure: Built in QGIS using the GeoPackage format (.gpkg), the system organizes data into relational tables (e.g., excavation sites, stratigraphic units, team records) and spatial layers, ensuring interoperability and mobile compatibility.

- Mobile Integration: Optimized for Android tablets via QField, the system enables real-time field data collection, synchronized with cloud-based updates (though limited by QField Cloud's 100MB storage constraints).

- Topographic Module: Supports GNSS data acquisition (e.g., Trimble Catalyst DA2) with automated geoid correction (ITALGEO2005) to transform ellipsoidal heights directly in the field.

- Raster Optimization: Implements Cloud-Optimized GeoTIFFs (COG) to compress high-resolution imagery (e.g., orthophotos) by up to 95% without significant quality loss, facilitating mobile use.

- Automated Documentation: Replaces manual workflows with QGIS Atlas to generate standardized PDF outputs (e.g., ICCD-compliant stratigraphic unit sheets) directly from the database.

Results: The system enhances data accuracy, reduces redundancy, and accelerates fieldwork-to-office transitions. Challenges include cloud storage limitations and proprietary hardware restrictions (e.g., total station compatibility). Future improvements may involve local server solutions for sensitive data and expanded GNSS integration.

Significance: This project demonstrates how low-cost, open-source GIS tools can optimize archaeological workflows in private-sector contexts, bridging gaps between academic methodologies and practical industry needs.

Dr. Ambra Marras

Photogrammetry and 3D modeling for archaeological documentation: the case of the nuraghe S'Uraki of San Vero Milis

Internship at Archeogeo

The work focuses on the use of photogrammetry and 3D modeling for digital archaeological documentation, taking the S'Uraki nuragic complex of San Vero Milis as a case study.

The objective is to illustrate the methodologies and software used to acquire, process and interpret archaeological data using modern tools.

The analysis begins with a description of the site, its geographic location and historical context.

We continue with the explanation of the photogrammetric survey techniques and the equipment used, including the CANON EOS 400D camera, the DJI Mavic 2 drone and the FARO FOCUS laser scanner.

Subsequently, the data processing is analyzed with specialized software such as:

Agisoft Metashape for the creation of photogrammetric 3D models, Autodesk Recap Pro for the management of point clouds obtained with the laser scanner, Autodesk AutoCAD for the creation of plans, elevations and sections in vector, 3D Blender for the modeling and interpretation of data.

The work demonstrates how the combination of these technologies can improve the documentation and interpretation of archaeological sites, facilitating the conservation and dissemination of cultural heritage.

Dr. Chiara Milone

The Convent of the Sisters of Seravezza: Historical-Artistic Study and 3D Laser Scanner Survey

Internship at Red Studio società di ingegneria

This study analyzes the former convent of the Suore di Seravezza through an interdisciplinary approach that combines historical-archival research and advanced architectural surveying using 3D laser scanning technology. The research was conducted alongside a renovation project of the building, highlighting the importance of digital documentation for the conservation and enhancement of architectural heritage.

The study reconstructs the historical evolution of the complex, emphasizing the role of the Henraux family in its foundation and the transformations it underwent during the 19th and 20th centuries, including the impact of World War II and its subsequent use as an orphanage. At the same time, the research focuses on the application of laser scanning technology to obtain an accurate representation of the building's current state, producing a detailed three-dimensional model.

The results highlight the advantages of 3D scanning in surveying historical heritage, overcoming the limitations of traditional methodologies and ensuring precise metric and material documentation. The architectural analysis and collected data provide a crucial reference for future restoration and conservation efforts.

This research approach serves as an exemplary case of integrating humanities and technology, demonstrating the value of new technologies in the preservation of cultural heritage.
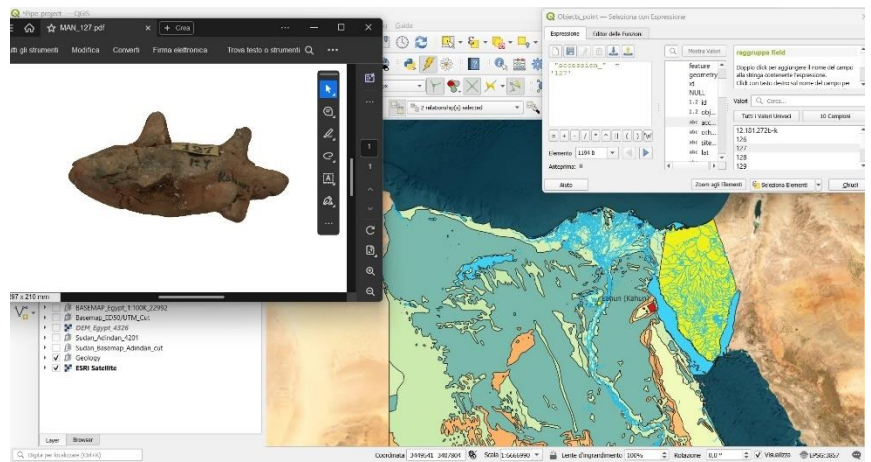
Dr. Sara Pecchioli

The role of new technologies in archaeology: the case study of PIPE Project

From 3D photogrammetry of artifacts to the creation of a stand-alone database on open-source GIS software.

Internship at Dipartimento di Civiltà e Forme del Sapere - Università di Pisa

This paper aims to present the initial results obtained from the introduction of two new investigative approaches within the PIPE Project, PRIN of the Chair of Egyptology at the University of Pisa. The objective is to delineate the profile of clay manufacturers in the Nile Valley through the study of handmade figurines produced during the Middle Bronze Age (2000-1500 BCE). The project, directed by Gianluca Miniaci, integrates typological and archaeological context analysis with technological, geomorphological, archaeometrical and fingerprint analysis, seeking to reconstruct the social history of a class often considered marginal, but which could shed light on still little-known practices and concepts of Ancient Egyptian culture.

In this context, the technologies introduced into the project, photogrammetry and GIS, represent an innovative approach. The work carried out should thus be seen as a preliminary phase, aimed at establishing an operational strategy that, in the future, can be implemented and applied to the entire corpus of data.

Regarding the photogrammetric reconstruction, efforts have been made to develop a reference standard for defining an operational protocol applicable to all models. The resulting reconstructions will be used not only for study purposes, but also for the creation of an open-access platform for the public.

At the same time, the data related to the artefacts have been formatted to create an embryonic stand-alone database compatible with QGIS, an open-source GIS software. In the future, once the formatting of the entire database has been completed, it will be possible to create a new database compatible with the software that will allow spatial analyses to be carried out not only of the artefacts, but also of the sites and archaeological contexts in which they were found.

To integrate the results obtained in both areas of study, a hyperlink has finally been created, allowing the visualisation of the 3D models directly within the GIS software.

Although the adopted approach is still at an experimental stage, the possibilities offered by the technologies used will allow for the access of content, such as the 3D models, that would otherwise be inaccessible, and to obtain new information from the diachronic and synchronic analysis of the data.