An overview of the utilization of Machine Learning (ML) in archaeological research: Information extraction from archive maps and low-altitude images.

Keywords: *Archaeology, Machine Learning (ML), Object detection, Classification, Earth Observation*

One of the most common techniques applied for detecting and characterization of is the pedestrian survey, with fieldwalking being the most common type of survey (Orengo H.A., Garcia-Molsosa A. 2019). It is a fact that many archaeological sites have been discovered with the contribution of historical maps and texts, while others have been discovered almost by accident during other construction projects. Nevertheless, traditional pattern recognition methods (i.e., through photointerpretation) may have limited applicability for archaeological research for covering large areas or looking into an extensive archival dataset.

During the last decade, progress in the approach to uncovering archaeological sites or features through Machine Learning (ML) techniques has been reported in the literature. This progress allowed archaeologists to advance the traditional methods and support the detection of archaeological proxies (Jamil et al., 2020). This advancement is demonstrated through numerous articles highlighting decision-making and the analysis of scientific models using ML techniques with minimal human interaction. Preliminary through several articles related to our study, it appears that few archaeological studies are based on the use of historical maps. A series of historical maps may provide important information not only for archaeological but also for historical research. Archaeological sites, historical monuments, and other archaeological areas of interest are recorded through landscape features, including toponyms, specific symbolism, or topographic expressions (Petrie et al., 2019). Further important findings, together with those published by Agapiou et al. (2021), followed the work of Orengo and Garcia-Molsosa (2019), show that low-altitude remote sensing sensors can give us significant outcomes.

The research goals are focused on two areas: (a) to evaluate, study and extract information from historical maps that present a large amount of archaeologically relevant information (Garcia-Molsosa et al., 2021) such as those of Kitchener's maps in Cyprus (Figure 1), while on the other hand, (b) to adopt low-altitude multispectral cameras, covering images beyond the visible part of the spectrum, and apply machine learning detection methods for the detection of surface ceramics.

To extract information from historical maps, certain amount of processing will be necessary, like digitization and georeferencing, while features will be extracted manually. As for the workflow that integrates images of low-altitude multispectral cameras, comprises photogrammetry to join all these photographs in a single orthomosaic, machine learning (random forest) and other geospatial analyses using a Geographical Information System (GIS) software to identify and isolate ceramic fragments (Figure 2). Finally, a comparison of both processes and valuation of their results is expected to give us significant results as for the accuracy of the framework and the techniques for detection of surface and sub-surface archaeological remains in Cyprus.

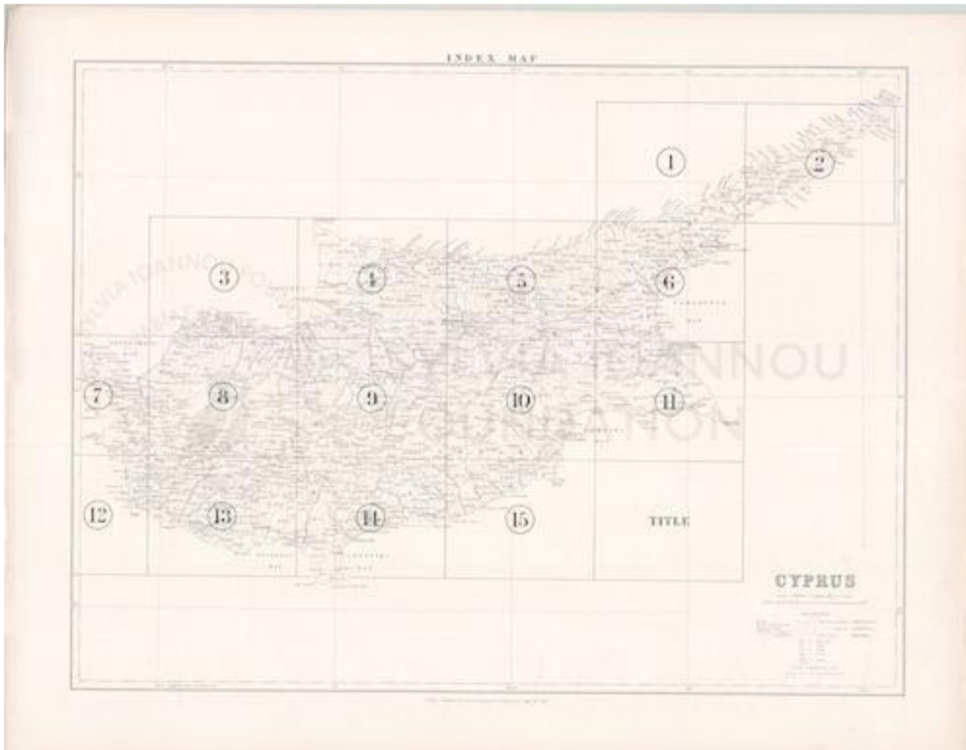

Figure 1: The survey of Cyprus by Horatio Herbert Kitchener during 1878 – 1883. The first topographic survey of the island (index map) (source: Sylvia Ioannou Foundation)

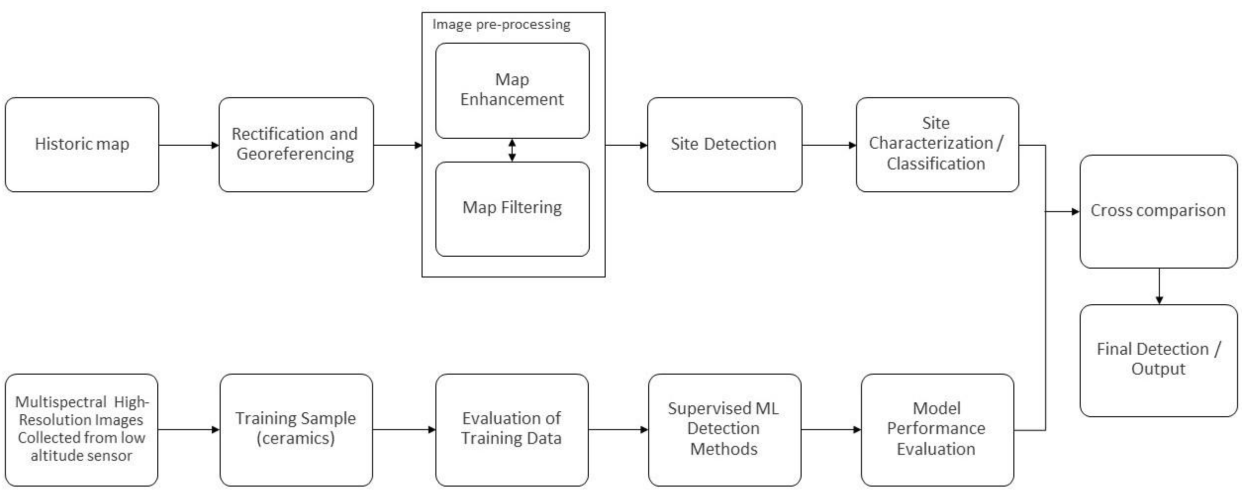

Figure 2: Framework using historical maps that present a large amount of archaeologically relevant information and processing steps using images beyond the visible part of the spectrum.

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