

# FROM PIXEL TO PATTERN: TRANSFORMING BELL-BEAKER POTTERY ANALYSIS WITH AI

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This work weaves a narrative where advanced technology meets ancient artifacts, shedding light on the intricate Bell-Beaker pottery that has mystified historians and archaeologists alike. Bell-Beaker pottery, known for its distinctive bell-shaped profiles and richly decorated surfaces, serves as a testament to the sophisticated craftsmanship and cultural interconnectedness of prehistoric communities. The intricate patterns and motifs adorning these vessels have long been thought to hold keys to understanding the social structures, trade networks, and technological advancements of the Beaker culture, which spread across Western Europe during the late Neolithic to early Bronze Age.

Leveraging the prowess of artificial intelligence, this study harnesses the power of computer vision and unsupervised machine learning to unravel the complexity of Bell-Beaker decorations. Through a meticulous orchestration of image processing functions and clustering algorithms, the research aims to classify these ancient artifacts based on the intricacy and designs of their decorations.

At the heart of this exploration lies a suite of specialized image processing functions. Computer vision techniques are employed to analyze the spacing between bands, detect zigzag patterns and complexity and intersections quantification. These processes are instrumental in extracting meaningful patterns and features from the decorations, offering glimpses into the cultural, chronological, or functional contexts of the pottery. The feature extraction phase meticulously gathers texture properties, edge characteristics, and other pertinent features from the images. Subsequent clustering and analysis employ methods, grouping images based on extracted features and visualizing them effectively with PCA and SOM.

The study delves into anomaly detection and evaluates clustering effectiveness through some metrics to gather data about the performance. The insights gleaned from these analyses illuminate new pathways in the categorization of Bell-Beaker pottery. This research not only highlights the integration of artificial intelligence with archaeological investigations but also underscores the invaluable contributions of unsupervised learning and computer vision to the preservation of cultural heritage. "From Pixel to Pattern" is a proposal that to the merges past and present, where ancient artifacts and modern technology unite to uncover the enduring legacies of human communities. Through this lens, the Bell-Beaker pottery of the Iberian Peninsula is reinterpreted, offering a fresh perspective.