A Model Digital Library for 3D Pottery Data

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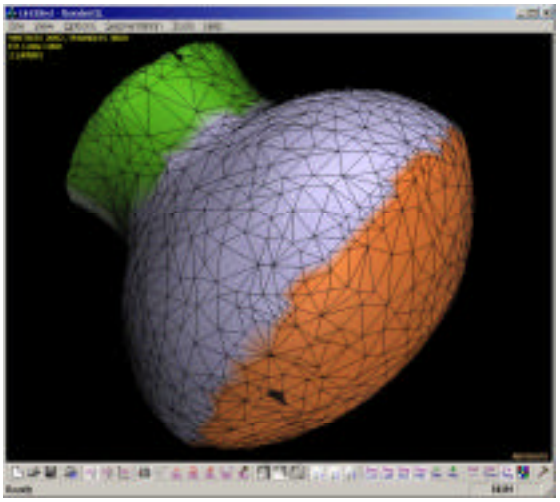
This presentation describes development of a model integrated storage, archival, and sketch-based query and retrieval system for 3D objects developed under an National Science Foundation Knowledge and Distributed Intelligence grant at Arizona State University. The project team includes interdisciplinary researchers from departments throughout the university and the Partnership for Research in Stereo Modeling (PRISM). The project attempts to develop a model digital library that can catalog, organize and support interaction with 3 dimensional materials and artifacts.

The focus of the first phase of the project has been a group of Native American ceramic vessels from a collection created during renovation of the Roosevelt Dam in Arizona. From the perspective of the overall project we hoped to build the interdisciplinary team that would function for the balance of the project. The goals of the team were to develop strategies for acquiring, modeling, and cataloging information about the artifacts, and make decisions about storage, search and retrieval of this information that will generalize to the other project components, and to design an initial user interface to permit interaction with the modeled data. From the perspective of the researchers in Anthropology, additional project goals were to document and obtain representations of the vessels before they were repatriated and lost to future study, to obtain more accurate measurement data than is possible with calipers and hand tools, and to broaden the researchers palette by developing new tools for analysis and inquiry.

The first step was to identify and acquire descriptive data about the vessels. A laser scanner was used to create a 3D scan of a given vessel. The scanner data at this point provides only a "point cloud" of information that visually describes, but does not physically represent the vessel. The data is then processed by overlaying a three-dimensional, triangulated mesh onto the point cloud data. The result is a model of the vessel that is now composed of parametric surfaces with physical, measurable attributes. Key identifying features of the vessel must be identified to support search and data retrieval. The project team developed a catalog of terms describing these features within the context of anthropological description, cataloging standards, and emerging metadata classifications. Mathematical models were developed to translate these features into measurable descriptions. Software was developed to extract features from the vessel data. An additional result is generation of vessel measurements far more accurate than has been possible using the traditional tools of anthropology.



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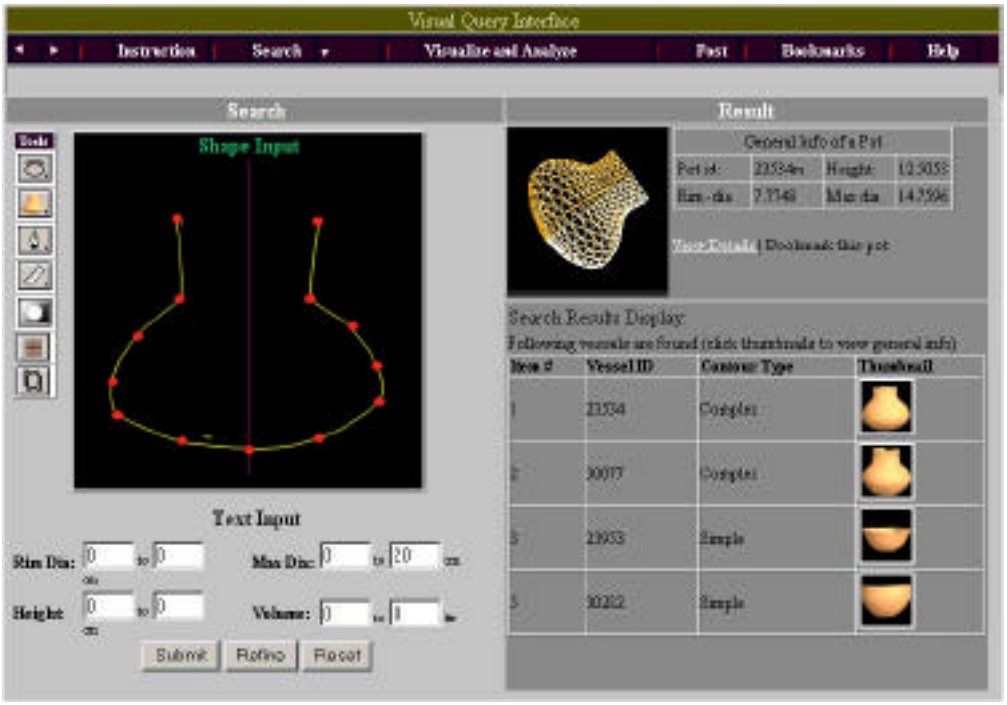
The project uses an XML schema to catalog and organize the 2D and 3D vessel data. The 2D data from existing databases can be incorporated in to the project by creating a schema to translate and link the search processes with databases housing the 3D data. The project currently provides access to data from the existing Roosevelt ceramic vessel databases and additional spatial and volume data acquired for approximately 100 vessels.

The web accessible visual query process developed for the project permits users to search the databases of vessel data with queries by interacting with sketches or outlines of sample vessel profiles in their browser window, or by selecting sample vessel shapes from the menu provided in addition to traditional text and metric search criteria. The interface provides access to both original and modeled data, and to interactive 2D profiles and 3D models of the vessels that meet the search criteria.



The ASU KDI project will also develop and evaluate models to address several other types of data selected to represent different design challenges, volumetric and spatial elements, and modeling requirements. Included in this phase of the project are lithic tools and identification and selection of matching surfaces for refitting, condyle surfaces of bones to study wear patterns, cellular DNA structures in fertilized mouse egg cells, 3D ultrasound data, and developing a cataloging and retrieval process for diatom shapes. The goal is to create an extendable model for a digital library of 3D data that captures, models, catalogs, and permits search, retrieval and interactive analysis of the data.

We are interested in pursuing collaborative projects to expand and extend the current ceramic vessel database. Additional information about the project and project team is available at the ASU KDI web site: http://3dk.asu.edu

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