

PROBADO3D – New Ways of Indexing and Experiencing Architectural 3D Databases

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Abstract—Nowadays, in Digital Libraries, non-textual documents are indexed and accessed based on textual meta data. This kind of meta data is expensive to obtain, and in many cases, the content cannot be described completely and free of ambiguities. PROBADO3D aims to overcome this limitation by developing content-based access methods for 3D models in the architectural domain.

Index Terms—Content-Based Indexing, 3D Shape Retrieval, Digital Library

I. INTRODUCTION

PROBADO is a research effort to develop Digital Library support for non-textual documents. The main goal is to contribute to all parts of the Digital Library workflow from content acquisition over semi-automatic indexing to search and presentation. PROBADO3D is a part of the PROBADO framework [1] designed to support 3D documents, with the focus on the architectural domain. This demonstration will present an overview of the current progress of the project.

II. CONTENT ACQUISITION

The German National Library of Science and Technology, which references relevant scientific material for all areas of engineering, is currently setting up a repository for architectural 3D models. Momentarily, the PROBADO3D index contains about 7000 building, construction unit and object models.

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Contributors are either students of architecture and component manufacturers or the models are part of architectural CAD application libraries or public databases for architectural CAD models. The control over the original files still resides with their external servers, including access to the files (free, pay-per-view, etc). Only the index- and preview data are stored within the PROBADO3D system. Users requesting a model will be redirected to the server hosting the original file (see Fig. 1).

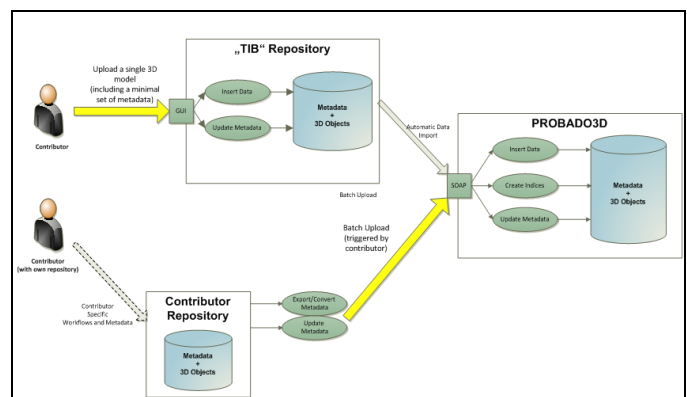


Figure 1 Processing Pipeline for Integrating 3D Models into PROBADO3D [2]

III. CONTENT-BASED INDEXING

The currently supported content-based indexing modules are described in the following section.

A. Shape Similarity

Similarity between 3D objects is currently computed using global shape descriptors based on spin-images [9]. These descriptors are easy to compute and allow for fast retrieval of even large amounts of models, which is crucial in a query-by-example scenario. Additionally, methods based on local descriptors and supervised learning [7] are about to be integrated into the framework, enabling automatic classification of 3D objects according to an architectural shape taxonomy [3].

B. Room Connectivity Graph

While the before mentioned methods for characterizing shape similarity mainly uses techniques suited for retrieval of arbitrary 3D objects, the concept of Room Connectivity

Graphs (RCG) is especially tailored to models from the architectural domain. It is designed for characterizing the structure of buildings [4]; Rooms are represented by vertices, connections like doors, windows, stairs, etc. are represented by edges. The graph is enriched by semantic attributes like the dimension of rooms or the type of the connection (see Fig. 2)

C. Semantic fitting using parametric models

Semantic enrichment methods based on procedural shape representations [8] are currently implemented and integrated into the PROBADO3D system. By fitting a procedural description to the target model the semantic information carried with the generative description can then also be applied to the target model (e.g. number of columns, stairs, etc).

In order to verify and control the quality of the different indexing services a 3D shape benchmark for architectural data has been developed [3].

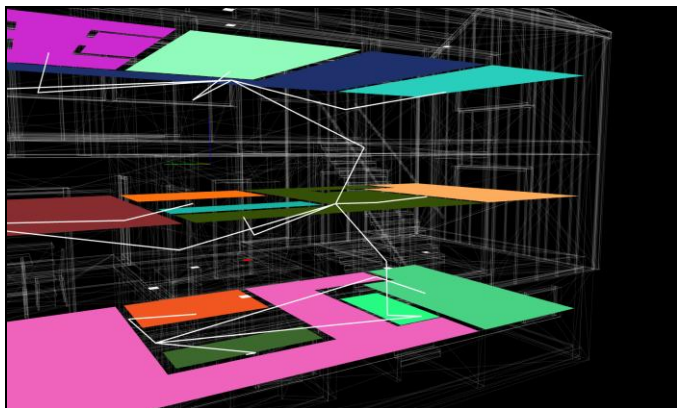


Figure 2 Automatically detected room connectivity graph

IV. USER INTERFACE

Design and usability of the search interface are a crucial aspect for the acceptance of a service like PROBADO3D. The user interfaces for searching, browsing and representation are based on the RIA technology (Rich Internet Application). The current prototype of PROBADO3D implements the following query interfaces [5]:

- searching in the textual metadata of the objects (title, description, etc)
- browsing the repository content using different filters (category, contributor, etc.)
- upload of a model for a query-by-example
- RCG based search using a 2D interface for constructing query graphs
- an interactive 3D modeling environment for formulating 3D queries[6]

In addition to the web based user interfaces, 3rd party modeling tools like Google™ Sketchup can also be used for accessing the PROBADO3D search services.

Different result representations, e.g. the 2D thumbnail cloud (see Fig. 3), allow the user to interactively explore the result sets, e.g. use one result as a new query object or view a 3D preview.

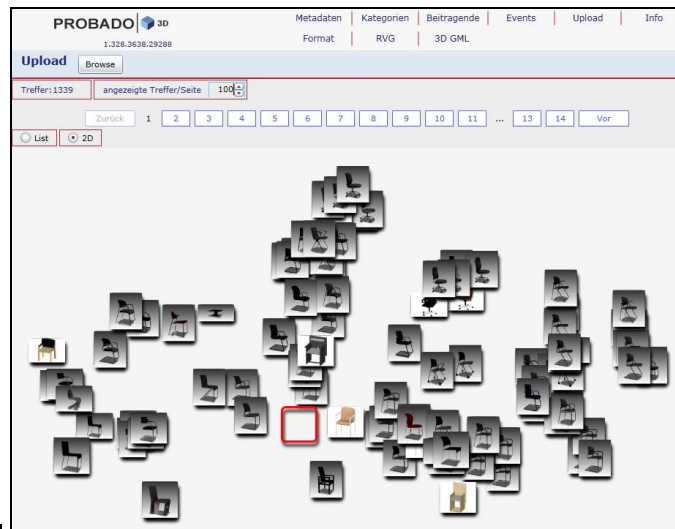


Figure 3 “Thumbnail Cloud” – a 2D result visualization of a content based query [5]

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