A METHODOLOGY FOR THE PROMOTION OF CULTURAL HERITAGE SITES THROUGH THE USE OF LOW-COST TECHNOLOGIES AND PROCEDURES

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PROBLEM

In the Cultural Heritage field, despite the possibilities offered by digital technologies, the high costs that are generally connected with their use, the lack of standard procedures and the need to train expert operators often limit the wide-spread digitization of sites and artifacts.
Nevertheless a wide variety of sites and artifacts that share similar geometric and radiometric characteristics could strongly benefit from their promotion through the web.
In these case studies, that could be documented through low-resolution 3d models, is it possible to single out standard procedures and low-cost technologies that can be used also by non expert operators?

MOTIVATION

- researches in the field of image-based technologies, such as, in particular, the Structure from Motion one, as well as the development of open-source algorithms and software aimed at helping the processing, management and visualization of 3d data through the web represent remarkable attempts to extend the use of digital technologies and procedures in the Cultural Heritage field;

- since in the Cultural Heritage field the multi-scalar approach is an indispensable practice in order to achieve different and changing communication aims, low-resolution reality-based 3d models can actually be built using low-cost technologies and can therefore provide effective representations that can easily be shared through the web;

- as far as the training of expert operators is concerned, education can play and important role, as it can reduce costs and times and therefore widen the digitization of sites and artifacts.

AIM

The purpose of this contribution is to show a methodology aimed at easing the work of Institutions called to promote their heritage by documenting and virtually reconstructing sites and artifacts using low-cost procedures and existing technologies that can be adopted and easily used by operators who do not have specific computer skills, with consequent benefits in reduction in times and costs and in knowledge sharing.

FIELD OF APPLICATION

The present procedure provides the best quality results if used on artifacts that have evident sculptural characteristics, such as, for example, limited dimensions. It is also suited for artifacts that are generally isolated with respect to the context in which they are located and that present limited occlusions or inaccessible areas.

OUR METHODOLOGY: THE ADOPTED WORKFLOW

1. THE INPUT DATA

The input data consist in sequences of uncalibrated 2d images that have minimum 50% overlap.
Particular attention has to be paid to illumination conditions. In order to avoid sharp shadows and marked radiometric differences among adjacent images it is generally useful to equalize photographs.
A reliable and significant dimension of each artifact has to be measured in order to assign the correct scale to 3d models.

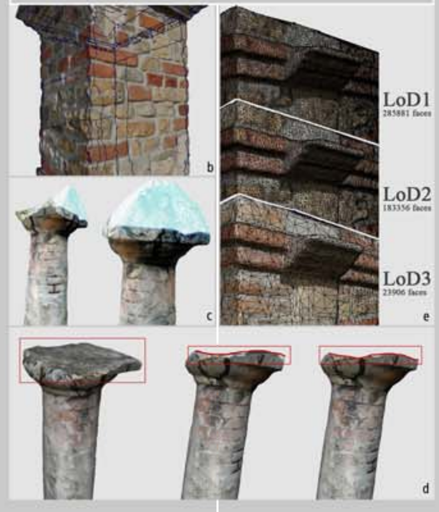
2. FROM 2D IMAGES TO 3D DATA

The transposition of 2d images to 3d geometry is organized as follows:

2.1 CONSTRUCTION OF THE 3D MESH USING A SFM APPROACH
(*fig. a* shows the use of Autodesk® 123D Catch®);

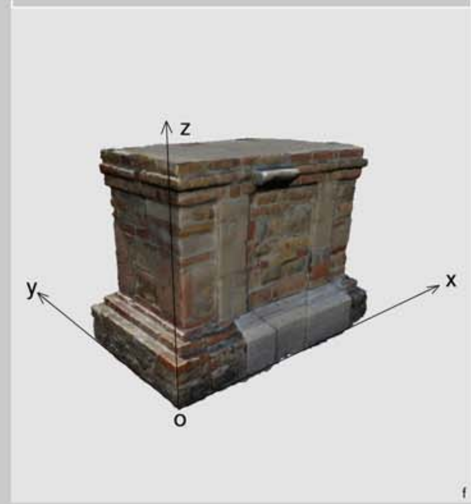

a

2.2 POST-PROCESSING OF DATA



b c d e

2.3 SCALE AND ORIENTATION OF THE 3D MODEL WITH RESPECT A RELATIVE OR AN ABSOLUTE REFERENCE SYSTEM



f

Critical aspects:
- lacks due to errors in the orientation of camera;
- topological errors (e.g. non manifold, self intersecting, crossing faces) *fig. b*;
- lacks due to occlusions or inaccessibility *fig. c*;
- measurement errors along borders *fig. d*;
- definition of the required Level of Detail (LoD) of the information *fig. e*;
- measurement of a reliable and significant dimension of the artifact (this selection is subjective and often measures are acquired using a direct measurement methodology).

Adopted solutions:
- manual stitching between adjacent images;
- correction of topological errors using different algorithms;
- use of filling holes tools and manual texture mapping;
- use of smoothing algorithms *fig. d*;
- creation of different LoDs (in *fig. e*: maximum, standard and mobile);
- selection of a long and sharp edge on each artifact.

3. VISUALIZATION

Different kinds of outputs:
- non geo-referred 3d models (*fig. g*, use of X3DOM technology to view a 3d model inside a browser window);
- geo-referred 3d models (*fig. h*, use of Google Earth or Google Maps GL).

Web visualization through:
- desktops;
- mobile devices (*fig. i*, use of Autodesk® Inventor Publisher Mobile Viewer®).


g h i

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