

SURVEY TECHNIQUES AND VIRTUAL REALITY FOR THE RECOVERY PLAN OF A FORTIFIED MEDITERRANEAN TOWN.

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ABSTRACT:

The construction of 3D models, their realistic photo restitution via synthetic images and the development of dynamic simulations are the most suited and potentially richest tools for the reconstruction of architectural images as well as the planning of urban interventions in historical cities.

The case of study concerns the most ancient part of the historical centre of Castellammare del Golfo in Western Sicily, which has been built around a maritime medieval nucleus constituted by an Arab Norman castle.

The suburb, which suffered a severe decay during the last decades, have been recently object restored without an unitary plan of conservation. A study of an integrated plan of recovery of the colours of the facades of the suburb and of the urban illumination supported by an European grant is in progress. Within this framework a research based on integrated techniques of computer aided surveying and numerical and digital methodologies for the creation of a virtual 3D model has been undertaken. The goal is to reproduce the aggregate of the buildings and the open air spaces with geometric precision and good accuracy of the colours and textures of the constructive materials. The survey has been carried out using an integrated topographic station equipped with a laser diastimeter, while the textures have been surveyed by digital photogrammetry.

Several urban shapes obtained via a mosaic of rectified photos form the geometric and visual starting point for the project of the colour plan, which aims to restore the original colours and constitutes a model for all the ancient constructed area. The 3D model also allows to control the volumes and types of the building in order to develop a recovery plan for the different building units and a new design of the public space.

1. INTRODUCTION

The Virtual Reality techniques can extend our perceptive abilities, making possible the interactions between numerical simulations and collected data.

From this point of view the virtual reality applications are absolutely connected to the scientific visualization, because they create original procedures of navigation and interrogations of visible, invisible, hypothetical and imaginary worlds.

The research relayed on virtual systems to produce, to navigate and to explore reconstructed environments of cultural interest.

Therefore in a natural process the results of the experiences of CNR ITABC in Scientific Visualization evolved in Virtual Reality applications.

The Project "Mediterranean Towers and Fortresses: Oriented Revitalisation Actions", METAFORA financed by the Programme Cultura 2000 and aimed to document architectural examples of Mediterranean fortified architecture, gave us the chance to perform a full analysis in order to recovery the historical part of Castellammare del Golfo, a town in the Western Sicily.

The necessity to evaluate the complex of the buildings not only from the point of view of their conservative conditions, but also of their spatial and architectonic unity, has triggered the realization of an exact geometric virtual model and a precise representation of the urban texture.

Thus it has been possible to navigate inside real environments to study actual situations from inaccessible points of view.

A modelling optimised for real time applications has been developed, by drawing on the computer the geometry of the scene, that we intend to reconstruct.

The single objects have been built by set of polygons, then the colours have been defined, and finally the textures, i.e., the images that dress the geometries of the models, have been drawn. To the purpose digital photogrammetry softwares, which provide photorealistic effects, have been used.

The models have been produced at different levels of details in order to optimise the visualization.

The creation of these 3D digital models aimed to generate the visualization of a possible restoration and the re-use of an historical complex within a multidisciplinary environment.

The research has been organized in a way that it could exploit different expertises and involve continuous comparison between the several professional ties.

2. THE CREATION OF THE MODEL

2.1 Topographical survey

The topographical surveys, essential in order to determine the spatial coordinates of the main photographic points (needed for the orientation of the photograms and for the creation of the three-dimensional models), have been at the same time of the photographic surveys.

Firstly a geometric net to link the topographic stations, later used for the intersection of the main points, has been set. The achieved accuracy in the connection of the traverse station is about a millimetre.

The geometric net and the main points have been determined using the electronic stations Pentax PCSI and Leica T1100 equipped with Disto laser rays and an automatic recorder of data.

The position of the photogrammetric control points, needed to create the virtual models during the restitution, has been studied in such way that at least six measured points either architectural or artificial appeared in every image. On the base of this project of location of the control points, the facades have been signed, using self sticking square targets, 4 cm. Long.

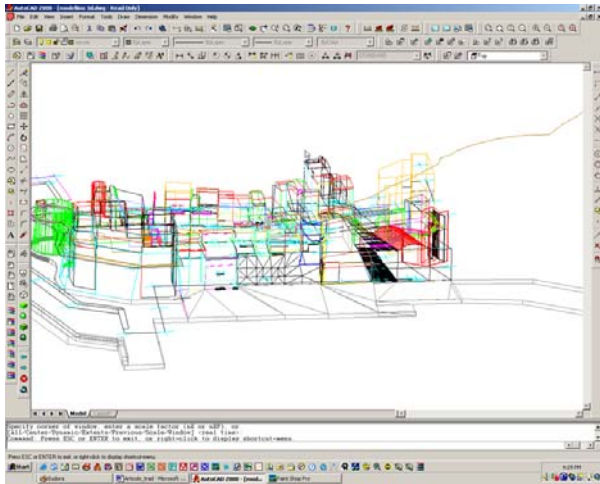


Figure 1. The graphic elaboration

The absolute coordinates of these signs, architectural and not, has been determined by collimation from two vertexes of the polygonal. The measures of the elevation of the control points and of the stations has been reported on the logbook.

The topographical software generally produces graphic elaborates whose primitives are disposed on various plans. Therefore we had to transfer all of them on the data plane. The goal is to work in the elevation reported on the logbook, without artificial steps in the drawing.

To the purpose an autocad software has been used with the routine lisp that by default report all the primitives on the plane zero.

The reference system of these coordinates is absolute because it has been linked to the absolute elevations.

2.2 Photogrammetric survey

The takes have been done using the metric camera Rollei 6006 with lenses (40, 80, 250 mm.). A photographic film of 100 Asa sensibility has been used. Further photos of details have been taken with the digital camera Canon.

The photos have been scanned at 600 dpi.

The project of the takes has been studied in order to guarantee the vision of all the details of the facades

For the full cover of the facades approximately 80 photos have been needed.

2.3 The creation of the facades.

The heights relative to the facades, as well as the shapes of the single buildings, have been taken from the photogrammetric rectifications.

The bitmap image obtained from the MSR Rollei package, has been imported in autocad and geo-referenced with respect to the control points of the topographical survey.

The referenced image has been modeled on surface creating different items according to the needs (mesh, regions or 3D

solids). The surface has been rotated around the X axes of 90° and positioned on the plane at the true elevation. The elements in projection, as the balconies, have been modeled and then positioned on the surfaces.

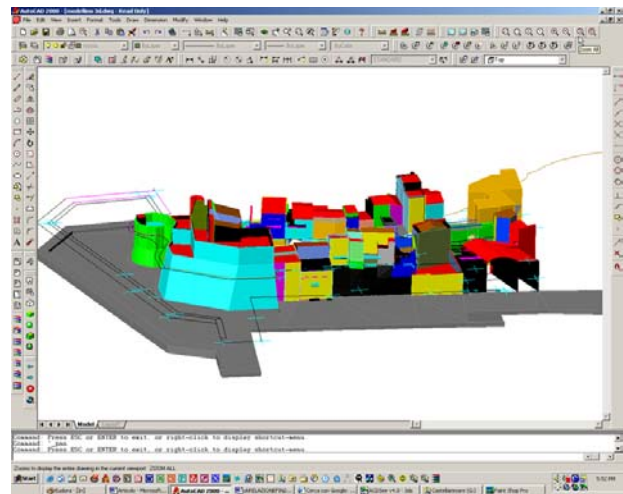


Figure 2. Modelling surface with mesh and 3D solid

2.4 Editing of the images.

The images showed some elements that have been corrected.

The shades, the chromatic differences that depend from the different exposition to the sun of neighbor surfaces, the spontaneous vegetation and the elements of decoration have been removed with the photographic retouch

Aiming to a realistic representation we have maintained those elements, degraded and degrading, that have character of permanence, like electrical cable, gutters of heterogeneous material, scraped surfaces, etc. because we didn't want to give a "mannered" vision of the reality in the virtual representation.

All the projections that we have been recreated during the modelling have been removed from the bitmap.

During the creation of the virtual model of a complex object like the suburb of Castellammare del Golfo, we often were unable to obtain all the information needed for the precise collection and plotting of the data. In such a situation the representation has been achieved by linking and comparing all the available data, using a comparison with items of known sizes and mostly relying on the expertise of the plotting.

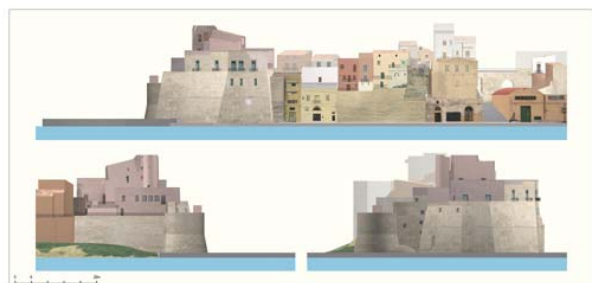


Figure 3. External virtual sections

2.5 Importation and trimming of the model.

The 3D model has been imported from the program of modeling (autocad) in the 3Dsmax software.

All the trimming of the model have been done with this software through the assignment to the surfaces of the edited images.

The modeling of the pavement has been realized with a 3ds mesh and via the creation of surfaces that are hooked to the base of the buildings.

Then the model has been equipped with natural 3d elements, like the reefs on the back, through a modeling adapted to the contour lines obtained by the photogrammetric model of Castellammare del Golfo.

Once the illumination of the model has been established, we have proceeded to the rendering of the views and to create the virtual movie.

A virtual movie has been created with "3dsstudio", interpolating the variations that exist between the key images and compiling the single photogram in a .avi format.



Figure 4 Virtual section and plan

3. CONCLUSIONS

This type of research allows to plan the interventions of conservation in historical zone.

To design with the cad 3D techniques, means to work directly on the three dimensional model. This implies that the executive technical sketches, the plans, the sections, the prospectuses, the axonometries and the perspectives directly result from the 3D project.

Moreover the use of the 3D model allows to make more detailed architectural – functional studies than those done with the traditional drawing techniques. With the 3D model we can stress the interferences between the different elements of the building and the visual impact within its environment.

In addition the three-dimensional modeling allows to perceive through real photographic representations and animations the reality as it will appear after the intervention, it will possible.

The real photographic representation is more effective in the evaluation of a project: because the "photos" of the intervention to realize are inspected. At various times the exam of the conventional sketches, where one has to visualize in his own mind how the intervention will appear once executed, this does not imply any cognitive effort.



Figure 5 Virtual view

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