Virtual architecture in the free space

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Abstract

The multi-projection image techniques offer interesting possibilities for architecture communication and augmented reality. This poster shows experimental solutions for pseudo-holographic projection 360°, so-called "holographic bell", and projection screen. The more intense research regarding the technical and technological possibilities and the materials of the semi-reflecting plates is being carried out in the EARCOM laboratory of DICEA of Univpm in Ancona. The main goal is to design a good container, ensuring that the content is predominant: low-cost bells, with the maximum projection surface and minimizing the structure.

Categories and Subject Descriptors (according to ACM CCS): I.3.7 [Computer Graphics]: Three-Dimensional Graphics and Realism—Virtual reality

1. Introduction

If "Seeing is a creative act", as claimed by Gillo Dorfles, the apparently passive act of viewing is highly distinctive of the understanding process. In the representation of the Architectural Heritage (AH), digital technology offers huge possibilities. The challenge is to reproduce the 3D model floating in the free space, so that the user does not perceive the two-dimensional media. The perception of space is a founding element of architecture, therefore the main goal of augmented reality applications is to make the architecture experienceable. Very interesting possibilities for development lie in the techniques of image multi-projection. The main goal of the research consists in obtaining a low cost, easily reproducible system for the representation of the model, ensuring scientific consistency, visual and geometrical accuracy and semantic understanding.

2. Multi-image projection techniques

The overcoming of the two-dimensional representation is made possible by the use of the projection on different media. A response to the described problems is provided by the technique of architectural projections, i.e. giant projections with high brightness that replace the screen with the facade of the building. The immersive projections and pseudo holographic projections may replace the represented artefact. The first ones place the user at the center of a system of walls on which a spherical panorama or a display of the three-dimensional model is projected. They can simulate a real walk within the space represented through the use of tracking systems. The second technique, of greater interest, can perceive the three-dimensionally reconstructed AH model in the free space.

2.1. Analysis on the state of the art

The pseudoholographic projections technique is based on the reprocessing of an old system called Pepper's Ghost. The deceptive technique, used in theater during the last years of the XIX century, employed a glass plate and special illumination arrangements. Subsequent applications are countless, but the main fields of appliance are the spectacularization and advertising. Moreover, the accomplishments so far achieved are complex, slow and expensive. The "hologram architecture", even if not immersive, it's very communicative: it has the additional advantage of being interactive and it can be decomposed with simple movements or with a "click". The recreated coherent perspective views can be realized in closed or open environments.

2.2. Technique description

Two kinds of approaches to the technique exist: one allows a 360° view around the object, the other one allows the view

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through a single plate. The latter case is a formal simplification of the first one. The application of the system on a single projection panel is nevertheless spectacular and much faster, useful for testing materials and types of projectors. To obtain a 360° pseudo-holographic projection is instead necessary to build a massive structure called "holographic bell". To achieve good levels of perception the optimization of materials and form is required. The projection system includes four high brightness and contrast projectors, with a very small focal length and equipped with keystone correction and projection curtains that do not affect the chromaticity of the image with a high reflectivity of light. The fast technological developments provide higher performances and excellent cost competitiveness. To obtain the holographic image are required oblique panels made in a semi-transparent material with a high refractive index, but provided with an antireflection film suitably sized that contrasts the formation of the reflection on the second interface that disturbs the view. The present study investigated several ways to avoid the splitting of the image: we choose the use of the film, instead of plates of variable thickness or curves.

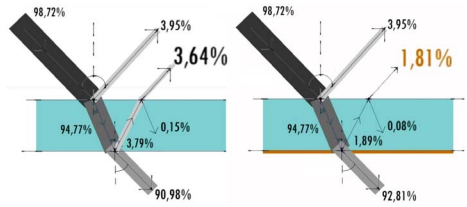

Figure 1: *Schematic diagram of the flows fractions with or without the film.*

The light beam emitted from the projector impresses the image on the cloth, from which a beam of plane waves, meeting the oblique semitransparent surface, is reflected to the eye of the observer. This last perceives the reflected image virtually positioned inside the bell. Furthermore, a fundamental characteristic of this mechanism is that the projected objects has to be in motion. The depth clue is given by the motion parallax: changes in shape and speed suffered by objects while they are moving make the entity projected on a flat surface perceived as a three-dimensional one. The illusory effect is real, but this is not visible in 2D monitor. The ideal container should be a cone to ensure the continuity of the vision. To obtain a coherent image a model processing that considers the curvature of the reflecting medium should be required, despite a slower processing phase. We therefore deduced that the optimum shape is the pyramid. A change may occur to the inclination of the four plates and to the straight or reverse positioning of the pyramid. This case presents problems related to the image overlapping, but they've been evaluated as secondary in the overall perception of the user (see attached video simulation).

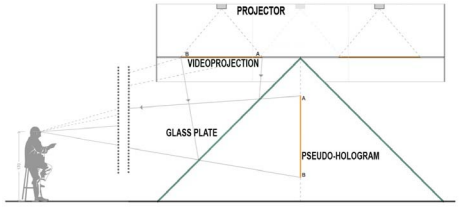

Figure 2: *"Holographic bell" cross-section.*

3. Applications

The objects chosen for the described applications are sculptures and architectural artifacts. The sculptures are particularly suitable for this experiment. Surveying, modeling and visual simulation of some Roman statues, which holograms are now projected in the National Museum in Tripoli Libya, have been a relevant experience. In this case, in collaboration with companies in the field of multimedia technology, special projection curtains with a holographic effect have been used for the reproduction of the Lybico-Punic Mausoleums. Case studies on the architecture of Andrea Palladio permitted to check how the projections adapt to both photorealistic rendering, and to critical analysis of the artifact. It was thus possible to provide a further application to the analysis, moving from the wooden model to the digital one. The more intense research regarding the technical and technological possibilities and the materials of the semi-reflecting plates is being carried out in the EARCOM laboratory of DICEA of Univpm in Ancona. The main goal is to design a good container, ensuring that the content is predominant: low-cost bells, with the maximum projection surface and minimizing the structure.

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