

Le Corbusier in Bogota 1947-1951: Designing a VR experience

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Abstract

"Le Corbusier en Bogotá: 1947-1951" is a public exhibition that is being held in two different Museums in Bogotá, and celebrates the work of this great architect in planning the urban area of the city. We have developed a VR installation that allows visitors to compare Le Corbusier's plan for Bogotá with the current layout of the city, as a way to show his ideas and concepts, and as a way to complement and enhance this exhibition. This paper presents our development experience, early evaluation with experts, and the current setup at the Museum.

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

1. Introduction

Urban planning has posed big problems and challenges for designers, government, and citizens since early ages of civilization around the world. Few visionaries have tried to create theories at the scale of cities, and one of them was Charles Édouard Jeanneret-Gris, better known as Le Corbusier, a famous architect, designer, and painter. Le Corbusier traveled around the world sharing his ideas and knowledge about modern architecture. During his travel through South America he visited Bogotá-Colombia [BP91], where he was invited by the government to design a plan for the evolution of this city's downtown. From 1947 to 1951 Le Corbusier designed his plan for this city, and although his ideas were not adopted for political reasons, his ideas greatly influenced new generations of Latin American architects. Currently, there are very few copies of what he called the "Director" plan, mostly in Universities outside of Colombia and in private collections.

Le Corbusier's work is currently used by architecture programs at universities to teach modern architecture due to the influence of his work throughout the world. Le Corbusier's work has been studied for many years by experts, but there is a lack of reference material about his work in Colombia. This is the main reason for "Le Corbusier en Bogotá: 1947-1951" an exhibition in two different Museums, the "Insti-

tuto Distrital de Patrimonio Cultural" (Cultural Heritage District's Institute) and the "Casa de la Moneda" (Colombian's Mint House), that is currently open to the public. The exhibition contains large format urban maps, multimedia projections, original documents, pictures, models, as traditional mechanisms for observing architectural designs. We were invited to complement the exhibition at the "Casa de la Moneda" with a Virtual Reality (VR) setup, in order to create an interactive and modern installation for the analysis and enjoyment of LeCorbusier's work. Our setup allows visitors to navigate and compare Le Corbusier's planned city and the actual city.

2. Related work

Virtual environments oriented to cultural heritage have provided the museum's visitor real and reliable experiences, they are a very important medium to publish and share the cultural heritage. World museums are adopting the use of virtual environments considering their advantages and disadvantages, some of the more interesting applications are the reconstruction of ancient city. From the architecture view of point it's very important the building models to study and analyze the urban proposals and illustrate the ideas to governments and citizens.

The first work revised was "Reconstructing Leonardo's

Ideal city - From handwritten codexes to Webtalk-II: a 3D collaborative virtual environment system" [BP01], This work is a case of use of virtual environments oriented to cultural heritage and collaborative virtual environments. The application was developed on a framework named WebTalk-II that uses Java and Java 3D. This application exposed the most important ideas that Leonardo considered for the ideal city, the model contains buildings, water channels, and Leonardo's designed machines. The application development considered three kinds of geometries, the city terrain that was taken from an existing wooden model on display at the museum, the buildings were taken from the wooden model and the sketches of Leonardo and the machines that were taken from small wooden models at the museum.

Another case study was "Virtual Rome" [PCC*08], this project was developed on a web-based infrastructure for make easier the distribution. The application was created to help archaeologists, bringing them with different models to compare through the time and space. The users could show current landscape, ancient landscape, ancient vegetation, interiors and other interesting views. The project required web integration, 3D models, natural elements, and visual quality effects. The Sources for this application were different formats from vector layers to 3D models. [CCP09]

In "3D MURALE: A Multimedia System for Archaeology" [CIG*01] is introduced the 3D Measurement and Virtual Reconstruction of ancient lost world of Europe system (3D Murale). This work presents a set of tools for recording, reconstructing, encoding, visualizing and database searching that operate on buildings, building parts, statues, terrain geometry and texture. This paper describes the reconstruction process for ancient lost worlds as recording, recording post processing, restoration, integration, preparation and visualization

Books [O'b10] were created as future reference of this exhibition. Figure 1 shows one of LeCorbusier's initial sketches, which is used as presentation of the exhibition.



Figure 1: Exhibition brochure [O'b10]

3. Le Corbusier's plan

The Latin-American Corbusier's work is not widely known, despite the fact that is very important in his career since it was there where he established some new concepts to urban

planning. He divided his work in two main pieces: The Director plan and the Regulator plan. The first concept was the director plan, that propose a division of the city by zones, using some parameters like heights, buildings rules, population density, profiles, intersections, parking, lighting, arborizations of the roads, public services planning, etc. The second concept was the regulator plan, developed by Jose Luis Sert and Paul Lester Wiener. It establishes the use of the defined zones in the director plan. [Tar06]



Figure 2: Sketch that illustrates the Le Corbusier's plan. Draw by Juana Salcedo [Sal10]

The basic schema for the director plan was presented on September of 1950, the proposal was received by the government and some governmental institution such as the Industrial National Association and Commercials National Federation were called to form an analysis committee. This committee should made an inform for the final schema. Finally on April of 1951 it's exposed the plan using texts, photos, images, and large format urban maps, that shows the Le Corbusier's vision.

4. Designing the interactive model

We wanted to create a novel way to interact with Le Corbusier work. Current approaches in Architecture use physical models to get a reliable vision of the original idea However the physical models bring a very limited interaction or simply they don't offer interaction with the user. Finally we decide to design a 3D visual interface to show the model but also an interactive interface to get a better perception of Le Corbusier work.

In collaboration with our Faculty of Architecture, we designed an interactive, 3D building model of Le Corbusier's plan. The design is composed by two big models; the first model presents the Le Corbusier's vision with huge buildings, wide green areas, and a city divide by zones. The second model is an approximated reconstruction of the actual city. The main idea of the application is to contrast the two models, giving the user the possibility to change between the models and navigate through the model.

5. Developing the interactive model

The interactive model was developed using Java, Jogl, and SVGAT an application to represent complex systems [Iba08]. The development was divided by two cycles, the first one was the modeling and the second one was the user interface design.



Figure 3: Urban map of Le Corbusier's plan [O'b10]

5.1. Modeling

The modeling establishes a protocol to take the original source of data that can be composed by text, images, plans, textures and 3D models, to build some preliminary parts of the model. After the generation of preliminary models, these are edited and compiled to a previous version of Le Corbusier's plan. Finally the generated models are examined and discussed by the experts team that evaluates the models and suggest the necessary modifications to create an accurate model.

The preliminary models are generated using the data of the original proposal, the plans, images and descriptive text. The plans must be digitalized, and the information required to reconstruct the 3D model is extracted and complemented with additional information from reference images and the descriptions Figure 2,3. The preliminary models are 3D objects placed over a flat map, the roads, the parks, the pedestrian roads must be generated separately and later they are superimposed with the others models, showed in Figure 4.

5.2. Interaction and visualization

We decided to follow a user-centered design approach in order to address the needs for final users, who are not necessarily expert in architecture nor VR interfaces. Many devices were tested to guarantee an intuitive and natural interaction, common devices like mouse and keyboard are hard to manipulate a 3D model, complex devices like trackers are not easy to use and they are not practice for a public exhibition. There are devices like Gamepads, Joysticks and Wheels, that are easier and more natural to interact, finally after a subjective evaluation between experts the selected device was the

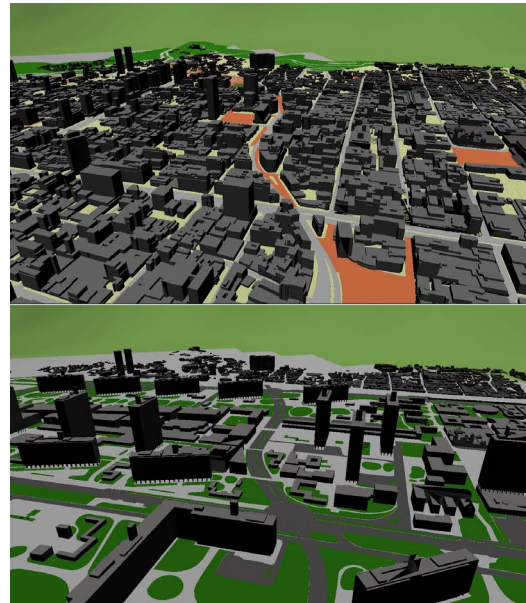


Figure 4: Screenshot of the interactive model

Logitech Driving Force GT wheel, because is more intuitive to navigate through the city like a car or an airplane showed in Figure 5.

The visualization will be stereo because this technology brings to the user a more realistic and immersive experience that improve the interaction significantly. Between the stereo techniques we chose a passive stereo projection, because technology to implements an active projection is more expensive than a technology to implements a passive projection. The stereo passive projection was selected because it's possible use common projectors with a pair of filters and the glasses are more accessible and robust that the glasses needed in an active stereo Projection.

6. Evaluating the interface

An early evaluation with experts was used to design the interface. The evaluation was executed by cycles, the first cycle was the evaluation of the visual interface, the second one was the evaluation of the interaction and finally the evaluation of the completed application. Every cycle is composed by :

- 1.The interface is presented to the experts
- 2.The Important aspects are review by experts using a talk aloud technique. Figure 6
- 3.The data collected is registered

The data collected consisted in suggestions and revisions to the model and the interface, finally the experts helped us



Figure 5: Mounting for the interactive model at "La casa de la moneda" Museum



Figure 6: User interacting with the interface

to improve the models significantly because they know Le Corbusier Work really well and interaction adjust was made using experts knowledge.

7. Lessons learned and future Work

We considered that a multidisciplinary team produces a more completed work because each disciplines offers a different viewpoint and new ideas for the application. We found that the interactive model developed helped users to explore, navigate and understand differences between the city planned by Le Corbusier and the current city. We also noted the importance of referencing landmarks to help users to locate themselves in the interactive model.

We understood that a final mounting for a public exhibition is more difficult than a laboratory mounting, because there are many complicated procedures as permissions, equipment transport and logistic issues. A dependable team is essential to overpass all possible troubles and avoid to take for granted acts or tasks.

The users experience was amazing for most of the visitors,

also an educative experience depends on previous knowledge of the city and the sense of location for each user.

As future work we will include trees to bring users with a more reliable experience in accordance with Le Corbusier's work. Others important features are collision detection to avoid the user to navigate through buildings, and the use of textures to get a more real model.

The interaction could be improved using other interaction techniques, and it would be necessary make a user interface evaluation using the current interface.

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