Photogrammetry for the reconstruction of realistic visual landscapes that serve for the creation of scenographies in audiovisual and multimedia products

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Abstract. Photogrammetry is a technique that allows the construction of hyperrealistic 3D objects. Currently, its use in the audiovisual industry has become an option to lower production budgets that are linked to art and equipment displacement, but the greatest opportunity is the creation of scenographies that simulate realistic and geolocalized visual landscapes, to starting from thinking about the details that make a space have determining characteristics and structures. Community intervention shapes a place to give it a unique look. In that case, the use of photogrammetry transcends the fact of creating places to recreate them from a city, a place or a time, based on the characteristics of the site. Recognizing this, an analysis and search of the elements that characterize Medellín, Colombia and that are necessary for the construction of a digital scenography has begun. Thus, the objective of this article is to describe the analysis that subsequently led to the theoretical construction of the visual landscape and its elevation in photogrammetry. Among the most relevant results of this research is the creation of a methodology for taking photogrammetry for the creation of scenery.

1. Introduction

Photogrammetry is the discipline responsible for calculating the dimensions and positions of objects in space, based on measurements made on photographs [1]. The process generates a realistic model of the objects. These textured models can be used for different purposes, including video, use in interactive products, and their application in fields such as engineering, architecture and archeology [2].

The beginnings of photogrammetry occurred 1800, when photography began to be considered as a means to obtain data beyond graphic description [3]. However, it is with digital photography that presents the possibility of reconstruction of 3D objects with high resolution [4]. It consists of a technological tool that allows measuring digital photos to obtain geometries, radiometries, and semantic information of areas or objects that will be of relevance and will provide usefulness in terms of evaluation, monitoring and / or conservation of heritage assets among others [5]. This step facilitated the use of photogrammetry in other fields, such as architectural and archaeological reconstruction. In these cases, the detail with which the pieces are registered has made this a conservation possibility, which helps the restoration or visual registration of spaces [6].
Starting from the previous experiences registered in the bibliography and attending to the relationship between architecture and cinema, where the second one is proposed as a document that supports and evidences urban transformations [7]; it was found, in photogrammetry, that this knowledge could be useful for other fields such as audiovisual, since some of the problems facing audiovisual productions revolve around achieving the appropriate scenarios [8]. This search for places for recordings is called "scouting" and consists of finding the places that match the time, space and needs of the literary script, but, in addition to practical issues such as access to the site, cost and duration of the recording. These factors raise the cost of production and in many cases the producers opt for solutions such as the construction of the location and its recreation by the art department. However, this generates historical and spatial inaccuracies that are evident to viewers or extend pre-production and recording time.

This is how in the field of audiovisual production, photogrammetry has allowed the streamlining of workflow processes, which allow digital doubles from characters or scenes to be generated with visual accuracy, achieving the hyperrealistic effect in the final product through visual effects (VFX) for digital composition.

1.1. Creation of scenarios and space recognition

The history of creating scenarios begins with the invention of theater. The need to set a situation in different spaces has led to the use of artistic elements to enrich the art direction and set design. The perspective and the need for three dimensions generated different techniques that finally moved to the cinema [9]. The scenarios are part of a series of motivations and provisions that from the script and the director's intentionality set a standard for the credibility of the viewer. Because, the importance of a good scenario is based on the combination of three spaces: the real one, the screen, the shooting, these elements shape the scenery and audiovisual language [10].

According to Tomadoni [11] "space is a social process built, through space-time", this generates visual characteristics that make the space unique. These details are with the naked eye, just look at the daily landscapes to find that the differences between one space and another is the intervention that the human makes by shaping the places and making them unique [8]: graffiti, urban furniture, flora, colors, between Other things come into this list.

Based on the low availability of digital elements for the construction of the local landscape, this research project is formulated, which seeks to offer a library of typical objects or buildings in the city, that characterize the landscape of Medellín, Colombia, so that they can be served to simplify the creation of scenarios in the post-production stage where the visual effects are added, they impact preproduction when making the set designs.

2. Experimental procedure

This research uses photogrammetry to generate a library of props that recognize the elements that build the visual landscape of Medellín, Colombia, as part of the characterization of the city.

During the first part, the search for information related to the project was carried out. There was a shortage of scientific texts on the specific subject of photogrammetry and cinema. However, the theme of architecture and cinema stands out, as well as that of photogrammetry and architecture. Based on this knowledge, an analysis of the visual landscape of Medellín, Colombia began, basing the study on factors such as: history, common and repetitive elements in the city, differential or characteristic elements of the city, tourist sites, meeting places and recognized by citizens. The collection of this data was achieved through interviews with experts and the general public.

As a result of qualitative research, the following objects are defined: Metro train station elements, bus stops, sculptures, emblematic buildings, churches, water sources, means of transport, bicycle stations, telephones, garbage can, trees and street furniture. After defining the elements for photogrammetry, a chronological description is made from the investigation to the technical process, segmented into the following phases, Figure 1.
2.1. Contextualization of the project
In the first phase, a thorough literature review was carried out in search of articles, studies and/or research that support the project, as it is an original initiative in the application of photogrammetry techniques for the articulation of scenarios in audiovisual productions. No precedents were found in writings of a scientific nature, however, in the fields of archaeology and architecture, if a background was found with positive results that support the implementation of photogrammetry from confined spaces to large scenarios using various technical methods, such as the case of article practice and uses of digital photogrammetry in Archaeology [13] where there is an exhaustive methodological description against photogrammetry for historical preservation.

2.2. The technical process for the adequate photogrammetric capture was established
With a photographic equipment composed of 24 Canon T6 cameras, located in circular disposition, distributed in 4 rings at different heights for small and medium-sized objects, in the case of buildings are made sectored photographs of the facade to a camera, the number of photographs is determined by the size of the lens.

2.3. Create three-dimensional photogrammetric models of objects
Structures or facades. An exploration is carried out between two software alternatives for modeling from photographs that are on the market at a professional level, Agisoft Photoscan [13] and Autodesk ReCap, both of which offer high quality solutions. In this particular case it is necessary to use the Agisoft software, because Autodesk has a limitation in the number of photographs that the “Chunk” admits and since they are large objects it is preferable to have more photographs to preserve the details. This process consists of uploading the photographic files to the software, so that it is responsible for assembling them from the common points in the texture of the photographed objects.

2.4. Perform the cleaning of the objects
It is essential to guarantee the compatibility of the object with digital composition software, the retopology allows to lower the density of the mesh and improve its structure for the editing of the object, the creation of UV maps the textures in understandable images for a graphic artist. Texturing and retopology processes are carried out with the Zbrush and Blender softwar (Figure 2 and Figure 3).
Figure 2. A sample of the partial results, the virgin of Lude located in the “Parque Lleras” in Medellín, Colombia.

Figure 3. A sample of the partial results, to the “Unidad deportiva Maria Luisa Calle” in Medellín, Colombia.

The photographic capture is carried out by a specialized camera and lighting team, and according to the needs of each case, the photographic parameters required for the different objectives are established, planning the scheme according to the requirements of the Agisoft PhotoScan software.

3. Results and discussion

To ensure uniformity in the results of the photogrammetry process, it is necessary to have the appropriate equipment against object specificities. The planning of the process requires prior knowledge regarding: plans, scales, installation and management of specialized software. This allows that from the analysis of the object (size, location, depth, height and lighting of the place) the appropriate procedure is performed. It must be taken into account that the photogrammetry has variations according to the claim, the place and the object. In this case, for urban landscapes it is different from that of small objects. For this reason, applying the same methodologies produces unwanted results. In photogrammetry for audiovisual productions it is important to highlight the artistic concept, colors and shapes, however, in architectural photogrammetry more precision is required, this does not mean that it requires less effort, since the level of complexity arises from the object size and shape, lighting conditions and photography equipment available. That is how, the standardization for the creation procedure of scenarios in photogrammetry is useful in reducing the time invested in capturing (see Figure 4).
According to above, the results of this project are procedural, since the documentation for taking urban photogrammetry gives a light to this standardization. These are some parameters and conclusions that were reached experimentally:

- The images must have the same format joint photographic experts group (JPG) or RAW and a good graphic resolution (Minimum 10 Mpx).
- Define the scope of the object (be it a facade, a building or a part of the street furniture) this allows defining the technique to be used.
- The greater the irregularity of the topology, a greater number of photographs is necessary.
- Areas with complex topology require additional photos in detail.
- Have a precise approach to the facade, element or piece that is required. Part of the work done by the software is based on the good quality of the images and the correct approach.
- The number of photographs required is directly related to the size of the structure that is intended to be erected; A larger size, more cameras are necessary, and for smaller sizes, it is best to capture with a single camera.
- As for lighting, it has been discovered that it must be uniform and smooth, avoiding direct lights at all costs, since they produce a marked contrast between the areas of shadow and light that will be interpreted as texture of the object and will represent an obstacle to the lighting of the postproduction scene
- It is not recommended to work outdoors when sunlight produces a hard shadow. In this case, diffusers should be used to avoid generating overexposed areas or very marked contrast between light and shadow.
- The details with low volume, such as the hair or the leaves, cannot be recreated in the three-dimensional model by means of photogrammetry, only which has a clear volume in three dimensions for the production of the mesh can be recognized. For two-dimensional elements the procedure is different.
- High knowledge in photography and lighting is required, as well as a good lens to achieve high quality models, through manual configurations.

**Figure 4.** A sample of the partial results, “Edificio EPM” facade in Medellin, Colombia.

Based on the above, a series of experiments carried out in the “Servicio Nacional de Aprendizaje (SENA)”, “Centro de Servicios y Gestión Empresarial Laboratorio de Animación”, Medellin, Colombia can be evidenced, where the exploration of the photogrammetric technique is continued, solving the errors that field work throws (see Figure 5).
Figure 5. A sample of the partial results, Means of transport / “Turibus” in Medellín, Colombia.

4. Conclusions
We can conclude that the use of photogrammetry, allows obtaining three-dimensional digital models suitable for the simulation of scenographies in audiovisual products from an object, structure or facade, as can be evidenced in partial results, with the achievement of surveys, however, it is necessary to delve into the technical conditions of photography, to obtain high quality results. And generate a methodology that serves to lift landscapes for audiovisual products, which responds to the characteristics of the market.

Photogrammetry, not only helps to solve some contingencies for the creation of scenarios, but also reinforces the idea of visual conservation of the heritage offered by the cinema. In the metropolitan area Medellín, Colombia there is architectural diversity, which can enrich audiovisual proposals, but in many cases access and costs make it difficult to use for small productions, in this case the landscape library made with photogrammetry, would be a tool that drives the production.

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