Chapter 16

Hand Held 3D Scanning for Cultural Heritage: Experimenting Low Cost Structure Sensor Scan

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ABSTRACT

In the last years 3D scanning has become an important resource in many fields, in particular it has played a key role in study and preservation of Cultural Heritage. Moreover today, thanks to the miniaturization of electronic components, it has been possible produce a new category of 3D scanners, also known as handheld scanners. Handheld scanners combine a relatively low cost with the advantage of the portability. The aim of this chapter is two-fold: first, a survey about the most recent 3D handheld scanners is presented. As second, a study about the possibility to employ the handheld scanners in the field of Cultural Heritage is conducted. In this investigation, a doorway of the Benedictine Monastery of Catania, has been used as study case for a comparison between stationary Time of Flight scanner, photogrammetry-based 3D reconstruction and handheld scanning. The study is completed by an evaluation of the meshes quality obtained with the three different kinds of technology and a 3D modeling reproduction of the case-study doorway.

DOI: 10.4018/978-1-5225-0675-1.ch016
INTRODUCTION

3D scanning has gone a long way since its first appearance in cultural heritage digitization and modeling (Remondino, 2011; Bandiera et al, 2010; Benedetti et al, 2010; Andreozzi, 2003). The costly and bulky scanners of few years ago are lagging behind some new emerging technologies that are delivering a long term dream of the practitioner of cultural heritage: fast, accurate, low cost, “personal” scanning with a hand held device. The scanning methodology at the focus of this study is hence well distinct from the well tested, reliable, but costly active laser scanning or Time of Flight (ToF) scanning. Point cloud collection of an artifact is just the begin of several different pipelines, as a matter of fact the effectiveness of a tool should always be tested against the final use one wish to do with the collected data, such as, e.g.: documenting an artifact to diagnose problems in its preservation and plan restoration and/or protection actions; creating a digital representation of the artifact for pure archival reasons; building a photo realistic representation for use in virtual tour; making a vectorial simplified representation in order to produce, through 3d printing techniques, a copy (maquette) of the original.

Among the emerging low cost hand held scanners we have chosen the Structure Sensor device to verify a 3D pipeline acquisition on an Architectural Cultural Heritage object: the XVIII century doorway placed in the monastery of Benedettini in Catania, listed in UNESCO’ world heritage list. Envisioning the massive use of this cheap and easy to use device in the next years, it is necessary to test its effectiveness in terms of easiness of 3D data collection, processing, mesh resolution and metric accuracy against the size and features of the objects in order to identify the possible fields of application. The features of the chosen case study, in terms of dimension and richness of details, well fit with the aim of this research due to the presence of both planar, complex (mouldings) and sculpted geometries.

The 3D pipeline outlined in this chapter will follow, as much as possible, a low cost and open source workflow from 3D data collecting to the digital replica.

The methodological approach involved an interdisciplinary team composed by computer scientists and architectural representation/surveying researchers that strictly interacted in each step of the research and integrated their own contribute in order to better understand and solve some relevant and critical issues.

The chapter is structured as follows: - At first we will provide a state of the art panorama of the hand held scanners that are currently available on the market with some previsions about the ones that are likely to emerge in the short term. The review is complemented with a non-specialistic, but accurate description of the algorithms that are used in most of the commercially available devices; - The test carried out on the chosen case study is then introduced. The doorway has been 3D acquired by means of a Structure Sensor device. We have also carried out the comparison with both Image Based Modeling (IBM) and ToF laser scanner techniques in order to point out weaknesses and advantages of the hand scanning approach in relation to the other two well assessed technologies; - The chapter completes the discussion of these issues related to data acquisition with an exploration of the modeling issues to obtain a digital replica in an open source environment suitable for architectural representation and communication purposes.

Handheld 3D Scanning

The 3D scanning is used to acquire the three dimensional geometrical structure of an object in a real environment in order to manipulate it for many possible aims. Usually, the result of a 3D scanning is a set of points in the virtual space called “point cloud”. Those points are used to create a surface “mesh” by a triangulation procedure. In the last decade 3D scanning has played a relevant role in many research