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ABSTRACT SUBMISSION FORM

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Title of the Paper: Creating Internet Friendly 3D Tours Using 3D Range Scanner Data

Theme: 3D scanning in Display and Exhibition

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ABSTRACT

Until recently, cultural heritage was promoted over the Web using digital photographs. The recent boost in multimedia technologies in combination with the affordable high bandwidth Internet connections and the continuous evolution of computer hardware had a major impact in increasing the popularity of the online 3D content. Over the last decade, the cultural heritage domain is following this evolution by promoting artefacts and monuments through the technology of interactive 3D computer graphics. At the same time, the progress in 3D digitisation systems allows the more accurate and realistic 3D representations of the exhibits. The previous statement can be supported by numerous projects focused on 3D virtual walkthroughs of architectural heritage. The methodologies used for collecting data required for the creation of 3D virtual walkthroughs are: empiric measurements, topographic techniques, terrestrial photogrammetry and 3D range scanning. This work is focused on creating Web friendly 3D virtual walkthroughs of cultural heritage sites and also discusses the major issues involving the digitisation and data processing phases. The digitisation of the remnants of a Byzantine castle situated in the city of Kavala (North-Eastern Greece) is given as a case study.

The castle (Acropolis) of Kavala is located on the top of the *Panagia* (Virgin Mary) peninsula where the old town is built. During the Byzantine times successive reconstructions and operations for the fortification of the town took place. The castle, as we see it today, was built in the first quarter of the 15th century, based on the Byzantine era's foundation. It is a two bailey castle with a tower situated in between.

The equipment used for the digitisation of the castle included, apart from a typical 6MP dSLR camera, a time-of-flight 3D colour range scanner (Optech ILRIS-3D). The scanner is a portable weather proof system with eye safety laser, capable of acquiring 2.000 points per second. The range accuracy of the system is 7mm at a distance of 100m while its maximum range is near 1.5 Km. The digitisation phase was performed by two persons in two days period and included mainly the inner part of the castle which is the actual walkthrough area. A number of scanner positions have been selected based on the castle's morphology and the system's capability of acquiring panoramic scans. However, the long acquisition times of panoramic (360^0x40^0) scans in combination with the limited on-site timeframe dictate the usage of single (40^ox40^o) scans. Finally, a total of six panoramic and seven single scans were acquired. Electrical power supply was available within the castle from the information desk and thus no power generator had to be carried on site. The scanning was performed under sunny weather allowing the system's internal camera to capture satisfactory colour texture information.

The raw scan data composed of 36 millions 3D points. These partial scans were merged using the *Iterative Closest Point* algorithm and with further processing (overlapping elimination, noisy and unnecessary parts removal) resulted a 27 millions 3D points. The resulted point cloud is by far denser than any surveying-photogrammetric technique that we have used in similar projects. However, a coarse triangulation of the point cloud resulted, a prohibitive for interactive and especially web-based, 3.3 million polygons mesh. Further, simplification of the mesh had to be performed in order to result a web-friendly 3D model. This process was manually performed due to the inadequate results produced by automated simplification methods. This is a time consuming process where the user manually generates simpler surfaces by selecting points on the dense polygon mesh in order to produce a much simpler while accurate 3D model (subset of the original point cloud) of the castle. The final model is composed by 15,000 polygons and it can be described using the VRML 2.0 format with a total of 430KB (gzip compressed). Furthermore, colour information from the scanner had to be rejected in the case of the 3.3 million polygon mesh. On the other hand, an automatically generated 3D mesh produced by using the complete dataset (27 millions RGB coloured points) would carry realistic colour texture information (vertex coloured) but it would be inapplicable for interactive web-based applications. Thus, colour texture information had to be created from photographs and manually mapped on the simplified model. A sum of 73 texture images was registered on the 3D model manually. The size of the texture images was 15 MB

compressed using the JPEG algorithm. In order to keep the total data size of the reconstruction to a minimum level, large surfaces were covered with seamless texture patterns (tiles) resulting a major realism reduction. Synthetic shadows were introduced on the model using the vertex-paint technique to enhance the visual realism of the titled based texturing approach.

The resulted textured 3D model can be downloaded even with low bandwidth Internet connections within acceptable amount of time. Furthermore, the low polygon model can be visualised in high frame rates with ordinary graphics cards. The realism of the 3D model can be considered similar to the realism levels found in many computer games. Alternatively, if realism is the main goal, complete orthographic photos will be used to map the model increasing dramatically both realism and amount of texture data.

It is a fact that 3D range scanning results high density and high accuracy 3D data. Until recently, those were used for scientific applications such as archiving, documentation, etc. In this paper, we have used the raw data produced by a range scanner to generate a 3D model for interactive web-based exhibition. Nevertheless, the procedure that have been followed indicates that there is a major need for research in the development of algorithms that will be able to automatically or semi-automatically generate accurate low polygon models from high density point clouds.