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3D scanning and implementation to practice

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Abstract

This article focuses on 3D scanning of objects and the following application to practices. With 3D scanning, a digital spatial model of an existing object is created and therefore this technology is much more accurate than 2D technology. Main fields of the use are construction, engineering, medical industry, culture and industry of footwear, design, and entertainment. 3D scanning can be used in simple, or even in more complex projects in order to monitor changes created by human activities or by nature itself.

Keywords: 3D scanning, 3D model, digitization, scanning

Introduction

Nowadays, in the period of digitization, there is an increasing demand for 3D digitization of objects. By the use of 3D scanning devices, it is possible to obtain models or components of the objects created by hardware, in a very short time. A model that was scanned this way is actually an exact copy of scanned object. An achieved output can be modified in a different software environments, which may bring the possibilities of change of scanned objects, resulting in a new outcome, with a precise shape specifications. Thanks to software modifications, we are able to create specific outputs, which are individual to new requirements for object scanning. With 3D scanning, a digital spatial model of an existing object is created and therefore this technology is much more accurate than 2D technology- a photo. For more quality outputs, it is necessary to consider much more difficult process called “post processing” In terms of post processing, it is essential to possess with a high power of computing technologies with a higher disk storage capacity.

Great emphasis is placed on mentioned post processing. On the following two images, a modification is declared, where each scanned object need to be cleared from undesirable defects and from other disruptive elements. Subsequently, the post processed and cleared models may be used as a basis for the other programs.

Figure 1 –Scanned object- Uniza ŽU before processing 4

Figure 2 –Scanned object- Uniza ŽU after processing 5

The principle of 3D laser scanning

Generally, 3D scanning is a 3D data collection of selected surface points of a specific object. Mainly, the points of this object are placed in coordinates X, Y, Z. Actual scanning works on the principle of transmitting the laser beams that are reflected by a rotating mirror. In scanning, the laser scanner is rotating at 360 degrees around the vertical axis and at the same time, it is transmitting laser pulses by using a rotating mirror. Thanks to this, the scanner covers almost the entire surroundings of the scanned object. There is the only one blind angle that arises during scanning, resulting from technical specifications and it is being generated directly by the scanner. Laser beams spread out and fall on the objects covered in the field of sight of the scanner. After that, they are being reflected from objects and returned back to the scanner, where the object will be again scanned by a sensor. Afterwards, a sensor will evaluate the shape of the scanned object surface, based on the time and the angle of beam return. The output of the scanning process is a point-cloud of the scanned object or its spatial part. After scanning, it is necessary to process and edit all scanned objects according to the customer requirements, which means, a post processing of a scanned object must be accomplished.

Use of 3D scanning of buildings

3D scanning can be used in simple, or even in more complex projects in order to monitor changes created by human activities or by nature itself. Scanning is used to obtain future technical solutions from interior and exterior spatial arrangements. In addition to gaining a number of points, based on the principle of a rotating laser beam reflected from the mirror, photographs are taken from the position of the scanner. These photos are used to integrate RGB color spectrum and also the device assigns this spectrum to a single point. In the resulting portrayal of the scanned object, this feature may be used for better orientation in the software environment of a user.

All these scanned models can be expressed parametrically as measurements of length, volume, and content. When making external solutions, there is a possibility of georeferencing the models into the relevant coordinate system. In addition, vector models are generated from the created point clouds and after they are being exported to an editable format which means, they can be further processed for example in a Computer Aided Design (CAD) environment or other.

The possibilities of use:

- Documentation of the entire renovation of buildings,
- scanning of unfinished buildings,
- 3D models of buildings, bridges, tunnels, halls etc.,
- documentation during reconstructions and o cultural monuments work,
- creation of 3D models of castles, palaces and cultural monuments such as statues or others,
- documentation during the construction- from the selection of a suitable plot of land to the final solution,
- printing objects on a 3D printer at a selected specific scale. [1]

The main use of 3D scans of components in practice

- In terms of the use of 3D scans in practice, 3D digitalization can be used for manufacturing companies in two main groups, namely reverse engineering and inspection control.
- The use of 3D scans has many advantages, for instance, demonstration of product function, improvement in quality and reduction of storage costs. In production planning for new products, the use of 3D scanner enables the user to get the required information much faster. In other features, such as product design, 3D scans are being used for different types of analysis, on actual CAD data editing, completing design during the continuance, and integrating prototype changes into the CAD model.
- In the production of goods, in reversed engineering, the use of scans is essential in the matrix production, manufacture of shapes, appliances, and designs, also in verification and control of the tool and virtual assemblies, that resulting in the programming of tools or robot prior to a production itself.
- The next step is the subsequent product control at its output, and control of components with 3D scans. 3D scanning is used for planned maintenance, where the actual status of parts and tools is being scanned. Moreover, it can be used in different training sessions, and presentations, or even for repairs, component improvements and various analyses of wear, deformations, etc. [2]

Other possible uses of 3D scans

Historical objects:
3D scanning has begun to be used, for example, for historical monuments and buildings and the other important artwork of our cultural heritage such as statues, pictures, plastics, handmade folk artwork and others. Mainly, it is a digitalisation process, followed by archiving of these artworks, for example, before renovation or manipulation. All these data are stored and can be used again for reprocessing, creating copies, imitations etc.

Entertainment industry:
Also, 3D scans can be used, for example, to produce toys, souvenirs, computer games, as well as in the movie industry and in animation studios etc. Mainly, the 3D scans of human shape are used in this sector, which enables excellent and accurate display of human body or other objects.

Medical industry:
3D scanners are increasingly used in medical industry. For example, in the production of individual medical devices, artificial joints and prostheses. A healthy part of the human body is being scanned and after it will be used for creating a real copy. In addition, other option of using 3D scanners in medicine is digitization of human tissues.

Presentations:
Different products are scanned with 3D scanner and after that they are being presented as a 3D model on manufacturer or intermediator websites. Also, 3D models may be placed to the animation simulations with the aim to make the most effective output and to attract the potential customer.

Conclusion:

3D digitalization is the main part of reversed engineering, thus the fastest developing means of increasing productivity of manufacturer. In the engineering industry, the introduction and operation of digitalization significantly reduce the time required for the construction, repair or inspection of components. Nowadays, the use of laser scanning systems in the development or in production is a foundation for the prosperity of each engineering company. In construction, 3D scans have the same importance as in the engineering industry. Today, the object scanning and other scan processing are being used quite often. In addition, working with 3D scanners may influence more industries, therefore, in many sectors where 3D scanners are not yet in use, they may find their application in the near future.

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