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3D SCANNING AS A MODERN TECHNOLOGY FOR CREATING 3D MODELS

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Abstract: This paper is oriented to 3D scanning as one of the most important sectors of digitization of modern digital enterprises to create 3D digital models. The result of this technology are digital models that are characterized by being highly accurate compared to reality. Today, 3D scanner developers are constantly improving the scanning parameters of these scanners and working on optimizations to create scanners that are used not only in engineering or construction, but also in the medical process of creating 3D models of human body parts.

1 Introduction

In modern engineering, 3D scanning appears to be one of the most economical options for spatial measurement and subsequent 3D modeling. Compared to conventional laser rangefinders, 3D scanners differ in the number of points targeted per unit of time. The result of this measurement is the so-called "point cloud", which can be understood as a set of points, and the subsequent interconnection of the points by the triangles forms a triangulation network that describes in more detail the scan shape [1-8].

Figure 1 Leica P30 3D Laser Scanner Assembly

Digitization is a process where the properties of real objects are transformed into digital form.

The essence of measuring and at the same time creating 3D digital models using 3D scanners is actually evaluating the distance of individual points from the moment the beam is sent by the scanner. For a better idea, the overall model does not create a single scan, but creates a group of scans that depends on the severity and size of the scanned object. Scanning is followed by program modification of the scanned data, where the model is unified and filtered into the required parameters for further digitization procedures.

2 Detailed description of the Leica P30

The Leica P30 is a 3D versatile laser terrestrial scanner that is suitable for a wide range of standard scanning solutions (Figure 1). The biggest advantage of this scanner is its high performance and ability to work even in demanding conditions.

The scanning speed is 1 million points per second, up to 120 m. He creates images in HDR mode for highly detailed 3D cloud points. Another advantage of this scanner is its low noise when scanning data. With two vistas, the scanning range is 360 degrees in the horizontal direction and 270 degrees in the vertical direction. The internal battery life is 5.5 hours and the external battery life is up to 7.5 hours, which ultimately ensures the scanner lasts a full day of work. The scanning range of this scanner is around 700 Mpix.

Work with this scanner is also possible at temperatures ranging from -20 ° C to 50 ° C. This scanner is most often used for capturing plant model and production halls, scanning buildings, rooms, machines, as well as reconstructing architectural monuments or documenting the actual state if the drawings are outdated or outdated.

The software link between the user and the scanner is provided by the Cyclone software [2].

2.1 Scanner decomposition

The Leica ScanStation P30 (Figure 2) consists of:
- scanStation P30,
- ethernet cable,
- internal batteries,
- AC power adapter,
- power cable,
- power adapter for battery charging station,
- power station,
- three-point stand,
- tripod,
- scanner transport case.

Figure 2 Leica P30 3D Laser Scanner Assembly

2.2 Basic scanning process

In the first step, the scanner is removed from the carrying case and placed on an unfolded three-point stand. The stand itself should be placed in a horizontal position. The security screw connects the scanner to the stand. Three rectification screws and a built-in round vial are used to level the scanner horizontally (Figure 3).

At the location of the battery, the cover is removed by pressing the appropriate button and then the charged battery is inserted into the battery holder and reinserted. The scanner is turned on simply when the scanner is properly set up and fully turned on, the main menu appears on the graphical display (Figure 4).

Each scan must be stored in the project. If no user-defined project is created, the default is used.

Figure 3 Rectification screws with vial

Figure 4 Scanner main menu image

3 Reference target marking system

Use the softkey in the scan menu to mark the target position. Subsequently, by entering the target identifier, the target height can be set if necessary and the target type can also be selected from the list.

The center of the target is indicated by arrows and then returned to the project to create a list of targets from that scanner's scan position. The target type must be determined before determining the target position. Reference target information can be retrieved from the target list using the INFO function. It is also possible to see if all targets have been scanned correctly.

If the target is correct, "OK" will be displayed (Figure 5). If there is any missing information, the message "BAD" will be displayed. After the target check is performed, it returns to the results window and the targets are saved.

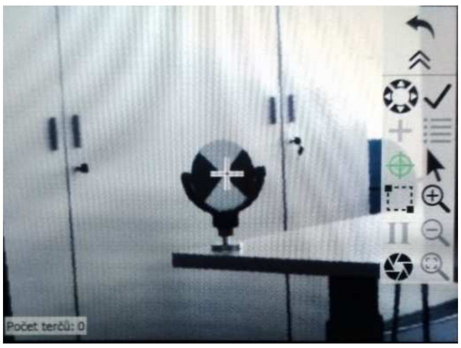

Figure 5 Targeting of references target

The target placement system is based on the target being visible. There must be no obstruction between the scanner and the target when viewed visually. Also, targets should not be placed in line with one another, as this could cause complications when joining scans. The target must be pointed at the straightest angle to the scanner. Furthermore, in order to link scans in Cyclone, at least two targets must be visible from the previous scan positions because of the non-registration of the target position when joining the scans. This procedure is repeated for each of the scan positions. In Figure 6, it is possible to follow the location of individual reference targets, which are indicated by yellow numbers. These targets are to a large extent logically placed on the corners of the hall for best visibility from multiple scan positions [9].

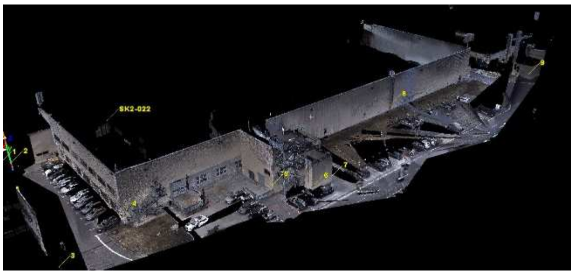

Figure 6 Scan of the side of the hall with a reference target number in CYCLONE

4 Data processing in Cyclone

Leica has developed a utility and processing program for the Leica ScanStation. The modular CycloneTM program (Figure 7) is the basis for the entire scanner work. It takes care of the entire workflow from selection and scanning, in connection with the interconnection of individual point clouds to the generation of the final model and subsequent visualization. The Cyclon software platform contains 6 modules. Each of these modules has its own specific purpose [9].

Figure 7 Registation of scan positions in CYCLONE [10]

5 Registration of "point cloud"

The point cloud registration is based on the exact placement of the individual clouds in the space according to a uniform coordinate system.

Registration joins:

- Same targets into one

  - Target 1 = 1 (SP1) = 1 (SP2) = 1 (SP3)
  - Target 2 = 2 (SP1) = 2 (SP2) = 2 (SP3)
  - Target 3 = 3 (SP1) = 3 (SP2) = 3 (SP3)

  (SP = Scanning Position)

- Determines the exact position of the scanner in each position based on the linked targets and places points in the space accordingly

- After registration, the scanner position from the first scan position becomes the zero (initial) point

6 Data processing procedure

Data processing procedure (Figure 8):

- the first step is to connect the scanner to the PC / USB via a USB cable and then copy the RAW data to the PC / USB,
- after opening Cyclon, it is necessary to create a new database for the imported project on the Cyclone server,
- click database in navigator to go to file / import scanstation data,
- registration of RAW data is created,
- the required scanning stations are inserted in the registration and targets are assigned,
- subsequently all entered data are registered,
- if all data is correct and registration is successful, the modelspace is then created,
- the modelspace created in this way is subsequently cleaned of data from noise and unwanted objects,
- to clean up data, the cloud is simplified with the Unify command,
- the last processing step is export to * .pts format.

7 Converting of scanned data

The conversion of the scanned data must be uploaded to Autodesk Recap^{TM} because Autodesk programs do not accept file with suffix "pts." This suffix is the output of Cyclone after data registration. In Recap, this data is then converted with the extension "rcp.", Which is then suitable for the next modelling process that is done in Revit "rvt.".

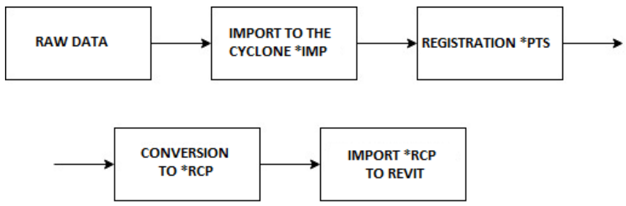

Figure 8 The entire process of data processing to the output suitable for Revit software for further processing

8 Conclusions

Currently, the reverse engineering industries will not do without 3D scanning technology. The main reasons, as mentioned, are its economic and technological aspects, which makes 3D scanning the best way to create 3D models.

In modern companies it is very important to orientate in this topic because of shortening the "time to market" by putting these 3D indoor scanners into practice. The main reason is not only the creation of 3D models of halls and factories but also layouts and also comparison of existing workplaces in order to optimize production and similar elements related to the overall production of products.

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