

3D Point Cloud Transformation Method for Display on V-World

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Abstract: To be well prepared against global 3D map services such as Google-Earth and World-Wind, the Republic of Korea has recently launched and operated the spatial information open platform integrated map service titled 'V-World'. V-World provides participatory services to users who produce a 3D model in person, but the 3D modeling requires a lot of time and money. To reduce the time and cost, therefore, this study proposes a 3D building modeling technique by immediately enlisting the 3D-point cloud obtained through laser technology or recent diverse video media on the V-World. In order for the 3D-point cloud to be listed on the V-World, it should be converted into a V-World-supported 3DS file format through mesh and clustering processes.

Keywords: V-World, 3D Point Cloud, 3D Building Modeling, Point to Mesh, Clustering

1. Introduction

'V-World' refers to a spatial information open platform integrated map service that provides diverse contents such as national spatial information, 3D building, and image maps to general users [1]. V-World provides an open API to help a developer develop new services using user contents and participatory services in which users register the spots they want in person and produce a 3D model.

Recently, there have been a lot of studies on the acquisition of 3D-point cloud that is produced using laser technologies such as Light Detection And Ranging (LiDAR) and Kinect and through various video media including mobile cameras, digital cameras, and dash cams. Therefore, this study attempted to propose a 3D building modeling technique that can put the 3D-point cloud on V-World.

In conventional 3D building modeling, a building was drawn in person using related software such as 3DS MAX and Sketch Up in consideration of actual size and ratio. However, this kind of traditional method requires a lot of time and money in creating each 3D building model. If a building has a complicated structure, time and cost further increase. In the case of V-World, 3D building modeling making it not available except in some capital areas even though the 3D building modeling services are developed targeting the buildings in Korea. Even though 3D modeling is completed, in addition, the building may need to be updated. Therefore, it is way too much to handle all these manually. Hence, this study tried to suggest a method to convert the 3D-point cloud obtained from the building into a 3DS file format and immediately add it to V-World to reduce the time and money spent for the production of the 3D building and build more 3D buildings in V-World.

2. Experimental Details

2.1. Acquisition of 3D-Point Cloud

For 3D-point cloud, the data acquired in an 'xyz' file format after scanning the facades of Lake Hall (Konkuk University residence hall) using terrestrial LiDAR (Leica ScanStationC10) in May 2014 were used..



Fig. 1 : Test-Bed(Konkuk University Residence Lake Hall)



Fig. 2 : Data Acquisition System(Leica ScanStationC10)

2.2. Software

To enlist the 3D-point cloud on V-World, data should be converted or produced in a file format suitable for the map service. Because V-World supports a 3DS file format only, the data in an ‘xyz’ file format obtained through the terrestrial LiDAR should be converted into a 3DS file format. For this conversion, MeshLab and 3DS Max programs were used.

1) MeshLab V1.3.3

MeshLab is a free software program with which diverse 3D data can be imported/exported and edited. In this study, 3D-point cloud in an ‘xyz’ file format obtained through the terrestrial LiDAR was imported. Then, a face was formed by converting this point data into a net/mesh type. Then, data was edited and exported for operation in 3DS MAX [5], [6].

2) 3DS MAX 2014

3DS MAX is a design software program for 3D modeling and computer graphics. It is most widely used among various current 3D modeling programs. Because it supports a 3DS file format, it is used as software for the production of the 3D model suitable to V-World. In this study, it was used as a kind of data transformation software program, which is needed to convert the data in a different format exported from MeshLab into a 3DS file format.

3. Experimental And Results

A process of enlisting 3D-point cloud on V-World is shown in Fig. 3 below. The 3D-point cloud is being converted into a 3DS file format after going through the following processes in sequence: point → net/mesh → face.

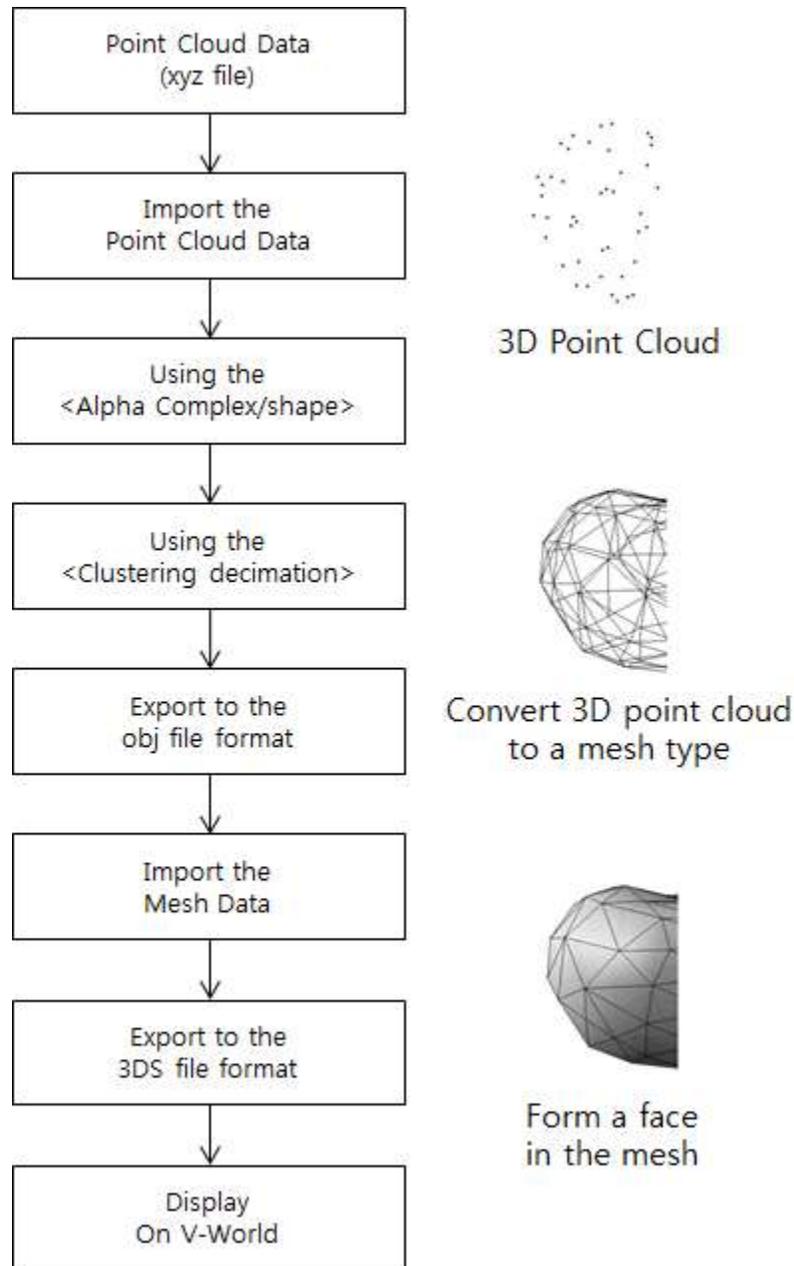


Fig. 3 : A Process of Enlisting 3D-point Cloud on V-World

3.1. Exporting 3D-point Cloud on MeshLab

First of all, the 3D-point cloud should be imported into MeshLab. The data file formats supported by MeshLab include XYZ Point Cloud (.xyz), TXT (.txt) and ASC (.asc). In this study, an 'xyz' file format obtained from the terrestrial LiDAR (Leica ScanStationC10) was imported into MeshLab as shown in Fig. 4 below:



Fig. 4 : 3D Point Cloud

3.2. Face Formation Through Conversion of 3D-Point Cloud into Mesh Type

A process of converting 3D-point cloud into a mesh type is an intermediate stage to convert the point data into face data. In this study, MeshLab's 'Alpha Complex/Shape' was used. This function creates a great number of faces stemming from the mesh in the 3D-point cloud through 2D triangulation [2], [4]. Fig. 5 and Table 1 reveal changes after meshing:

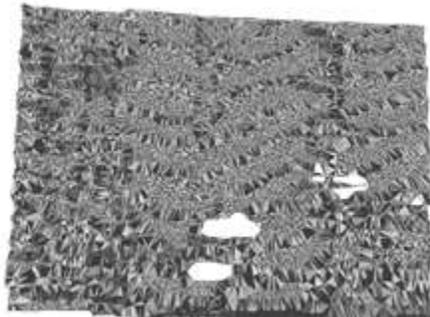


Fig. 5 : After Meshing

TABLE I: Comparison Before and After Meshing

	No. of Vertices	No. of Faces
Before alpha complex/shape	592,854	0
After alpha complex/shape	592,854	6,989,363

3.3. Clustering Decimation

If 3D-point cloud is imported to the 3DS MAX after being exported in an 'obj' format after going through a prior meshing process, there will not be a big problem provided that the data is limited. The 3D-point cloud, usually comprised of hundreds of thousands or millions of points, creates faces far more than points through meshing. Because a large amount of data cannot be handled in 3DS MAX, it cannot be released in a 3DS format. Hence, there should be an attempt to reduce the number of faces. In MeshLab, the number of vertices is reduced by creating a stereoscopic grid that surrounds the mesh using clustering decimation. In addition, a mesh is being formed again by the newly given vertices.

According to the experiment, the number of faces to be handled by 3DS MAX was mostly about 30,000 or below. Clustering should be continued until the optimum number of faces is obtained [3], [4]. Fig. 6 and Table 2 reveal changes after clustering:



Fig. 6 : After Clustering

TABLE II: Comparison Before and After Clustering

	No. of Vertices	No. of Faces
Before clustering decimation	592,854	6,989,363
After clustering decimation	3,308	21,108

3.4. Conversion into 3DS MAX-Based 3DS File Format

If pre-processing jobs such as meshing and clustering are all completed in MeshLab, data is exported in an ‘obj’ file format to make it importable in the 3DS MAX. After it is imported in the 3DS MAX, it is immediately exported in a 3DS format without a particular operation [7].

3.5. Test Results

When 3D-point cloud was listed on V-World using the results of the face-processed test, a face-processed 3D-point cloud model was listed on V-World as shown in Fig. 7. Because the 3D-point cloud was included, and RGB value was lost during the conversion of data format, the quality as a 3D building model diminished. However, the outline with the same boundaries of imported data, as seen in Fig. 4, was found.



Fig. 7 : 3D Point Cloud Enlisted on V-World

4. Conclusion

This study attempted to enlist 3D-point cloud obtained through the scanning of buildings using terrestrial LiDAR on V-World by processing it into a file format suitable to V-World. After importing the 3D-point cloud to MeshLab, a face was formed through meshing using MeshLab's function. Then, a large amount of faces was reduced to a level able to process in 3DS MAX through clustering. Lastly, the file format was converted into a 3DS format in 3DS MAX. As a result, face-processed 3D-point cloud appeared on V-World. Because all values were gone but each point's coordinates during the face processing, a building outline was expressed. To color the building, therefore, separate texturing and rendering should be performed. Because the errors of initial input data (ex: unnecessary point caused by mismatching, absence of point due to a blind spot during building scanning, location of the points, etc.) were reflected as they were, in addition, even though an empty space was found, or a face was created through meshing, the face wasn't even and smooth. If this kind of problem can be gradually improved through system advancement and improvement of 3D-point matching technology, and diverse high-quality 3D-point cloud can be obtained, it appears that a 3D building model could be produced faster than the conventional manner in which a 3D building model is created manually.

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