

Close Range Photogrammetry using TRIVIM for 3D Modeling

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Abstract: This paper focuses on the generation of 3D street scenarios using a set of 2D image based on the principles of close range photogrammetry. Photogrammetry is the art, science and technology of obtaining reliable information about physical objects and the environment through processes of recording, measuring, and interpreting photographic images, patterns of EMS radiant energy and other phenomena. In this paper 3D modelling has been done using Trivim which is a free open source and R&D application for non-commercial use in training and capacity building for close range photogrammetry developed at the Indian Institute of Remote Sensing (IIRS), Dehradun India. Software would provide a visualization and decision support tool by creating georeferenced, photorealistic models attached with attribute data base for variety of applications.

Keywords: Trivim, 3D modeling, Close Range Photogrammetry, Georeferencing, Camera calibration.

1. Introduction

Photogrammetry is the art, science and technology of obtaining reliable information about physical objects and the environment through processes of recording, measuring, and interpreting photographic images, patterns of EMS radiant energy and other phenomena. Photogrammetry produces

- Coordinates of real world points of objects
- Maps or Plans like topographic maps
- Orthorectified images
- Digital Terrain Models (DEMs)
- without contacting the surface to be measured and at a predetermined accuracy. Accuracy is mainly determined by the scale of the photograph. Photogrammetry is used in
 - Map making
 - Geographic Information System(GIS)
 - Surveying
 - Architecture
 - Accident analysis
 - Movie making
 - Mining and heavy industries
 - Virtual reality etc.

Photogrammetry can of various types like Space Photogrammetry , Aerial Photogrammetry, Terrestrial Photogrammetry and Close range Photogrammetry. Close Range Photogrammetry is Terrestrial photographs having object distances up to about 300m , Collection methods can be both ground- or aerial-based and camera is close to the subject and is typically hand-held or on a tripod (but can be on a vehicle too). 3D modeling is the process of developing a mathematical representation of any three-dimensional surface of an object via specialized software.

Trivim is new software useful for research work. Trivim can provide a 3D street view with attribute data related to research work which will be georeferenced. Photogrammetry is basic tool for Trivim. Trivim is a free open source and an R&D application for non-commercial use in training and capacity building for close range photogrammetry developed at the Indian Institute of Remote

Sensing (IIRS), Dehradun India. Software would provide a visualization and decision support tool by creating georeferenced, photorealistic models attached with attribute data base for variety of applications.

2. Statement of the Problem

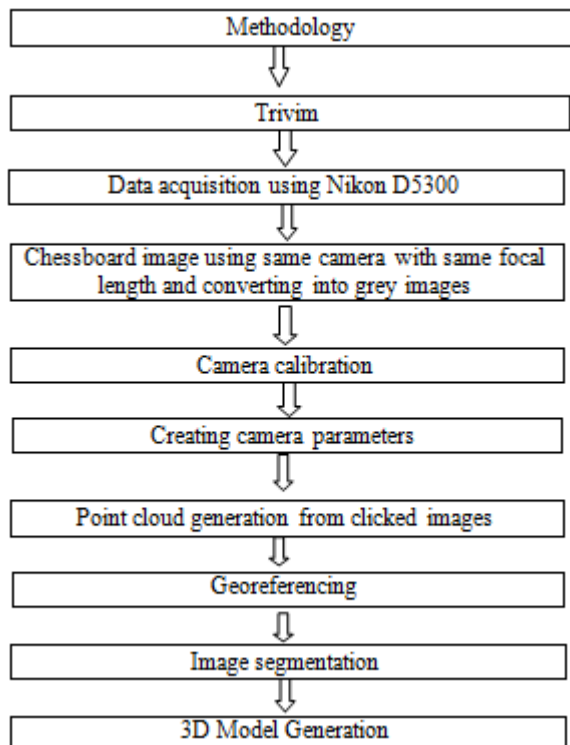
In the last decade the demand of 3D models for objects and places has been increasing drastically for visualization and interpretation purposes. It represents an interesting tool for the documentation and interactive visualization purposes to create a virtual reality environment. Various commercial software are available for the image processing and 3D modeling. Most professional 3D software is expensive, however there is always some free software that one can use and make 3D model out of it. In this paper Trivim is used to make 3d street view using the principle of close range photogrammetry.

Study Area and Data set

- Street along the main cantonment road Dehradun has been captured using the Nikon D5300 camera with a focal length of 18mm approximately at a 10 meters distance from the shops.
- A distance of approximately 2meters was taken at every consecutive photograph to maintain an 80% overlap between the photographs.

Research Question

- What is the use of open source software in 3D modeling?
- How to make a 3D model of a street view using Trivim?
 - Is it user friendly so that can be used by students and research scholars without computer background?

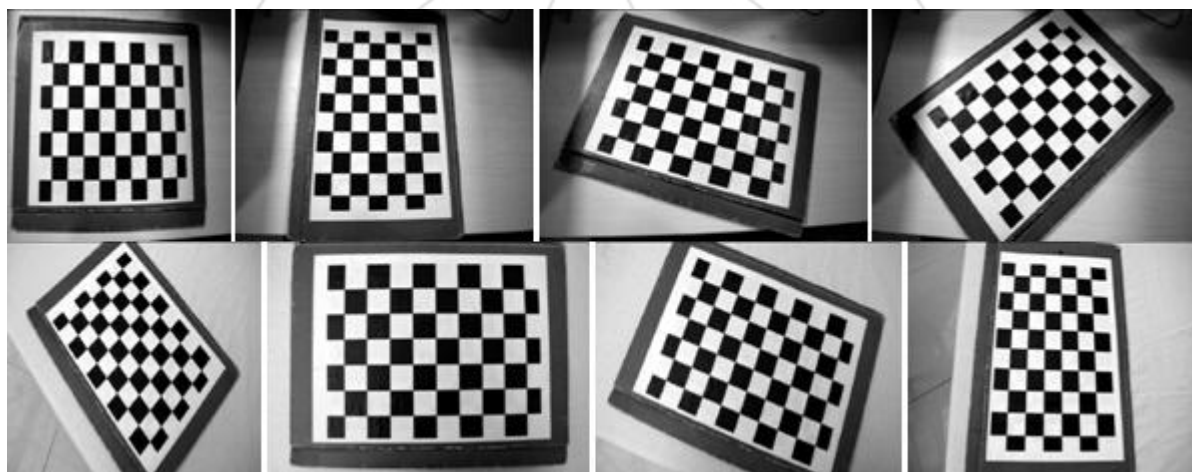


3. Generation of 3D Street View Using TRIVIM

- **Creating a new project**
 Create a new project first of all with a desired name in the Trivim software and choose that folder that give data based entry name or can load the already saved folder.
- **Camera calibration**
 It is carried out for actually determining the camera distance, focal length, principle point coordinates etc. Calibrates the camera and estimates the interior orientation parameters.

4. Grey Images for Camera Calibration

Grey images of the chess board have to be taken with same camera and wavelength as was taken to click photographs of the area. 3d model cannot be made without camera calibration. While collecting photographs of the study area grey images of chess board can be collected to remove confusion at later stage.



- **Field planning**

Lets the user estimate the time required for image acquisition and number of photos required. It requires the information of length, distance from the building and time taken to click one pic & percentage of overlap etc.

- **Point Cloud Generation**

After field planning, 3D point cloud from the set of two overlapping 2D images has to be made. It is a set of point clouds in a set of coordinate system and usually defined by the x,y,z coordinates and represents the external surface of the object. Image directory will be selected to create point cloud generation.

- **Geo referencing**

After point cloud is generated, georeferenced point cloud is activated and data is georeferenced with the already created automated georef file in the project folder. It is done to match the point cloud data with the real world coordinates.

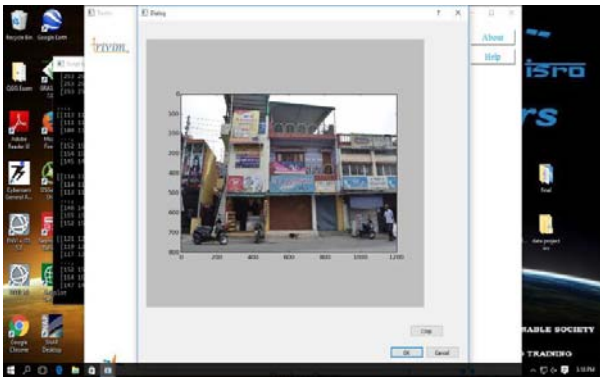
- **Image Segmentation**

It is used to capture the texture of various buildings.

Select particular images and crop the buildings of each floor and enter its attribute. This step is repeated for all the floors of the building and for all buildings in the data set.

Note: KML files of the all the buildings can be made using Google Earth as it will be required for the 3d generation at later stage.

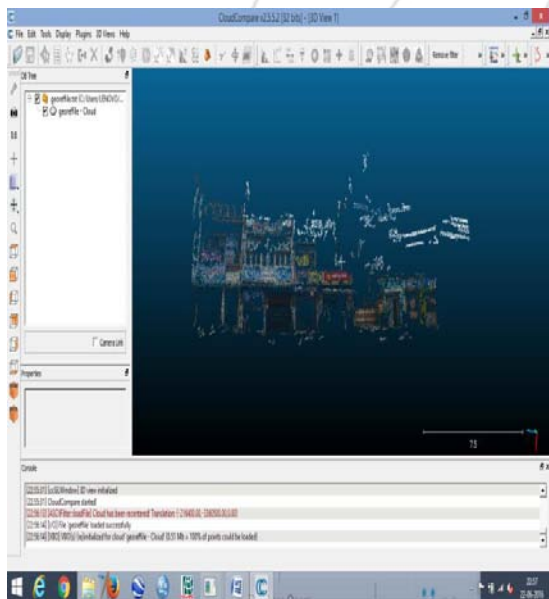
- **Select Image Segmentation**



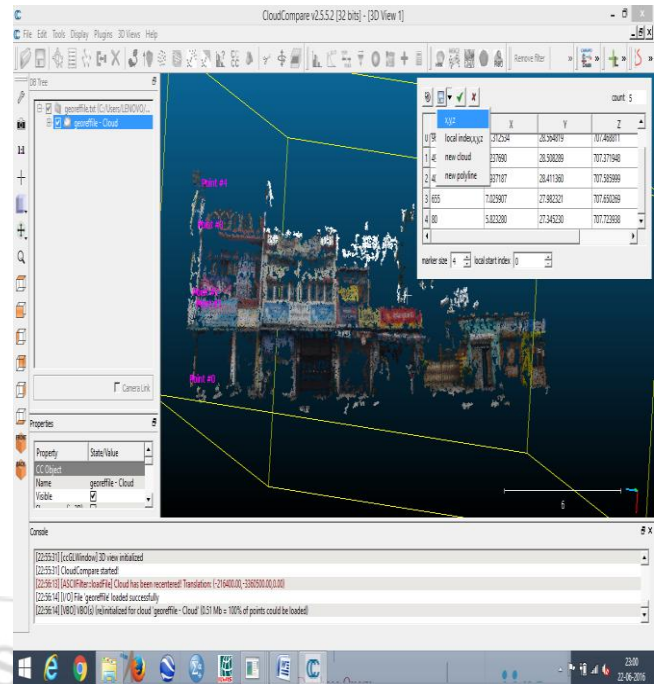
Crop the first floor in a building and name it and give name to the type of building and submit. Repeat this process for all the floors of a building and for all the buildings

• Height Extraction

This feature allows the user to create building segments to be used as units for database creation and query and enables auto measurement of real world heights of each building segment. Click on height extraction button and browse for the point cloud file present in the project folder and open point cloud. Open cloud compare application and click ok and yes to all buttons and it gives the cloud points and adjusts accordingly.



Pick two points for each floor for extracting height and save as x,y,z points in new height folder under the main project folder and save point. Repeat the same step for each building.



Close the cloud compare window and go back to same height extraction page. Select the extract height folder of current project and click ok.

• 3D model Generation

It Compiles the planimetry, elevation and attributes information related to the building segment and creates a 3D model with fine textures that is visualized on a web portal such as Google earth. Load the KML file and footprint of building one and load footprint for build2 and click the construct button.

• Database Query

In this stage, load the attribute that gives the name and area attribute. For asking a query, write the name of the building and it will give the result and save the result. Provides options for simple query related to the user defined database.

5. Conclusion

- 1) Trivim is open source software so can be accessed by anyone and at a same time user friendly. There is no need to run the lengthy process of installation and can be easily downloaded from IIRS official website.
- 2) It can be helpful in creating 3d street views without using any commercial software and can be helpful in various applications like surveying done by various government departments like taxation, municipal department as well as for primary surveys done during data collection by the students, during election for distribution of voter cards etc.
- 3) For using this software a high end geotagged camera is required which is costly. To keep in view the possible use for the students who cannot afford a costly camera, a mobile based app has also been designed by the IIRS, Dehradun.

References

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