

Research Article

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## Image Based 3D Modeling of Campus (Department of Civil Engineering, IIT Roorkee, Uttarakhand, India) by Using SketchUp

Surendra Pal Singh<sup>1</sup>, Kamal Jain<sup>1</sup> and V. Ravibabu Mandla<sup>2</sup>

<sup>1</sup>Geomatics Engineering Section, Department of Civil Engineering, Indian Institute of Technology, Roorkee, Uttarakhand, India

<sup>2</sup>Schools of Mechanical and Building Sciences, Vellore Institute of Technology (VIT) University, Vellore, Tamilnadu, India

Correspondence should be addressed to Surendra Pal Singh, surendra.geomatics@gmail.com

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**Abstract** Virtual 3D modeling is a very important and hot topic for researchers of Geomatics. For all over the world, so many educational institutes are available with its own campus. Campus is the land on which Institute; College or University buildings are situated. In the modern digital era, the demand of 3D Campus is increasing. Virtual 3D model of campus gives a good and photo-realistic appearance. In Geomatics market, So many image based techniques are available for 3D modeling. Photogrammetry and Laser scanning are the main Geomatics techniques. But due to many drawbacks in these techniques, a new approach is possible to make virtual 3D Campus. Time and Cost main key issue for this. In this paper, we are giving a simple and cheapest solution to create virtual 3D campus of any educational institute. This 3D campus model can be exported in various other formats for various applications. These 3D models can be exported to Google Earth. These 3D campus models can also be published on the website of that Institute or University. In this study, we used simple digital images and very cost effective software. This paper will describe the introduction, methodology, advantages, drawbacks and limitations of this method. In this study, we used the study area, Campus of Department of Civil Engineering, Indian Institute of Technology, Roorkee (Uttarakhand), India.

**Keywords** *Geomatics, Virtual Campus, 3D Modeling*

### 1. Introduction

Virtual 3D modeling is a very important and hot topic for researchers of Geomatics. 3D city models have evolved to important tools for urban decision processes and information system especially in planning, simulation, networks, and navigation (Markus and Jurgen, 2008). Educational Institute or University has its own campus. Campus is also an important indicator for the quality of Educational Institute. Campus is a land of College, Institute or University, on which the buildings are situated.

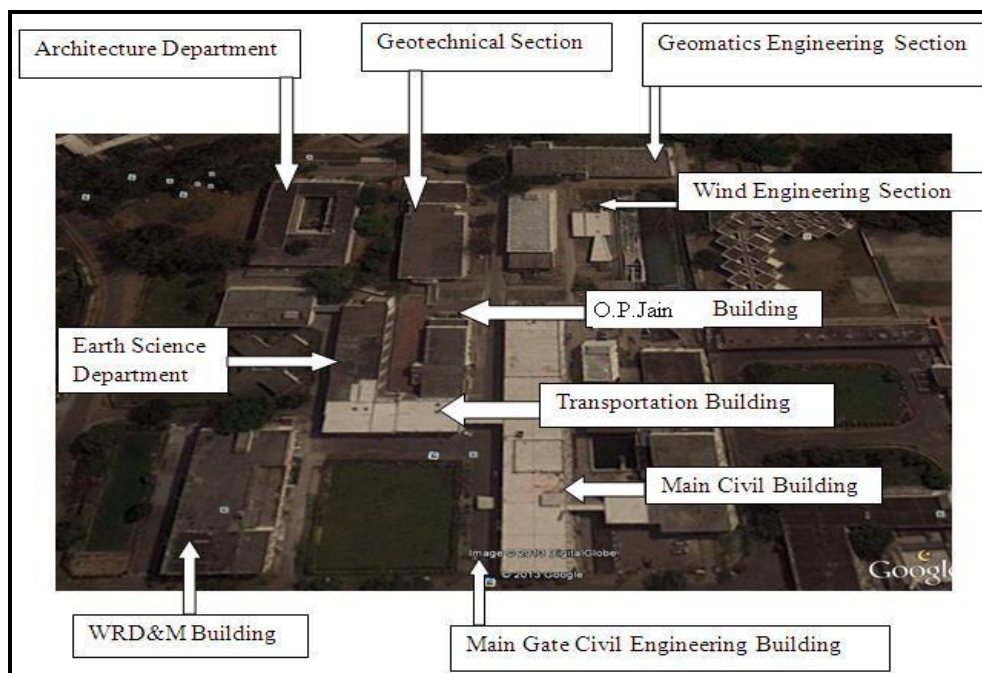
Usually campus includes the academic and non-academic buildings. In the modern digital era, the demand of 3D Campus is increasing. Virtual 3D model of campus gives a good and photo-realistic appearance. In Geomatics techniques, so many image based techniques are available for 3D building modeling. Each 3D modeling methods and techniques have some advantage and also some limitations (Singh *et al.*, 2013). Photogrammetry and Laser scanning are the main Geomatics techniques. In case of satellite and aerial images, the availability of the data could be a problem due to weather conditions or restrictions on flights (Fabio and Rizzi, 2010).

Close Range Photogrammetry is also a good tool to create Virtual 3D model of Campus (M.Shashi and Kamal Jain, 2007; Singh *et al.*, 2012), But due to many drawbacks in these techniques, a new approach is possible to make virtual 3D Campus. Cost and Time are main key issues for this. In this paper, we are giving a simple and cheapest solution to create virtual 3D campus of any educational institute. This 3D campus model can be exported in various other formats for various applications. This method and techniques will be very useful for the owner of College, Institute or University. By using this method they can make a virtual model of campus. These 3D campus models can also be published on the website of that Institute or University. The 3D Campus models can be used for simulation and analysis from visualization and animation (Emem, 2002b).

In this study, we used simple digital images and very cost effective SketchUp software. So the need of this kind of study is very important and useful for 3D modeling community.

## 2. Study Area

In this study, we used the area of Department of Civil Engineering, Indian Institute of Technology-Roorkee, Roorkee, (Uttarakhand) India. This department is the oldest and largest in India. It was Roorkee Civil Engineering College and established in November 25, 1847. In 1954, it renamed as Thomason College of Civil Engineering. It was University of Roorkee from 1948-2001. From 2001, it becomes seventh IIT as Indian Institute of Technology-Roorkee.



**Figure 1:** Department of Civil Engineering, IIT-Roorkee, India  
(Source: Google Earth, June, 2013)

The Civil Engineering Department surrounding by Department of Architecture, Department of Water Resources Development and Management (WRD&M), and has the following main sections and buildings: Geomatics Section Building, Geotechnical Section Building (having CAD Lab and Research Scholar Wing), Lecture Hall building (having Newton room and Reyleigh rooms), Wind Engineering Section, O.P. Jain auditorium building, Transportation building, Main Civil building, and Hydraulics building. The location of Departments of Civil Engineering is showing in Figure 1.

In this study, we make the 3D model of Department of Civil Engineering, Indian Institute of Technology, Roorkee, India. We make this department by using SketchUp; an image based 3D modeling software. Images are taken from a Sony Cyber-shot DSC HX7V digital camera.

### 3. Image Based Modeling by Using SketchUp

Earlier, SketchUp was the product of Google, now it is product of Trimble. It is a 3D modeling software. It works on the sketch-based modeling approach. It supports 2D and 3D model export functions among other features.

In recently, its latest commercial version is SketchUp Pro 2013, (earlier it was SketchUp Pro 8), a free version is also available with name as SketchUp make, that integrates with Google Earth. The model can be exported to Google's "3D Warehouse", to share these 3D models to anybody. These models are useful for the various ranges of applications such as Architectural, Civil Engineering, Mechanical, and Film & Game industry.

The SketchUp (free version) have the capability to export the models in .kmz, while the SketchUp Pro version can export these models to .3ds, .wrl, .xsi, .dwg, .dxf, .fbx, and .obj file formats.

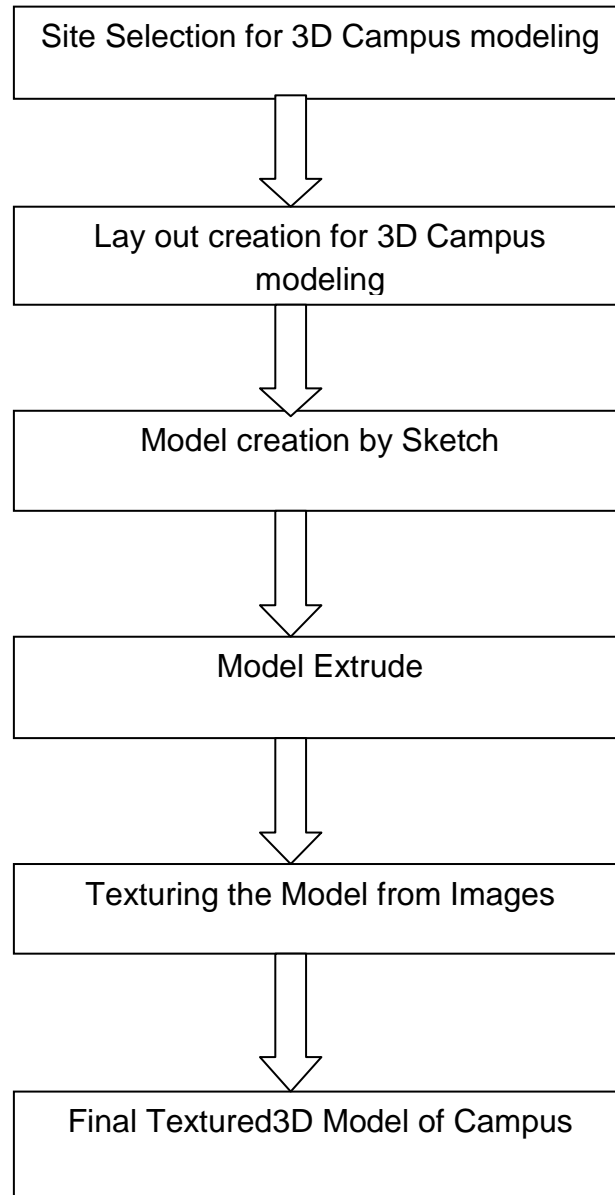
### 4. Main Features of SketchUp

Following are the main features in SketchUp:

- a) We can draw, modify, measure, rotate, scale and move geometry.
- b) We can add and use accurate dimensions of buildings.
- c) Interiors of building can also be seen in slice view.
- d) We can add pre-made texture and can also add new texture.
- e) We can add pre-made element of a city like tree, car, doors, window and people or we can also add new elements of city.
- f) Walk through model also possible, and we can produce a movie of that area also.
- g) It can take 2D images in .JPG, .PNG, .TIF, .TGA, .BMP formats.
- h) It can import 3D model from .SKP (from SketchUp), Google Earth Terrain, .3Ds, .DEM.
- i) We can make and export the animation and walk-through as MOV or AVI files.
- j) We can make Geo-located models and placed them in Google Earth.
- k) We can export a Google earth file directly in KMZ format.
- l) We can also create add-on programs using the Ruby programming language.

### 5. Methodology

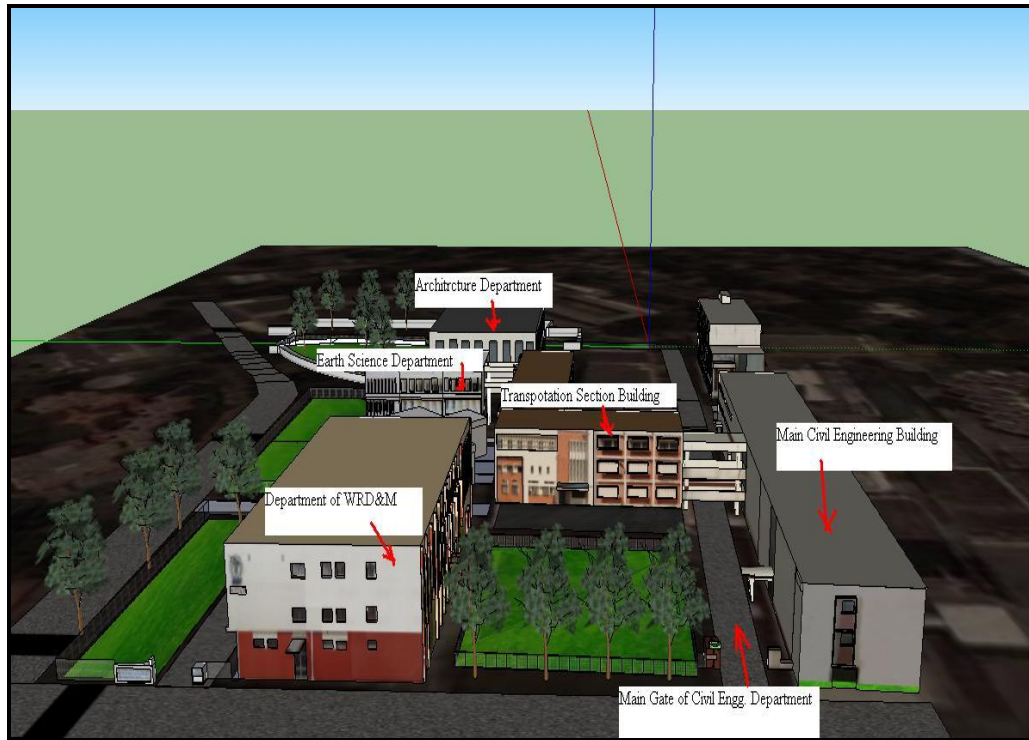
Firstly, we select the desired location of an area from Google Earth for 3D Modeling. Then we sketch the model and extrude the model. At the last, we give the texture from images. Overall method can be shown in given fellow diagram:



**Figure 2:** Flow Diagram of Methodology

In the First step, we select and choose the desired campus of Department of Civil Engineering, Indian Institute of Technology, Roorkee, India, an educational institute from Google Earth. After this, export this campus area in SketchUp. Then we choose and select the desired Buildings of institute. For Department of Civil Engineering, we choose the Transportation section Building, Civil Engineering main gate and main building, O.P. Jain Auditorium building, Geotechnical building, Lecture hall building, Geomatics Section building. We also make the surrounding department of near Civil Engineering Department such as Department of Water Resources & Management (WRD&M), Department of Earth Science, and Department of Architecture.

In Figure 3, and Figure 4, showing the final textured 3D model of Department of Civil Engineering, IIT-Roorkee, by using SketchUp software.



**Figure 3:** 3D model of Civil Engineering Department, IIT-Roorkee (India) by using SketchUp



**Figure 4:** Another View of 3D model of Department of Civil Engineering, IIT-Roorkee, India



## 6. Main Advantages

Following are the main advantages of this SketchUp Software:

- This software is very simple and easy to use.
- Less trained person can also make the 3D model by using this software.
- It is very cost effective solution to create 3D City model.
- Dimensions of buildings can also be added.
- External city elements can also be added.

## 7. Limitations

Following are the main limitation for this method:

- Its textured quality is not very much advanced.
- The quality of model is not also very high level.
- Its accuracy depends on external dimension measurements.
- The quality of external city elements (like Tree, Bus) is also not good.
- Roof texture is also not accurate.

## 8. Results and Discussion

With the help of this work, we obtained a 3D model of campus i.e. Department of Civil Engineering, Indian Institute of Technology, Roorkee, India. This model is very basic and textured model. Street texture and Road texture is showing very well but roof texture is not correct. It is due to the unavailability of roof images from camera. In this 3D model other city elements such as Tree and Car (Vehicles) are also not showing properly. Texturing and modeling is not very easy for these elements.

This model has good 3D visualization and useful for 3D simulation and modeling of IIT-Roorkee campus. This model can be exported in various formats for various applications like Multimedia. This 3D model is also useful for Navigation. It can be published on website of Institute.

## 9. Conclusion

Normally, 3D modeling of any campus is very important. Various techniques and methods are available for 3D campus modeling. Each 3D modeling methods and techniques have some advantage and also some limitations. Some techniques are very costly and not very easy to make the 3D Campus. Satellite and aerial images is not easily available due to weather conditions or restrictions on flights. Satellite Images and Aerial Images are very costly and not easy to obtain for a simple institute. Normal and simple institute cannot afford these costly techniques. So this 3D modeling method gives a very low cost and effective solution for Virtual 3D modeling for a campus or university or institute.

Dimensional analysis is also possible in this method. We can find measured input values of the dimensions of buildings. It is very easy to use and also gives good photo-realistic look. Texture quality depends on camera quality. High resolution gives better textured model.

The main aim of this paper was to provide a very simple and cost effective method for 3D modeling user community to create Virtual 3D model of a Campus or Institute or University. The 3D Campus models can be published on website of Institute or University to attract the visitors for simulation and analysis from visualization and animation.

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