TECHNISCHE UNIVERSITÄT DRESDEN
Institut für Kartographie

On the Use of Adaptive Sketch Textures in a 3D Model of a Townscape

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Motivation

Lanscape visualisations have gained great popularity through the past years. A breakthrough in the 3D concept concept has also reached cartography. This leads to a considerable advance in techniques to upgrade from 2D information into 3D or 2 1/2D with fairly little interaction (Prechtel, 2015).

The challenge for a sketch-like visualisation is to create reality in the mind of the observer without applying realistic techniques. Such representations have the potential to make graphics clear and comprehensible (Jahnke, 2013). NPR 3D visualisations are characterised by a low sensibility of the stylised textures to heavy downsizing. If well chosen they will still preserve the essentials of architectural design that can be compared to the current state of the exterior (Prechtel, 2016).

Whilst the use of photorealistic techniques in many navigation systems and 3D web visualisations is mainly applied to facilitate the mental mapping between the digital visualisation and the reality, the application of sketch-based techniques, as one mode of digital NPR visualisation, is intended to help the user to carry out specific task more effectively (Semmo, 2016). Furthermore, the downsizing of the information in the image will speed up the rendering in a web-based environment.

NPR techniques could be applicable in emergency assistance, urban planning, 3D cadastre, navigation, tourist information, planning evacuation, and disaster management (Biljecki et al., 2015). Likewise, they can form a virtual environment in games. Furthermore, they may transfer object information without obvious visual equivalent, as shown for a structured model of an university environment (Prechtel, 2016).

Methodology

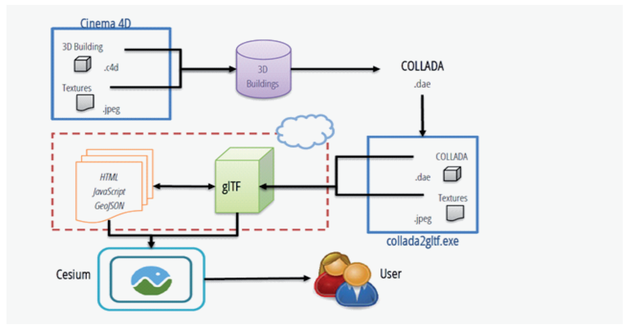


Figure 1. General workflow for the web-based application for the project.

1. Data preparation: This process covers the design of the 3D features in the scene, style transformation techniques and transformation into glTF format.

Figure 2. Area of study: Technische Universität Dresden (Aerial image from Google).

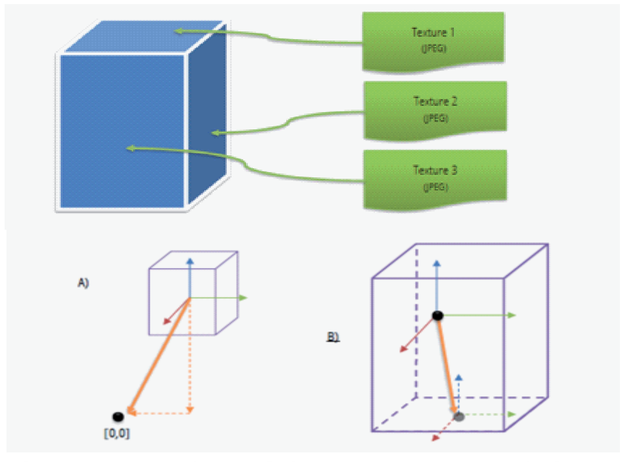


Figure 3. Binding of the textures to each façade of the buildings. A) Translation of the object to the project origin, B) anchor point is set in the centroid projected to the lowest level of the object (Cinema 4D).

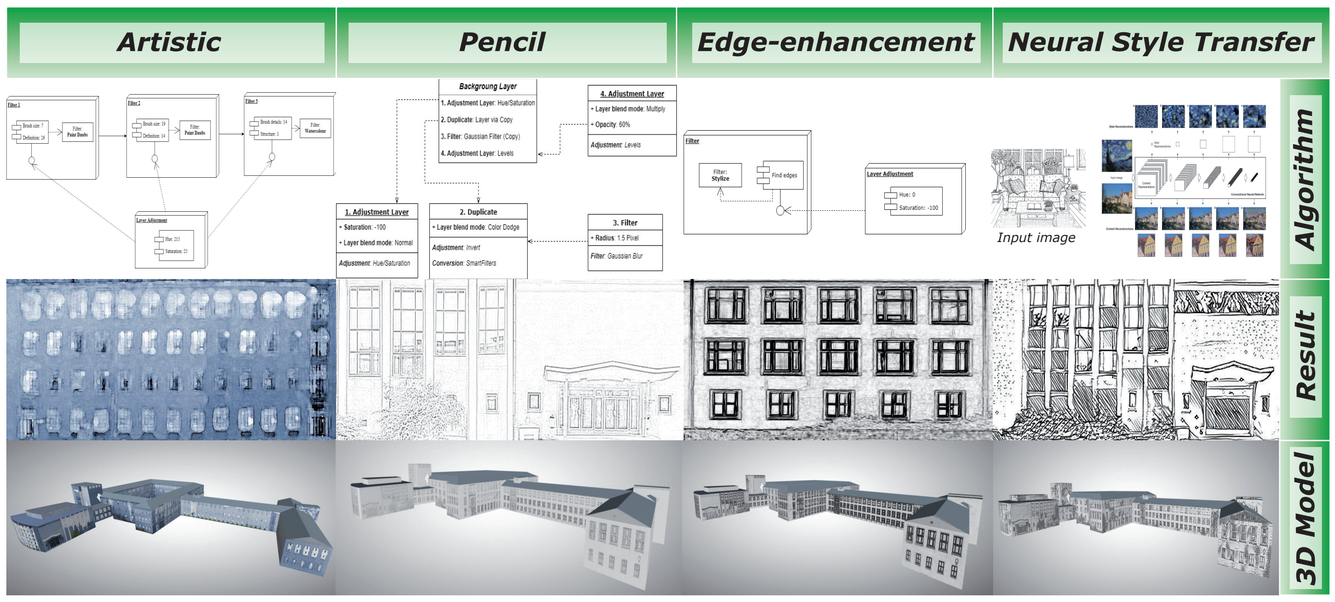


Figure 4. Scheme for texture styles in the 3D models. **Artistic**: style is based on a watercolour simulation design. **Pencil**: visual effect of a pencil drawing. **Edge-enhacement**: gradient-based edge detection. **NST**: transfer tof texture from source to target image by separation of semantic content and stylistic content. Style will be adapted from a selected sample (Image Representation in a Convolutional Neural Network Gatys et al., 2016, input image style: showcase.deeparteffects.com).

COLLADA and glTF

Cesium accepts different input 3D sources; its native and efficient format is glTF but KML and COLLADA can be integrated as well.

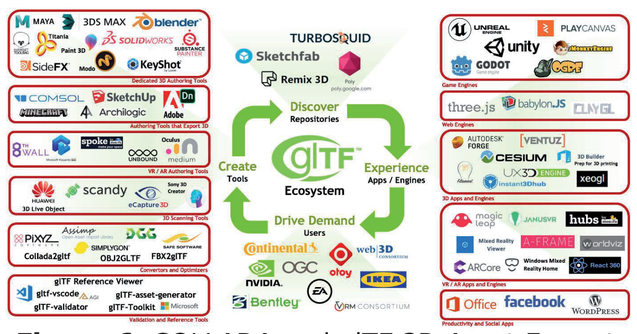
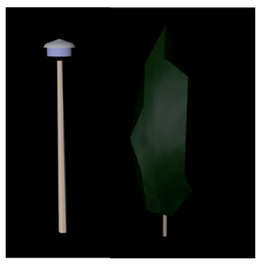


Figure 6. COLLADA and glTF 3D Asset Formats (https://www.khronos.org/gltf/).

2. Implementation and Visualization: Visualisation makes use of a Virtual Globe (CESIUM). It can dynamically be modified from a menu placed at the corner of the viewer. Data loading is executed in a For-Loop by accessing the glTF files and associating their names to the corresponding coordinates. As a complementary part of the scene, additional features as trees and streetlights can be added to the scene. An augmentation by further objects of interest (e.g. bicycle stands) is possible.



The following information describes the setup framework and the initial parameters.

Parameter	Property	Value
Initial Position	Latitude	51.0215°
	Longitude	13.72055556°
	Height	200 m
Initial Orientation	Heading	25°
	Pitch	-13°
	Roll	0°

Figure 5. Initial setup Cesium https://cintymd.github.io/

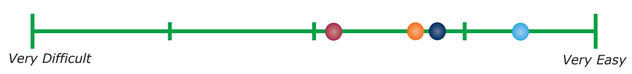
3. Evaluation: 10 participants a) completed a background questionnaire, b) performed tasks within the digital model, c) gave insight in their perception of the different texture styles, and d) gave ideas on sensible additional contents of the model.

#	Task
1	Find the provided information using all the tools in the App
2	Find the provided information using the "Artistic" and "Pencil" styles
3	Find the provided information using the "Edge Enhancement" and "CNN" style
4	Infer information from the 3D models using all the tools in the App

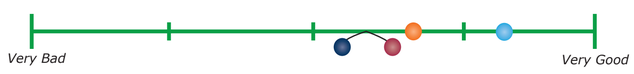
After completing all the tasks, the user's evaluations for the different styles is the following:

Usefulness to carry out the tasks

Difficulty to identify elements



Communication of information



Aesthetic design

- Artistic
- Neural Style Transfer
- Edge-enhanced
- Pencil-based

Conclusion and Future work

We have devised a methodology which supports the creation of NPR based on Cesium as a virtual globe. Additionally, we have provided further options of a composition of virtual environments by optionally combining non-photorealistic building models and trees, streetlamps and object wireframes.

A number of important limitations needs to be considered. First, the current study has only examined the operation of 3D models in a relatively small campus area. Second, the scope of this study was limited in terms of cartographic design examples and optional information supplements (e.g. filtering, mapping symbolisation, transparencies and colour schemes). Third, the number of participants in the evaluation is small.

It would be interesting to assess the different perception of the user when applying more design techniques, developing the monochrome sketch approach from this work and to compare experiences of individuals of different age and background. This would contribute to an optimised offer of a versatile 3D model.

References

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