3D augmented reality for improving social acceptance and public participation of wind farms

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Introduction

Public perception of the impact of wind turbines on the landscape is crucial for their acceptance. Concerning the visual assessment of wind farms, a critical gap lies in effective visualization tools to improve the public perception of alternative wind turbines layouts. The local participation with respect to the installation of wind turbines has been investigated in the last decades (Devine-Wright 2005; Wolsink 2007) showing that the acceptance is influenced by the perception of the landscape and the value given to the aesthetic impact on the environment. In addition, according to previous work, the social acceptance is a key aspect for a successful market development (Hall et al. 2013; Pepermans and Loots 2013) and stakeholders admit the lack of usuful instruments to support social acceptance (Huber and Horbaty 2012; Pierre and Christine 2009). The technological advances in digital landscape visualization techniques allow using digital 3D visualizations for landscape design, planning and management (Lange 2011). In this paper, we describe the advantages of a 3D dynamical and interactive visualization platform for an augmented reality to support wind energy planners to enhance the social acceptance of new energy projects.

Approach

The layout of wind turbines is optimized in order to maximize the economic profit using different IT solutions based on CFD but neglecting the analysis of their visual impact. Often visual assessments are carried out by superimposing wind turbines on fixed images taken from few viewpoints limiting thus a full perspective of the whole landscape. The developed platform uses, first, GIS data and geoprocessing to identify suitable locations of wind turbines far from natural and anthropological constraints (Figure 1). The suitable regions are identified by using a multi-criteria decision analysis (MCDA) which classifies areas using a matrix of weights corresponding to the land suitability. These weights are set by planners based on their experience and by experts' opinions. Then, the obtained suitable regions are integrated into a 3D visualization (web)platform that allows to place 3D wind turbines models in the allowed areas. A user can navigate through a given project using customized functions in order to get an augmented and more realistic perception of the impact of wind turbines on the landscape. The user can both simulate a walk at the ground level and fly over the project region to gain a personal perspective. The interactivity feature of the platform allows modifying the positions of wind turbines within the allowed areas.

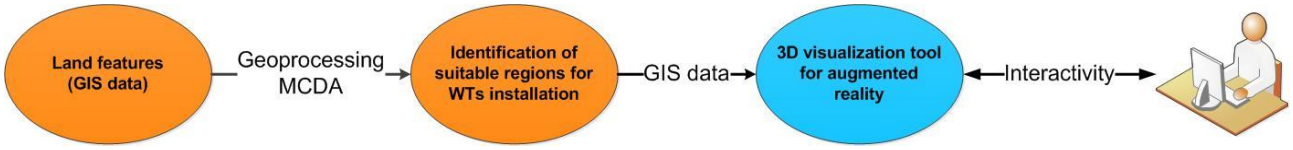

Figure 1: geoprocessing of the developed platform for an augmented 3D interactive visualization of wind turbines

Main body of abstract

The values of the landscape threaten by massive infrastructures such as wind turbines are a typical reason raising local protests and opposition. This reasonable concern of local population stems from both a lack of knowledge of wind turbines technology and the lack of efficient form of communication and visualization allowing one to get a visual interactive experience of how a project will look like. The superimposition of fixed images from few viewpoints is a great limitation when showing new wind farm projects since it does not show their impact from different perspectives. Since the local population is familiar with their landscape and has a high consideration of the landscape and natural values as part of their welfare, they look at the wind turbines as a thread for their wellbeing. Any sort of environment and landscape can be reproduced with high resolution and fidelity (Figure 2). Additional features of the 3D visualization are the shadowing and flickering of the tower and the blades of wind turbines depending on the position of the sun and the simulation of the different weather conditions.

Figure 2

The flexibility of the 3D interactive platform allows integrating functionalities useful for wind farm planners in order to obtain and quick overview and visualization of a wind energy layout. The platform is useful to enhance the communication with the local population and to identify critical aspect of a wind farm layout (e.g. wind turbines position not accepted by the population). Previous work demonstrated how a 3D dynamic visualization can support users in better understanding the impact of wind turbines on the landscape (Manyoky et al. 2015). The platform can be also used as a useful tool for public participation by integrating and exchanging comments and feedback between all stakeholders involved in the projects. Suitable locations for wind turbines can be graded depending on the individual perspective and finally ranked based on their suitability.

Conclusions

The social acceptance of wind energy projects can be improved by using 3D interactive visualization platform which allows a user to navigate through a more realistic representation of the landscape. The 3D platform realistically reproduces 3-dimensional objects of the environment using GIS data and high-resolution satellite images. It helps users to experience the visual impact of wind energy projects from different viewpoints and to have a better understanding and perspective of the impact of wind farm projects on the landscape. The developed platform can be applied to any region and for any wind farm size, layout and wind turbine model.

The adopted process overcomes the limitations of fixed images usually used to reproduce the visual impact from a limited number of viewpoints. The flexibility of the platform allows integrating also assessments of visual impact of other elements of wind energy projects such as transmission line interconnection.

Learning objectives

Augmented reality of wind turbines in the landscape by using 3D visualization platforms.
Enhancement of social acceptance of wind energy projects by enabling local population and stakeholders to experience a more realistic navigation through the wind turbines.
Improvement of public participation and support to decision makers

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