

# Game engines in urban planning

## Visual and sound representations in public space

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### Introduction

New tools and techniques for the creation of virtual urban environments are increasingly used in various stages of urban planning. The continuous improvement of the informatics, in terms of calculation capability, ease of use and accessibility of the hardware, enables to integrate into the planning process tools that few years ago were available for technicians only. In the last few years a sort of pitch invasion of technologies, in the field of computer graphics, has been noticed: software commonly used for developing videogames, called game engines, are increasingly used also in various disciplines not closely related to a playful attitude. This has been made possible for different reasons: the increase of ease of use, the more realistic renders of the graphics engine, the improved interoperability among the software, the affordability of the products; all these key factors allow us to conduct different workflows that, refined in further steps, enable innovative processes for planning and evaluating urban design projects.

The research fields, where the game engine can be used, are numerous: simulations in a hazardous situation that cannot be reproduced in a real environment without risk for users, such as in nuclear power plants [1] or for virtual fire drill [8], similar tools are used also for military simulators to recruitment and training. Another application of this product is to improve the sightseeing of archeology sites, sometimes inaccessible, or to provide the opportunity to different types of users to benefit for art collections and virtual museums [10].

In the field of architectural and urban planning, game engines can improve the interactive visualization of the proposed project, in comparison to other simulation products e.g. map, video animation or photomontage. This software enables the user to move without constraints in the virtual urban environment in order to evaluate the impact of design solutions from different points of view [6]. Moreover, it can introduce other sensorial stimuli, like the sound environment that is rarely considered in urban planning simulation [2]; it also provides real-time tools to visualize other environmental factors [5], and enriches the simulation with dynamic aspects, e.g. vehicular traffic. It is possible to develop a product which, by the side of the designer, allows a more complete analysis of the urban environment by providing a virtual reality tool for the evaluation of different design solutions and, on the side of the municipality and users, an alternative way to display images and video in which the viewpoint is not predetermined by the designer. Finally,

extending its features, the game engine can be used not only to evaluate design projects but also as a design tool [7, 6, 11], and can be enriched with multiuser features, commonly present in this kind of software, in order to allow user participation in the design process [4, 3].

### **The choice of the game engine**

Nowadays there are manifold products, each one with specific characteristics, strengths and weaknesses. The software was chosen taking into account a set of elements relevant for our purpose:

- usability and user friendly interface;
- import of readymade models;
- rapid import of materials and textures;
- customizing the point of view from the camera;
- advanced solar simulation;
- ability to integrate other elements of perception, in particular, support for sound elements;
- export to different platforms and scalable graphics performance.

After this review, we choose to use Unity3D because it presents a user-interface similar to many commonly used modeling programs; it allows us to import sound and readymade digital models, complete with textures, materials and animations in various formats; it includes an internal tool for creating the vegetation. Furthermore, it allows us to manage and change the point of view and finally allows a high customization thanks to the ability to use different types of programming languages (C #, boo, javascript).

### **Aims**

The aim of the project is to investigate the use of game engine as a tool for urban planning practice, in particular, considering the perception of the urban environment as a set of different sensory spheres, how soundscape and visualscape of a public urban space can be played in a dynamic and interactive virtual environment. It is of primary importance to develop a robust workflow from the beginning of the process, in order to avoid time-consuming operations [9, 12]. The first step is to develop the three-dimensional model of the case study area, enriched with the real texture of buildings and materials that compose the urban open space. The selected site is a park of a university campus. This area is used by students and residents as a place for resting and recreation. The site is rectangular in shape, bordered to north and south by the urban fabric, to west with a crowded street and to east with the tramway.

The model contains elements of vegetation, different kinds of urban furniture and the dynamic elements of the vehicular traffic. The model thus created is then imported into Unity3D.

At the same time investigations are carried out on the sound sources that characterize the park. The sonic landscape is various, there is noise (traffic) that

limits resting, interspersed with positive elements (fountains) that help to increase environmental comfort. The different sounds recorded are then connected to the virtual objects in the game engine. The product provides other two additional tools that are programmed in javascript: the first tool can hide/show different design solutions, or urban furniture, in real time, and the second tool allows a preliminary study for shadowing conditions, changing the position of the sun for equinox and solstice. These action can be activated using an on-screen menu.

## **Conclusion and Future works**

This work presents an investigation of the possible use of game engines for urban design simulation and evaluation purposes. The possibility to create a virtual urban environment enriched not only with visual elements but also with the sound component, and the possibility to interact and visualize in real time the impact of new project proposals, provides a useful communication tool for non-experts. On the other side, concerning ease of use, this product can be employed as an educational tool to illustrate the characteristics and dynamics of the visual impact and the urban soundscape.

Nowadays this software has a weak user interface, which was developed for videogames and constitutes a hindrance in the usability of the product for a large part of users. Regarding visual perception, the display system, currently a monitor, should move to the stereoscopic vision in order to increase the immersivity in virtual environments. Finally, it would be useful to investigate the possibility to integrate a GIS database in real-time with game engine for providing a richer information into an interactive virtual environment.

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