Large Scale Interactive Modeling in Rural Areas

Establishing Immediate Designs Using Techniques of Mixed Realitiy

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ABSTRACT
The development of tools for large scale designs in an outdoor environment is based on time, mobility and quality. In a digital workflow only mobile devices with all their inbuilt sensors and techniques adapted from Mixed- and Augmented Reality systems possess the technical capabilities to deliver feasible and practical results.

KEYWORDS: Augmented Reality, Modeling, Composite Images, Interactive Design

Introduction

The necessary undertaking to plan and design buildings in rural and remote areas is always a demanding task. The lack of infrastructure does not only hamper all kind of projects, it also prevents the development of a functional infrastructure itself. In addition the eventual absence of topological data or the lack of accuracy can be a significant shortcoming.

From the beginning the planning and development of large scale buildings seems almost impossible, while in fact insufficient data is the main source of uncertainty and hence delays. Important decisions of the design might be postponed or reversed because of the lack of informations.

This observation is based on the assumption, that the construction's site and the the office's space, the location, where the construction really is planned, are not the same. In this common scenario all informations must be collected on the construction's site and then transferred to and stored at the planning's site, an office's space.

On-site computational Design

The introduction of GPS (Global Positioning System) and the general improvement of computation now offers the integration of two steps of the computer aided design process: the early designs like sketches and some of the survey of the land.

Initial designs

In architecture concrete sketches were always and by some still are a good medium to estimate the initial proportion of a design. With the introduction of computational design this has changed. Hand-drawn sketches are not well integrated into the all-digital workflow of common CAD-software. Instead to overcome this problem by integrating this practice new generic forms of design have emerged. Such concepts should automatically establish designs based on self-organisation or morphogenesis. In other words, a new pattern is supposed to fill the gap.

On theother hand creating a design with digital instruments is easier than ever by using the new mobile devices (Pintaric et al 2005). With advancement like

new forms of the UI-design, especially the complex multi-point gestures on a touch screen, and overall enhancements in portability the question is not anymore if, but how classical CAD can be transformed into mobile CAD. There is no answer yet, as CAD is still bound to desktop computing.

Topographical Data

Data from the building's site is a fundamental information for the planning. Usually this data is retrieved from external sources beforehand, usually either from public sources or official institution. In particular those sources are slim at the best, if it comes to rural and remote places.

With the improvements of the GPS service now a decent accuracy all over the Earth is provided. Especially the shutdown of the 'selective availability' in 2000 opened the chance to use GPS-devices as new instruments of planning and designing.

Though the usage of such a ubiquitous system can not substitute a thorough survey, it provides some means to immediately grab accurate positions by just passing by. If there isn't any topographical data or the informations are outdated, this is a more than convenient method.

Already in digital form some basic data processing may provide the just needed informations.

Strategies of Initial Design

Integrating an initial design into the all digital workflow of computational design is a crucial point. In general two practical techniques have emerged: digitizing and generic design. Both are not really well integrated. While digitizing implies an external source, generic designs have only little flexibility and somehow are limited to create a real initiate design or an innovative first draft.

Immediate design

An important aspect of any creative process is direct feedback. Sketches or drafts facilitate immediate results. In a classical workflow they are both ready for communication and further development.

In a digital workflow only few other forms of immediate designs have been emerged, and only sketching boards with implicit digitization have prevailed. In an outdoor environment access to important data becomes an additional obstacle.

This might change in the future, as our project will demonstrate (Lonsing 2009), but not yet.

Composite Images

Making decisions about a project in its early stage without a fair knowledge about its surrounding is an almost impossible task. A common digital workflow demands a digital model, detailed and large enough to cover all of its surrounding, a complete virtual environment model, to display the virtual design therein.

Figure 01

It seems like this is by default, but not necessarily. Once the virtual environment model is abdicated, and instead the site itself is explored and viewed from different locations, other methods come into mind.

One straightforward technique would be the composition of images from the real world and overlaid drawings of virtual models, as it is known from AR (Augmented Reality) or MR (Mixed Reality). Some closer looks into the underlying techniques reveal some obstacles (Anders, 1999).

Technologie of MR and AR

Mixed Reality systems are, based on their underlying technology, divided into tracking-based and marker-based systems (Avery et al. 2008). Tracking based systems are, as all sensors and capabilities are integrated into one device, relatively self-sufficient. Sensors and processors being integrated within one device, the quality of tracking-based systems is often wanting. Synchronizing the views of both actual and virtual cameras is of mandatory, and there is no mediating reference within the image it-self. Also the overlay image is sometimes jagged with respect to the actual camera image.

Tracking-based MR- or AR-applications utilized for outdoor tasks like the mobile AR-apps are insufficient regarding their synchronization capabilities. They are not suitable for a real three-dimensional experience (Piekarski 1999).

On the other hand marker-based AR-systems are known for their quality images. The perfect synchronization

between real-world images and virtual models, based on image processing is no issue at all. However they are bound to specific locations by the several markers needed to calibrate the image capturing device. In practice it limits the size of a marker, usually made from cardboard, to the size of a letter, and thus allows rather small scene, likely something on a tabletop or in an assigned studio.

Both AR systems are not really ideal for a real outdoor AR-experience. (Schall et al.).

Concept

The proposed systems is using a special marker set-up (Lonsing 2007). Instead of using elaborate images with a multitude of recognizable points the marker itself is tracked and only one single feature is remotely sensed and measured from direct viewing. This feature is the diameter of a sphere, as this value is constant from all viewing directions. In the real world it will be a an inflatable and deployable captured ballon.

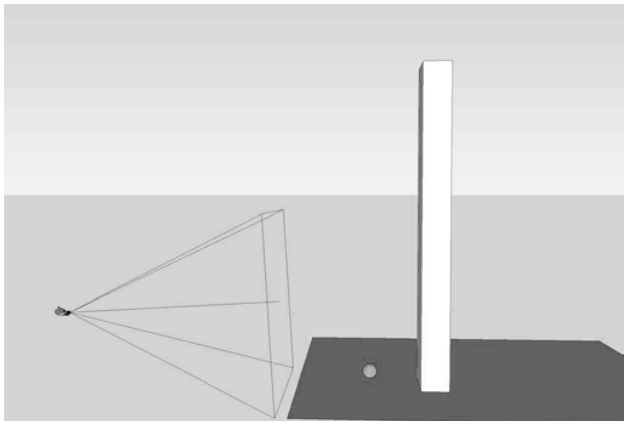

Figure 02

Enhancing this special technology the system also permits the usage of cameras with a flexible focal length, an important feature in an uncontrolled outdoor environment.

Modeler

What is still missing is software to create realistic three-dimensional shapes. The available software kits, in most cases based on present-state gaming-engines, are not really adequate for architecture.

As consequence an interactive modeler is developed (Anders and Lonsing, 2005). Almost from scratch and based on simple geometrical shapes it transforms gestures or line graphics into two-dimensional figures and then into simple three-dimensional euclidean shapes. This approach is sufficient for the desired immediate on-site designs and discussions about it. The shapes can be transformed with simple gestures like pinching for sizing or panning for moving. By now no CAD-program is migrated to mobile devices.

On the mobile devices with one or possibly more views from different directions composite images are displayed to show the design in its context in real time.

Prototype

The current prototype is the first implementation of our system on mobile devices. The prototype, still under development, on a mobile platform with interactive modeler and locative technologies shows some possible future directions for augmenting the design process and opens up new forms of the appreciation of unbuild architecture (Lonsing 2009).

Although the objects itself are not real, the distance between them and an observer carrying the mobile device is. The same is valid for the dimensions of the virtual structures. Instead of creating a complex surrounding model from different sources, and maybe the explicit collection of data on the site, the site itself becomes a 1:1 model.

In remote and rural areas this allows not only for simple and easy visualizations, but also for rapid modeling and hence spontaneous designs.

Conclusion

However, the development of systems of MR and AR are still driven by technology, as the introduction of the new generation of smart phones did demonstrate. In general most mobile devices, smart phones, or tablet computers are very flexible and computationally up to the task. This led to a wealth of halfway useful applications based on mapping tools, collective database or social networks, although the research is still mainly focused on how to overcome hard- and software issues. There is no reason to assume that in an all-digital workflow three-dimensional modeling or CAD are secondary steps after initial sketches are performed.

Existing modeling applications are still bound to desktop computers and tabletops. With techniques like real-time compositing and live-video streams some modeling programs are under development to play with virtual models on a real desk. These are typical marker-based MR-applications.

By contrast, the simple combination of CAD and GPS, a prerequisite of all outdoor systems and typical on mobile devices, is not a serious alternative. Without some means of registration and/or image processing it can just not work.

Therefor a marker with a single feature as inflatable marker ball was introduce and did provide significant enhancements. The first prototype on regular computers

has already shown some results.

Figure 03

Outlook

In favor of integrating conservative techniques like sketching and drawing on paper the chances of the post-desktop are to be used. The long standing concepts and methods to create an architectural should not be neglected. The new mobile devices offer all necessary capacity to initiate and develop an architectural design in almost any environment.

Besides its limitations the actual system still under development gives a sense of the system's potential and capabilities, as it propose interactive modeling on mobile devices.

The launch of a large-scale project can then be considered as an instrument as part of an underlying planning and development strategy. The only missing link is a decent modeler and a wish to leave the cozy office.

Only if the usage of the technologies inherent to the new generation of smart phones is regarded as a real task, not as a simple toy for socializing or tool for gaming, and will go beyond simple tagging and three-dimensional modeling, the large scale virtual models can be developed in an interactive fashion in all environments.

References

Anders, Peter and Lonsing, Werner: 2005, AmbiViewer: A Tool for Creating Architectural Mixed Reality, 292-299, ACSA 2005 Mexico, also: 104-113, ACADIA, Savannah, GA 2005

Anders, Peter:, Designing Mixed Reality: Principles, Projects and Practice. 276-283 ACADIA. Halifax, Nova Scotia, 2007.8

Anders, Peter: Envisioning Cyberspace, New York 1999

Lonsing, Werner: A Mixed-Reality-System for non-destructive Reconstructions, 71-81, DACH 2007, Tainan, Taiwan 2007.4

Lonsing, W.:, Composite Images on Mobile Devices Augmenting Reality in an Outdoor Environment, 270-272, ACADIA. Chicago, IL, 2009

Pierkarski, W., Gunther, B. and Thomas, B.: Integrating Virtual and Augmented Realities in an Outdoor Application, 45-54, IWAR, IEEE, Washington DC, 1999

Pintaric, T., Wagner, D., Ledermann, F. and Schmalstieg, D.: Towards Massively Multi-User Augmented Reality on Handheld Devices. PERVASIVE 2005, Munich 2005

Thomas, B. H., Piekarski, W. and B. Gunther: Using Augmented Reality to Visualise Architecture Designs in an Outdoor Environment; DCNET 1999, Sydney, Australia 1999

Schall, G., Wagner, D., Reitmayr, G., Taichmann, E., Wieser, M., Schmalstieg, D. and B. Hofmann-Wellenhof: Global Pose Estimation using Multi-Sensor Fusion for Outdoor Augmented Reality. ISMAR, Orlando, FL 2009.21