

[Demo] On-Site Augmented Collaborative Architecture Visualization

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ABSTRACT

The early design phase for a new building is a crucial stage in the design process of architects. It has to be ensured that the building fits into the future environment. The Collaborative Design Platform targets this issue by integrating modern digital means with well known traditional concepts. Well-used styrofoam blocks are still cut by hand but are now tracked, placed and visualized in 3D by use of a tabletop platform and a TV screen showing an arbitrary view of the scenery.

With this demonstration, we get one step further and provide an interactive visualization at the proposed building site, further enhancing collaboration between different audiences. Mobile phones and tablet devices are used to visualize marker-less registered virtual building structures and immediately show changes made to the models in the Collaborative Design laboratory. This way, architects can get a direct impression about how a building will integrate within the environment and residents can get an early impression about future plans.

Index Terms: H.5.m [Information interfaces and presentation]: Miscellaneous

1 INTRODUCTION

The Collaborative Design Platform (CDP [2]) is an interdisciplinary research project which combines analog means of architectural design with modern digital techniques. The CDP supports early design phases in which the outer shape of a new building is planned and its integration into the environment is estimated. Physical models can be placed on a digital map of an interactive tabletop and can then be extended by virtual information and computer simulations. The automatic digitization of the models and the insertion into a three-dimensional city model results in an easier to comprehend picture of how a new building impacts on the already existing environment. To yield more personalized views, a virtual camera can be placed in the environment to view the new scenery from different perspectives on a large TV screen (see Fig. 1).

Since the impression remains to experts working at the CDP tabletop, it should be possible to observe designed buildings in full-size at their planned locations via a mobile application. As to that, the intention was to use Augmented Reality methods for on-site visualization. With our smartphone application, it is now possible to get an impression on how the virtual buildings of the tabletop look like in the physical world. Purposing the data transfer between the CDP tabletop and the mobile device, an existing network protocol (the CDP Protocol) has been adapted and extended to serve the demand for data transfer to mobile devices. This protocol also

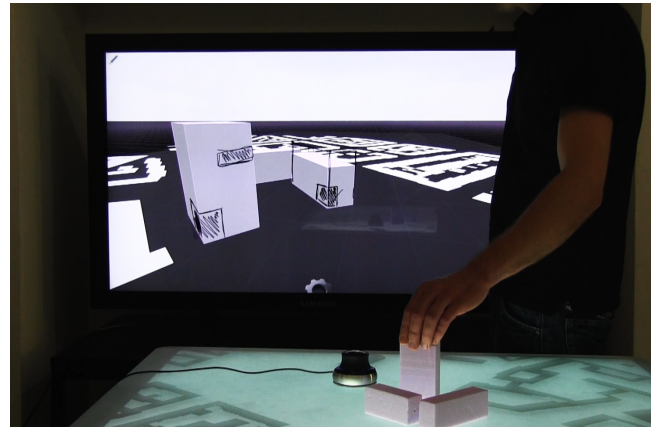


Figure 1: CDP tabletop environment for designing the shape and sketching additional contours

provides means to immediately visualize changes made to the laboratory setup at the planned building site. The demonstration shows the capability of today's tracking algorithms w.r.t. a realistic on-site presentation of virtual buildings.

2 INTERACTIVE COMMUNICATION

The demonstration takes place in front of a building, pointing a smartphone or tablet device to it. To start the Augmented Reality application an initial pose estimation has to be executed by dragging a 3D line model of contours of a nearby structure to overlap the corresponding structure (i.e. a neighboring, already existing building) on the camera image. As soon as the tracking routine¹ estimated the first pose, it starts collecting natural features into a 3D point cloud. At the chair of Architecture Informatics the CDP interactive tabletop (see Fig. 1) is running and waits for the smartphone client to connect. When tracking is initialized, the on-site client connects to the laboratory server, fetches the data of the virtual models and the augmentation begins. One now can watch the virtual buildings in full-size. Any Styrofoam blocks put on the CDP tabletop will be displayed immediately on the mobile device (see Fig. 2). Architects can move or extend the virtual models and 3D sketches with contours [3], and any change is directly transferred to the visualization device on site (see Fig. 3).

3 RELATED WORK

Wang et al. [5] provide rationales for on-site information systems for construction site activities. Among others, they state a demand for interdependency between different roles of participating individuals in a building project and a demand for a link between (digital) paper and the physical situation.

Kwon et al. [1] developed a defect management system with on-site visualization on tablet devices. Yet, the system requires the

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Figure 2: 3D models of shapes from the CDP table are transported to the on-site location

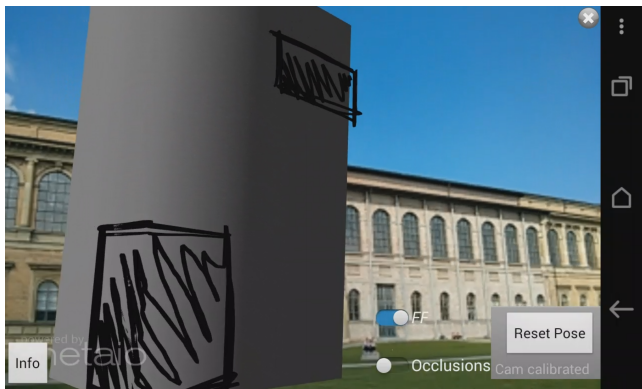


Figure 3: On-site AR visualization

users to install markers to register the visual content.

Zollmann et al. [6] built a monitoring and documentation tool for construction sites using aerial snapshots. Their work focuses on data capturing, 3-D reconstruction and progress information with dedicated visualization techniques.

Sorensen [4] uses on-site AR to improve communication of construction and maintenance plans of large scale buildings.

4 INTEGRATING DIFFERENT AUDIENCES

The quasi-realtime visualization bears the opportunity to serve various means. Not only architects can explore and arguably discuss different setups on site, this system can also be used to give residents an impression about how a future building would look like and how it would integrate with the environment.

Each user installs the application for the mobile device and can explore the proposed building. The users get an impression on how the styrofoam models could look like after building the physical counterpart. It is possible to observe occlusions of the new building with respect to the existing.

In addition, a sun trajectory simulation has been added to the system. Users get a feeling about the incidence of light on the virtual buildings in real-time and in a fast-forward mode.

5 LOW EFFORT COLLABORATION

Since no marker requires deployment in the target area and since the virtual building gets integrated into the specific target environment in full-size, they are directly comparable to the already existing environment.

Instead of using a prepared marker or a recorded point cloud of the target environment, there is a onetime effort for this application to create a linemodel and a surface model of a real building or structure. The line model is compared to edges determined from the camera image in the initialization phase (see Fig. 4a). The surface model represents the area on which the tracking routine creates its feature map during the live tracking. (see Fig. 4b) In future architectural processes most of the needed 3D models will be available in an appropriate level of detail on respective databases. Then the one-time effort of creating a model for each scenario would no longer be required.

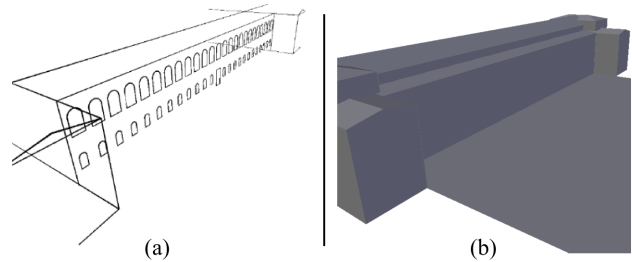


Figure 4: Required 3D models for initialization phase (a) and tracking phase (b)

6 CONCLUSIONS

Proposed new buildings often generate resistance and extensive debate among the residents. One reason for this is that the future neighbors feel uninformed about what is going to be built. With such a visualization tool at hand, planned buildings can be shown to interested people already during the design phase, potentially reducing opposition and offering the possibility to leave a comment or to rate which variant shall be taken into account by the architects in their further design progress.

Yet, such a tool is also supportive to architects. They now have the chance to yield shorter iterations in concept development. Design proposals can not only be estimated with a world in miniature, but also in real life-size.

The presented prototype application supports both demands.

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