Viewing Ambispace

The use of the AmbiViewer to create composed worlds in architecture

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Abstract. *AmbiSpace is introduced to describe the dual nature of composite image as perceived reception rather than claiming it as reality. AmbiViewer is the tool to create architectural composite images and is technically described as prototype.*

Keywords. *Ambispace, Design Methodology, 3D-Modeling, Animation, Visualization*

Computational or digital architecture rendered and merged into real scenes as composite presentations are results of established techniques to project spatial ideas into visual appearance. They are targeted to a broad audience for reception. These techniques are used either in a studio environment, where images or footage are submerged with the static rendering of an architectural project, or in a laboratory environment with sophisticated devices to provide a three-dimensional and real-time experience. The latter case often is labeled as 'Augmented Reality' or 'Mixed Reality'.

Both techniques, static rendering and on-site augmenting, are sufficient enough for presentation purposes, or, in cases of more than one rendering, to provide alternatives.

If it comes to design, their efficiency to develop architecture certainly is limited. While presentations created in a studio are bound to the material taken from the site, usually photos from a specific point of view taken at one time, concepts of 'Augmented-' or 'Mixed-Reality' systems are heavily dependent on technically enhanced locations and only then are suitable of transforming reality in some kind of virtual spaces. To enhance the technique of composite images behind the scope of presentations towards a designing instrument another concept is needed.

Composite Presentations in Architecture

The design process in architecture has a creative and sensing part. This is reflected in composite images: while the rendered three-dimensional objects are resulting from a creative process, the real scene is absolutely a result of sensory activities. The main reason for choosing this ambiguous process is simply that architecture, designing and erecting buildings, is not a serial production. It is the building site, the specific location of a desired building, which takes the ambit into consideration to approach a design, even if buildings are produced in a serial manner.

Therefor in architecture composite presentations are a common form to show the appearance of new designed but yet not constructed buildings on their desired site. To reveal specific aspects images are taken from predefined locations upon those renderings of the future building are performed. Besides drawings and sketches the technique of combining images and drawings from different sources in order to present architecture was first established with the invention of photography and then called ‘photomontage’. The combination of images or photos from the real world and drawings or renderings from a phantastic world in a processed manner soon was established and became partly very popular.

With the introduction of computers the usage of this technique is exploded. As part of the presenation of future buildings it is now common to produce a fitting rendering and layer it onto a digital photography previously taken.

Based on the very same concept yet another technique has emerged. Using motion cameras and advanced computer technologies image capturing and rendering in real-time has lead to the technique now known as ‘augmenting’ or ‘augmented reality’. Generally an augmented reality system generates a composite view, which is a combination of the real scene viewed by a user and a virtual scene generated by a computer. To generate the virtual part to match the image of the real scene according to the eye-point of the user it is necessary that this position is known at any time. Therefor the eye-point must be tracked by a tracking device, the distinguishing feature of augmented reality systems.

Synchronization

In order to combine two images their views must be synchronized. Synchronization is technical based on two states, a leading and one or more trailing state. It is obvious that the camera in the real world is in the lead while the virtual camera is trailing. Generally, the leading camera in the real world must provide a template for the trailing camera in the virtual world with all necessary parameters, as eye-point coordinates, view-point coordinates and field of view. Additional values are position of the sun and other lighting values. These values must be obtained in real-time, otherwise parts of the system remain static.

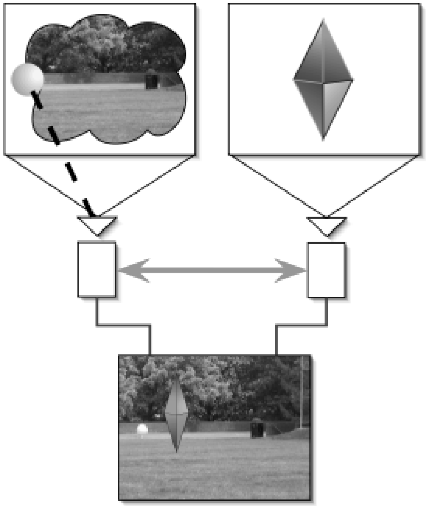

Figure 1. Synchronization

Alternate Realities

It often remains unquestioned that the use of the term reality in various combinations with misleading adjectives like ‘virtual’, ‘augmented’ or ‘mixed’ does neglect reality as a single entity, compared with the uncommon usage of ‘world’.

Unreal spaces

Three important points of unreal spaces are worthwhile mentionable:) unreal space has a defined location, that can be altered, unreal space is timeless, there is no exact point in time when the created space should exists, and unreal space is variant without the loss of time. There may be more aspects.

In contrast real space is bound to a specific location, that can not be altered, it is bound to its time, a specific space only exists at a specific point in time, and a space can not be changed without using time, even there is no doubt that every real space is variant and changes over time.

Combining real and unreal spaces in one presentation demands either the release of the real space from its boundaries, an almost impossible task, or connecting the virtual elements to the real space.

Ambispace

To describe the visionary and receptive perception of space as result of merging physical and fictional objects in one embodiment the idea of 'Ambispace' is introduced. Composed of 'ambi' and 'space' this embodiment is used to describes the indecisive character and double nature of composite spaces also as the demanding and challenging notion of design.

The prefix 'ambi' is originated from Latin 'ambi', 'amb' and Greek 'amphO', 'amphi', the meaning is either 'both' or 'around'. Most of the common adjectives in the English language are applicable to architecture: 'ambiguous' as 'capable of being understood in two or more possible senses or ways', 'ambitious' as 'having a desire to achieve a particular goal' or 'ambivalent' as 'uncertainty as to which approach to follow'. Additional there are words directly related to space, 'ambience' as 'a feeling or mood associated with a particular place', and 'ambit' as 'the bounds or limits of a place or district' (all definitions Merriam-Webster online).

The AmbiViewer-system

Based on these observations and in combination with the computational power already at hand the requirements and needs are outlined and an adequate program system is under development.

Demands

While the sensing component is almost the same as in other systems, consisting of live or real-time imaging combined with localization devices, the creative part has to be as dynamic and interactive as possible. Only if sizing, moving and modifying three-dimensional objects is similar or almost similar to the work with common CAD-software, a system viewing into 'ambispace' can substitute the conventional design process in the studio. Additionally the system must be independently deployable to every desired location without restrictions.

Prototype

The tool to view into ambispace is already developed as a prototype system. The program-system AmbiViewer utilizes an interactive modeler and several other devices to produce composite images in real-time.

Although comparable with other 'Augmented-Reality'-systems, it uses only positioning devices for tracking and lacks the feature of a secondary devices like a gyroscope. Compared with a fixed mounted system inside a studio it lacks the set of markers common for these types of system. Instead the program-system AmbiViewer combines a unique set of different devices, cameras, GPS-devices, a marker and a Computer, and several parts of information technologies, remote-sensing, image-processing and 3D-modelling, and instead of fancy goggles a simple laptop-screen is sufficient.

The immediate sensing part is realized using cameras and GPS-devices. Live-streaming video was chosen as the only adequate method of input for a real-time application, while common GPS-devices, both wired and wireless, are used to determine the multiple and changing positions of cameras and markers. The average time interval for one position fix is usually one second or less, the average accuracy under a clear sky is less than 1 m.

The single fiduciary feature of the system is the marker ball. To sense the ball in the image the marker's color in relation to its background needs to be as distinctive as possible. Detecting the marker is a process in three steps, tresholding the image from the camera and transforming it into a bipolar image, finding the area of interests and

Figure 2. Series of 4 images at a specific location with timestamp, taken in less than 10 minutes.

fixing the center and the diameter of the marker in image-coordinates. The center in relation to the center of the images determines the exact viewing direction, while the diameter of the marker in combination is used to determine the field-of-view of the camera. The latter case allows the use of almost every camera, even zoom-cameras.

With the values for the perspective at hand, the three-dimensional objects are modelled with the interactive-modeler. This important part of program enables a user to dynamically change various parts of the model inside the perspective view of the real scene just taken, or in case of video, streaming in.

The final step of synchronization the virtual camera with the real-world camera is setting the canvas-size of the virtual camera to exact the same size as to the image size delivered delivered by the real-world camera. The final composition of virtual and real scene then is only to add the bitmap of the virtual scene to the bitmap of the real scene without further transformations in the memory of the graphics card.

Conclusion

More important than technically describing the project is the experience, that developing and testing the application lead to a new perception of space, the viewing of ambispace.

While ambispace has a hybrid nature, one part virtual, the other part physical space, each object

Figure 3: AmbiSpace, natural and virtual objects grouped together (the lower red ball is real).

here is either fictional or real. What is taken as fiction or as reality however is dependent on the reception of an observer. This result makes the concept not of ‘ambispace’ as an object but of ‘viewing ambispace’ distinctive from other systems.

Compared with an ‘Augmented Reality’ system similarities are evident. The sensing part, consisting of image capturing and positioning devices is almost identical. The virtual part consisting of a modelling tool is however different.

The real difference between ‘Augmented Reality’ and the concept of ‘Ambispace’ is the view on the images as element of a composite image. The results of the sensing needs not to be static, it might be transformed to suite the needs from the creative part. In other words, the images can be modified to support the three-dimensional model, not to compete it. Therefor the images are not taken as real as given, and the model is no longer ‘augmenting’ the real scene.

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