Interactive Virtual Reality for a Grasping Understanding of an Architectonic Concept

DOMINIK LENGYEL and CATHERINE TOULOUSE, University of Cottbus, Germany

During the Counterreformation In the early seventeenth century, the archbishop of Würzburg, Julius Echter von Mespelbrunn, 1545–1617, built and transformed several hundred mostly village churches that seem to follow a common principle that by itself has never been realised due to the varying preconditions. Prof. Dr. Barbara Schock-Werner, architect, art historian and former master builder of Cologne Cathedral, verbally described this hypothetical ideal church in her habilitation treatise. The research problem was to find a way to translate this very concrete verbal description into an adequate visual representation. Its aim was to substitute the verbal hypothesis by its visual counterpart. The project demonstrated in this paper describes not only how the ideal church has been translated from the verbal into a virtually modelled form, but also how it has been mediated to the public by an interactive Virtual Reality experience introduced by a narrative film and a physical model of the ideal church. The Virtual Reality experience includes four phases. In the first phase the operator learns how to compose typical Echter churches from a given set of building parts of nine churches, i.e. eight existing plus the ideal church. He composes by identifying, selecting and arranging the parts in their appropriate orientation. As he operates in the virtual space, he handles virtual representations of his hands by special controllers. The objects themselves are represented in the scale one to one hundred, i. e. in a common model scale that inspires a manual interaction. And as the also seem to behave physically correct, handling and behaviour encourage the operator to experiment. When the operator successfully composes a church's volume, his visual presentation switches to an original scale representation that allows walking around the churches. The ideal church can also be visited from the inside. It is one of the specific strengths of Virtual Reality not only to simulate space and interact with it but to deliberately switch between different states, e. g. scales, levels of details or levels of abstraction. The benefit is the shift from realism to abstraction, just as in any other media like images or texts. Abstraction in any way or media allows to demonstrate, explain, illustrate and in the end understand concepts directly which otherwise can only be perceived subtly.

CULTURAL HERITAGE AND HISTORICAL SETTING

Julius Echter von Mespelbrunn built about four hundred churches in the position of the prince-archbishop of Würzburg during the counterreformation in the early seventeenth century. Among others, one of his intentions was to demonstrate the superiority of Catholicism over Protestantism which fully succeeded according to chronists.

For this vast project that he undertook amongst many other building projects, first of all he manifested his responsibility for form and design of all building projects within his bishopric. This general responsibility led to a certain and most probably intentional homogeneity in the exterior and interior appearance of the churches. Some of the churches were built on existing sites or even on parts of existing churches. For example, in a number of cases he took over and integrated the church towers.

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Authors addresses: Dominik Lengyel and Catherine Toulouse, Chair for Visualisation, Institute for Building and Art History, Brandenburg University of Technology Cottbus-Senftenberg, Platz der Deutschen Einheit 1, 03046 Cottbus, Germany; email: lengyel@b-tu.de; Lengyel Toulouse Architekten, Sundgauer Str. 29, 14169 Berlin, info@lengyeltoulouse.com

Fig. 1. Julius Echter's ideal church with school and parish house in a paradigmatic village context [Lengyel and Toulouse 2017a,b] © Lengyel Toulouse Architekten

In general, his new or transformed churches resemble each other to a rather high degree. On the outside their basic formal design components, that is nave, choir, vestry and tower, are assembled in a highly conformable way. Just as well in the inside vaults, altar, pulpit and baptismal font follow common design rules. Even the overall colouring design of walls and decoration is mostly uniform or very similar. It seems obvious that there must have been a clear vision, a primordial idea of the churches before they have been built.

BUILDING RESEARCH AND HYPOTHESES

This vision has hypothetically been formulated by Prof. Dr. Barbara Schock-Werner, the former master builder of Cologne Cathedral [Barbara Schock-Werner 2017]. The historic ideal has not survived, if there has ever been a formal description at all, so it had to be reconstructed indirectly. The verbal hypothesis describes every single feature of an ideal church from the outside to the inside as if it was built in a detailed way. The reader can imagine visiting the ideal church and is strongly reminded of existing churches. The structure of this description is not a generalization in the form of a strong formal abstraction as executed for example in the case of the urban texture of the antic metropole of Pergamon (Fig. 2) or the urban texture around Cologne Cathedral (Fig. 3) in times when as little is known about the single buildings that a rough and obvious geometric abstraction clearly explains this uncertainty in archaeological knowledge [Lengyel and Toulouse 2016]. In the case of Echter's churches the idealisation is realised as a series of descriptions of rather subtly idealized single features of existing churches, an assemblage of the most common and most typical single components, a combination of existing parts that in reality have not been built as part of one single church. This also comprises the standard surrounding buildings school and parish houses (Fig. 1). The term 'idealisation' is meant as the most probable original form and appearance of the church as conceived by Julius Echter. Still, the ideal church is not a simple arrangement of existing parts as these contain obviously unintended irregularities and have undergone deterioration and sometimes even restauration, which gives them a unique and singular shape. On the contrary, describing their respective ideas means to imagine and describe their original and intended shape which necessarily is more abstract than their today's remaining descendents.

Fig. 2. Antic metropole of Pergamon at around 200 AD [Lengyel and Toulouse 2018] © Lengyel and Toulouse, University of Cottbus

ABSTRACTION AND VISUALISATION

Based on these prerequisites and on occasion of the envisaged exhibition on Echter's cultural impact on his era, which included architecture only among other fields, the idea arose to visualize this idea of a church that would become the origin of several hundred instances, so to create a visual counterpart to the existing verbal description.

The result is a translation into a three dimensional composition mediated in still images, moving image and in Virtual Reality. A geometric translation of a verbal scientific hypothesis means an original architectonic design. This is an important step since the ideal church's visualisation does not fully rely on existing features. This design includes and combines visible and invisible features. Visible are the features adopted and idealised from several realised churches, invisible is their commonality, their conformity as a result of the examination of several hundred individual churches. That is, the translation of the hypothesis from a verbal to a visual form is to create completely new objects, new pieces of abstract geometry that obviously resemble to a high degree of architecture in its appropriate historic context. But the design process also concerns the difference between realised architecture and an appropriate degree of abstraction, not only to illustrate the churches' own hypothetical design ideas, but also to clearly demonstrate that the ideal church is virtual architecture, an idea as a design origin and not a realised building. The challenge in this approach is to achieve an appearance that credibly represents a supposed design thinking of Julius Echter and that also recreates Echter's idea of architecture in the imagination of the viewer of the visualisation (Fig. 4).

Most supposedly Echter's concept is restricted on those elements of architectonic design that directly control the building construction, technical issues and visual and economic concerns, that is the regulation of the overall form and the proportion of the major building elements, the number of tower floors, window axes and entrances, the colouring of internal and external walls, the construction of the vaults and the overall composition of the interior decoration. He might most probably have invested less effort concerning minor deviations due to local building techniques or less experienced craftsmen. This is why Echter's ideal church does in principle not include the ubiquitous defects of his realised churches but instead their genuine, accurate and idealized appearance. In the same sense any of the usual changes that the realised churches underwent, deformations during or after their construction, destruction, conversions or refurbishments, are not considered. This also helps to let the visualisation clearly appear as a visualisation of hypotheses and not as a simulation of built architecture. On the contrary, and this is the main purpose of a visualisation as such, an idea is supposed to be perceived as an idea. All by itself the visualisation pursues to be identified as an idea and to create an awareness of the concept that Julius Echter might have most probably had in his mind [Deuring 2016]

Fig. 3. Alter Dom, the predecessor of Cologne Cathedral [Lengyel and Toulouse 2011; 2013] © Lengyel Toulouse Architekten

Modelling this new geometry means does not mean to simplify, as one could expect when taking the term abstraction literally, but to recreate its formal shape in weighing and considering its overall visual appearance. While dividing a building into semantic sections like nave, choir and tower, the subdivisions that need to take place within each single section is more complex. As one of the simplest examples in the case of the Ideal Church, the interior surface between the windows is recreated absolutely flat and perpendicular to ground and façade planes. The three steps weighing of edges, the rectification of angles and the modularisation of measure constitute the major part of the design of abstraction.

Perception and examination of these visualisations are intended to engage with Echter's architectural vision, but also to appreciate the quality of his overall architectonic contribution. This also leads to a deeper understanding of any of the individual built churches when visited after the perception and understanding of the ideal church. As nearly all churches have some of the features of the ideal church, the differences between any particular built church and the ideal church is noticed more clearly and may even lead to a deeper understanding of the conditions and prerequisites of the particular building's site and community. All together the mediation of the ideal church as a hypothesis as such and the ideal church's hypothetical appearance in particular strengthen the identification of the local community with their local church and also with the bishopric in total.

MEDIATION IN AN EXHIBITION

In the exhibition, three different ways of representation complemented each other, each performing on a different level of perception to fulfil a most complete understanding of the three-dimensional design idea. Three-dimensional space perception in reality depends mainly on stereoscopy, that is two different projections, one for each eye. This stereoscopic projection has been accomplished by virtual reality glasses but also by an autostereoscopic screen, that carries a foil of small prisms that separate the visibility of the two integrated projection for each eye for a certain, adjustable distance for nine possible positions in front of the screen, and that presents a film with speaker text that explains Julius Echter's architecture. As these still images are composed architectural views we call them "virtual photography" as we treat the virtual model as if it was real and construct the view [Rosa 1994] it as if we were using a real physical camera on the search for perspectives that explain the buildings' characteristics as directly as

Fig. 4. Julius Echter's ideal church [Lengyel and Toulouse 2017a; b] © Lengyel Toulouse Architekten

possible. Real three-dimensional perception is made possible via a three-dimensional print of the ideal church. Not comparable to original scale at all, at least the print is half a meter tall (Fig. 5).

The 3D print serves as an overview over the spatial relations of the building parts. As is does not show any materiality, it stands in the tradition of classical architectural clay models. The unobstructed view with the eyes without VR glasses let the viewer examine the plasticity of the surfaces in the most intensive way. This is why any relief has to be considered carefully. Again, this is a matter of weighing essential against existing but irrelevant features. The roof tiling for example seems not to follow certain rules as far as the verbal description of the ideal church revealed. In order to emphasize the described features we agreed in not to show the single tiles, so that other more important features like the cornerstones get the visual presence that they have on the built churches, too. This example clearly shows how different media demand different approaches and clearly a different modelling. The cornerstones' plasticity is exaggerated while the roof tiles are omitted. The clay model method underlines visual features with plasticity even if in case of the built churches the same features are nearly co-planar cornerstones or distinct pieces of roof tiles.

In its plasticity and direct visual accessibility without any technical means the physical model serves as a spatial introduction conditioning the visitor for the church's architectural shape. The visitor is visually and mentally prepared for the uncomfortable VR experience and can overcome the technical challenges more easily.

The virtual reality projection finally is not only at original scale but it also is interactive, so the viewer can grasp certain objects and manipulate them in several ways concerning their position in space or their visual appearance in order to try different alternatives. This approach allows experimenting playfully with the churches' design and by this experience understands it. For the museum visitor, technological fascination seduces to a more intensive awareness of the topic and therefore to a deeper understanding of the mechanisms of architectural design.

INTERACTIVITY AND UNDERSTANDING

The user is allowed to freely combine the building's components and functions. Compositions created by the user will be compared with Echter's ideal church and with eight realised churches. The task after free experimenting is to reconstruct one of the eight selected churches or the ideal church respectively. Visual feedback supports the user in accurate positioning (Fig. 6). While experimenting, on the other hand, there is a nearly infinite number of possible combinations. Experimenting in a technologically advanced way with Echter's design components allows the visitor of the exhibition to overcome the general distance between exhibits and visitors that also arises from the temporal distance over five centuries.

Fig. 5. 3D print of Julius Echter's ideal church [Lengyel and Toulouse 2017a; b]
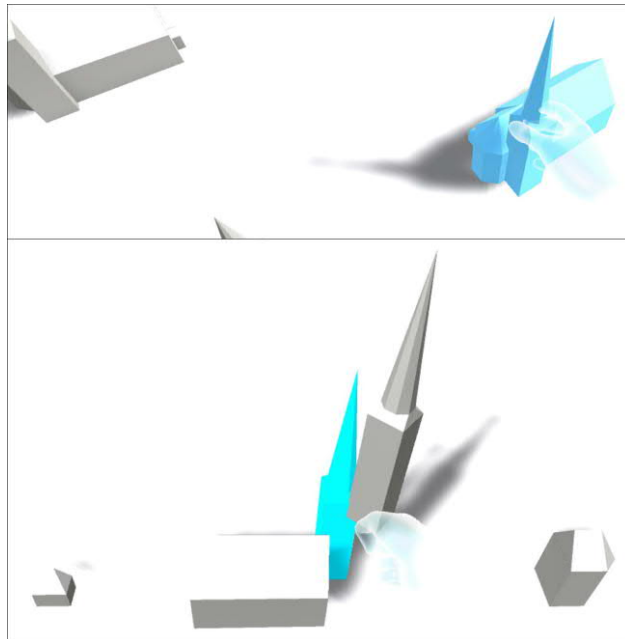*© Lengyel Toulouse Architekten*

Fig. 6. Interactive optical user guidance, screen shot from Virtual Reality [Lengyel and Toulouse 2017a; b]
© Lengyel Toulouse Architekten

Fig. 7. The gallery of Julius Echter's ideal church [Lengyel and Toulouse 2017a; b] © Lengyel Toulouse Architekten

In the first phase of the interaction the user gets to know the eight realised churches and the ideal church and is asked to select one of those in order to recompose the selection in the second phase from a given set of building parts, that is nave, choir, vestry and tower by identifying, selecting. The composition is performed be arranging and orienting these parts with special controllers that represent the user's hands. The objects in these two first phases of the interaction are represented in the common and comfortable model scale 1:100. This suggests to the user an easy handling of the building parts' abstract representations on his virtual work desk, supported by a physically correct behaviour. That is, if the user reopens his hands, the building hold in the hands falls back down to the ground. The only non-realistic addition to the physical behaviour is an automatic upturn back to the building parts' initial orientation, so that architecture not only metaphorically but literally stands on the ground instead of lying on it. The physical simulation of the parts' handling and behaviour encourages the user to freely experiment with their position.

The objects' weight is adjusted to the impression of light cardboard models to encourage experimenting without having to be afraid of accidentally damaging something. The building parts in this phase are represented in the most abstract respective way. This ensures that the user does not reflect a realised church in its whole appearance but its general spatial constitution. The user learns to think architecturally that is in abstract shapes that represent ideas rather than stones stacked onto each other. Dealing with ideas instead of construction material focuses on the core meaning of the treated object [Pierce 1986]. When the user changes from experimenting to reconstructing and successfully composes a predefined church's set, he is forwarded to the third phase of the interaction that is another model state as original scale model. In this original scale phase the user can walk around the churches. In the case of the ideal church, the user can also walk into the inside of the church (Fig. 7).

The virtual portals are touch sensitive and the user can pass over from outside to inside and vice versa. Other than in scale 1:100, in this original scale physical change of the building parts' position and orientation would contradict the expected architecture's behaviour and irritate the user's imagination of walking around in built architecture. But this does not concern visual features. The colouring of some elements of Echter's colour concept is therefore editable in original scale. As most of Echter's four hundred churches had mouldings and edges in either yellowish or reddish colour, this feature is interchangeable by pointing and clicking on the according surfaces. Also the windows' traceries, one of the most characteristic and famous features of Echters' churches, are changeable. But other than the colouring, and because almost every window tracery in Echter's churches is individual, even if they resemble each other to a certain degree and can be sorted in well distinguishable groups, each window provides five pre-defined alternative traceries in a cyclic order. This allows including diversity as a key feature of Echter's design rules in one single ideal church. Versatility as a design method can therefore be experienced through interaction with the virtual environment.

Fig. 8. The parish church St. Peter and Paul in Schönau. (Photography: Lengyel Toulouse Architekten)

And at the same time the counterpart of versatility, that is consistency, ensures the unity of all churches, the uniformity of the whole as opposition to the versatility of its parts. On the other hand, the variations in the tower helmets have been considered as neglectable. Except two different ways of laying the roof tiles, nearly all tower helmets follow the same overall principle in shape, an iconographic feature for identifying a church by Julius Echter (Fig. 8). This is how architectonic design develops a series of decisions that are directly related to the intended mediation and understanding of the given architecture.

As the section about Echter's churches was part of a major exhibition about his overall tangible cultural heritage, all visitors were necessarily exposed to the 3D print and the autostereoscopic display. The VR glasses were naturally used by only a fraction of the visitors that were motivated for accessing an uncomfortable technical device like VR glasses. To compensate for that, members of the museum staff have been instructed for assisting and evaluating the VR experience. Although the exhibition was visited primarily by visitors that were particularly interested in Echter's heritage and, as Würzburg is situated in the geographical centre of the area of Echter's churches, most visitors would know at least a number of them, the result fulfilled the expectations, that is, visitors having experienced the VR church reported a conviction of deeper understanding of Echter's architectonic concept. Although not being under laboratory conditions, the reports of the members of the museum gave an interesting insight into the acceptance on one hand and effects on the other hand of the VR experience as a supplement to other media.

Fig. 9. The gallery of Julius Echter's ideal church © Lengyel Toulouse Architekten

CONCLUSION

The user experiences architecture and understands basic principles of architectonic design and visualisation, e. g. that different scales demand a different refinement and consequently different modes of mediation, interaction and manipulation. It is one of the specific strengths of Virtual Reality not only to simulate space and interact with it, but to deliberately switch between different states. These states can be scales as realised at the transition from compositing to promenading, that is the transition from the second to the third phase in the project described above, but this can also be levels of details or, most important, levels of abstraction. At our interactive experience of Echter's churches all these features are combined when the user enters the third phase, the interactive promenade. Particularly abstraction, if carefully designed, allows to demonstrate, explain, illustrate and understand concepts that otherwise would be perceived only subtly [Lengyel and Toulouse 2016]. Virtual Reality setups turn out to be a development that allows a deeper understanding of architecture especially in the case of lost or hypothetic architecture. This relies not only on the more spatial experience, that is more explicit than flat projections and not even only on the interactive moving through space, which already enhances the spatial experience substantially. It strongly profits from – and maybe even relies on – the real interaction that is made possible almost exclusively by Virtual Reality, the near to real grasping of objects combined with touch sensitive surfaces that react in a predefined way or cause other elements to perform predefined actions, altogether a combination of different perceptions and the experience of effective intervention. Interactive Virtual Reality will most probably enhance and simplify the mediation of cultural heritage – if performed accordingly (Fig. 9).

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