Negotiating Reality

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Abstract

Our understanding of *research through design* is demonstrated by a close examination of the methods used in the project lifeClipper2. This design research project investigates the applicability of immersive outdoor Augmented Reality (AR). lifeClipper2 offers an audiovisual walking experience in a virtually extended public space and focuses on audiovisual perception as well as on the development of the appropriate technology. The project involves contributions of partners from different fields of research. Thus, lifeClipper2 is able to test the potential of AR for visualizing architecture and archaeological information and to challenge our understanding of perception and interaction. Using examples from our research, the paper reflects on how scenario design contributes to the production of design knowledge and explores the possibilities and variations of AR. Finally, the paper drafts our approach to design research. The three tenets of our work are: the use of scenarios as a tool of interdisciplinary research, the experimental exploration of media and the intention to make design knowledge explicit.

Keywords:

augmented reality; locative media; hybrid environment; immersion; perception; experience design; research through design; scenario design

The aim of this paper is to demonstrate our understanding of *research through design* by a close examination of the methods used in the project lifeClipper2. This design research project investigates the applicability of immersive outdoor Augmented Reality (AR). lifeClipper2 offers an audiovisual walking experience in a virtually extended public space and focuses on audiovisual perception as well as on the development of the appropriate technology. The project involves contributions of partners from different fields of research. Thus, lifeClipper2 is

able to test the potential of AR for visualizing architecture and archaeological information and to challenge our understanding of perception and interaction. Using examples from our research, the paper reflects on how scenario design contributes to the production of design knowledge. The results of our technological endeavour, however, will not be pursued in this paper.

Creating scenarios

lifeClipper2 investigates the potential and applicability of immersive outdoor Augmented Reality (AR). AR is the superimposition upon the user's perception of the physical world of virtual elements that are subtly located and woven into the real surroundings. AR technology is part of a rapid development that aims at invisibly integrating computers into our everyday life. Using AR, physical surroundings are extended and thus augmented by the presentation of virtual elements. While the term "Mixed Reality" describes a concept where virtual content and the real world intermingle, AR, as a submode of Mixed Reality, adds specific virtual elements to the physical world (Schnabel, Wang, Seichter, & Kvan 2007, 3–4). The AR-project lifeClipper2 offers an audiovisual walking experience in a virtually extended public space. A technical apparatus, whose development is part of the project (though not the subject matter of this paper), allows the users of lifeClipper2 to see and hear virtual elements in a staged outdoor area. lifeClipper2 explores the potential of AR for project visualization, urban planning, tourism, and perception studies in close collaboration with partners from different fields of research. lifeClipper2 is the continuation of the art project "lifeClipper", a free artistic interpretation of Augmented Reality, in the context of applied research (Torpus & Buehlmann, 2005 and Torpus, n.d.).

Fig. 1: lifeClipper2-user on walking tour in Basel.

On the one hand, the aim of research of lifeClipper2 is to make the fusion of the real and the virtual in AR applications as seamless as possible. On the other hand, the potential of AR is explored by working out the interfaces, transitions, and boundaries between "real" and "augmented" reality. The various methods of research applied by lifeClipper2 include the exploratory design of different scenarios, the adaptation of structures such as cutting techniques and spatial conceptions from other media, the use of a simulator, and evaluation of user experiences. The particular advantage of immersive outdoor AR is the enrichment of the physical world with virtual elements. So, scenario design starts with the definition of a theme that is appropriate to a selected location, whereas the selection of the location depends upon the potential scenario. The demands made by research partners place seminal restrictions upon the wide range of possible locations and scenarios. A promising scenario is one that captures change and connects themes of broad cultural interest with urbanistic realities, technological challenges and large amount of data, thus involving partners and skills from different fields. According to Rabin's article in the *Design Dictionary*, "scenario planning" is a method used by a variety of disciplines ranging from architectural design to software design, with the goal to represent veridical users doing veridical tasks: "It [scenario planning] provides a powerful heuristic device and facilitates brainstorming focused on end users. Scenarios can be captured using a variety of techniques including storyboards, high or low fidelity prototypes, or simple text-based narrative" (Rabin, 2008, pp. 348–349). Although lifeClipper2 uses scenario design as a heuristic method focusing on user experience, the narrative action of scenario design itself is conceived as a process that goes through different stages, constantly challenging its outcome. The first stage of scenario design, scenario development, includes the capturing of the scenario in a text-based script. The ideas are drafted in images and sounds and simulated in 3D. Within this stage of scenario design, structures, stylistic devices and tools from architecture and film are tested by transferring them to the medium of AR in order to explore their possible use and extension. The simulated scenarios are further explored by means of audiovisual case studies before finally being implemented as locative media in an outdoor environment, thus introducing the second stage of scenario design. During the outdoor test of the simulation, locative elements and technical calibration are gradually improved. We refer to the second stage of scenario design as "scenario implementation". The result of the adjustment process is the setting of the experiment that is tested with users and may or may not be subject to evaluation.

In several iterative cycles, these distinct stages of research are mutually influential and informative. The design of scenarios that makes the interdisciplinary approach of design research apparent is the main focus of our design and innovation research. Scenarios are spelled out in the shared "language of experience, which unites us in the world", as Stappers (2007, p. 87) denotes in his analysis of prototypes.

> "Prototypes and other expressions such as sketches, diagrams and *scenarios*, are the core means by which the designer builds the connection between fields of knowledge and progresses toward a product. Prototypes serve to instantiate hypotheses from contributing disciplines, and to communicate principles, facts and considerations between disciplines." (Stappers 2007, p. 87, our emphasis)

Exploring different scenarios – our "prototypes" – the tasks and backgrounds of the various disciplines involved in a design project overlap. In multidisciplinary research, as conducted in lifeClipper2, skills like communication, integration of expertise and the ability to deal with incomplete information become increasingly important. In accordance with Stappers, we believe that the designing act of creating and implementing scenarios is the essence of research through design, that this act generates knowledge, and that it is the duty of designers to feed this knowledge back into other disciplines such as hard- and software developers or urban planners (cf. Stappers 2007, p. 87). In order to reflect upon the methods used in lifeClipper2, the process of the design of two scenarios is rendered in more detail below.

Example 1: Archiviz

The focus of the scenario "Archiviz" is the evaluation of the potential of the medium AR in urban planning, in comparison with the conventional medium of architectural plans. The landscape architecture project "Undine", proposed for the conversion of Basel's St. Johann harbour, serves as an example to test AR technology as an alternative tool for assessing and communicating urban planning. Here, the selection of location was biased by the content of the scenario. The use of AR in the field of urban planning is supported by AR's ability to connect design and vision (as virtual elements) with the given urban context. Seichter and Schnabel (2005) and Wang, Chen, Gong and Hsieh (2007) present related research. Moreover, AR can be described as an empirical model that can be assessed from the perspective of the observer on a 1:1 scale where conventions of natural perception hold true. In the course of the scenario design process, the following research question gradually emerged: Can AR add value to the assessment and communication of an architectural project in comparison with conventional representation techniques such as plans and renderings?

As the scope of this scenario is a comparison of two approaches for urban planning, the resulting experimental setting is tested by users, monitored and evaluated. The design of the scenario evolves in three stages. First, the content of the scenario is defined and restricted. In collaboration with experts from Basel's Urban Design and Planning Department, the content of communication of the landscape architecture project "Undine" is analysed and pressing themes are extracted, where recurrence and emphasis in media coverage meet the criteria for "pressing". Based on the results of this analysis, a questionnaire is composed for user evaluation. A further step of scenario development is the adaptation of established tools from architectural design to AR space and the investigation of different modes of presentation for the

assessing of urbanistic projects (superimposing model in 3D). These investigations are related to material (with/without texture), section (moveable), perspective (interactive bird's eye view), grid (subsidiary layers, grid structures), transparency (changeable transparency) and layers (activation/deactivation of 3D elements such as trees, buildings etc.). After the development of the content, the implementation phase of the scenario is started. The location in which the experiment is to be conducted is measured and filled into the existing calibration model as a refined 3D model. The model of the project "Undine" is built according to the implemented tools and questions. It is adjusted to the calibration model and located with a high degree of precision. The implemented tools and modes of presentation are tested and adjusted in the field. This stage of the process involves contributions from research partners in Geomatics Engineering, Microelectronics, Land Registry and Surveying Office, Hard- and Software Developers, and other fields. It is characterized by the richness of detail that is negotiated in the design decisions. The resulting experiment setting is then tested in the field: The questionnaire and the concept of surveying are adjusted, the programming of the interaction and its related measurement functions conducted (e.g. what combination of views is used for answering what question and for how long?). By means of observation from the outside (monitoring and recording of selected audiovisual perspectives, video recording of walk and behaviour as well as interview) and from the inside (interview reflecting individual perception, questionnaire to be filled out at the end of the tour) the behaviour of a group of laypersons and a group of experts (specialists from the department of urban planning, architects, planners) using the same system is surveyed. The group of laypersons is surveyed with respect to their understanding of the landscape architecture project, the group of experts with respect to the project assessment. At this stage, the project is still running. User tests will be conducted within the coming months. The analysis and documentation of the results will shed light upon the potential of the application of AR in comparison with architectural plans, as well as upon the potential of the realisation of the different themes in matters of content and design.

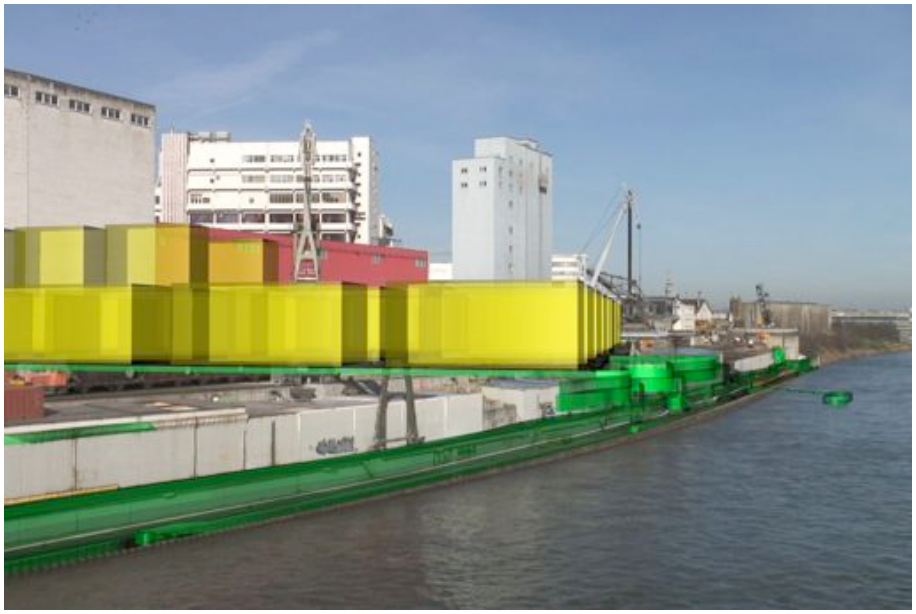

Fig 3. Archiviz: Investigation of the potential of Augmented Reality in urban design.

Thus, the exploratory design of scenarios evolves in distinct stages, as a tightrope walk between open, creative phases and clear-cut research questions that aim at accurate answers. The narrative process of scenario design is a constant oscillation between following rules and challenging them. Design is about composition, synthesis (in contrast to analysis), content, rhythm, sequence, and intervals. The different methods we use include qualitative research methods such as content analysis and interviews, quantitative methods such as surveys and user evaluation as well as "pure" design methods such as adaptation of structures from established media, and simulation. We see the crucial task of design in its functioning as a network, interlinking the forces and demands of various disciplines and parties and dealing with the complexity and contradictions that emerge in multidisciplinary research. In this sense, we avoid limiting design to a "predefined methodology" and understand the world of design as open, "and at the same time as complete in itself, as a realm containing a wide variety of languages, and of forms of thought and work" (Gänshirt 2007, p. 17). Through various experiments, tests, and studies, cycles of investigation and evaluation, the best solutions are gradually worked out: "Designing is a process of approaching concrete reality laboriously and gradually: working from the large to the small scale, starting with the abstract and becoming more and more concrete" (Gänshirt 2007, p. 65). By interlinking different disciplines, gradually approaching the desired outcome, redefining it, and experimenting with methods and media, lifeClipper2's scenario design is a constant negotiation of reality, for example the reality of a research questions and experimental settings.

Example 2: Playground

Another scenario of lifeClipper2, "Playground", focuses on phenomena beyond Euclidian space. Playground is an inquiry into the virtual optical system by means of playing with the

commonly applied parameters for texture, projection surface, foreground/background and masking functions. It is an experimentation with the medium of AR and an exploration of its impacts on human perception and on the creation of interaction, atmospheres and emotions.

Typically, AR visualization technology uses a background screen onto which the live recording (realized with cameras fixed to the Head Mounted Display) is projected. The virtual model is positioned in front of the screen. Additionally, image effects can alter the compound image displayed by the graphic card.

Fig 4. Conventional AR design uses a background screen and positions virtual elements in front of it.

In short, the key challenge of AR technology is to refine the calibration of the model in order to dissolve the fractures between the virtual and the real; the key challenge of design is to develop an appropriate audiovisual language for AR. This conventional setting is completely overthrown within the development of the lifeClipper2-scenario Playground. The idea of the live recording as a hosting background scenery is abandoned. Instead, the live video is projected onto other virtual elements. The 3D-model itself can be used as a projection screen, using frontal mapping. Thus, the live recording of “reality” becomes an optional texture of an optional figure. The live video is handled as a design element, moveable and mouldable. It is needed only to provide basic orientation for the user. The scenario development of Playground aims at exploring as-yet unemployed stylistic and technical possibilities of AR as a medium. It includes two major changes:

1. The plane background screen is no longer used for the projection of the live video only, but able to change position and form, to dissolve, to blow away like a withered leave and open up the view on an unknown, abstract world. For optional, pre-processed recordings a spherical projection screen is introduced. This sphere forms the artificial horizon of the visual field

around the 3D-model.

2. Parts of the 3D-model are used as projection screens for the live recording. As the separated layers of the 3D-model are distinctly textured, the live video can be applied to specific areas and be sampled and composited as dynamically as any other texture.

Additionally, a small spherical “mask”, a third type of virtual screen, can be fixed to the user’s head and moves along with her/him. The orientation of this sphere however is anchored in the field. This screen is used for auratic effects and can be multiplied, forming different shells around the visitor. The change from any virtual screen to another is possible by smooth transitions, which allows the combination of the different approaches.

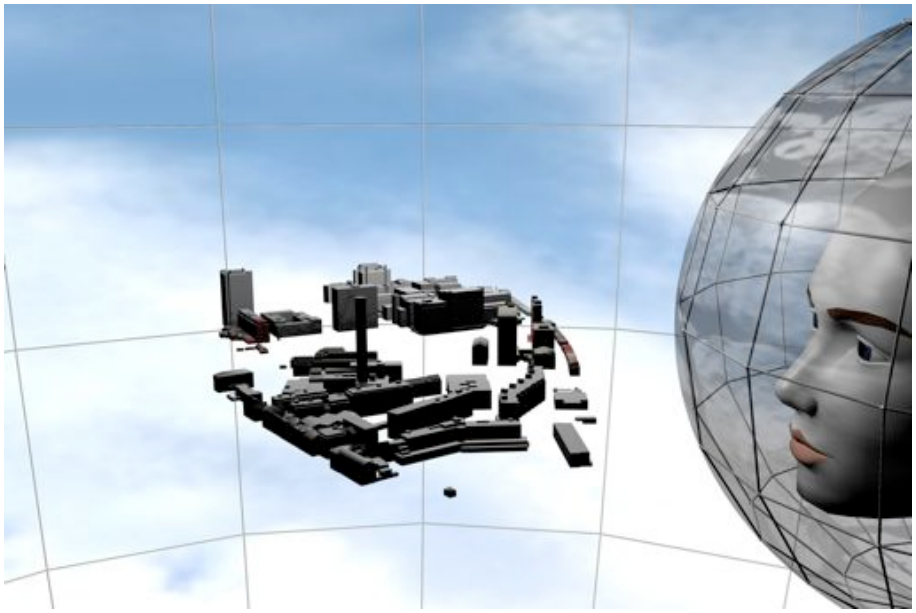

Fig 5. Playground: Three virtual projection screens for the life recording.

The scenario “Playground” is implemented in the St. Johannspark in Basel. The paths of the park form the basic referential system and the theme of the scenario. Playground behaves like a living organism, the paths are expanding and changing their shape according to user interaction. By adding new spatial dimensions to the 3D-reconstructed model, new referential gravities are simulated, dissolving the Euclidian space and challenging the user’s sense of balance. The virtually superimposed 3D-model can blend, mix, add, hide and merge parts of reality and virtuality and provide new centres of gravity, thus creating a different spatial framework. The experience of the real world through AR becomes part of another narration. The sense of the “real” and the sense of where one belongs to are playfully manipulated. The virtually created “second” frame of reference has its own coherent existence. It can be encountered in different places within the terrain. In addition to the terrain, the infrastructure of the park such as lamps, benches, and fences are part of the virtual model and altered in terms of scale, colour and shape. The scenario implementation balances out possible applications and interactions. At the stage of the experimental setting, user and staged terrain should be able

to influence each other mutually (this part of our research is currently in progress). The user will interact with the scenario by walking around (altering position and walking pace) and looking around (altering view angle and orientation). The scenario will respond to the user by changing its appearance and character. For example, it will react to increasing or fading attention of the user (the duration of looking at something within one field of view) by growing its virtual extensions or reducing itself to a "normal" representation of the real; further, ground and virtual elements are distorted or enriched according to the user position. Playground orchestrates reality and virtuality by composing distance, forms, layers, motions and textures of the AR visualization.

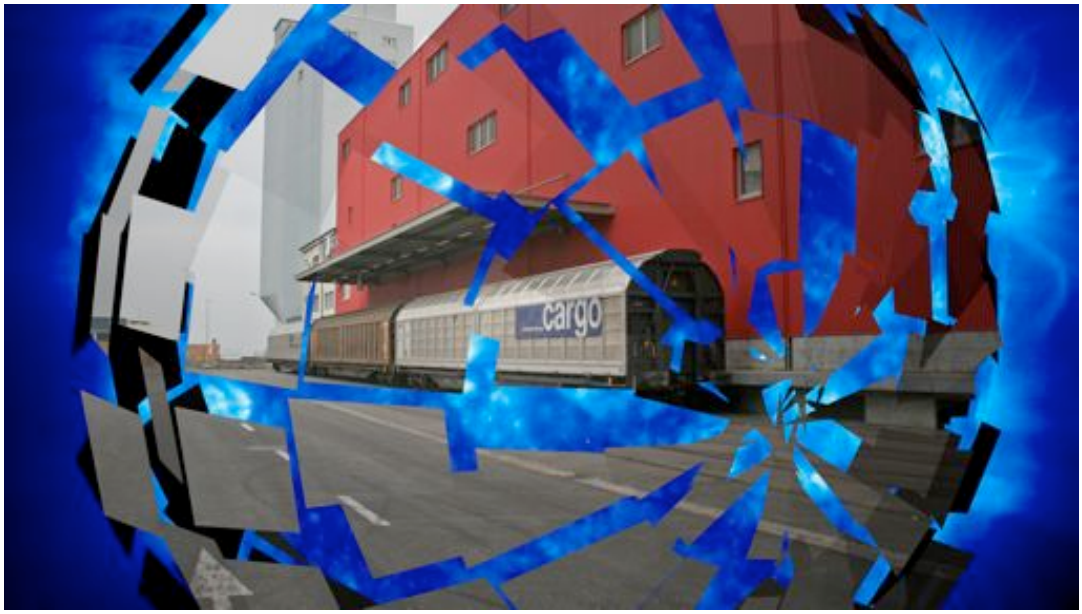

Fig 6. Playground: Playfully manipulating the sense of the "real".

The experimental exploration of AR takes the possibilities and variations of interactivity to a higher level. This does however not obliterate the role of the researcher as author of the possible experiences and reiterates the problem of – as Manovich puts it – "totalitarian" interactivity (Maonvich, 1996):

> Now, with interactive media, instead of looking at a painting and mentally following our own private associations to other images, memories, ideas, we are asked to click on the image on the screen in order to go to another image on the screen, and so on. Thus we are asked to follow pre-programmed, objectively existing associations. In short, […], we are asked to mistake the structure of somebody else's mind for our own. (Manovich, 1996, p.2)

Since there is no more clicking on images needed in AR-applications such as lifeClipper2, the inherent restrictions of interaction become both more and less apparent. By offering a plethora of interaction experiences, each of which designed and "authored" by the researcher, lifeClipper2 highlights the manipulative character of interactive media and exploits its ability to condense subjective and objective associations. The experimental setting of Playground does

technology, information representation and human-computer interaction.

Reflecting methodology

As illustrated in the lifeClipper2 scenarios "Archiviz" and "Playground", a crucial part of our research is dedicated to the question of how we can challenge and loosen our conventions of perception, thought and action by experimenting with methods and media. We agree with Krippendorff that designers are motivated by challenges, opportunities and the possibility of introducing variations into the world (Krippendorff 2007, p. 70). Within the research project lifeClipper2, we conduct this research into opportunities and variations in the process of scenario design by exposing ourselves and others to surrounding conditions that are neither coded nor familiar, and that deny immediate recognition. Thus, "reality" is negotiated.

In conclusion, we draft our approach to design research with following statements that recapitulate the most important points made.

1) Scenario as key tool of research. The common ground of communication between different disciplines and stakeholders of design is established by means of a scenario. A scenario is a narration cast in the language of experience that allows access to everyone. It is able to convey particular and new experiences, and to create new possibilities.

2) Exploration of media. The scope and ability of media used in a project are constantly challenged, the transfer of structures and methods from one medium to another is encouraged. By the multidisciplinary exploration of media design, new applications are created.

3) Making design knowledge explicit. Design knowledge that is generated by scenario design is made explicit as a basis for innovation and exchange and for feedback to other disciplines.

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