lifeClipper3 – An Augmented Walking Experience

Field evaluation of an experience design approach for immersive outdoor augmented reality

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ABSTRACT

lifeClipper3 is a media art project in which a walk is audiovisually expanded into a game-like experience by means of "augmented reality" technologies. For visitors this creates an immersive experience which is unique in each case, and which challenges and calls into question habitual modes of perception.
In this paper the "experience design" strategies used in lifeClipper3 are introduced, and examined by means of qualitative ethnographic methods in a visitor evaluation. The resulting insights are intended to be beneficial for similarly designed future AR art projects.

KEYWORDS: Augmented reality, mixed reality, reactive environment, locative media, location-based, ubiquitous computing, pervasive game, computer vision, mobile computing, experience design, design research, field evaluation
INDEX TERMS: H.5.1 [Multimedia Information Systems]: Artificial, Augmented and Virtual Reality - Virtual Reality for Art and Entertainment; H.5.2 [Information Interfaces and Presentation]: User Interfaces - User-centered design, Evaluation/Methodology; J.5 [Computer Applications]: Arts and Humanities—Fine arts.

1 INTRODUCTION

lifeClipper3 is an immersive augmented reality (AR) project in which a person – equipped with a wearable computer system and head-mounted display – takes an escorted walk through St. Johann's Park in Basel. In the process he or she explores both the real-life goings-on in the park and virtual image and sound input. The walk was deliberately chosen as a framework to create a link with the cultural practice of *flânerie*. In his Passagenwerk (Arcades Project), which he began writing in 1927, Walter Benjamin described the cultural practice of *flânerie* which had first emerged in 19th century Paris. [1] In lifeClipper3 the *flâneur*, unlike the 19th century *flâneur*, hovers at the threshold between the real and virtual world. This threshold or interface and its mixing, which only becomes possible through human perception, form the focal point of lifeClipper3.

From a technical point of view, virtual reality is independent of the many laws of physics in the real world. In lifeClipper3, however, it stays close enough to the familiar that it can still be categorized: it creates links with cultural modes of behavior, with the laws of nature (climate, season, day and night) and with the media literacy of the users. It does not have to reproduce prevailing physical and cultural rules, but has to take its bearings from these so as to remain accessible for our perceptions. Within lifeClipper3 there is an ecosystem, plants and animals. It is necessary that this be linked with parameters in the real world so that both worlds can fuse together in our perception. This aspect is also one of Scott S. Snibbe's and Hayes S. Raffle's design principles for immersive media. They express this as follows: "The media should augment and reinforce existing collocated social behaviors." [2]

In lifeClipper3 augmented reality takes place on several levels: the real geographic field is spatially congruent with a 3D model. The camera images of the park mingle with the virtual images and the real sound is also overlaid with virtual sound. At the same time, every walk is unique: the situation in the park is always different in terms of time of day, light, weather, temperature, encounters with people and animals. The real climate is juxtaposed with a virtual climate, the real living beings with virtual ones. Both worlds can be influenced by the user. At the same time the element of chance plays a part in both the real and the synthetic worlds. This gives rise to unique, non-reproducible situations.

Even if a walk was fully reproducible in all the points mentioned, individual users would perceive it differently, since they bring different experiences to bear (culture, age, gender, media literacy etc.).

To allow the users' individual associations to flow as freely as possible, the park is reduced to a purely spatial reference system. References to the significance and history of the park or to the city of Basel are deliberately omitted.

As a participatory artwork, lifeClipper3 abandons the role of the observer facing the artwork. The recipients become participants. They observe the artwork from inside. The artistic intention of lifeClipper3 is to stimulate and expand users' perceptions with the creation of novel experiences.

The "Theory" section presents the medial foundations and the artistic intention of the project, and situates it in relation to its predecessors. The intentions and special features of the project are then presented by means of a more detailed examination of the following: dramaturgy and systemic approach, design conditions, montage, interaction, immersion and perception. A central part of this paper is a visitor evaluation with experts, to test how the lifeClipper3 experience works in practice, and verify the effect it actually produces. For this the project is treated as a case study. The results of this evaluation provide a basis for the design of further immersive, location-related open-air AR applications. In the "Discussion" section lifeClipper3 is situated in terms of theory and media, with comparisons being made to computer game genres, AR games, and new-media art projects. The discussion ends with a methodical comparison to evaluations of similar projects. In the "Conclusions and Outlooks" section the results of the evaluation are summarized and conclusions are drawn for future projects with regard to issues of content and design.

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2 THEORY

This section explains the basic principles and the content and design strategies of the new-media art project lifeClipper3 (2.1-2.7).

2.1 Technology and media: the basics

lifeClipper3 is, in terms of media, an augmented reality (AR) application. The physical environment, in this case St Johann's Park in Basel, is extended (augmented) with virtual input. Unlike virtual reality (VR), in which the observers enter a purely synthetic world, AR ensures the audiovisual integration of reality, thus offering a novel range of design possibilities. The use of AR for entertainment, tourism or computer games has only been discussed in the AR community – which is still in its infancy – since the beginning of the new millennium. In the meantime various attempts have been made to adapt computer games for AR or to create virtual events in cultural heritage sites. An AR discourse on design is only just developing.

In terms of technology, the lifeClipper3 system is based on a wearable computer apparatus with GPS and sensors for direction and biofeedback which are used outdoors. A head-mounted display (HMD) with camera, microphone and headphones inputs information into the walkers' field of perception, depending on their location and viewing direction. The images and sounds registered are parametrically processed by the computer system in real time and enhanced with synthetic audiovisual elements. On their walk through the staged terrain the walkers influence both the images and sounds registered and the superimposed input through changes in their position and viewing direction. Using a finger mouse, they can take snapshots of their surroundings and document their trip. The coordinates of the virtual, spatially congruent 3D model of the park are constantly reconciled (calibrated) as well as possible with the geographical coordinates of the real park on the basis of the user's position (x, y, z) and viewing direction (u, v, w). This means that narrative elements such as 3D objects and sounds can be spatially positioned and precisely anchored in the spatial context of the real park landscape.

Figure 1. lifeClipper3 equipment and walk situation

2.2 Preceding projects

Since 2003 a series of AR projects has been developed by Jan Torpus at the Institute for Research in Art and Design at the University for Design and Art at the FHNW (University of Applied Sciences Northwestern Switzerland), or as independent new-media art projects. Collaboration in interdisciplinary teams has led to the creation of the design research projects living-room1, living-room2 and lifeClipper2, and the new-media art projects lifeClipper1 and lifeClipper3, which is documented in this publication (an overview of the projects can be found at http://www.lifeclipper.net). The mutual influence of these orientations has proven very fruitful. The design research projects, in which clearly defined requirements were determined and technically innovative products were created, were all based on scenario developments, with a focus on possible applications for the consumer market, interior design, architectural visualization, archaeology and game development. In the art projects the focus was and is on artistic stagings and investigations of human perception.

2.3 Dramaturgy and systemic approach

Through the mixing of real and digital impressions during the lifeClipper3 walk, visitors experience the unfamiliar. They catch glimpses of parallel worlds governed by different kinds of laws. This calls into question the culturally and physically determined experience of everyday life and stimulates visitors' imagination. This commingling disconcerts visitors and challenges familiar reality.

For content development and design implementation in the interdisciplinary team a script was developed. Here three fundamentally different virtual systems are used, creating a wealth of situations as they are combined in time and place: a location-sensitive system, a cyclic climate system, and a more complex chaotic ecosystem.

Since the park is foregrounded as the fundamental spatial reference model and is explored in the form of walks, the locational reference is most obvious in lifeClipper3. The staging involves a fixed system which takes into account the characteristic and morphological structures of the park and is subdivided into different regions.

The climate cycle is a periodic system which can vary in intensity and duration. It gives the overall system a base rhythm which repeatedly interrupts the second, chaotic system and leads to a recurring new beginning. Five different climates are lined up one after the other, creating, in their periodic sequence, a season-like narrative connection between life, death and new beginnings.

The elements of the ecosystem have both parametrically controllable features and behavioral patterns and random generators built in. The events in this emerging ecosystem are thus unpredictable and unique. The variety of situations and occurrences is not governed by any higher laws, but by the correlations of the individual local components which make up the whole. The ecosystem is defined by the behavior of the lifeClipper3 creatures (plants, herbivores, carnivores, and visitor avatar), which is partly random, partly governed by patterns, and the interplay between them and the environment. This paper does not go into the structure of the content in any further detail. The script can however be downloaded from the website http://www.lifeClipper3.torpus.com.

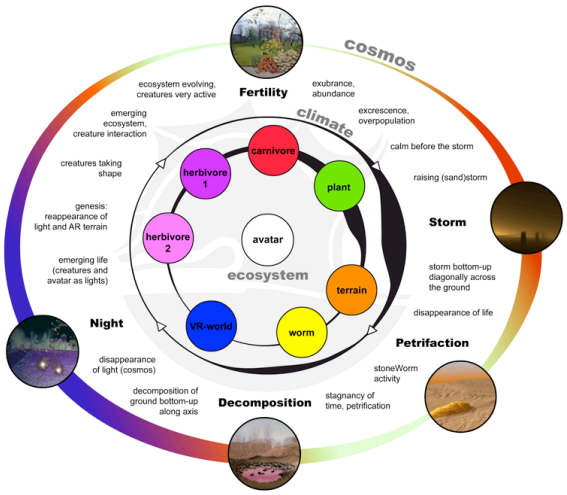

Figure 2. Graphic representation of the script

2.4 Design conditions

The more the real video image differs qualitatively from the virtual one, the more difficult it is to create the illusion in the eye of the observer that the two are one.

The technical prerequisite for the creation of this illusion is therefore the best possible mixture of the real and the virtual. Given the different image sources (in the case of video-based AR), this is not easy. Reality is represented as a pixelated, compressed video image with low resolution, while the virtual image components are vector-based, sharp edged renderings. In order to make the images similar in quality, the best possible camera must be used on the one hand and the image quality of the synthetic components can be reduced on the other. Another trick for artistic works is to alienate the camera image atmospherically in such a way that it is no longer primarily compared with everyday reality.

The problem of the coherence of the different image sources is sufficiently well known from photo montage as well as digital film montage (compositing). With regard to digital film montage with subsequently produced special effects and hundreds of overlaid levels of montage, Barbara Flückiger refers to aesthetic coherence. If the components are not coherently assembled, the viewer is torn from the illusion and begins to assess and analyze what he or she has seen as an artifact. According to Flückiger, what then happens is a "*shift in the processing of perception from the sensory to the semantic level: image formation itself can become the object of cognitive reflection. According to the classic doctrine of mainstream film, this shift in mode is to be avoided because the film would then be exposed as an artifact and its function as a medium of illusion would be undermined.*" [3] Even if the medium of AR offers a great deal of room for artistic-reflective investigations of the medium itself, lifeClipper3 is primarily concerned with creating plausible immersion and cinematic illusions, and also with recognizing and making accessible some of the structures necessary for this.

Even if the current state of outdoor AR technology, with its high-precision differential GPS and direction sensors, permits surprising precision in the spatial calibration of reality with the virtual model rendered and overlaid in real time, our eyes easily perceive the smallest dislocations. Mainly due to a lack of optical congruence at a distance and implausible psychophysical depth perception, it is simply impossible to assemble an image perfectly. In AR staging, the virtual elements usually float in the air without relational information concerning size or position. For lifeClipper3, this is mainly problematic for the small, isolated elements of the ecosystem.

The psychology of perception describes many laws that help people to recognize spatial depth in their day-to-day life. Some of these can be transferred into an AR system relatively easily. Shadow or light, for example, that is cast by a virtual body onto a real one, or atmospheric perspectives caused by fog contribute considerably to the plausible mixing of the real and the virtual. Changes in volume and frequency in the sound world or changed sizes of familiar elements or surfaces can also contribute to this. Others are more difficult to implement, and limit design options or force the director to tell a story differently or to convey the content differently. In lifeClipper3 the terrain is therefore additionally subdivided into different zones that only reveal their virtual input if the walker has come close enough. Thus elements such as plants, for example, that should adhere to the ground, primarily grow around the viewer, cast shadows, or mix with the real ground texture through transparently flowing stalks and trunks.

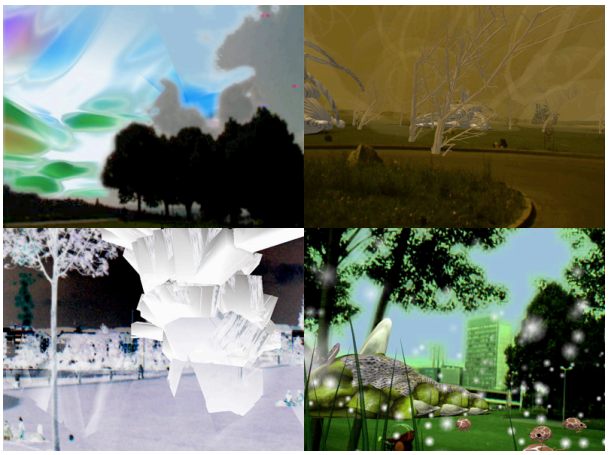

Figure 3. lifeClipper3 screenshots

2.5 Montage in augmented space

In classic augmented reality (AR), the reality represented (the video image) is the dominant framework, which encompasses and integrates the additional virtual components. This is achieved by showing the video image, which is filmed before the viewer's eyes, as a background image. It is mounted as a real-time video stream like a texture on a remote 3D projection body in the virtual space (mapping) and the virtual elements are placed in front of it. If the virtual elements are matched to reality in the correct perspective through tracking, and are dynamically positioned in real time, and if the projection body for the background video always remains properly positioned in the field of vision, this creates the visual illusion that the virtual elements are part of the video image and therefore reality.

lifeClipper3 experiments with the possibilities of montage technologies in augmented space and partially breaks with the classic conventions described above. The projection body in the background is only used for the sky and horizon line of the park, which is separated from the sky by a luma key. With this exclusion, the real sky can be replaced by a virtual sky that merges with the real image along the horizon line. This produces the possibility of simulating climatic changes, times of day, or other cosmic configurations. But the main part of the video is directly projected with planar mapping onto the 3D model which

has been made of the park, and which comes to lie over the park as congruently as possible through accurate tracking. Through this approach, the projected pixels of the video coincide with the spatial representation in the virtual space. Although the projection throws shadows on the organically formed 3D terrain and calibration errors become visible along the border between the two projection bodies (terrain and horizon), the montage system offers distinct advantages:

It makes it possible to position virtual elements in the corresponding positions and to have them merge with the real image through effects. This is achieved by means of light and shadow, fog, or by having the virtual elements plunge into the ground of the real terrain.

Figure 4. Studies for ground penetration and virtual sky

But the 3D simulation of the park is not only a projection surface for the real-time video image: it can also be overlaid with prefabricated textures in whole or in part. That way the real terrain can be converted into other states and changed and staged through flowing transitions. This happens in lifeClipper3 when, for instance, the terrain is transformed into a desert landscape after the storm. On the one hand the park is still recognizable through its morphology and contours, with simulated infrastructure elements such as street lamps, park benches, and railings serving as reference points, and yet on the other hand it has changed its state. Since the now completely virtual environment still adapts to the position and viewing direction of the walker and coincides in perspective with the reality that is still recognizable at the edge of the glasses, the space is perceived as immersive. Here, augmented reality does not arise through an audio-visual montage of virtual and real image and sound components within the headset (HMD), but through mental allocation and superimposition. The mixing proportions between the real and virtual are fluid and vary from one climate to the next. Since the virtually reconstructed terrain consists of a polygon structure, not only superficial but also spatial-morphological interventions can be carried out.

While the real terrain and the position of the walkers in the park are always subject to basic physical laws, the virtual world is free of these limitations. Colors, light, and basic atmospheric moods can be changed anytime and anywhere for the staging. In lifeClipper3, for example, virtual creatures can fly very slowly, as though they were in a water-like element, and can penetrate the ground of the terrain as though it were not made out of solid material. These virtual elements with their own physical laws are contrasted with many real sensorially perceptible attributes of the park: variations in the ground surface, for example, remind walkers of their contact with the ground. Wind and smell change when one reaches the Rhine riverbank. Depending on the weather, the park has moderate to high numbers of visitors; people have barbecues, play ball games, laugh and go for walks. These random situations are incorporated into the world of lifeClipper3 and enrich it.

lifeClipper3 has been deliberately separated from the cultural context of the town of Basel. The small park, newly laid out only 20 years ago, is included solely as a play area with a system of paths, various hills, meadows, trees, the Rhine, and the rest of the park infrastructure. Historical and infrastructural references are blanked out.

In addition to the augmentation of reality through 3D elements, changes in the audio-visual parameters can change the appearance and atmosphere of the park. For example, the video stream that is engaged can be colored, inverted or darkened in real time. Direct changes to the video image lead to alienation of the representation of the real and therefore move closer to the strange aesthetic of the superimposed, synthetically generated 3D world. This leads to a plausible mixture of the two media forms of live video stream and 3D model and therefore to a more holistic, immersive experience. As with the image, there are also two types of sound: on the one hand, it is recorded with a microphone in the park and altered, and on the other hand it consists of prefabricated samples which are added in. The mixing of these two basic types means that it is possible to speak of augmented reality in the world of sound as well; here too parametric changes in real time are made in response to chance events and the real environment.

One of the qualities of the location-sensitive system in combination with the iterative cycle is that walkers do not have to follow a prescribed route, and so can move freely within the park and, depending on the walking route chosen, access a different selection and sequence of experiences. In order to give them an intense experience even if they only move around part of the terrain and only get to see and hear a fraction of the total staging, an emergent ecosystem capable of triggering a wealth of events was introduced. Unfortunately the HMD reduces the visitors' field of vision to a 45° angle, which is very limiting for the staging. An effective means of drawing attention to things happening outside the field of vision is locally positioned sound. Noises which have previously been visually assignable to an occurrence are also recognized acoustically outside the field of vision, and provide an auditory supplement to the limited field of vision. Marshall McLuhan describes the spatial attributes of the world of sound as follows: "*The universe is the potential map of auditory space. We are not Argus-eyed but we are Argus-eared. We hear instantly anything from any direction and at any distance within very wide limits. Whereas the eyes are bounded, directed and limited to considerably less than half the visible world at any given moment, the ears are all-encompassing, constantly alert to any sounds originating in their boundless sphere.*" [4] The auditory compositions and harmonies are also parametrically generated. They change according to where the visitor is, which way she is looking, and how close she is to which - and how many - creatures.

2.6 Interaction

Avatars ordinarily represent players in virtual worlds or serve as visual elements for collaborative or communicative systems. This occurs without any connection to the player's actual physical location. The lifeClipper3 walker, however, is physically in situ. He/she is in the midst of the action and simultaneously at the point of intersection between the two worlds. As with a first-person shooter, the visitor's extremities might allow him/her to recognize his/her own self. This approach was not implemented in the framework of the lifeClipper3 project, however.

The walker can interact with the lifeClipper3 world in various ways: through movement in the park (standing still, walking, running), through viewing direction (horizontal, vertical, lingering), and through breathing (fast, deep, regular breathing). Implementation of additional graphic interfaces (GUI) besides the park landscape was consciously avoided so that the walkers would interact directly with the physical reality as in everyday life and would not have to learn abstract menu structures and functions.

Maurice Merleau-Ponty describes the natural interaction with the space that surrounds us as follows: "*Our body is not in space like things; it inhabits or haunts space. It applies itself to space like a hand to an instrument, and when we wish to move about we do not move the body as we move an object. We transport it without instruments as if by magic, since it is ours and because through it we have direct access to space.*" [5]

2.7 Immersion and perception

In his book "The Language of New Media" [6], Lev Manovich speaks about the screen society. He describes the tendency in historical Western culture to present everything on screens and thus to fix the body of the observer in the space in front of the screen. Virtual reality is the first to break with this media tradition, establishing a new relationship between observer and picture. The entire field of vision is thus covered and the gaze is no longer solely focused on a flat image or a window onto another world. The other world can be perceived in perspective, explored from personally selected viewing angles and even entered. The physical movements are no longer executed by the camera, but, in a free form, by the visitor.

Since the observer is, in a purely physical sense, no longer in front of the screen, but right in the middle of things, AR in general and lifeClipper3 in particular allow a form of physical immersion which must be compensated, in most computer games, by other kinds of immersion. In media terms, then, there is a good chance that AR will give a sense of immersion.

Applications in the field of virtual reality have not yet reached the mass public, even if there are publicly accessible simulators and slot machines for this. In principle, however, there is a discernable tendency to dissolve the screen and to open up the artificial space, and augmented reality aims to take the next step, blurring the boundaries between the real and the virtual, and the distinction between play and everyday life. Naturally, even with the most deceptive pictorial illusion, the user or player still has to agree to go along with the illusion.

A person who no longer experiences any difference between reality and fiction loses his or her sense of reality, which cannot be the aim of either computer games or AR applications.

Various attempts have been made to distinguish between types of immersion. In their design patterns for computer games, Staffan Björk from Sweden and Jussi Holopainen from Finland – both computer game researchers – distinguish between four forms of immersion: spatial immersion, emotional immersion, cognitive immersion and senso-motoric immersion [7]. A similar distinction is made by Ernest Adams from the USA. From the perspective of the game designer he divides immersion into three categories: senso-motoric (solving problems through skill), strategic (developing strategies to win) and narrative immersion. Since there are no problems to solve in lifeClipper3, where the aim lies in exploration and *flânerie*, what is relevant for the staging of the content is, alongside the spatial immersion inherent in the medium, narrative immersion. Adams describes this as follows: "It is the feeling of being inside a story, completely involved and accepting the world and events of the story as real. It is the same immersion as that in a good book or movie, but in video games, the player is also an actor within the story." [8] In lifeClipper3 there is neither a linear narrative nor a story to be discovered. The narrative is limited to the presentation of a fictitious world with its own laws, occurrences and events which come together in visitors' perceptions to create a whole. Here the route taken can become the individual narrative thread. Don Carson, who worked as a Senior Show Designer at Walt Disney Imagineering, argued that game designers could learn a great deal from techniques of "Environmental Storytelling" which Disney uses for the design of theme parks. *"The story element is infused into the physical space a guest walks or rides through. It is the physical space that does much of the work of conveying the story the designers are trying to tell (...). Armed only with their own knowledge of the world, and those visions collected from movies and books, the audience is ripe to be dropped into your adventure."*[9] In lifeClipper3 too the real space is staged, even if this has only been done virtually so far. No introductory film sequences are shown, as is usually the case in games. The space must explain itself and thereby also allows personal interpretational liberty for associations or, as Don Carson describes it, for the accumulated knowledge which, depending on cultural background, is incorporated into the story.

2.8 Evaluation

In the final phase of development lifeClipper3 was evaluated with qualitative ethnographic methods by users in the field, so that the insights gained could be used to make final adjustments to the structure, content and design. The following section explains the test arrangement, the methods used, the focus of the study, the form of the analysis and the initial insights and conclusions.

Figure 5. Expert in the field (with interested passerby) and expert snapshot (HMD screenshot)

2.8.1 Qualitative/empirical test arrangement

The evaluation of lifeClipper3 involves feedback from eight specifically selected experts with expertise in the field of new media. It is based on a combination of various established approaches from usability evaluation and methods of qualitative ethnographic research. The evaluation setting is basically drawn up in two parts.

In the first part of the evaluation the test persons were invited to go for a lifeClipper3 walk and to describe their experiences in the process (thinking aloud protocol). They were accompanied and observed during their walk (field observation) to establish how they dealt with the system and how they coped with it in the field.Topics which arose were taken up and discussed in more depth by their guide, but no interview was carried out. The comments and the videos which came about by means of the headset (HMD) were recorded and later analyzed and processed. In addition to the commentary, the test persons were given the task of recording what they experienced during the walk (cultural probes) and considered worth documenting with a remote-control release (finger mouse) integrated into the system.

Each walk lasted thirty minutes and consisted of a prescribed circuit and a second part in which the participants could move freely.

In the second part of the evaluation – after each lifeClipper3 walk – a short conversation was held, looking back and reflecting on the experience (retrospective testing).

At this point the structures and intentions (script) of the project were described and the test persons were asked to talk about what they had experienced and relate it to the script. This second part of the evaluation was audio recorded and subjected to a qualitative evaluation.

2.8.2 Explanations on the transcriptions

The transcription of the video and audio recordings involves a deductive approach in which passages were selected with regard to the issues relevant to the evaluation (see above) and were subjected to post-editing. The audio recordings of the commentaries were only partially transcribed and no linguistic analysis of the content – to examine the finer points of the test persons' phrasing – was undertaken. In the transcription the comments in Swiss German were translated into standard German. The oral style was retained.

2.8.3 Focus of content and investigations

Experience with the lifeClipper1 and lifeClipper2 projects has shown that visitors must first get used to the medium and the wearable computer system before they can concentrate on the audiovisual content. In order to be able to focus more quickly on the key thematic elements, experts were thus invited who were familiar with AR technologies, who knew the lifeClipper project series and who had already been introduced to the basic concerns of the project at hand. Within the framework of the evaluation, tips and insights valuable for the design and form of the implementation were sought. The aim was to test the following aspects:

1. The total experience, the perception and interpretation of the design-related audiovisual approaches
2. Perceptibility of the dramaturgic strategies of the script (time, place, interaction, narration, emergence)
3. Use of the forms of interaction and recognition of the correlations between the virtual agents
4. Degree of immersion
5. Mixing proportions between real and virtual

Insights and conclusions on these investigations can be found at point 2.8.4. and 4.

2.8.4 Insights and findings

In this section only the most important, repeatedly occurring observations and statements of the experts are summarized and only exemplary or exceptional statements are quoted.

Did the test persons recognize which atmospheric elements were triggered temporally (without interaction) and which were triggered by location (through interaction)?

As a general principle it seems to be difficult to distinguish between scenes which were triggered temporally without interaction, and those triggered by location, through interaction. There has as yet been little evidence to support the assumption that slower changes are perceived more as temporal, and not as interactively triggered phenomena. Repetitions have a positive learning effect during a walk. Since a temporally triggered event probably will not recur at the same place during the same behavioral patterns, the test persons can assume that they are not the direct cause of the scene and thus become aware of a higher logic.

Expert 1: "Now I'm probably in a desert or at a beach and the change has come without me having moved much. Up till now I always had the feeling that I was controlling everything because I was moving. This wasn't like that. … So here is a sequence which I don't control directly by means of my position."

Expert 2: "If you were sitting in the cinema you'd probably notice the temporal structures more. But when you're in the space and getting your bearings, you blank it out completely."

Mixed forms – from reality with slight virtual extensions to a completely virtual world.

The breakdown of reality and commingling with virtual components receives a fundamentally positive response. The test persons often play at the intersection between the real and the virtual by combining audiovisual changes and superimposed virtual elements with extracts from pictures and chance events in the park. (cf. also [10])

Expert 3: "I actually find the part-immersion fascinating. I was standing down there and then mothers with prams came up and then the animals went through in front of them and so on. That's a picture which has something poetic about it."

The role of observer and reporter is further emphasized by the fact that the test persons have the opportunity to take photos of their reality with a remote-control release, and are aware that their experience is being recorded.

Alongside the audiovisual mixes in the HMD, augmentations can also be produced at the edge of the glasses if the reality of the park remains visible out of the corner of the viewer's eye. Since the virtual terrain overlaps almost completely with the real terrain, and behaves spatially almost like reality when the subject moves in the field or moves his or her head, it is assigned to reality even without visual mixing within the HMD.

Expert 1: "I thought the best moment was the one in the desert. Although you're completely in the virtual space and wearing glasses, you do the superimposing in your head."

Interactive game or atmospheric experiential space?

The actions of the virtual creatures of the ecosystem are largely understood. Their behaviors among themselves and between them and the test persons are manifested through spontaneous reactions. Some of the test persons seem at times to accept the virtual elements as real, and dodge them as if they had a physical presence.

Expert 4: "There's this fascinating fish. I think it's going to crash into me. Ow, these fish are crashing into me. They're a bit aggressive, these red fish, and make an unfriendly sound."

A certain awareness of possible forms of interaction is already present. Most of the test persons understand the experiential space less as a game world than as an artistic staging which one visits and explores. Instead of concrete actions and missions the project can offer mental stimuli, which provoke and associate novel forms of perception.

Expert 3: "Maybe it's not a question of an action, but of possibilities, of possible actions. That you as producer actually don't offer any actions, but only possibilities."

Directing attention

Some of the test persons do not realize until afterwards that they have only explored the staged landscape horizontally, and never looked up into the sky or down in front of their feet. In the location-sensitive narrative space, it is sometimes necessary to dramaturgically direct attention, especially when associations are meant to be made between abstract processes. This can occur for example by means of recognition of moving elements or sounds positioned in 3D (cf. also [11])

Acoustics and sound

In the lifeClipper3 staging, as is customary in film montage, the world of sound is often brought forward slightly and thus announces events which are not yet visible. Sound connects sequences of visual scenes to create a whole. Since the sounds are positioned spatially, they are also helpful for orientation purposes. They expand the restricted field of vision of the HMD and thus the perceived environment. Music and sound are also very important for lifeClipper3 on the emotional level, and are perceived by the test persons like film music..

Expert 5: "Where is that elephant?" She hears something and looks around. "Now you feel as though there must be a huge animal coming, but no animal comes at all."

Expert 5: “I think that the congruence between sound and image is more decisive for the degree of immersion than the congruence between the real and virtual contents on the visual level.”
Expert 1: “The thing that’s absolutely cinematic, of course, is the music. It’s absolutely Solaris II or something like that.”

Overall experience and immersion, familiarization with the system
Immersion is often equated by the test persons with the degree of involvement (through interaction or intensive engagement), the audiovisual alienation of the environment and the virtuality (the more virtual, the more immersive). Among the mixed forms between real and virtual world, the climate “night” is particularly popular. For this climate reality is still easily recognizable as such, but is veiled in twilight by means of dark blue tones and exclusion (luma key).
All the test persons begin to move more freely after about three to five minutes, as they have already got used to the new situation. In two cases bodily influences such as tiredness and visceral sensitivities are pointed out. In terms of weight and volume the equipment is not yet optimized and is generally considered to be a hindrance. In one case, however, the putting on of the equipment was positively received, as a ritual of transition or rite of passage. The willingness of the test persons to take risks and to engage fully with the experience varies considerably.

Design approach of the “game world”
There is little concrete feedback on the design approaches and structures. It is generally felt, however, that the virtual input should be kept close to reality.
Expert 4: “I don’t think it should get any more abstract. I think it could be more mixed, that the environment could play a greater part and the things you encounter here in the park.”

Staged fantasy world vs. information layer
In two cases the test persons complained that the project was too disconnected and fanciful and that no referential layer of information about the park was included.
Expert 8: “I think a layer of information would be interesting, with content being conveyed partly through typography or sound as well, and not necessarily with 3D. I think that an approach which looks at the place as a concentration of layerings and times and which looks for connections (allusion to an archaeological staging in lifeClipper 2) would be more interesting than fantasy superimpositions which could be staged anywhere.”

Orientation and isolation of the parallel worlds
On the one hand the virtual elements make orientation more difficult. On the other hand they offer an additional layer of information which can aid orientation. This is most interesting when test persons do not yet know the place and later only remember it as an experience in its virtually augmented form.
Expert 5: “You even have some degree of orientation in the park, because you know we started over at that (virtual) grass.”
The exclusive experience of disconnected simultaneity at the same place is appreciated.
Expert 1: “I do find it very exclusive, the fact that only I see it and that it’s really a completely different world.”

Comparison with the preceding versions, lifeClipper 1 and 2
As some of the test persons had experienced earlier lifeClipper implementations, interesting comparisons are made. The goal of staging an entertaining, half-hour long, artistic, immersive experience seems to have been successful, at least in comparison to the preceding versions.
Expert 1: “What struck me was: this time, it’s been going for 2-3 minutes and you’ve already forgotten the technology.”

3 DISCUSSION

In this section connections are made between lifeClipper3 and computer game genres, new-media art projects, and scholarly publications in the field of design research.

3.1 Computer game genres

The comparison with computer games is central for AR applications because this is where the existing media literacy of the users can be built upon – or where existing media literacy raises expectations regarding augmented reality. Blair MacIntyre et al. speak in this context of "remediation". [11]
lifeClipper3 borrows components from various game genres. A comparison with adventure games and artificial life games is most obvious.
Adventure games are notable amongst other things for being interactive narratives which make it possible to participate in the adventure at close quarters through emotional identification with an avatar. Since the interaction is not restricted to shooting, driving, constructing or similar activities, and the single player can move about freely, an extensive, self-contained system must be developed. This also applies to lifeClipper3 as an AR staging. The photographic recording of important moments in lifeClipper3 is comparable with the mission in the adventure game “Wild Earth Africa” [12], in which the players go on a photo safari. In lifeClipper3 the photography has not been a central mission so far, but it seems to have great potential.
Artificial life games are based on the achievements of Artificial Intelligence. As explained in section 2.3, “Dramaturgy and systemic approach”, lifeClipper3 builds partly on a generative system which generates an ecosystem with random situations but also clearly defined behavioral patterns for creatures and plants and correlations between them. The decoding of these characteristics and correlations makes it possible to recognize concepts and connections. Ernest Adams and Andrew Rollings call this a “conceptual reasoning challenge”. [13] lifeClipper3 is meant to inspire curiosity, and the desire to discover the AR world, understand it and clarify its rules. The virtual life forms in lifeClipper3 do possess artificial intelligence with specific behavioral patterns. Unlike games such as Creatures [14] or Spore [15], however, in which beings are created and evolutionary processes simulated, lifeClipper3 is solely concerned with creating rich, life-like situations.

3.2 AR games and new-media art

In terms of medium, the most obvious comparison is with AR games such as “ARQuake”[16], “PacManhattan”[17] or “Epidemic Menace”[18]. In the first two, the computer games Quake and PacMan were transferred from the screen to the AR space, whereby only a rudimentary attempt was made to respond to the spatial context of reality. Nor were elements of content from the real surroundings, or the fundamentals of design, taken into account in Epidemic Menace, which has a specially developed story and a mission to carry out. Developments of this kind came about worldwide at various universities at the beginning of the 21st century, and were early, mostly technically accomplished, playful applications of AR technologies.
Since then, however, a broad field of various media forms of play has developed in the area of new-media art or the frontier zone between art and game development. In their book “Space, Time, Play” [19], the editors present articles by well-known media theorists, artists, and game developers, introducing a colorful jumble of genres such as “augmented reality games” (ARGs),

“alternate reality games (ARGs)”, “ubiquitous games”, “pervasive games”, “geo-games”, “location-based games” and the like. All the projects introduced in this section are concerned with the superimposing and mixing of a virtual game world with the real, generally urban environment, and with the communication, collaboration or competition between several players who are active in one world or another and have to compile and combine different kinds of information into a whole in order to reach the goal.

Artworks such as “Can you see me now?” [20], commercialized games such as “Botfighters” [21] or “MOGI” [22], advertising campaigns such as “Perplex City” [23] or “Beast” [24] show the spectrum in which stories can be told and games played on everyday objects such as smartphones, using technology which has only recently become affordable.

Although at first glance a great affinity might be assumed to exist between these developments and the lifeClipper3 project, lifeClipper3 differs fundamentally from these in various respects. Instead of everyday technology, a highly developed wearable computer system with an HMD is used. The players are transposed completely and immersively into an alternative reality, which, for safety reasons, can only be experienced in a protected framework with a personal guide. The experience engages the senses; it is personal, fantastical, unworldly, and hardly to be compared with a game intended for social entertainment. lifeClipper3 is not concerned with taking a usually invisible layer of information which has become readable through the increased networking of the data streams, and making it usable, visible, and available for creative play. Instead it is concerned with creating an immersive, accessible form of emotional cinematic experience.

Projects which come closer to the immersive, sensory quality of lifeClipper3 than those mentioned above can be found, amongst other places, in the field of exclusively auditory georeferenced new-media art. The Canadian artist Janet Cardiff has become known for her “audio walks” [25]. Visitors have stories revealed to them which have happened or could have happened in the places they are in, solely through instructions and directions given with a portable audio player and without technical georeferencing. The auditory performance leaves a great deal of room for personal imagination and is thus similar to a situated audio play. Since the late 1990s it has also been possible to find examples for location-sensitive acoustic stagings (audio-scapes) which experiment with new technologies of geoinformation and real time montage. In “Taxonomy of Mobile-Sound Art” [26] Frauke Behrendt gives a good overview of what is known as “Placed Sounds”. There are also examples to be mentioned in the field of acoustic stagings of cultural heritage, such as the “Historic Oakland Cemetery of Atlanta” [27] or Time Warp [28].

3.3 Design research

Since the beginning of the new millennium increasing numbers of interesting scientific papers have been written on AR in the context of experience design, art, narrative and games. If one limits the search, however, excluding topics such as the following, the choice of comparable studies quickly narrows down:

- technical development of software tools and hardware devices
- location-sensitive AR editing tools for design processes and content management
- guide and information systems for commercial applications
- educational and collaborative environments
- social, multi-user and role-play games
- applications for handheld devices
- tangible indoor interfaces

If one concentrates on staging strategies with immersive AR in public outdoor spaces and their effect on the audience, one finds only a handful of studies which can be referred to specifically. These scientific papers are included in the course of the present study where contextually relevant. In the following, the focus is on papers containing an evaluation, in order to compare the research methods used.

The evaluation methods used for lifeClipper3 – thinking aloud protocol, field observation, cultural probes and retrospective testing – are among the standard methods of evaluating AR applications outdoors [29] [30]. Josephine Reid et al. argue that test settings of outdoor AR projects should be tried out on test subjects during the developmental phase by means of "research field trials", and that the results should then be incorporated into the subsequent development. They call this approach "emergence driven research methodology". It corresponds to the approach used in lifeClipper3, where the results of the evaluation were also incorporated into the subsequent development.

A few studies on AR applications outdoors use quantitative methods as well as qualitative ones. By means of GPS Tracking, they make visible the paths taken by the test persons [27] or produce graphs about the length of stay and content accessed [29] [31]. For lifeClipper3 the GPS tracking data of the test persons is available and would even make it possible, in combination with viewing direction coordinates, to reconstruct the walks virtually in 3D. This was done for the preceding project, lifeClipper2. Since this data is of little significance for the central questions of the evaluation, this method was not used for lifeClipper3. A quantitative evaluation was also eschewed, firstly because the sample of test persons was too small, and secondly because the evaluation was aimed more at discovering how the walk was experienced, and not what exactly happened. The uniqueness of each walk is another reason not to make a quantitative comparison between them.

4 Conclusions

Based on the conclusions of the qualitative/empirical evaluation and the theoretical research, various essential points can be extracted. They are structured along the research questions mentioned in 2.8.3.

4.1 The total experience, the perception and interpretation of the design-related audiovisual approaches

The compiling of the experiences and the feedback of the experts have shown that lifeClipper3 has developed in various ways in comparison with the preceding projects lifeClipper1 and lifeClipper2. The technical system allows the best spatial immersion so far. It proves disadvantageous, however, that the equipment has not become lighter than in previous projects. The criticism was made that the equipment hindered free, playful immersion. Now that the computing power in particular has been pushed to its limits in lifeClipper3, an optimization of weight and volume or, better still, a wireless connection to a stationary computer would be desirable.

The willingness to take risks and to engage fully with the experience varied considerably from one test person to the next. A certain willingness to experiment thus remains a personal prerequisite for an interesting experience in a lifeClipper-like setting, and therefore also defines the possible target group.

The aim to implement an artistic staging which, in a non-linear, location-sensitive, freely accessible setting, is dense enough on the experiential level to allow visitors to immerse themselves in an AR world for a fairly long period of time, has been achieved.

It was confirmed once again that minimal interventions by means of virtual input and parametric audiovisual real-time changes,

where it is not clear whether they are real or virtually superimposed, are at least as fascinating and disconcerting as elaborately designed audiovisual parallel worlds.
It would be desirable, in a later implementation, to work with physical components of staging as well. Sculptures or other artistic interventions in the park would inspire curiosity and could reveal their augmented meaning by means of virtual supplements during a lifeClipper3 walk.
The visitors' exclusive experience and the conversation with the person accompanying them were much appreciated.

4.2 Perceptibility of the dramaturgic strategies of the script (time, place, interaction, narration, emergence)

Most of the test persons could not make distinctions between content triggered by location and by time. It remains to be examined whether longer learning processes in the system, through multiple visits, would trigger a different type of understanding and sense of time and space.

4.3 Use of the forms of interaction and recognition of the correlations between the virtual agents

Enjoyment of the game and attentiveness to various forms of interaction was already present. Nonetheless, the test persons were sometimes unsure to what extent they could influence the lifeClipper3 world. The expansion of the interaction and a clarifying graphic interface (GUI) would mean, however, that people would engage less with reality as interface and with the point of contact between the real and the virtual. This would work against the actual essence of a contextualized AR staging. The behavioural patterns of virtual agents and their correlations and forms of interaction should thus be closely aligned with the conditions in the park.
The role and state of mind of the walkers have sometimes been designated as observing or isolated (under a bell jar). The planned implementation of an AR avatar as a skin seen from inside could intensify the bell jar effect even more. Further experiments must be carried out here so that this isolation does not become too dominant, and so that the feeling of interactive connectedness and integration is fostered.

4.4 Degree of immersion

The degree of immersion was generally equated with the degree of involvement through interaction or with a greater virtual image component.
As expected, the spatial positioning of sounds for locations, climates and creatures was very helpful for the staging. Since the visitors were able to mentally assign the sounds around them, the environment became playable even outside their field of vision, thus making the staging considerably more immersive. It was also proven that sounds can create connections between more abstract narrative elements.

4.5 Mixing proportions between real and virtual

The popular climate "Night" showed that it can be more effective for the aesthetic staging if the reality depicted no longer acts as an all-encompassing background, but is perceived solely as a fragmented image component.
Elements which come to lie over the real terrain in fully virtual form were generally given a positive reception by the visitors, as they were able to mentally connect the virtual and the real with just a few points of reference. An important basic prerequisite for this is an HMD without blinkers which ensures that reality can still be seen out of the corner of the eye.
The test persons enjoyed playing at the intersection between the real and the virtual, by combining audiovisual alterations and 3D superimpositions with interesting image extracts and motifs, or creatively altered chance events in the park in real time, placing them in other mood landscapes and contexts of content.

4.6 Possible predictions for commercialization

The question of whether the vision of "tomorrow's immersive cinema" will become popular with a wider audience can hardly be answered with this evaluation of lifeClipper3. It will not be of commercial interest for this sector until the environment can be surveyed with spatial tracking, transformed into 3D models in real time, and the virtual enhancements can be composed dynamically. Then, depending on personal profiles and areas of interest, "ubiquitous adventure channels" could be accessed and reality could thus be played upon in real time. lifeClipper3 is in this respect a test setting which works on the assumption that these technical challenges will soon be overcome, but that the issues of content and design will remain similar.

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