Interactive Installations Analysis
- Interaction Design of a Sensory Garden Event -

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Abstract: Interactive Mixed Reality installations combine multimedia with novel multi-modal interaction techniques. As an example of mixed reality environments the "Sensoric Garden" - seven installations shown during a festival in Bremen - are described. As this kind of event cannot be evaluated in terms of usability or effectiveness, we need other categories to assess the attractiveness or "joy of use" of installations. Categories from the discourse on interaction design and interactivity were found helpful for a design reflection into why some installations were an "interactive success" and others failed to meet expectations and received little visitor attention.   *Copyright © 2002 IFAC*

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1. INTRODUCTION

In 2002 a festival celebrated the 200th anniversary of Bremen's central park located in the medieval town ramparts. During three nights of this festival the media informatics student project METHEA invited to an interactive installation bringing the "theatre hill" (former place of the destroyed theatre) to life again.

The installation (respectively performance), entitled *Sensoric Garden*, was both end result and presentation of an obligatory one-year project in this bachelor curriculum. It consisted of an ensemble of thematically connected separate installations and can be interpreted as a mixed reality environment (Billinghurst and Kato, 1999). The 19 Students wanted to connect interactivity and theatre, to create multi-modal installations with novel interaction techniques augmenting the real theatre hill. Seven installations were distributed in an enclosed area of about 800 m[2] with flower fields, pathways, places and short stairs (Fig. 1). Installations had been positioned on paths, places and open spaces. During the three nights of June 20th to 22nd more than 600 visitors saw and promenaded the Sensoric Garden.

The project was supported by F.W. Bruns and his group from the research centre artec (art, work, technology) and J. Richard from cultural and theatre studies. The project topic continues the research tradition of this group on the merging of real and virtual worlds in production technology, informatics, vocational training and arts and on new forms of man-machine interaction (Bruns, 1993) which recently resulted in the forming of artecLab.

One of the authors, not being involved in the creation of installations, was present during the entire first two evenings of the event, accompanied by a foreign visitor. They observed closely how visitors interacted with the installations as both were interested in interaction design and issues of real world interfaces. Figure 1 shows the layout of the theatre hill which provided an enclosed area where one could easily overview about half of the area from most places. Thus it was possible to monitor patterns of visitors walking around, passing by and remaining, of crowds forming and moving and to observe visitors at specific installations from nearby. Another independent student-group (Cappenberg et al, 2001) evaluated the event with 15 interviews and a questionnaire (90 visitors).
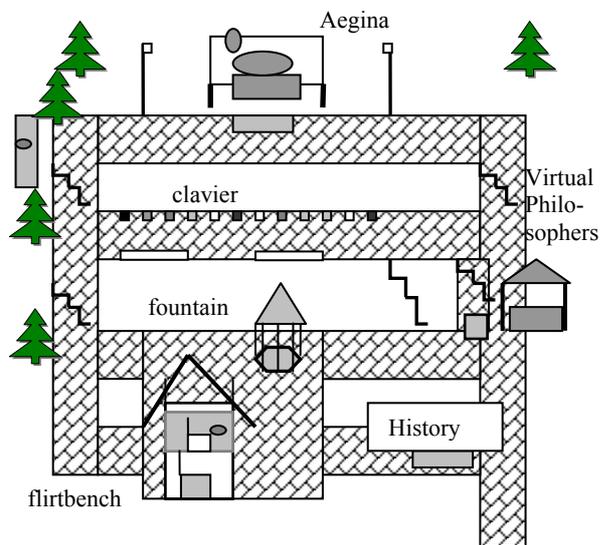
Fig. 1: Sketch of the of the theatre hill layout.

About 100 visitors were usually present, walking around slowly, talking with friends, taking time to discover installations and observing other visitors. Their long stay (22 pm until 1 am) and negligence to bad weather (rain) gave evidence of their interest in the installations and their fascination. Most visitors (67%) evaluated the whole event as very good or good and described it as "fairytale atmosphere" and in harmony with the natural surrounding; 57% participated actively (Cappenberg et al, 2001).

The authors initially found it difficult to explain *why* certain installations were a success in terms of visitor attraction and what made others fail in receiving prolonged engagement. A later inquiry into interaction design and interactivity provided a new starting point for an analysis of the interactive potential and respective strengths and weaknesses of installations. The structure of this paper mirrors this process, first providing details on the installations, then giving a short introduction into interaction design before re-examining and reflecting upon the installations using concepts from interaction design.

DESCRIPTION OF INSTALLATIONS

At the entrance of the enclosed area a large screen allowed an inquiry into the *history* of the theater hill. Via stepping on a touch sensitive carpet, visitors could navigate. The sensitive spots of the carpet had been painted with foot step images. The carpet itself was connected with a rewired keyboard controller.

At a large square visitors found a red-lighted pergola with an inviting red sofa, called *flirt-bench* which was filled with music. People saw themselves mirrored on a large curtain by video-back-projection (Fig. 2). On the sofa they found paper cards with black and white patterns. These were substituted in the virtual mirror by fantastic virtual objects following every movement in 3D perspective, using AR Toolkit as pattern recognition and VRML overlay technology from Washington University

(Kato and Billinghurst, 1999). Here visitors often sat down in pairs or small groups and played with the marker cards and virtual objects.

Next to the flirt-bench the *fountain* was located (Fig. 3). This was a circular well with touch sensors on its rim triggering water jets. Stepping on sensors made the jet underneath the rim sprinkle into the well. From the roof of the well, varying images were projected onto the fountain.

On the next path visitors found the *clavier*: a walkway with small light sensors interrupted by walking across the path (Fig. 4). Triggering sensors created an echo of light and sound. Coloured spot lights reacted were one put ones feet and midi beats and drums produced an ambient sound arrangement. The installation utilized a parallel I/o-box connected

Fig. 2: A group on the FlirtBench holding cards with markers and virtual flowers (anonymised)

Fig. 3: The fountain with surrounding pressure maps

Fig. 4: Clavier during set-up

Fig. 5: Steering Aegina via footsteps

to the serial PC interface to steer parallel bidirectional I/O ports. Visitors danced, jumped from light to light and created music pieces. Other visitors used the park benches along the path to rest.

On the right hand side of the park a highly frequented pavilion showed the 3D-world of a Greek temple housing *virtual philosophers* (a female philosopher and Diogenes). On being asked questions via a microphone they always answered with discussions about realness and virtuality. Despite of large stickers telling not to touch buttons, some visitors could not resist pressing the red button on the input desk, which put the temple on fire. Now philosophers begged for help and asked visitors to use the real pump next to the input desk. Pumping extinguished the fire with virtual water. Now the philosophers thanked and asked to reflect how virtuality effects what we do in the real world.

On the back of the park the statue of *Aegina* (by Gerhard Marks) came to life and attracted constant crowds. Through a projection screen one often could see the real statue, which seemed to rise up as avatar and started to explore a small planet where she met other statues and objects. Bremen residents recognized these as elements of the ramparts park. On meeting Aegina, the statues would come to life too for a few moments in animations. Her movement was steered via touch sensors on a carpet lying before the screen. The world of virtual Aegina had been created using Director Shockwave, 3DStudioMax and Poser.

Left to Aegina in an area in-between trees, a screen was hung from which *animated magical figures* (3D images) flew down to look upon the setting and observe the scenery (*A Summernights Dream*).

LEARNING FROM INTERACTION DESIGN

Whereas research from *human factors*, software *ergonomics* or *HCI* traditionally focused on analysing **usability** and **effectiveness** of systems in work situations, the new field of *interaction design* beeing influenced by product design, art and game development is more interested in **joy of use**, **seduction**, **entertainment**, and the **use experience** of interactive products. Form & function, look & feel are considered as a unity. "Good interaction design

makes sure the machines in our lives are graceful to use as well as beautiful to look at. It involves the aesthetics of use as well as the aesthetics of form." (Crampton-Smith 2002). Usability only ensures that systems are effective to use and do not frustrate users. *Joy of use* refers to positive enjoyment and can motivate people to use a product regardless of traditional measures of usability.

While no unified (accepted) theory of interactivity exists so far, many researchers (Shedroff, 2000; Crawford 2002; Löwgren, 2001, 2002; Svanaes, 2000; Winograd, 1997) (focusing on different aspects) share a viewpoint of *interaction as a process* where the user experience is created by the interrelation of system behaviour and user behaviour. To experience this process, users must enter it; they must interact in order to conceive the "dynamic gestalt" or *feel* of interactive products (Löwgren, 2001; Crawford, 2002; Rijken, 1999).

Thus „Interaction Design is the art of effectively creating valuable, meaningful, interesting, compelling and empowering information, interactions and experiences for other people" (Shedroff, 2000). Shedroff identifies *user control* and *feedback* as essential for interactivity and as typical features *creativity and productivity,* (human) *communication* and *adaptation*. To some extent passive experience is possible, but interaction needs action (Shedroff, 2000; Crawford ,2002).

To further pin down what is meaningful or compelling experience and when what kind of experience is adequate, researchers begin to explore *"use qualities"* like playability, seduction, pliability (tight perception-action loops), immersion, transparency, surprise and parafunctionality (Löwgren, 2002) or *expressiveness* of embodied interaction (Djajadiningrat et al, 2000). These qualities are useful for analysing systems and for setting requirements.

Winograd (1999) introduced the metaphor of interaction design as „design of spaces for human communication & interaction" and explained that software generates spaces in which the user lives (Crawford, 2002). The analogy is with architects who create spaces which users appropriate and fill with own life, while predetermining feasible adaptation and movement paths. "The user creates an ‚experience' while acting within an information environment. (…) It reminds me of how a building or a town doesn't force a single specific route or function, but offers a number of connected spaces and possibilities. However, design decisions do ultimatively determine the possible experiences. The space then works as a process facilitator. Experience is the dynamic end result of design (…)." (Rijken 99)

Game designer Crawford (2002) builds on this metaphor and *visualises (inter)action spaces* as decision trees with knots denoting states and branches denoting possible actions (that is: verbs) of users. Such trees can be narrow or broad, flat or deep
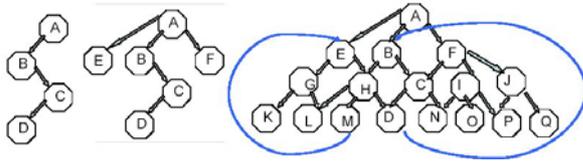
Fig. 6: Interaction spaces as decision trees: (left) a linear "storyline", (middle) an interaction space with few choices and sudden stops, (right) the "linkmesh" principle: dense, tightly meshed trees (flat version) with variable behaviour inside knots

tightly or weakly meshed. Linear successions of knots offer only the illusion of an interaction space as there are no possible decisions. Trees with short branches (flat) make users stop in mid point and are very predictable. Link-meshes provide long interaction chains without necessitating excessive definitions of states and state changes (trees grow exponentially). Putting computational power inside knots allows for variable system behaviour dependent on prior interaction history.

Good interaction spaces are usually deep, but narrow and tightly meshed, offering functional power for a defined set of problems without being overwhelming. Good interaction spaces offer a good proportion of conceivable (visible and imaginable) states to (in fact) possible next states. Thus possible actions should be easily discernible. Crawford emphasises "verb design", as verbs denote possible actions. Verbs should be concise, but abstract in order to cover a range of situations.

As qualities explored within interaction design are new to scientific study, it is unknown how to measure them. Some might be open to measurement, some can only be described using relative comparisons. Many will defy quantification (that is why they are termed qualities), as e.g. joy and aesthetics are subjective and situated. Understanding these qualities can help us attain a better understanding of the interactive experience provided by systems. Using these qualities and categories from interaction design to analyse systems can be described as a *design reflection*.

DISCUSSING THE INSTALLATIONS WITH CATEGORIES DESCRIBING INTERACTIVITY

Authors observed that only interactive installations resulted in prolonged engagement regardless of aesthetic quality. The non-interactive exhibit, showing mystic creatures in 3D flying by and observing the scenery, received short glances only despite of visual aesthetics comparable with Aegina. People usually walked by and did seldom stop to watch (cp. Cappenberg, 2001). This effect might be strengthened through the competition of installations.

Visitors seemed to enjoy embodied interaction. They quickly understood how to use the touch sensitive carpets for navigation, but also asked for more information on how to control some installations.

Embodied interaction eased collaborative interaction by making actions visible and allowing for distributed coordinated action. It lent expressiveness to visitor behaviour which could form a performance in its own right (especially with clavier and flirt-bench). Interaction in-between visitors seemed to be an important element of the visitor experience as well. This also shows in the questionnaire, where Aegina and the clavier were chosen as favourite installations and visitors ranked in liking: interacting oneself, the installation by itself and observing other visitors interacting (Cappenberg, 2001).

Besides of Aegina and flirt-bench the clavier attracted most long-term or repeated interaction. Several people even danced with umbrellas in the rain. Some used umbrellas and other objects to trigger multiple sensors. Inadvertently passing visitors come into musical interaction with intentional interactors. There was a constant gathering of observers (see Fig. 9), but no crowds as one could watch this installation from several places.

Visual and sonic effects had high aesthetics. The clavier provided a *simultaneously passive and active experience* as people danced to the music they were at the same time *creating*. "Composing" music posed a *challenge* while not frustrating people as effects were always pleasing (playability, seduction, challenge). In particular the installation encouraged *group creativity* (see Fig. 10) when dancing together. Interaction was transformed into a public performance, allowing for *embodied expressiveness*.

Fig. 7: Real Aegina visible through the screen and virtual Aegina exploring the planet

Fig. 8: Aegina running and visitors watching

Aegina (Fig. 7 and 8) was the main attraction with a constant large crowd. Often two or three persons coordinated in navigating the touch-sensitive carpet in discussion with bystanders to steer her to another statue. Whenever a meeting occurred, an animation of one to three minutes stopped input from the carpet. Many visitors seemed to come back to see scenes missed before or to see them once more.

The system gave *high control* to visitors and provided *instant multi-sensorial feedback*. It offered *simple means* of interaction with a direct and transparent mapping of action and reaction. Simple actions (blocking light sensors) were *contextualized* by the physical space, resulting in a *narrow and closed, but fine-meshed interaction space* with effects dependent on location and allowing jumping, running back and forth, using third objects, etc.

An interesting feature of this installation was the mix of predefined animations and active control of Aegina's movement. Although the general principle of control was simple, *interaction needed conscious control*. Results were somewhat delayed and people had to figure out when to stop moving forward to e.g. meet a statue left-hand. The interaction space was easy to understand by its real-space analogy, *fine meshed,* and offered sufficient decision space (stepwise walking). The metaphor of a globe had a good mapping of possible actions and ensured a logically closed (complete) action space. As with the clavier, the actions themselves were simple, but *contextualized* by location. The installation had *high*

Fig. 9: Typical visitor crowd observing the clavier

Fig 10: Visitors playing as a group with the clavier despite of rain

aesthetic and even poetic quality, drawing observers into *immersion*. It also offered *surprise* and *humour* in referencing local statues. Meeting small statues (with small hot spots) provided some *challenge*.

Analysis of the structure of interaction spaces was especially revealing in comparing clavier and fountain. The latter usually received short attention only, except for some teenagers adopting it for water fights, scaring away other visitors (also observed by Cappenberg (2001)). People walked around the rim once and then went on to other installations. Problems of this installation can be tracked down to limited technical functioning, restricted expressiveness and the uniform action space.

Depth and fine-meshedness of the claviers interaction space, where simple elementary actions result in rich and aesthetically pleasing system reactions, attracted long-term interaction. The *uniform reaction* of the fountain which did not create interesting patterns made visitors turn away soon. The touch sensors were arranged in a circle and water jets targeted the middle. Thus the effect of an action had *little variation*. Even if coordinating control, visitors could not create interesting patterns. This interaction space can be described as *flat and unconnected*. If depicting it as a decision tree, knots would contain almost identical states concerning system effects (only physical place was different) – the tree therefore would almost collapse. Except for differences in water pressure the installation offered *little surprise* or challenge. The images projected onto the fountain were not affected much by the water jets, thus not providing the visual effects hoped for by fountain builders.

Installations allowing *creativity and communication* were especially successful in attracting interaction and observers. The flirt-bench despite its simple means of interaction had extensive phases of interaction by two or more sofa-sitters who experimented with turning the cards, handed virtual objects from one card to another, handed over cards and invented games. People *appropriated* the cards and the virtual mirror and integrated it into *conversation and playful behaviour*. The clavier allowed for creativity and communication in creating music while Aegina made people communicate *about* her.

Interaction styles and qualities ranged from *responsive tight-loop system reactions* (clavier, flirt-bench) over more *reflective, conscious interaction* (Aegina) to few interaction options and slow feedback (virtual philosophers). The flirt-bench was highly seductive in attracting sofa-sitters, providing instant feedback, success experience, and making them experiment. The virtual philosophers were fun to interact with, *provoked* visitors through the content of their talk and *surprised* with unexpected interaction means (a pump). They were a success although this installation was quite rough in its aesthetics and the interaction space was small. People were eager to put fire to the temple and extinguish it

again (doing the forbidden). *Challenging* visitors to some degree deepened visitor engagement and made them coordinate in reaching goals, e.g. when steering Aegina or when trying to compose music.

It is interesting to contrast the observations of attraction with the interviews and questionnaires about the subjective judgement (Cappenberg, 2001). Some visitors criticised insufficient aesthetics and density of installations in the tight space of the theatre hill. But overall they liked the event, judged it as harmonious and fairy-like while feeling active and in control. Asking visitors for their favourite installation resulted in the following ranking: clavier (33%), Aegina (28%), fountain (20%), virtual philosophers (16%), flirt-bench (13%), magical figures (8%), history (2%). Thus the more interactive, the higher ranked installations are. Unfortunately visitors were not asked to rank *all* installations, so competition for votes might fudge the full picture (resulting in the low numbers for the flirt-bench and the higher ranking for the fountain). Overall Cappenberg et al (2001) observe a lively and mystic atmosphere.

SUMMARY

This paper presented a set of interactive installations which can be classified as a Mixed Reality environment shown during an open air event in a city park. Concepts and categories from interaction design improved the understanding of the attractiveness of specific installations to visitors and helped identify their strengths and weaknesses. Knowing which kind of interaction spaces tend to be interesting, one is better able to assess design proposals and to improve interaction designs. Principles like the contextualisation of simple actions through location, enabling the formation of larger patterns of effects and transforming interaction into a performance of its own sake can be useful as guiding principles for future interactive installations.

The ability to steer Aegina and to choose encounters in combination with the aesthetics and humour of the animations provided a balance for the predetermination of these animations. Aesthetics alone were not sufficient to attract visitors to non-interactive installation. The small interaction space of the fountain in combination with its malfunctioning attracted only moderate visitor engagement. Nevertheless, probably due to its interesting aesthetics and unusualness, it received a high ranking in the questionnaire. Humour, surprise, the ability to do something forbidden and novel interaction means made up for the virtual philosophers limited aesthetics and simple interaction space. Discussion thus shows that no singular concept (aesthetics, challenge or size of interaction spaces) is sufficient to explain attractiveness and interactive experience of installations. Instead qualities combine and complement each other.

REFERENCES

Bruns, F.W. (1993) Zur Rückgewinnung von Sinnlichkeit - Eine neue Form des Umgangs mit Rechnern. *Technische Rundschau* 29/30. 14-18.

Billinghurst, M., Kato, H. (1999) Collaborative Mixed Reality. *International Symposium Mixed reality*. pp. 261-284. Springer.

Cappenberg, S., Reissert, A., Reese, N., Eser, K. (2001). *Sensoric Garden – Ausarbeitung der Präsentation des Sensoric Garden*. Semester report for class "*Future*" of J. Richard: *Living in artificial Worlds*, Bremen University.

Crampton-Smith, G. (2002). Who will design the cathedrals of information technology? In: *Proc. of DIS 2002*. pp.24-25. ACM, N.Y.

Crawford, C. (2002) *The Art of Interactive Design*. No Starch Press, San Francisco.

Djajadiningrat, T., K. Overbeeke and Wensveen Chris (2000). Augmenting fun and beauty: A pamphlet. In: *Proc. of DARE'2000*, pp. 131-134. ACM, N.Y.

Kato, H. and Billinghurst, M. (1999). Marker Tracking and HMD Calibration for a video-based Augmented Reality Conferencing System. In Proceedings of 2nd Int. Workshop on Augmented Reality (IWAR 99).

Löwgren J. (2002). *The use qualities of digital designs*. Draft 1.0, Oct 21, 2002. http://webzone.k3.mah.se/k3jolo/Material/nqDD v1.pdf. See also: Articulating the use qualities of digital design. In: *Aesthetic Computing*, (P. Fishwick (Ed.)). MIT Press, Cambridge forthcoming.

Löwgren, J. (2001). From HCI to Interaction Design. In: *Human Computer Interaction: Issues and Challenges,* (Chen, Q. (Ed.)). pp. 29-43. Idea Group Publishing, Hershey, PA.

Osterloh and A., Schoch, M. (2002) *Virtual Sensoric Garden.* Bachelor thesis with interactive CD-ROM, documentation of project. Bremen University.

Rijken, D. (1999) Information in Space: Explorations in Media and Architecture. *Interactions,* **6**/3. 44-57.

Shedroff, N. (2000) Information Interaction Design: A Unified Field Theory of Design. In: *Information Design* (Jacobson, B. (Ed.)), pp. 267-292. MIT Press, Cambridge.

Svanaes. D. (2000) *Understanding Interactivity*. PhD thesis. Computer Science Department NTNU Trondheim, Norway 2000.

Winograd, T. (1997): From Computing Machinery to Interaction Design. In: *Beyond Calculation: The Next Fifty Years of Computing*, (Denning, P.; Metcalfe, R. (Eds.)), pp. 149-162, Springer.