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Designing Interactive Public Art Installations: New Material therefore New Challenges

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Abstract. The new materials in public art installations give the birth to interactivity and participation, which in turn, introduces new challenges, not only in the creative design process, but also in how to involve the participants in this process and in evaluating the targeted experience such as social connectedness and inclusion. Six design cases are presented, as examples for interactive and participatory forms of these installations. The design techniques and the user experience evaluation methods overlap in these cases and many of these techniques and methods have been found to be useful in our practice.

1 Introduction

Currently the cities are coming to life in the digital world. How this digital city becomes meaningful to us remains to be seen but the first signs point towards visual solutions that augment the buildings, bridges, statues etc. The augmented layer can be used as decoration, but also as public media where the social interactivity can take pace [1]. One of the ways to approach these challenges is for example interactive public installations. The current development in public art installations involves a significant amount of new material and technology, resulting new dynamic, interactive or participatory forms that require the artists and designers to construct their work from a system view and with a good understanding of human-system interaction. It is no longer about carving stones and casting bronze; it is time to sculpture the interactive experience with the public participation [2, 3].

1.1 Five generations of materials

The term “public arts” often reminds people of the traditional art forms such as sculptures, murals and installations in public spaces in cities. Even the bricks in the pavements of a city square or the grass of the lawns in a park can be used as the material by the artists for these public arts. For artists, material is of vital importance in expressing their thoughts, motives and emotions [4]. Material is a language of art and it has gone through several generations in the art history. From natural materials to recent smart materials [5], there has been distinctively five generations: the first generation of natural materials such as wood, bamboo, cotton, fur, leather and stones; the second

generation of man-made materials such as wood-based panels, paper, cement, metal, ceramic and glass; the third generation of synthetic materials such as plastic, rubber and fiber; the fourth generation of composite materials such as fiber-reinforced materials used in aerospace components; the fifth generation of smart materials with one or more properties that can be changed or controlled by external stimuli, such as force, temperature, electricity or magnetic fields. The advances in the material science has pushed the evolution of material technology forward, which has also a great impact on its application in the field of arts [5].

In the traditional public arts, the materials of the first and second generation are most often used. Along with the development of the material technology, the synthetic and composite materials are more and more applied, however the forms of the public arts remain static. The recent development of the smart materials and especially the digital media brings dynamic forms to the public arts that utilize different modalities of the senses. The further development in sensor technology, computer and mobile networks brings interactivity to public arts.

1.2 Four levels of interactivity

Based on the work of Edmonds et al [6], Wang, Hu and Rauterberg defined three generations of art and generative technology according to the carrying material, technology and interactivity [7]: 1) Static forms: there is no interaction between the art artifact and the viewer, and the artifact does not respond to its context and environment. 2) Dynamic forms: the art artifact has its internal mechanism to change its forms, depending on time or limited to reacting to the changes in its environment such as temperature, sound or light. The viewer is however a passive observer and has no influence on the behavior of the artifact. 3) Interactive forms: the viewer has an active role in influencing the dynamic form of the art object. The input from the viewer can be gesture, motion, sound as well as other human activity that can be captured by the artifact's sensorial layer. When interactivity is introduced, the "dialog" between the viewer and the perceived dynamic form of the artifact can always vary depending on the difficult-to-predict behavior of the human viewer. Later Hu et al [2] introduced the fourth generation of the public art forms – participatory forms – Interactive art platforms that allow social interactivity and creativity contribute to the physical and digital parts of the artifact. Artists and designers do not create the public media arts as a final result, but create them as platforms for other artists and the public to contribute to the artifact. The creation process, together with the results of this process, forms the dynamic media artifact that grows with the creative input from the social environment and over time.

The new materials in public art installations give the birth to interactivity and participation, and in turn, the interactivity and participation also introduces new challenges, not only in the creative design process, but also in how to involve the participants in this process and in evaluating the targeted experience such as social connectedness and inclusion. Next we present several design cases, giving examples to interactive and participatory forms, then sharing our practices and experiences in facing and handling these challenges.

2 Interactive forms

2.1 Blobulous

Blobulous (**Fig. 1**) allows participants to interact through projected avatars, blogs of dots, which react to their movement and body signal. The participant's heart rate is mapped to the color of her avatar [8, 9]. Wireless heart rate sensors are used to capture and send heart rate data from users and a ZigBee network to handle communication between sensors and the avatars.



Fig. 1. Blobulous



Fig. 2. Yang Sheng

2.2 Yang Sheng

Yang Sheng is an ancient Chinese Philosophy to maintain and improve one's health through daily activities. Tai Chi is one of the common meditation practices which originates in China and is still popular today, but not among the younger generation. To attract the young to this tradition, this installation uses computer vision to track the movements of the Tai Chi players and visualize their movements as well as "chi", the life energy, with a floating sphere controlled by the movements (**Fig. 2**).

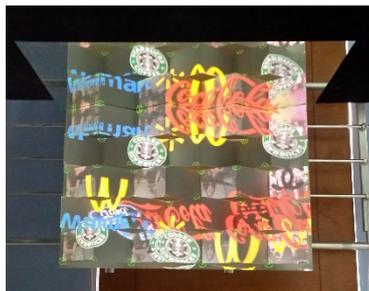


Fig. 3. Replication

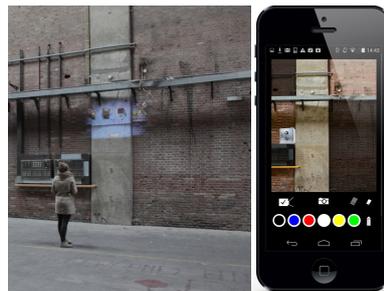


Fig. 4. Strijp-T-together

2.3 Replication

People walk past the wall and find themselves projected on it in a grid of delayed videos; each newly appearing video copying the previous one (**Fig. 3**). Slowly, the influence and domination of the West is shown with an increasing number of logos which progressively overwhelm and cover the person and the scenery. The drama

revolves around the idea that China is replicating the West, to create the awareness of the western culture creating a new patina on top of the Chinese culture.

3 Participatory forms

3.1 Strijp-T-together

Strip T is an old industrial area rebuilt to accommodate and foster creative industries. However there is hardly any social interaction among people from different companies. Strijp-T-together is designed to stimulate the social interaction with a mobile application and a projection in the main entrance hall (Fig. 4). The photo of a space is used on the mobile as the background and an addition can be made by drawing or adding other graphical objects. These additions will be projected into the space and will also be shown on the mobile of the others as background. People can then react on each other's drawings and additions to trigger social interaction [10].

3.2 Leave your mark

With the installation "Leave your mark", people can "draw" and leave their mark behind on the public space, to express themselves (Fig. 5). The concept involves projection mapping to digitally augment buildings. In some locations the installation will be provided with a camera. The feed of this camera will be projected onto the installation at another location. If a person walks by this second location, she could possibly see someone, a complete stranger, leaving the mark on the first installation. The goal is to increase their feelings of inclusion and connectedness in the city [11].



Fig. 5. Leave your mark

3.3 Moon rising from sea

This installation is designed for the city of Taicang, China. The installation is roughly 10 by 10 meters on its base and 8 meters high. On top of the base are constructions that give the impressions of a large sail, and the moon rising from the waves. Images, animations and videos can be projected onto the inner surface of sail in the evenings (Fig. 6), allowing the public to contribute their photos from social media to induce the feeling of social connectedness [8, 11, 12].



Fig. 6. Moon rising from sea

4 Practices in the design process

In the design process of above mentioned installations, many design techniques were found to be useful. These techniques including learning from performance art, cardboard modelling, acting out and video prototyping, not listing them all.

Dynamic art forms and interactive public installations have much in common: both have a time core to drive the dynamics; both have to manage inside a public space and the space has to be carefully structured for functions and interactions; both have to accommodate active or passive participants with different roles and goals. Traditional dynamic arts have much to offer and it is valuable to explore how the elements and techniques could contribute to interaction design [13-15].

Installations in public spaces are three dimensional, or if we take time into account because of the dynamic nature of interaction, four dimensional. Cardboard modelling, especially when integrated with advanced mechanical and electronic techniques and components, is a powerful tool for tangible or rich interaction [16, 17].

When designing for social interaction in public spaces, the interactive nature of the design requires conceptualizing, visualizing and communicating the dynamics of the interaction. The integration of design processes and software design processes is often necessary [18, 19]. The acting-out design approach [20] utilizes the designers body to simulate the elements and the behavior of the design, providing and communicating the insights at earlier stages of a design process when a prototype is not yet available.

High-fidelity prototyping of installations in a large scale or for a big or busy public space is often costly and challenging, if not impossible. Video prototyping allows the designers to create simulation of the installation and the interaction using simple materials and equipment [21].

A combination of video prototyping and acting out can be also used in context with the help of portable projectors: prepared video prototypes are projected onto artifacts and objects in the real-life context using projection-mapping techniques. This serves as documentation for evaluation, but also as input for further design iterations.

5 User experience evaluation

We present some of the methods that were used for evaluation in the projects mentioned earlier and that were found to be handy for designers, instead of extensively

reviewing the literature about and reflecting on how user experience shall be evaluated in public spaces.

5.1 Qualitative methods

Interviews with experiential prototypes. Interactive installations for public spaces have to be experienced in the actual space for the users to understand the design and to give valuable input or feedback. This is done for most of the projects mentioned.

Co-reflection. In the project Strijp-T-together, co-reflection was used as a qualitative and constructive approach on evaluating whether the installation triggers social interaction [10]. “Co-reflection sessions can be developed in three parts: exploration on the current situation, ideation through a discovery process and confrontation between users and designers” [22].

Observations in context. It is important to observe in the context when design for public spaces in order to understand the situations and to get a good grasp of the problems to be solved or the opportunities to be identified. Observing in context has demonstrated its effectiveness not only to get the input for the ideas and concepts, but also in evaluating whether the design has achieved its goal – but in the latter case, a prototype would be necessary.

5.2 Quantitative measures

Connectedness. Social Connectedness Scale Revised (SCS_R) questionnaire [23] was chosen to evaluate the level of social connectedness of participants in the projects “leave your mark”, Blobulous and Strijp-T-together. SCS-R is based on an earlier version of Social Connectedness Scale [24]. SCS-R consists of 20 items (10 positive and 10 negative). The negatively worded items are reverse scored and summed with the positively worded items to create a scale score. A higher score on the SCS-R indicates a stronger feeling of social connectedness.

Social Inclusion. The Inclusion of community in self scale [25] is a simple yet effective pictorial measure consisting of six pairs of circles. Each pair of same-sized circles overlaps slightly more than the preceding pair. Each circle on the left of the pair represents the participant, while the circle on the right represents the community. Connectedness to the community at large is assessed by the participant marking the pair of circles that best describe her relationship with the community. It is found to be useful in projects “Leaving your mark” and “Strijp-T-together”.

Attractiveness. AttrakDiff [26] is an instrument for measuring the attractiveness of interactive products. With the help of pairs of opposite adjectives, users can indicate their perception of the product. These adjective-pairs make a collation of the evaluation dimensions possible. The following product dimensions are evaluated: Pragmatic Quality, Hedonic Quality - Stimulation, Hedonic Quality - Identity and Attractiveness. Hedonic and pragmatic qualities are independent of one another, and contribute equally to the rating of attractiveness and they are mapped into a visual output. This method has been used to measure the attractiveness of Blobulus [9].

6 Concluding remarks

The recent development in material and technology creates new opportunities for the artist and designers to create interactive public art installations, merging physical material with digital content, allowing social engagement and participation. Six design cases are presented in this paper, as examples for interactive and participatory forms of these installations. The targeted spaces and user groups, design concepts and implementing technologies vary, aiming at different social experiences. The design techniques and the user experience evaluation methods overlap and many of these techniques and methods have been found to be useful in our practice. We consider it to be an interesting and promising area in design research on social and cultural computing [27] in public spaces. The practice and experience presented in this paper are first steps of our effort in facing the new challenges in both design and research in this area.

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