Using an Interactive Model for designing Public Displays

Marije Kanis, Chantal Steur, Wouter Kievit, Steven Versluis, Duane Blaauw, Marcel Bolten & Mettina Veenstra
Amsterdam University of Applied Sciences
Duivendrechtsekade 36-38
1096 AH Amsterdam, The Netherlands
m.kanis@hva.nl

This paper introduces an interactive scale model as a dynamic prototyping tool for designing public displays. This work particularly focuses on a technology-enhanced model that was developed for prototyping an interactive display for the Nieuwe Kerk, a historic church building on the Dam Square in Amsterdam. The physical scale model is enhanced with a screen, camera and (sensor) technology to simulate and test potential scenarios and interactions with the screen content and its dynamic environment. To explore how such interactive models can contribute to the design of urban displays, different studies were conducted, namely a questionnaire with (outdoor) media experts (*n*=17) and three focus group sessions with architects, technology design students and public of the Dam square (*n*=14). The results suggest that interactive models can indeed be a helpful tool for the dynamic discussion and co-creation of interactive outdoor media in public space. Recommendations are presented for achieving this goal.

Interactive scale models. Architectural models. Public screens. Interactive displays. Prototyping.

1. INTRODUCTION

The presence of outdoor media, namely large digital screens in public space has grown over the last recent years. However, research [1, 2] shows that these are not always designed and used to its best potential. Accordingly, outdoor media companies often experience resistance against public screens, such as on the part of local planning authorities and citizens. Still, public displays can make a positive contribution to public space, such as enhance social interaction (e.g. [3]), provide augmented information (e.g. [4]) and entertain (e.g. [5]). Particularly, large displays that are interactive (e.g. [6, 7]) are interesting in terms of engaging the public. However, designing and setting large interactive displays in public spaces is not a trivial task [7] as these affect different stakeholders (ranging from architectural designers and urban planners to content providers and the on-site public) and form an integral part of the dynamic local and historic environment. Hence, the experience of a screen in public space is typically influenced by many dynamic factors, making the design and prototyping of a digital display a challenging task.

Static scale models as tangible (physical) representations of architectural constructions are often used as a tool to study and design architectural structures in urban space or to communicate design ideas to clients, committees, and the general public. When considering outdoor media in public space, architectural models could also be helpful for assisting and engaging different parties involved in the design process. However, as architectural models are static, these do not suffice for interactive outdoor media and its dynamic environment. Research studies indeed suggest that interactive, technology-enhanced physical models could be a useful tool for (geo) spatial design and urban planning [8], spatial prototyping and discussion [9] and the co-creation of interactive media [10]. Furthermore, the rising field of Geodesign contributes in developing helpful techniques and tools for the geographic decision-making process. However, tangible tools and models have yet largely been underexplored as a tool for the design and co-creation of interactive public displays. For this purpose, this paper introduces the design and study of a tangible, interactive model as a tool to dynamically design and engage relevant stakeholders, in an aim to improve the potential and added value of public screens.

2. THE DESIGN CASE

As an example case of how interactive scale models can be used as a tool for the design of

interactive displays in public space, this work focused on a public display for a historic building, called de Nieuwe Kerk that is situated on the central Dam Square in Amsterdam (See Fig. 1). The design case involved an interactive screen to replace the current banners and integrate with the historic window façade of the Nieuwe Kerk, a church building that currently mainly functions as a museum. The study was conducted in collaboration with UNStudio, an architectural firm interested in proposing such large ornamental display in a central, historic location.

Figure 1: *De Nieuwe Kerk (central) on the Dam square*

3. THE INTERACTIVE MODEL

The envisioned model was to explore the potential of a public display that could be used for testing different scenarios and screen content. Because interactive, technology-enhanced models for outdoor media are still unfamiliar area, it was also used as a test case of what (the design of) a physical interactive model for public space (and Geodesign) would entail.

3.1 Design process

The design process involved different iterations of the interactive model. To test the optimal scale of the model and give an idea of how the resolution of the screen would eventually look like, four cardboard versions of the Nieuwe Kerk church were first created (see Fig. 2).

Figure 2*: Four paper prototypes of the Nieuwe Kerk*

It was felt that for integrating a miniature screen, the best looking scale for the church was the 1:100 model. However, this scale was considered too big to be practical when including the whole area from where the screen could be seen. Therefore, two models using different scales (see Fig. 3) were created: one simulating the whole area from where the screen could be seen (scale 1:200) and one focusing on the screen and only its immediate area for making the interaction and the content on the screen more apparent for the user (scale 1:100).

Figure 3: *The area that was duplicated on a 1:200 scale, with the dotted area representing the 1:100 scale*

After the scale size of the model had been decided, all buildings required for the model were duplicated using styrofoam. Then some important buildings (such as the Dam palace) were enriched with more detailing so that it would be easier to recognize the site. The finished scale models were equipped with the necessary sensors and screen technology for making the models interactive.

Figure 4*: The 1:200 model with added detailing*

3.2 System design

The 1:200 model (as shown in Fig. 4) has been equipped with a small (endoscopic) USB 2.0 camera. This camera is connected to a computer. On the computer, a program (written in Java) is running and used for processing dynamic information obtained from the model. The camera monitors and (colour) tracks red pieces of paper (with miniature people) that are placed on the model. When users change the position of the red

pieces of paper (see Fig. 5), the content of the small-scale screen (as shown in Fig. 6) changes accordingly. This enables the user to interact with the model and change the screen content according to what people are doing on the square.

Figure 5*: Users change the positions of the red pieces (i.e. the public)*

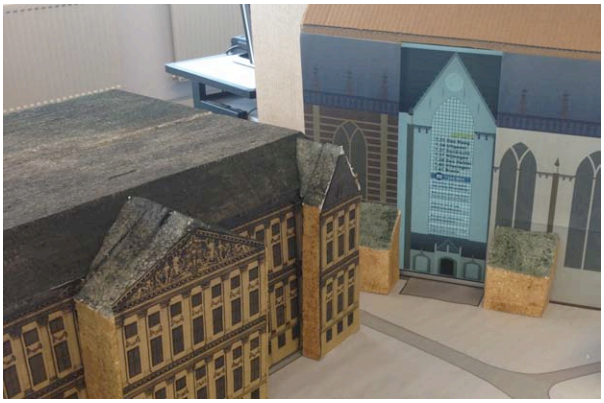

Figure 6: *The model with the interactive screen (right) which content is dependent on the monitored movement of the red pieces*

The system encompasses different modules, namely:

(i) a Camera module: for the content controlling of the interactive screen that is based on the objects on the model. It continuously loops through all the pixels while searching for a specific color, which is red in this case;

(ii) a Following module: enables the tracking of specific objects on the model that are detected via the camera to depict how these move around;

(iii) an Arduino Lighting module: for the communication with an Arduino microcontroller and controlling of different lights on the model. To simulate day and night, lights were placed on the model. When it is night in the model scenario, the lights from the Dam palace and the Bijenkorf department store are switched on.

(iv) a Time module: for controlling the content on the screen according to specific time and day.

These different modules enable the user to interact with the technology-enhanced scale model. The small-scale screen changes its content depending on the set time (e.g. morning, afternoon, evening), and can also be manipulated by changing the position of the Dam square public (represented as red pieces of paper).

4. STUDY

A questionnaire study and sessions with three different focus groups were conducted to inform the iterative design of the interactive model and evaluate its usefulness as a tool for the design and co-creation of public displays.

4.1 Questionnaire study: method

An on-line questionnaire was distributed amongst the target group of (outdoor) media experts: architects, urban planners, (interactive) media designers and urban screen specialists. This led to seventeen participants. The questionnaire items focused on the looks, functionality and usefulness of an interactive model. It was used to inform the iterative design of the model.

4.2 Focus group study: method

After the questionnaire study, focus group sessions were consecutively held with architects at UNstudio (*n*=2), technical students at the University of Applied Sciences in Amsterdam (*n*=5) and public (tourists and locals) of the Dam Square in the café of the Nieuwe Kerk (*n*=6) to evaluate the model. During the first focus group session, the architect participants proposed different scenarios for enriching the discussions with the interactive model, which fed the forthcoming discussions in the following focus groups. The formats of the different sessions were appropriated for the different focus groups and locations, but were all to evaluate the usefulness of the interactive model as a tool for discussion, co-creation and design.

4.3 Results questionnaire

The questionnaire results from 17 participants gave insights in the required looks and functionalities of the model and informed the iterative design process. Different aspects were evaluated on a five-point Likert scale (1=very unimportant, 5= very important) to establish the most important

requirements for the interactive model. The results were as follows:

Detailing and recognizability: Most participants found the detailing and particularly the recognizability of the model for the build constructs more important than the detailing and the recognizability of the scenery, such, as trees and street lighting.

Adjustable light-intensity: The idea of equipping the model with a light-sensor for monitoring the current light-intensity, so to accordingly adjust the brightness of the screen was not found to be very important (*M*= 3.2).

Moveable screen: Having a moveable screen was also not found to be very important (*M*= 3.1).

Screen resolution: The participants generally found the resolution and scale of the miniaturized version of the screen important (*M*=3.6). It was found that the small-scale version of the screen should have a size and resolution that would match with the eventual public screen.

Mobility: The mobility of the overall model itself was also generally found to be important (*M*= 3.9).

Interactive content: When looking at what the participants found important when regarding the interactive functionality of the screen, the most important feature (*M*=4.0) was that the content would change depending on the time set. The participants also found it important (*M*= 3.7) that the visitors on-site would be able to engage with the screen content.

4.4 Results focus group sessions

The usefulness of the model was demonstrated by the recognition of the model and the extent to which it provoked discussion and creativity.

Recognizability & interaction: All the focus group participants were able to recognize the model as the Dam Square. This included the tourists that immediately recognized the square they had just been visiting. The participants had more difficulties with understanding the interactive functionality of the model. However, after a short explanation of the camera and color tracking software, the study participants were all able to understand the interactive functionality and play with the model.

Discussion: Interestingly, during all the focus groups sessions, the model provoked a lot of debate and discussion with themes ranging from urban screens, ways of interacting, soft- and hardware, the Dam square location, screen content to privacy policies. It was found that being able to visualise certain scenarios and ideas with the model, made it much easier to stimulate a discussion than without.

Creativity: The model also provoked creativity. This is best illustrated by the results from the student focus group: From the ten students, eight participants came up with creative ideas for screen content. Amongst the tourists and locals at the Dam square, all participants debated about various ideas for content for the screen. The discussions often led to new debates on what people expect from a certain screen at such a location. While the Dam square participants discussions and proposed ideas were focused around the screen content, such as having a puzzle game with clues displayed on the screen, the majority of the technical student participants (70%) came up with more additional technical-oriented ideas, such as enhancing the screen interactivity with pressure sensors or control pads.

4.5 Discussion

The final interactive model considers the results of the questionnaire study, in terms of the interaction with and detailing of the model, and the scale and resolution of the screen. The model was also created not to be bigger than 100x100cm for reasons of mobility. Still, the model needs to be made more robust for practical reasons (e.g. use outside) and needs more iterations and study for achieving optimal interactive functionality and design. Further work is also needed to explore and advance its usefulness for the field of Geodesign.

The study results suggest that interactive tangible models can be useful as a tool for the creative discussion of a proposed design by different parties. However, as the terrain of interactive scale models has been largely unexplored, more study is needed on how such tangible interactive tool and for which purposes it can be best designed and used for.

5. RECOMMENDATIONS

Through the design of the interactive models and its study, various lessons were learned. The recommendations are as follows:

(i) Interactive scale models can be a valuable contribution to the prototyping and (co-) design of (interactive) urban media, but need further study, maturing and attention to reach its full potential;

(ii) When making a scale model, establish a clear purpose and then work out what sort of model will best achieve your goals. In other words, what is the model for and what needs to be visualised, communicated and discussed?

(iii) When making an *interactive* model, consider which dynamic environmental elements, scenarios and variables are most important to be tested;

(iv) When sourcing materials for your model, your best bet is to investigate your local art and craft shop or (hobbyist) model making supply shop online. Access to a 3D printer could be helpful, but is not essential. For technical materials

such as small sized screens you will usually find a good range of materials on the Internet, but do get what you need early so to avoid having to halt the prototyping process because of long delivery times;

(v) When making interactive models, you can draw upon a broad range of knowledge from the field of architectural model making (e.g. [11]). However, consider that *interactive* models can be different in many goals and aspects, such as in the role of technology, focus on outdoor media (instead of buildings) and scale;

(vi) To save time and valuable resources, note that you do not need to visualize everything and every detail with an interactive physical model. For example, you can also use a Layar augmented-reality application for visualising how a proposed design could look like in urban space, or use other non-digital material, such as paper scenarios;

(vii) Mobility should be considered as an important aspect of the model design, particularly when wanting to locally engage different parties in the discussion and prototyping process.
Consider and balance technical requirements, such as battery life, Internet connections, additional computers and weather proofness as this affect mobility, the practicality and usefulness of the model;

(viii) Make use of the tangible advantages of a physical scale model and make the technology-enhanced model and its interaction affordances as self-explanatory and attractive as possible for optimal engagement;

(ix) Making interactive scale models is (technically) more complex than common architectural models, but also add an extra dynamic dimension and means for discussion and engagement.

6. CONCLUSION

This paper presented an interactive scale model as a tool for giving better insights and providing better discussion of the pitfalls, benefits and the possibilities of interactive displays in public space. The study showed how an interactive model can be used as a tool in the design of outdoor media for various stakeholders with different perspectives. Eventually, it is hoped that this work further develops and that interactive scale models will contribute to the better prototyping and acceptance of interactive public displays and urban design in general.

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