Augmented Shadows
Midterm Report

Dennis Boldt
Thomas Brian
Christine Jovik
Pierre-Jean Quilleré
Tomáš Wortner

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Introduction

Problem Domain

Our project is called “Augmented Shadows” which is a project for the upcoming Oslo Children’s Museum - the Oslo Barnemuseum\(^1\). The Barnemuseum is a new kind of museum that emphasises interactivity. The children are no longer passive, but take part into the installation and explore it. So the museum will help them to develop their creative thinking, self-confidence and understanding of the world around them. The installations should be multi-modal by using several senses: vision, hearing and touch.

The “Augmented Shadows” will use the users movements to generate animated shapes and adequate sounds. The aim of the “Augmented Shadows Project is to stimulate curiosity, learning by experience and exploration.

The Process of Interaction Design

Our report is based on the life cycle with the four basic activities in interaction design\(^2\):

1. Identifying the needs and establishing requirements (Understanding users),
2. Generating potential solutions (Design),
3. Building interactive versions of the design (Prototyping) and
4. Evaluating the design (evaluation).
We have used these activities for our “Augmented shadows”.

Firstly we have identified the needs and have established the requirements. Section 2 shows our understanding about the cognitive aspects of the children in the museum. In addition, we have defined our target group exactly, and our assumptions about this group. The usability of the “Augmented Shadows”, which includes efficiency and effectiveness, is also very important.

In the next step, we have generated a potential solution based on the design principles like feedback and consistency. Furthermore we have gathered data in the Teknisk Museum Oslo for the next step of the life cycle mode. This is shown in Section 3.

Based on the design principles we have built an interactive versions by creating a simple prototype. This prototype is described in Section 4 and includes the projection on the wall, the playing of the sounds and more detailed information about the technical solutions.

The last step was the evaluation of our design. The evaluation based on a field study at the Rudolf Steiner School in Oslo. We did some observations to do some user and usability studies. This shows us what is working and what is not working.
Assumptions - Conceptual Model

During the first steps of the process of interaction design we got some expectations about the possible usage of the prototype.

The children will stand in front of the wall and they will observe themselves, like in a mirror. Furthermore, they will start to joking and monkeying around. During that, they found out that they create some special water sounds. So, they will start to find out, how they are producing these sounds. They will find out, that the sounds are similar to the movements. The children will be really happy and will have a lot of fun by the interaction with the “Augmented Shadows”.

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Understanding

To make a good design it is important to know about the cognitive aspects of the users. In our everyday activities we involve different cognitive processes, such as remembering, learning seeing and selecting things to concentrate on. It's important to not overload users memories with complicated procedures, because our memory has it's limits in remembering. And to evoke the users attention and learning, the design should stimulate different senses and encourage exploration. Since our users are children, vivid colours and sounds will make attention easier, rather then written language.

Who are the users

The users of our installation will be children aged 0 to 12 and parents should also be able to interact. The installation will not rely on language for interaction. Disabled children will also be able to enjoy this installation because it will stimulate their other senses: a blind child could still hear the sounds triggered by the system, or a deaf child could see the visual feedback from his movements.

Our assumptions

We assume that children love moving around. They like music, sounds and animated figures. They also like to see themselves, for instance in a mirror, and it makes them do unusual movements. They learn by seeing how things react to their actions (both images and sounds).

Usability goals (ref: page 20-25)

In order to get an attractive installation for users, we need to keep in mind many goals during our conception and design process. These goals are listed below:

Effectiveness: Since our installation is thought for allowing users to interact with it by discovering the interactions between their actions and the feedback the installation give them, it should react in the same way each time the user does the same action but it also should have a simple first interaction when the user go
through the installation in order to make the user interested in it. In this way, we thought about and made some shapes following the users’ movements to tell them that the wall is more than a simple wall with some animation and that they can interact with it. During the test of our prototype, that’s worked better than we thought and children were playing with bubble trying to catch or eat them.

**Efficiency:** There is not really any task to carry out with our installation but its efficiency can be measured by how much the children enjoy it and learn about the feedback related to their actions.

**Safety:** It should be safe to use our installation. It has to protect the users from dangerous conditions. The environment should not scare the youngsters in any way. We also have to take care of the position of the projector to avoid to blind the children with it.

**Utility:** This point refers to having a good utility, to provide the right kind of functionality. We have two kind of functionality: sounds and shapes. The sounds must appear at the right time according to a child’s movement and the animated shapes must follow the users’ shadow.

**Learnability:** Since users don’t like spending a long time understanding how to use a system, it must be easy to learn. In this purpose and to give the children the chance to learn by themselves by experimentation, we give no specific instruction how to use the system except that the animation on the wall will interact by itself when a new child come in its action space. After this first interaction, we believe that the child will be curious enough to try to move again to know what happen and step by step he will learn how to use the system by trying more complex actions in front of the wall.

**Memorability:** Since the children have just to move to interact with our system, there is nothing to remember and everyone should be able to use it without any background of that kind of installation. Just a point about the disable children (especially blind children), they may need someone to explain them that the sound that the system just triggered is due to their action if they don’t figure out by themselves. After this first explanation, they will enjoy the system in the same way that the others children.
Design principles (ref: page 29-33)

Design principles are used in interaction design to aid thinking when designing for the user experience. They are used as triggers to designers, rather than a guide to tell them exactly what to do, and the most common principles are:

**Visibility:** The more visible the functions of the design are, the more likely users will be able to know what to do next. Since we are designing this for children, the visibility is very important, like the visual effects the shadow gives. That will encourage the user to do movements and explore.

**Feedback:** This is about giving information back when an action has been done, so the user know what has been accomplished and can carry on with the activity. If visibility and feedback it poor, the user easily will be frustrated and give up. The problem with feedback for us is when a user is standing still, because then the system will not respond to movements and give a proper sound. But the animated figure on the shadow will still be there.

**Constraints:** The design concept of constraining refers to determining ways of restricting the kinds of user interaction that can take place at a given moment. It's important to think about this when designing, because it not always optimal for a user to have full access to functions, if the function just can be used at a given time. Designed the system to only play one sound at a given moment, and one shadow at a given movement, else there would be chaos. And the size of the room will restrict the number of users at the same time.

**Consistency:** For achieving similar task it is important to use similar elements. In our installation we want to make some different environments. So if the users do a movement in one, let's say 'water', and a sound effect is being played, a similar movement should trigger another sound effect in another environment. If a user jumps in the 'water' environment and hear a splash, the user should be able to jump in 'winter' and trigger breaking ice sound. The animated figures will always appear around the users shadows with vivid colours in every environment. For
instant, in a 'jungle' environment the shadows could have elephant ears, and a woollen hat in 'winter'.

**Accordance:** An attribute of an object should allow people to know how to use it. The installation and the logic behind it is mostly virtual, since you really can't touch the shadows or sounds. But we believe that the users will understand how to use it. 'The mirror' will invite looking and moving, and the sound effects will invite repeating movements.

**Data gathering**

To establish a framework for understanding we needed to gather data about how children interact with each other and with similar environments like our project. Then we would get a bigger picture of the design of the interaction. Trying to predict how the children will use our installation. To do this we did indirect observation in the field at “Technical Museum”.

**Teknisk museum**

Important items we looked for in this observation was who is using the technology, how well they understand, what they do and how they react. What we found in general was that the children almost never read instructions, they love to touch/push buttons and if they don't understand something they ignore it or gets frustrated and go on to the next exhibition. In the most similar environment to our project, “Shadows”, both children and parents enjoyed the experience. But the space was a bit small, so some of them fought to stand in front of the mirror. The children who used this exhibition the most was they between 5 and 12. The dark shadow room seemed scary for youngster. Some resulted in crying.

This was useful early in our design. We got to understand the users context, task and goals.

We also did observation of our prototype at “Rudolf Steiner School”, to learn what works and doesn’t work by analysing the effect. This is written about in the evaluation section.
Prototyping

We decided to create a first prototype to show to the children at the Rudolf Steiner School. Due to a very short notice, we had to design something simple. The main goal was to test the reaction of the children and verify that our assumptions were correct.

We have two main parts in our installation: the sounds and the images.

Playing sounds

We wanted to play some music as the children use the installation. We chose to simply watch the children and trigger sounds manually depending on their actions. We downloaded some samples on the internet, and designed a simple Java program to play them when we pressed a key. We had a laptop with loudspeakers set up near the wall, and one of us was sitting behind it.

This kind of prototyping is called “Wizard of Oz”\(^5\). It is a very common experiment in HCI. Even though our intention is obviously to have the sounds played automatically in response to the children's movements, such a system is not easy to build. Therefore, we mock it by hiding a human behind a computer to do the same work as the final program should do. This is a very good way to test if having such a program would be actually useful without building it. It can also give answers to some questions that arise when we think a bit deeper: what kind of movements to react to? what kind of sounds to play? how long should the sounds be? etc.

Projection on the wall

For the interaction with the shadows, a “Wizard of Oz” is not as suitable. It is quite hard for a human being to input the position of the children in real-time. Therefore, we need a higher-fidelity prototype\(^6\).

What we designed then is a simple system to detect the presence of someone standing in front of the screen. We take a snapshot of the scene, and then
subtract the live video input with this snapshot. It is then very easy to threshold the resulting image, which gives a good idea of what's happening in the installation. We then simply cut this image into vertical slices, and count how many pixels are above the threshold in each slice. This gives us a number which is high if someone is standing there, and near zero if no one is in front of the wall.

We were then to design some animations to draw as a response to the children's movements. As we said in our Wonder Document, one of our ideas for a scene was water. We decided to draw bubbles that would follow the children as they walk in front of the wall. We also found a few sounds to fit into that theme: water splash, water poured into a cup, shaking bottles and waves.

**Technical solutions**

The detection of people standing in the field of view of the camera was done using Max/MSP. It is a visual programming environment, which means that one does not create a program with code as in a traditional programming environment, but by connecting several boxes to create a processing flow (a “patch” in Max/MSP language). The advantages of this paradigm is that the programmer gets instant feedback when designing a patch, as opposed to having to recompile and launch the whole program.

Max/MSP is dedicated to audio and video processing, and is well suited for prototyping our kind of application. It features a lot of image processing boxes such as addition and subtraction, thresholding, segmentation, etc. It is also trivial to capture live video from a webcam, and it features a lot of widgets like sliders, knobs, push or on/off buttons, which are useful to adjust values in realtime. This helps speeding up the designing of a prototype, because for instance we can instantly see the result of adjusting a threshold without having to stop the program.
While Max/MSP is very good at processing live video, it is not really designed to draw shapes into the screen. For this, we used another program called Processing. It is a Java-based programming environment aimed towards generation of images or animations with code. It uses a Java-like language, enhanced with several functions to ease the drawing of images or vector shapes. Our program draws bubbles moving towards the top of the screen. It shifts the bubbles depending on the values received from Max/MSP, so they follow the children as they move in front of the wall.

Max/MSP sends the computed values to Processing through UDP, using the Open Sound Control protocol. Both programs have libraries to use this protocol, so we could get the inter-application communication working within a few minutes.

For playing sounds, we created a Java program with four buttons, each one playing a sound. We can press the button, or assign a key to it, to trigger the sounds at will. Several sounds can be played at the same time, for instance a long background sound and a shorter, louder sound.
Observation

While building the prototype is interesting in itself because we get to think about what to build and we need to find solutions on how to do it, the reason we built this prototype was to observe how the children interacted with it.

We needed to think about how to keep a record of what happened. We did not write notes during the experiment, because it was not convenient to do so. The action is fast, and the environment is busy. Instead, we took pictures and videos which can be analysed later on.
Evaluation and Conclusion

Rudolf Steiner School

We went to Rudolf Steiner School to make a field study\(^{(7)}\) of our design. There was one big room with several installations and there were many children playing with it. So it was really natural location with natural users.

Environment

The room wasn't fitting for our prototype properly. It was too bright for the shadows to be visible enough to catch the children's attention. Also we didn't have enough space for the projector to be put in a proper distance, so usually the shadow was too big to fit on the screen. Then the children couldn't have seen the animation and couldn't have understood and reacted. That's why we think that the results are worse than they would be in a ideal environment.

Evaluation

We observed the children and we asked them as well. We took videos and pictures.

*Children playing with our prototype at Rudolf Steiner School*
What we saw

*Worked:*

- children liked the shadows
- children liked animations (represented by the bubbles)
- children interacted with the sound when it was loud enough
- children were interested in how the installation worked

*Didn't work:*

- the environment (described above)
- children wanted more colors. It was party problem of environment, but party of our prototype.
- the sound was too weak. We didn't have proper speakers and the room was too loud.
- the interaction was a bit unclear for some children. When the children didn't move to the sides there were actually no interaction, so they didn't see any interaction.

Conclusion

The evaluation was useful later in development. We got to investigate how well the development prototype supports the tasks and goals.

1. we need to get the projector further away and keep the children closer to the wall

2. the installation have to catch the children's attention more:

- the interaction has to be clear enough
- we have to add new interaction for the children who don't move. For example animated shadows around their body shape.
- make the sounds better
- use more vivid colors
- the room should be a little darker, but not too dark when that could be scary
References

1. Oslo Barnemuseum: http://www.oslobarnemuseum.org
2. Interaction Design: Beyond Human-Computer Interaction
   Chapter 9, The process of interaction design (Page 448)
4. Interaction Design: Beyond Human-Computer Interaction
   Chapter 7, Data Gathering (Page 290)
5. Interaction Design: Beyond Human-Computer Interaction
   Chapter 11, Low fidelity prototyping (Page 535)
6. Interaction Design: Beyond Human-Computer Interaction
   Chapter 11, High fidelity prototyping (Page 535)
7. Interaction Design: Beyond Human-Computer Interaction
   Chapter 12, Field studies (Page 591)