Bowl: token-based media for children

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Figure 1. The bowl interface in context.

Abstract
'Bowl' is a simple token-based media player designed as a self-contained interface for children between 2-4. The project focuses on the use of tangible interfaces for handling media in relevant physical and social contexts – in this case the home environment.

An initial investigation of containers leads to the consideration of bowls as interfaces for viewing, sharing and presenting media. Subsequent investigation of everyday objects leads to the use of toys and a range of familiar items as tokens with relationships to media. The resulting prototype and extensive user-testing shows strong relationships between playful activities and media consumption.

The project extends a rich history of previous work in token-based interfaces by implementing a long-term, iterative design and testing process in contextually relevant situations.

Keywords
Tangible interaction, token-based interaction, touch-based interactions, design, social media, media, children, video, interface, animation, interaction design, product design, RFID, RFID-based interactions.

Project/problem statement
In the broadest context the project's motivation has been to explore physical interfaces for increasingly ephemeral and intangible digital media; a rich area that has been explored before[2] . As media moves from *physical* towards *online, social* and *time shifted*

distribution with services like YouTube, Vimeo, TiVo, Apple TV and Microsoft Media Center there is a lack of suitable home interfaces for this content.

This is a research area that has been looked at in a multitude of ways in the field of *tangible computing*. Much research in tangible user interfaces (or TUIs) emerge from engineering and informatics perspectives[1] where we see very rich and complex system interfaces[11]. But here we see a lack of research into the contextual relevance of TUIs; where simple interactions may create or stimulate rich and complex uses, behaviours and situations. With a design-focused perspective we have created work with less infrastructural, technical and systems richness but with greater contextual, social and aesthetic richness.

"Exploring and manipulating physical objects is a key component of young children's learning"[12] and Tangible User Interfaces (TUIs) have been shown to be very suitable interfaces for children, There is a particular need for interfaces for young children at the age where media is becoming important, but before standard interfaces like the DVD or remote control can be comfortably adopted. From personal experience we see particular problems and opportunities with the use of media for kids around the ages of 2-4, where the handling and controlling of physical media is difficult, but there there is a rapidly developing interest in screen-based media both for learning and entertainment. The dominant forms of interface are the television set plus TiVo, DVD or VHS player and their associated remote controls, all of which lack at best basic usability for young children and at worst encourage extended viewing and allow for navigating into unsuitable content.

Patterns of typical media behavior in children includes passive media consumption, lightweight forms of addiction[9] and withdrawal symptoms or grumpiness on being removed from media experience. We want to experiment with design solutions that deal with these issues and that allow active and playful control over media and digital content. This is an opportunity to create prototypes that evaluate the possibilities for playful and social interactions with home media that is *less passive* or *lean-back*. Through the exploration of these playful interfaces we may also discover interaction patterns that can be applied more broadly as universal interfaces for media.

Einar's daughter, Anna – who features as our main user in this paper – was 2 years old at the start of the project. We saw an opportunity here to design, evaluate and iterate an interface aimed particularly at children of that age.

The project builds on a very rich history of token-based interaction research and projects, the interface foundations used here are not original. The concept of token and constraints came from the MIT Medialab-paper "Token+Constraints" [15], that presents several projects working with *tangible interactions* with *digital information* using *tokens* as interfaces.

We also build strongly on research in embodied interaction: looking particularly at experiences and habits that are remembered in the hands. Patterns in behaviour that are repeated often become subconscious acts. For example remembering where one keeps the salt, or how to pick up a coffee-cup etc. The home is dense with these embodied interactions and when working within this context these interactions should be studied.

Similar tangible and token-based media projects include a wide variety of musical interaction projects, modules designed for exhibition uses and other table-based interfaces. Like the Reactable[11] from Music Technology Group, where several simultaneous performers can share control over the a digital instrument by moving and

rotating physical objects on a luminous round table surface.

Projects such as the RFID Mon Amour[8] from the Interaction Designlab are designed for exhibition use, comprising of an RFID reader and a selection of tags that can be embedded in objects as tokens. Table-based interfaces such as the Symbolic Table[13] from Mediamatic use very similar touch-based interactions for triggering media content, but are aimed at creating a generic platform for building applications in an exhibition context.

Much of this work has shown the viability of tangible, object or token-based interactions for handling various media but these projects define very little about the context of use and rely on designers or engineers to take the interactions and content further.

In summary the project goals can be described as:

- To find suitable home media interfaces for children, using everyday objects and containers as a starting point.
- To create playful, physical activities around media usage.
- To create physical prototypes of an interface by combining simple technical infrastructures.
- To find or create suitable digital content and related physical objects for testing.
- To create relevant interactions involving the interface, physical objects and context, to find ways of introducing children to a technology-interface that they can handle themselves.
- Using this interface as a platform for user-testing to research and find suitable variables to test.
- A body of reflective knowledge and conclusions obtained through period of sustained evaluation, design and iteration.
- To examine the effects of this changing role of digital technology and content in the home.

Background

The project's goals emerged from multiple directions, in a multi-disciplinary environment composed of industrial and interaction designers looking at technology, physical products and social media. It is part of an ongoing research project called *Touch*[14] in the Industrial and Interaction design departments at the Oslo School of Architecture & Design. Touch investigates new applications for Radio Frequency IDentification (RFID) and Near Field Communications, specifically looking at emerging issues for *touch-based interactions* and the use of short-range wireless technologies like RFID to create new forms of interface.

Bowl emerged from three directions over a five month period. Discussions in early 2007 between members of the Touch project thinking about basic RFID-interactions, diploma students looking at social media and students looking at interactions in everyday life. The concept for a self-contained media player emerged during an *evidencing*[5] process looking at various concepts for sharing media using physical tokens. During this process we realized that a self-contained interface – one that didn't rely on infrastructure or critical mass of widespread adoption – might be an interesting design and commercial opportunity.

Challenge

The main challenge was to create working physical prototypes that remained functional over time in the relevant home-context rather than a laboratory. It was very important to be able to evaluate realistic media interactions without frustrating or alienating participants involved in the testing. Given that the target audience is very young this required good building and planning in order to achieve useful results.

The ethical issues of testing media interfaces on children have not gone overlooked. Overall we feel that encouraging media usage as part of a more playful and goal-directed activity – away from a lean-back passive consumption – can be seen as relatively non-controversial and serves to contextualise existing media patterns within existing playful activities.

The testing process was designed around everyday family life. The testing was planned to not interfere with Anna's usual activities and she was encouraged to engage with the bowl in her own way, as part of daily routine. The system would only be active at the times during day when Anna usually would be watching TV (late afternoon, weekend mornings etc). On days when Anna wanted to watch regular TV instead the system was turned off. During the testing period we tried to establish new routines that Anna understood; i.e. some of the media tokens were kept in a box on the second shelf. When Anna wanted to watch her movies she got out the box and asked for the bowl. By creating these new routines we wanted Anna to understand the context around the new media interface.

Solution

The emphasis of the project was the evaluation of interfaces and key concepts in our process were rapid prototyping, design iteration and long-term evaluation in context. This section describes our process, the solution and results.

A. Process

Overview

It was important for us to ground this project firmly within the context of the home and the initial phase of the project involved looking at touch-points in the home environment. We arranged workshops consisting of mapping and drawing sessions where participants explored and documented their homes. This provided us with valuable inspirational material around everyday details and embodied interactions which lead to interesting discoveries about objects, habits and patterns.

Some of our initial process involved research in second hand shops to discover new classes or categories of containers and tokens. We conducted brainstorming sessions in toy shops, kitchen-ware and interior shops which allowed us to see, feel and reflect on different kinds of everyday objects. This revealed new applications and content possibilities as well as stimulating thinking around material and technical issues.

In the first project phase we observed Anna's play with toys and her media-usage. At this time (2 years +) Anna had become very aware of what she wanted to watch. She would get the DVD-covers out of the shelf herself and bring them to her father, demanding to watch i.e. "Mickey Mouse and the broomstick". But she had no idea of how control the DVD-player herself, or how to use the remote-control to skip to the right episode. When watching TV she would frequently ask for films other than what was currently showing. It was clear that she had the ability and knowledge to choose for herself, but that the complicated media interface was a threshold to be overcome.

Based on these observations we started to design a suitable media-interface based on a container. We mapped out the challenges for both the *interaction details* and *technical setup*. Through workshops, prototyping, testing and creative methods we worked towards the *physical form of the interface*, the *types of interaction* and the *kinds of suitable content*.

Figure 2. Test-bowl 1.

Figure 3. Test-bowl 2.

Figure 4. Test-bowl 3.

Figure 5. Bowl studies.

Typology studies

Containers in the home proved to be an interesting starting point. Apart from studies of more meaningful objects[3] there has been little work in the direction of these relatively mundane, everyday objects that have little conscious meaning in everyday activity. In order to understand how containers might be used as an interface we created a typology of bowls. We studied numerous bowls found in our homes; documenting their use, associations, measurement and design.

When we start looking at bowls in the home we discovered that bowls can have very specific meanings. Some bowls are special 'Sunday' bowls and many are purely utility. The status and use of a bowl is determined by material, size, design and personal, social or historical value. Some bowls are connected to specific social contexts where they are used for sharing and presenting content i.e. a bowl with sweets. Other bowls belong in a more private context; in the hall containing keys, change, spare buttons etc.

From an aesthetic perspective the bowl is a very attractive object to work with. It has a general function but a specialised shape. The bowl also has a mechanical quality that serves to centre it's content. This makes it ideal for token-based interactions: an RFID-token placed in a bowl can be easily read by a reader in the bottom. This also enabled us to use a cheap RFID-reader with limited range and read-area.

When looking at tokens we wanted objects that are part of the everyday home. We wanted the kinds of toys that are found in the living room or other parts of the household – not just kept in a toy box. We wanted to find aesthetic objects that didn't interfere with home situations or everyday activities. We wanted to try out as many different shapes and sizes of tokens as we could. Some tokens needed clear associations to content but we also needed tokens that didn't have any existing media-association.

Figure 6. A large diversity of different toys were fitted with RFID-tags used as tokens.

As part of the typology study we introduced various bowls and tokens to Anna and observed her behaviour.

With results from this we ended up with three test-bowls (see figure 2-4) and several possible tokens and token-types.

Figure 7: The rapid prototyping of the basic platform: a simple wooden block with a USB interface.

Technical setup
A standard platform was built very early in the project, from which many bowls and tokens could be evaluated. The more in-depth and time-consuming software development took place with the test-platform in context, where timings and other interaction variables could be tweaked.

Through the development of the physical prototype the technical possibilities and challenges were rapidly discovered. It was important for this set-up to be lightweight and dynamic so that important interaction parameters could be tweaked and altered in-situ.

For more details see 'Solutions' below.

Figure 8: Overview of the user-test context: a regular living room with a TV-set, sofa and table.

User-tests
The user-tests were planned as a series of guided activities with different topics as directions. There were two main themes as guidelines:

1. "Token–Bowl"-interactions
2. "Token–Media"-experience and behaviour

This allowed for some separation of the interaction from the content; allowing us to evaluate interaction concepts as well as content concepts.

The tests were planned to be conducted in this order:

Test 1: Existing toys as token. *Testing the system with Anna's own toys as tokens for the content: i.e. a Mickey Mouse-doll = a Mickey Mouse movie. This was conducted before introducing any specially made tokens in order to see her reaction on her own toys having new abilities.*

Figure 9. "Bob the Builder…"; For the first iterations of the test 1 and 2 the most engaging content worked best, like the opening of *Bob the Builder* .

Figure 10. "Sunday Morning 07.00"; The Sunday morning test ended up as an combination of breakfast, TV and play.

Figure 11. "Picture-stick"; With a stick Anna can access pictures from her digital album.

Test 2: New tokens. *Introducing brand new objects as tokens. These new tokens had clear associations: i.e. Elephant figure = Elephant-movie. The goal for this test was to create and test different kind of tokens like dolls, wooden figures, picture-cards and simple shapes.*

The intention of these first two tests was to observe Anna's general reactions, and for her to learn how the system worked. The test were repeated until Anna was comfortable with the bowl-interface and until the technical setup was tweaked to a satisfying level. This took about a week and gave us lots of details to work with. Anna enjoyed the interaction experience and enthusiastically learnt how to get the different tokens to work. She understood that the dolls had to sit in the bowl etc. She also understood the tokens without clear connections to tokens; i.e. the mouse-doll worked perfectly as a token for Tom and Jerry. During this period we added more and more content and also tried longer clips of up to 25 minutes. This first test-week ended in the crucial Sunday-morning test: The system had been set up the night before, and Anna was sent into the living room alone in the morning. This resulted in a self organised morning with a combination of breakfast, media and play. Anna controlled the flow of movies herself, and did not have to ask for help at any point. The test showed that the interface worked seamlessly in a relevant context.

Test 3: Tokens for navigation. *The first two tests were designed to be simple, the third test was a bit more complicated. Anna's favourite movie was a DVD with several episodes about a mole. Each episode is about the Mole finding a specific object and trying to find out what it is / does; i.e. a lollipop, a blanket, a radio, a glittering stone. The idea for the test was to make tokens based on these objects and see if Anna understood the connections. Would this be a way for her to navigate within content she already knew?*

This test didn't succeed. Anna did not recognise the images on the different picture-cards as the episodes about the mole. The picture-cards were not as fun as the other tokens and Anna ended up ignoring them. We also tried using a single Mickey Mouse figure as the token for several, randomly picked Mickey-episodes. This only annoyed Anna because it made it difficult for her to get directly to the episode she wanted.

Figure 12. "Odd / weird tokens"; a stick that opens photos.

Test 4: Odd / weird tokens. *This test intended to find out how Anna reacted to tokens and movies where the associations and connections weren't clear. For example a stick that plays a new movie every time you stick it into the bowl.*

As we discovered with the random-Mickey token, random movie tokens didn't work. We did however try a stick that plays random pictures when placed in the bowl. This photo-stick had a very weak tag in one of the tips and had to be *stirred* in the bowl for the reader to pick it up. The pictures were chosen from an album of Anna's pictures. This turned out to be an interesting concept. Anna would stir the stick in the bowl and every time she

Figure 13. "Homemade tokens…"; Bark, twigs, cones and leaves fitted with RFID-tags.

Figure 14. "Organizing tokens"; Play with the tokens included organizing them in groups.

Figure 15."???"; At the end of the test-period the bowl-system was removed. Anna still tried to play movies by placing the tokens in bowls…

got up a picture she recognized (i.e. a visit to her grandparents), she would talk about it. The picture-viewing session became a very conversational experience where Anna would *show* her parents snaps and tell the stories about them herself.

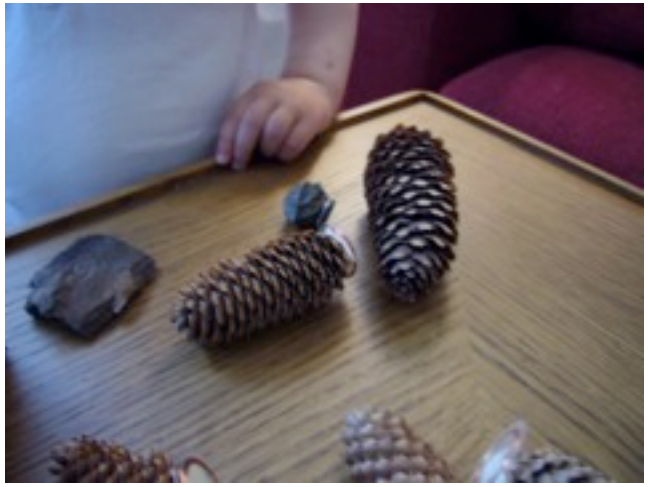

Figure 16. "Homemade tokens"; found pinecones as tokens for video-clips from a trip to the park.

Test 5: Homemade tokens and homemade content.
For this test Anna and her father made the tokens and the content together as a collaborative exploratory experiment. This involved finding or creating objects and linking them to home-made media.

For this test we visited the botanical garden one Sunday morning. Anna found twigs, cones, leaves and picked flowers. We made short video-clips and took photos of activities (i.e. throwing stones in the pond, feeding the ducks etc). We collected the things we found and brought them home with us. Here we fitted the things with RFID-tags and assigned them to the different video-clips. Anna got these new tokens and played back the clips. Later that Sunday her aunt came to visit and Anna showed her the clips herself with great enthusiasm. She told her aunt about her trip to the park by using the tokens and clips. This linkage between objects and experiences / memories show some great conceptual possibilities. There is more to this media-interface than just cartoons and Disney sing-a-longs. It can be developed towards holiday-snaps, family-photos, personal gifts, handicrafts, etc. Homemade content and/ or homemade tokens have great potential and will be investigated further.

Figure 17. Watching and playing with brand new Barbapapa figures / movies.

Iteration
These user-tests formed the basis of an ongoing test in daily situations. This allowed for further refinement of the content and interface. In fact we ended up conducting ten tests based on the results of the first evaluation. These tests included *choosing and organising tokens, one-to-many mappings, play, unfamiliar content and unfamiliar tokens*; *content she had no previous relationship* to i.e. Barbapapa, *self organised mornings* and *gradually changing the content of tokens*.

B. Solution details:

Figure 18. The test-platform is a piece of wood containing an RFID-reader and USB socket.

Overview

The physical prototype used here is the first iteration of the functional form. The prototype is simply a wooden block containing an RFID reader that supports multiple kinds of bowls as the container for tokens. When bowls are placed on top of the box, the bottom of the bowl becomes the active reader-area. When tokens are placed in the bowls they are then read through the bottom of the bowl. The box is connected by a USB cable to a media player/computer under the TV. There is a simple piece of software running on the media player/computer that plays back media and allows individual tokens to be linked to discrete media files. The media files are played back on the regular TV-set.

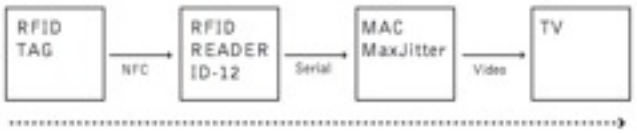

Figure 19: Technical diagram showing the modules of the technical setup.

Figure 20. Anna watching Minnie Mouse.

To describe the interactions and some of the experience the following is a typical in-context scenario describing one kind of interaction with the bowl:

- The TV is on but showing nothing
- Anna gets out her box of tokens and says she want to watch i.e. “Mickey Mouse ”
- Her father takes the bowl down from the shelf and plugs it in. Now the TV shows a simple still-image of the bowl. The bowl is placed in the living room table.
- While her father does this Anna gets out her tokens and places them on the table. She talks with them and plays a little. She organises the tokens in a group.
- Anna places one (a mouse) into the bowl.
- The TV plays a piece of media (Tom and Jerry), Anna takes the mouse out (the movie doesn’t stop). She puts it back (it doesn’t restart the clip).
- Anna takes another token (Barbapapa), places it in the bowl.
- It plays Barbapapa, overriding previous choices
- Changes the Barbapapa for a Barbamama figure.

Figure 21. The inside of the prototype-box. An Innovation ID-12 RFID-reader and an usb-adapter.

Figure 22. Tags fitted to the tokens by simply gluing them on.

Figure 23. Tag embedded into mouse-doll by carefully stitching it into its bum.

- It plays another episode of Barbapapa (with Barbamama as the protagonist).
- While watching Barbamama Anna puts the mouse-doll to bed on the sofa.
- The Barbamama-clip finishes and the TV shows the bowl image.
- Anna keeps on playing with the mouse a little longer.
- Then she puts a Mickey Mouse figure in the bowl.
- It plays an episode of *Mickey Mouse Clubhouse*.
- And so on.

This can be summarised as a simple model: When the child places a specific token in the bowl the TV plays a specific movie; i.e. "Bob the builder"-token = "Bob the Builder"-movie. When a new token is placed in the bowl, a new piece of media is played.

There were several challenges with prototyping this model. One was the simple but crucial task of gathering and choosing good content. A media-player is dependent on good media and it is impossible to prototype one without good movies. The very first user-test failed dramatically because Anna thought the movie-clips were too boring. It wasn't before we used recognisable and engaging content that Anna got interested in the bowl-system and started to learn how it worked.

Figure 24. Wooden elephant and RFID-tags used in the tokens.

Technical challenges

One clear problem – and perhaps opportunity – is the physical limitations of RFID technology. In particular the tag reading range is very small. When combined with multiple token sizes and different sized bowls, it is not certain that media will load properly each time. If the tokens are too small it is encouraging for them all to end up in the bowl together. If the tokens are too big the distance between the reader and the embedded RFID tag can be too great, the tag can end up at an angle or bouncing in and out of the field causing multiple readings. RFID should not be seen as a stable identification technology, it is very prone to errors and erratic behaviour.

Initial concept development posed the question: what if more than one token sits in a container? How should the system react and what content should it display? It seems natural to develop a system that responds to multiple tags and displays content according to combinations, etc. Technically the problem of reading multiple tokens in the same locations is solved by using an anti-collision capable RFID reader; the readers and

the tags contain functions that enables them to time their responses and to be read in sequence. The particular reader and standard that we are using (low frequency RFID EM 4001) doesn't support anti-collision protocols. But conceptually this is also a difficult question: what combinations of tokens make sense with media content?

In practice much of this doesn't have a meaningful impact on the experience. The action of stirring a twig or making sure that a bear sits in the container are just small behaviours and habits to learn within the system. Anna repeated the action of putting multiple tokens into the bowl a number of times but subsequently ignored it after finding out that it had no effect. She had no trouble adapting in very short periods of time, and the quality of the experience wasn't significantly impacted. When something wasn't working properly Anna simply removed whatever was in the bowl and tried over again with something else.

It is clear that Anna has created a simple user-model which she thoroughly understands; breaking this might be problematic. The software had to be developed to support this simple user-model. It had to be designed to solve hardware-issues (like double readings) in a consistent manner and to give the system a clear and predictable behaviour. Overall we found that the very simplest of mappings – such as the 1:1 relationship between tokens and media – were most effective.

C. Results

This study has been rich in both the details of physical interactions and conceptual possibilities. We have come a long way towards realising a suitable home media interface for children, using everyday objects and containers as a starting point. The interaction is simple, natural and works seamlessly as a media experience. The interface can be immediately satisfying without guidance or instruction. When trying the system with new users, the first interactions tend to explore the limits of the system: finding out how quickly it changes and probing back and forth to verify the link between object and content. The initial interactions almost always involve trying to put all of the objects in the bowl, but when this doesn’t result in any feedback, the interaction quickly turns exploring the various objects and their related content. For a 2-year-old very little is intuitive about interfaces but if the interactions are consistent and meaningful, learning is very quick.

It has been valuable to prototype the interactions over a relatively long testing period. Creating a functional technical prototype at an early stage, and subsequently iterating the hardware and software has been extremely productive. This has allowed us to solve technical, interactional and contextual challenges throughout the design process.

We deliberately used the first prototype as a platform for user-testing to research and find suitable variables to test. The experiences that evolved during these tests challenged our initial design assumptions. In particular a technical challenge that we thought would be critical to the success of the interaction turned out to be a non-issue. We were adamant we would have to find a technical solution to the multiple tag problem. But we quickly found that after three or so attempts at putting multiple objects in the bowl at the same time the interaction proved not to work and wasn't attempted again. Even though bowls have the physical affordance of containing multiple objects, the interaction-model that is created through the physical-media link is so strong that this is overshadowed in practice.

One of our goals was to examine the effects of the changing role of digital technology and content in the home as a result of new interfaces. The long-term testing has offered us an insight into this changing television-based experience. We see increasing

connection between playing and watching and more physical activity around media usage. The media playing is more dynamic and non-linear; Anna decides when to watch and when to change movies. At the end of the testing-period Anna's user-response was different. She had learnt how the system worked, and used it in a casual way; having full control over the interaction process. Interestingly, she also expected the system to be her personal media-interface, reflecting the fact that her toys were the media-objects. This resulted in some difficult episodes after the bowl-system was removed from the house: Anna was confused by the bowls and toys that no longer played movies and much of the original media-induced grumpiness ensued.

In the tests with the Photo-stick and the home-made content we saw possibilities for a closer integration of digital content and family life. By lowering the threshold for access and control over digital content it becomes a far more family-friendly part of the home. Here we see a potential for a technology-interface on terms with the social behaviours, interactions and aesthetics of the home.

Figure 5. Anna gets her tokens out of her film-box.

Methods evaluation

The initial planning involved five user-test tasks but due to the richness of the process, we ended up conducting about ten discrete topics and twenty different tests. This kind of extended testing in context throws up a lot of new areas and creates new problems to solve at each stage. We regard this sustained, rich access to relevant people and contexts and essential part of developing new interactive products. In evaluating the process we have to compare our initial design proposals with the final result to see the richness of the insights, particularly in the simplification of the technical and interactional aspects described above.

Next steps

At the time of writing a new set of prototypes of both the bowl and the tokens have been built, with a wider range of content. In particular we have built interfaces for social media which may allow mixed usage of the interface for both children and adults. For this we propose continued user-tests with adults where we evaluate the usefulness of these kinds of interactions for other user groups including the elderly. We want to use this test to gain qualitative feedback on the overall experience of the system, the usability, usefulness and desirability of such a device.

As a design exercise we are developing commercial models through *naming* and the creation of *packaging*, *branding* and *product development*. This may help to clearly explain the product through the use of multiple perspectives. For instance, how would the product be ‘shelf explanatory’ if it was sold by Disney, Hasbro, Apple, the BBC, etc. This work looks at the communication and context for tangible products and will be the focus of a future case-study.

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