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The Other Brother: Re-experiencing Spontaneous Moments from Domestic Life

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ABSTRACT
In this paper, we describe "The Other Brother", a semi-autonomous device that captures images and video of spontaneous moments in the course of everyday life. It was our goal to design a situated, tangible object for life-time capturing purposes. In addition to describing the object and our deployment findings, this paper also discusses the design process and the goals we were aiming to achieve through the design. This was an iterative process from initial sketches, concepts and physical explorations towards a final design and several prototypes. The final prototype acts as an agent that behaves to some extent autonomously, capturing spontaneous moments that enable people to re-experience these moments in a playful way. Testing The Other Brother in a domestic environment, we describe several findings of the impact of the object in the home, reflect on several design and interaction issues, and discuss future directions for continuation of this research.

Keywords
Agent, autonomous behavior, randomness, unpredictability, iterative design, image capture, spontaneity.

INTRODUCTION
As the boom in digital photography attests, as human beings we like to capture valuable moments throughout our lives, keep them safe and share them later with friends and family. Many of these are social events, such as birthdays, graduations, parties, and holidays. But there are all kinds of events that define our lives and are worthwhile capturing forever.

Nowadays the number of technologies that facilitate this phenomenon by means of digital media is becoming ever more diverse. People use (digital) photo and video cameras, PDAs, web-cams, mobile phones to capture these important experiences. While we used to use such technologies mainly for special events, such as being on a holiday or celebrating a birthday, many of today's more portable and ubiquitous technologies seem to spur us on to capture more and more, taking in not just special events but more mundane situations as well. An example here is the work of Kindberg et al. [7], which shows that the development of the cameraphone enables more and more people to instantly capture events whenever they desire, for all kinds of different purposes. Kirk et al. [8] also find in their study of "videowork", a distinction between lightweight (capturing in a more spontaneous way) and heavyweight video capture (capturing in a more planful way). This study also points to cameraphones as supporting lightweight capture, a growing trend in today's world. But capture devices are not the only technologies changing our behaviours. The use of laptops and web-cams in combination with the development of online image and video repositories also contributes to new ways of capturing and sharing moments from our lives. But why do people want to keep these captured moments? In addition to personal reminiscence, representations of important events signify and help us share in our relationships with others. For example, Petrelli et al. [14] describe several additional reasons why people archive their digital (and physical) items, such as for nostalgia, moral values, aesthetics and family bonds.

In this paper, we describe the development of a concept and prototype device designed to explore new ways of capturing and sharing life events. It was our goal to design a situated tangible device for a domestic setting, capturing natural and spontaneous social situations. Here, we focused on more serendipitous, lightweight ways in which moments could be captured.

Most conventional capturing technologies such as photo and video cameras require a person to take the initiative in acquiring the photo or video and to control the framing of the shot, leading to somewhat predictable results. However, an emerging class of technologies, often called "life-logging technologies", are designed so that the capturing process is more automated. Although the types of information logged are often much broader than just photo

or video (e.g. described in Gemmell et al. [4]) we consider photos and video as the main input for our system.

Another goal of the design was to explore new perspectives for capturing. Many life-logging systems take a personal view on the world for the purpose of capture. For example, Mann et al. [11] describe a wearable capturing system for personal experiences called EyeTap. The EyeTap is worn like a pair of glasses and consists of a mini-camera and display. The nature of its setup allows it to be used in an intuitive way and supports a continuous capturing modality, leading to the capture of spontaneous and unique moments. However, since the camera is located at eye-position, its perspective is from that of the user. Similarly other systems such as [1,5] also rely on the perspective of the user or wearer of the device. One nice feature of Sensecam [5] is that spontaneity of capture is increased due to the fact that sensors use data such as movement to determine when pictures are taken.

We believe that for the domestic setting, and for the capture of social situations in the home, the personal perspective may not be the best choice for a spontaneous capture system. Creating a capture modality initiated by an externally located object gives both an unpredictable and new perspective to re-experiencing the captured event, which contributes to the serendipitous result we want to achieve. However, all the afore mentioned systems capture the life of one individual in many different kind of situations. It was our intention to design an automated system to be used in a domestic environment, focusing on the capturing of different people within different social situations.

INITIAL DESIGN EXPLORATIONS

Since it was our purpose to design an innovative system, we did not focus on problem solving methodologies. Instead, we aimed for the creation of new possibilities for people to re-experience moments from the past by using a new design approach. By following the reflective, transformative design process, introduced by Hummels and Frens [6], we were able to "design for the unknown". This methodology helped us to iterate on an experimental level, which we subsequently reflected upon amongst ourselves and with others.

Starting the design process, we created several ideas and (physical) sketches based on the work of Oleksik et al. [13] which functioned as a starting point for the creative process. In this work, people were asked to capture ambient sounds within the domestic environment. It turned out that people treasured these ambient sound snippets, even though they had not expected to. These findings inspired us to find new ideas to further build on the value of ambient and spontaneous capture in the home. After finishing several physical sketches, it was decided to focus on the creation of ideas and concepts for an object that could capture moments spent with others in a domestic environment.

Fig. 1. Collection of the interactive physical sketches in which sound sources, light, data flow and human behaviour trigger the objects to actuate.

Ideas and concepts

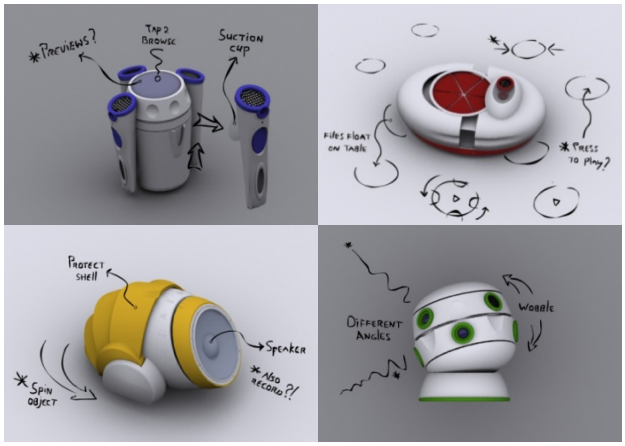

Fig. 2a-d. The four different concepts, from top left to right to bottom left to right, a. 4 everyone, b. Pull and save, c. Spin 2 capture and d. Where, what, who?

Four concepts were explored, each emphasizing a different setup, interaction and context in which the object could be used. The first concept, *"4 everyone"*, focused on the possibility of multiple people using a sound and image capture device at the same time. Here, the device could be taken apart, so that individual components could be used to record and place personal messages anywhere in the home. The second concept, "*pull and save"*, mainly focused on saving captured moments on top of an interactive surface. Using a microphone and camera, the device captures moments throughout the day or during special events in a time-based manner. By pulling the object's left and right part aside, recorded files drop onto the interactive surface and are saved. The third concept, *"Spin 2 capture",* mainly focused on fun in interaction, and had a more ambiguous functionality compared to the initial two concepts, leaving more open space for interpretation by the user. One of the main functions enables users to give the object a firm twist making it spin around and capture a moment. Whenever the object captures a moment, the protective shell on the back slides open and exposes a camera and microphone. The fourth concept, "*Where, what, who?"*, consists of an object that is able to move around randomly, triggered by sound from its environment. The object consists of two different

layers containing small microphones and cameras that spin around. Furthermore, the object is able to 'wobble' around changing the capturing angle. Because of the number of integrated microphones and cameras, it is a surprise to see what is finally being captured.

After the development of several different concepts it was decided to focus on the fourth one, "*Where, what, who?"*, to further develop its design. We selected this concept because of its serendipitous nature which we wanted to further explore by means of a first working prototype. Although this concept was chosen, there were some very interesting aspects from the other concepts that we also wanted to integrate when designing the prototype. The next section further explains the most important design goals for the object.

Design goals

Apart from the fact that we focused on designing a situated capturing device for the domestic environment, integrating a level of serendipity within the captured results was one of our main challenges. When it is not possible for the user to exactly know what is being captured, we predicted that the captured results would be much more surprising, and that that would increase the quality of re-experiencing these moments. Currently, whenever someone decides to take a picture, often the setting becomes rather unnatural. People are forced to laugh, sit together and pose. This does not always reflect the real activity that is going on at that moment. As an alternative, it was our goal to focus on capturing more natural and spontaneous situations. Instead of striving for a 'perfect setting', we wanted to capture spontaneous and unpredictable moments: this might mean capturing only half of the Christmas tree, or the corner of a few presents, or the glass of wine in mum's hand while she sings a Christmas song.

Furthermore, it also takes effort, especially in pleasant situations to go and get the camera to capture something. Although the concept is all about capturing photos, short video clips and sounds (and combinations of these), it is not the intention to compete with existing cameras, but to facilitate new possibilities.

Another important goal of the project was to explore different kinds of ways to present the captured moments to the user. Unlike the capture situation, here we wanted the user to be able to control what they could select and also to be able to manipulate those captured moments.

PROTOTYPE 1

On the basis of the initial concepts, we started to build a working prototype mainly based on the last concept, "*Where, what, who?"*, which incorporates the idea of a camera that can spin around. The main component of this prototype consisted of a digital photo camera controlled by external sensors and actuators. By using a standard digital camera, it was possible to take pictures but also to record short movie clips.

Fig. 3. The first prototype

After creating a base for the camera to be mounted on, the object was equipped with a stepping motor enabling it to have a 360 degree rotation freedom. It was decided to add two microphones to determine the origin of a sound source enabling the object to rotate to a source as the main focus area for possible capture. Having the two microphones positioned next to each other, a sound source coming from the left side of the microphones is picked up by the left microphone and subsequently makes the object turn to the left. The same thing happens for a sound source coming from the right of the microphones, making it turn to the right. Furthermore, a servo-mechanism was added as well to give users the possibility to change the capturing angle whenever necessary. In order to control all the attached sensors, actuators and the camera itself, an Arduino microchip was positioned at the back of the object that processed the incoming sounds. It was decided that breaching a sound threshold (exceeding a certain level of dB) should trigger the object to capture a picture or short movie-clip (depending on whether the camera is manually set to take pictures or short movie clips).

USER STUDY 1

The main focus of the first user study was to simply observe how people responded to the object and whether its purpose was clear. The prototype was deployed during three separate events with three different families during Christmas. This setting was ideal since Christmas provided an atmosphere that perfectly fits with the intended use of the concept. The families were simply asked to put the object on the table and use it whenever they spent time together. It was explained that the object would capture these moments. However, the precise way in which it worked was not explained in order to stimulate people to engage with it and find out themselves. A month after the actual event the participants were able to observe the captured moments and were asked to fill in a short questionnaire about their expectations and experiences.

Fig. 4. A few results from the first user study.

Findings user study 1

During this initial user deployment, the prototype captured several unique moments. One of these, which participants particularly liked, was a moment in which a little girl spit out something she did not like from her Christmas dinner. There were other similar kinds of funny or strange events that the participants also enjoyed viewing (see figure 4).

Participants were enthusiastically surprised with some of the captured moments, but also mentioned they did not dare to interact with the object because it looked very technological and fragile. Further, many questions arose around what the intention of the object exactly was. Furthermore, we found that whenever there was a flash (in case of a picture being taken) people started to respond towards the object and tried to manipulate it by shouting or clapping their hands. They were a bit disappointed that nothing changed whenever such an initiative was taken (when the object took a picture or made a short movie-clip it did not respond to anything). In the case of creating a movie-clip (in which no flash was used) there was almost no response so people simply did not know whether it was capturing or not. Feedback from the object was clearly an important issue to consider in the re-design.

PROTOTYPE 2

After the first user evaluation, it became clear that the appearance of the object interfered with the possibility for people to interact and actively manipulate the object. Since the essence of the concept is that the object captures moments triggered by the presence of people, building a closer relationship between the object and the user is essential, especially considering the fact that the user is not in direct control of what is being captured. The object takes the initiative in capturing moments and its relation with the user becomes part of the social situation.

In essence, we found that even the first simple prototype was becoming an additional character within the group; a character taking part in the social activity. Here we believed we could build on this aspect of its design, perhaps even changing its mood along with its behaviour and recording capacities. Therefore, it was decided to re-design the object as such and create a more character-like design aesthetic: "The Other Brother" was born.

As can be seen in Figure 5, the second prototype, The Other Brother is equipped with a front and back cover, a LED display, two interactive 'buttons', feedback lights and integrated RGB-LEDs to change its colour.

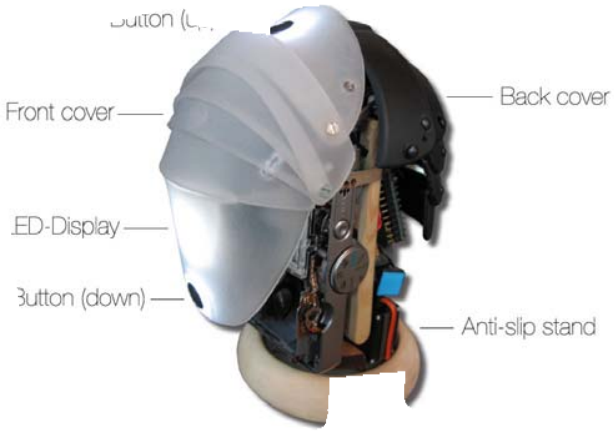

Fig. 5. The second prototype, "The Other Brother"

LED-display

The initial purpose of the LED-display was to provide additional feedback towards the user. In this design, the current mode of the camera depicts two different icons (picture vs. video). Furthermore, the display also provides additional feedback concerning capturing status and whether the object is being moved up or down. Next to these more practical forms of feedback, the object has several programmed behaviours to draw attention to itself. Attention is drawn to the device using a combination of movement, changing of the object's primary colour and several light signals on the display. The Other Brother captures photos, sounds and videos based on the contextual sound level, however when the object is not active for more than half an hour, these attention-drawing behaviours are triggered. Apart from this, it starts capturing moments triggered by a set time-frame as well.

Front & back cover

The front cover is a transparent layer which covers the fragile parts of the object (including the microphones) and consists of a moving part that slides open whenever the object decides to capture a moment. The decision to integrate the moving part into the object was based on the fact that people did not know whenever the object captured a movie-clip (they preferred to know this). The opening of the front cover whenever capture is taking place provides additional subtle feedback for the users. The back cover functions purely as a protection layer for the fragile electronics behind it. It is purposely made of a totally different material to clearly identify its separation from the functional front part.

RGB-LEDs

By adding two RGB-LEDs, the object can display a wide range of colours. The colour-changes are used to further emphasize and add richness to the object's behaviour and to draw the user's attention.

Interactive 'buttons'

On the upper and lower part of the front cover is a soft touch button which can be tapped in order to make the object move up or down. This can be done whenever the angle in which the object operates has to be adjusted. For example, whenever someone is sitting very close to the object, the object can be moved upwards making the focus area move upwards as well. Both buttons are surrounded with an unobtrusive light providing a feedback signal. Whenever the buttons are being touched they will light up a few times to confirm the movement.

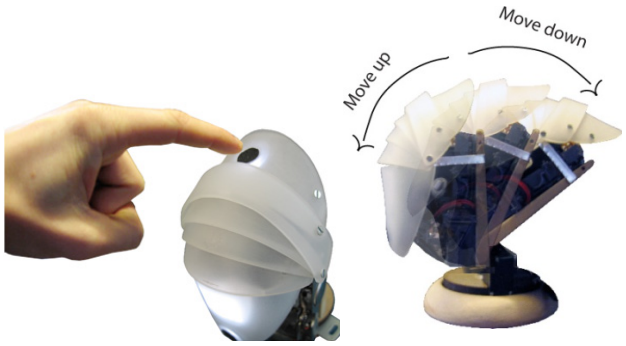

Fig. 6. Interactive buttons; tap makes object move up or down.

Additional changes

As well as the functionality of taking pictures and short movie clips, it was decided to increase the functionality of the device as well by enabling it to capture ten seconds of sound alongside the pictures being taken. Having a sound file being recorded as well increases the quality of the re-experience by adding an additional modality [3].

Furthermore, in order to prevent the object's power cable from completely winding up, the object is programmed to return to its starting position whenever the amount of left turns overruns the amount of right turns by a set amount and vice versa. During the initial deployment, it also became clear that the rotation movements of the object made the base turn around as well since the stepping motor turned out to be very slippery on smooth surfaces. For this reason a wooden base equipped with several anti-slip pads was added.

Web service

In addition to the re-design of the object itself, a web service was created to provide participants in the next deployment with a platform on which they could observe their captured moments. The web service provides all kinds of different clues and grows dynamically. Since The Other Brother makes you re-experience spontaneous moments from the past, it should be possible to view the captured moments soon after they took place. The aim was not to make captured moments available immediately, but rather for them to emerge a bit later, so they could finally be viewed using the web service.

Table-top animation

In parallel with developing the new fully working prototype and web service, a possible table-top interface was explored as well by means of a flash animation. Buxton [2] provides several interesting examples in which an interactive system can be explored by means of a simple linear movie-clip and acting on top of it. Although the level of refinement of this animation was high for such a short stage in the design, the purpose was to offer up a compelling alternative for the web service. This exploration was initiated to investigate an alternative, offering more user control over the captured data in contrast to the web service. In order to quickly make a decision about which captured files to keep and which ones to discard, the designed animation explores how someone could possibly interact with The Other Brother on an interactive surface. By placing the object on the surface, the captured moments are downloaded to the table and slowly slide out underneath the base of the object. The level of transparency of the visuals provides information about the time-frame of the captured files. Here, the older the content, the more transparent the files are. Furthermore, the files are grouped together based on separate events in which The Other Brother was deployed. When the files are uploaded to the table they can be dragged away from the object and be manipulated individually. Furthermore, it is possible to quickly delete a file, send it to a friend, to a community or to edit the file. Though the main emphasis in using the interactive surface is to quickly filter captured moments, it also provides the option to socialize, share moments with others and possibly also play games.

Fig. 7. Sequence from the table top animation.

USER STUDY 2

After the initial deployment and re-design a diary study [10] was executed within two different families. Apart from finding out whether its functionality and purpose was clear, the main goal of this study was to deploy The Other Brother within a domestic environment for a longer period of time and observe any possible changes in people's behaviour around it. Two very different families were approached for the deployment. The first family consisted of five people, a 50 year old father and mother, a 17 year old daughter and two sons (aged 22 and 19). The second family consisted of four people, a 33 year old father, a 32 year old mother, a two year old daughter and a baby.

The families were instructed to use The Other Brother for one week and were asked to keep track of their activities within a provided diary. Though the diary contained an introduction to the object's functionality, this was repeated verbally when introducing the prototype. A disposable camera was attached to the diary to allow participants to take pictures of The Other Brother in place in the home. Throughout the week, the object's memory card was changed on a daily basis which prevented the object from running out of saving capabilities. This also allowed us to retrieve the data to be loaded into the web service and have a quick feedback session with participants about their experiences.

During the first two days, there was no limitation in use or assigned tasks the users had to carry out. During the third and fourth days, the participants were asked to keep the object on as long as possible throughout the day. From day four, the participants were able to visit the web service and take a look at the captured moments from the first three days. From day five on, a digital picture frame with captured moments from the previous days was displayed within the home. During the last two days, the participants could decide themselves whether they wanted The Other Brother to capture photos or video. Finally, the diary study was concluded with an interview and a final meeting in which all results, questions, remarks and suggestions were discussed.

Fig. 8. The diary the participants had to fill in.

Findings user study 2

The parents of the first family were quite sceptical about using the object since they worried it would be difficult for them to understand what exactly was being recorded and when. Since they really valued their privacy, their behaviour was not totally natural while The Other Brother was on. This did not happen in the second family in which privacy did not seem to be an issue for them. The children of the first family also did not seem to have any privacy issues, one of them even stated the following: *"...when you are going to take pictures you can use The Other Brother for it anyway, it* (the fact that The Other Brother is always on, jh*) does not matter does it?"* As also confirmed by the work of O'Hara et al. [12], both families mentioned that as long as they were in final control of The Other Brother and could decide what to keep and discard, they did not have any privacy issues.

Initially the first family used the object mainly during dinner-time. After using the object for a few days in a row during dinner they wondered why they should use it every day. Nevertheless, the children used the object in different situations and also forced the object to capture moments by clapping their hands or making weird noises. Finally viewing the children's captured moments, the parents became enthusiastic as well. The children also liked the fact that The Other Brother was switched on continuously; and, at a certain point they simply did not pay any attention to it anymore. This made the result very exciting, since they did not know exactly what was being captured. This was confirmed by the parents of the second family. They mentioned that everybody was actively exploring the object in the beginning. However, after a while they did not really pay that much attention to it anymore, leading to more spontaneous and unpredictable recordings. Another interesting comment was made by the daughter of the first family who felt accompanied by the object while she spent an afternoon alone: *"It was sociable, it made me feel less alone, I had something to talk to....I liked it staying with us for a whole week".*

Within the second family, the object was initially placed at a distance from the activity that was going on. However, after the first day The Other Brother was put on the dining table to be more part of the social activities. After the first few days, they were able to view the results and were very enthusiastic. From the fourth day on the mother also turned on The Other Brother during day time to capture moments she spent with her children. During a final session with the parents, it became clear that the result exceeded their expectations. This includes the fact that the pictures were supported by ambient sounds and this was a complete surprise to them. Generally they thought the result was much more surprising than a normal picture: "*More than I expected, I expected maybe half a picture, but you get a picture with sound, really an impression of the ambience".*

Fig. 9. A few results from the second user study.

PROTOTYPE 3

From these two user studies there were several interesting findings we wanted to use as an input for another re-design of The Other Brother. Since the interactive buttons were not used and none of the participants noticed the different icons displayed on the LED-display we decided to remove both features. Removing these features also made sense since we wanted to replace the power cable by rechargeable batteries embedded within the device. Removing the LED-display decreased the total power consumption of the device. People also wanted to set the sensitivity of response as well, being able to adjust the level of interference of the character. Furthermore, one of the most interesting findings and opportunities for the re-design of The Other Brother was the fact that it is currently triggered by a sound level breaching a certain threshold. However, it is much more interesting to use the deviation of an average value to trigger The Other Brother, enabling it to capture a much larger number of different and possibly more interesting moments.

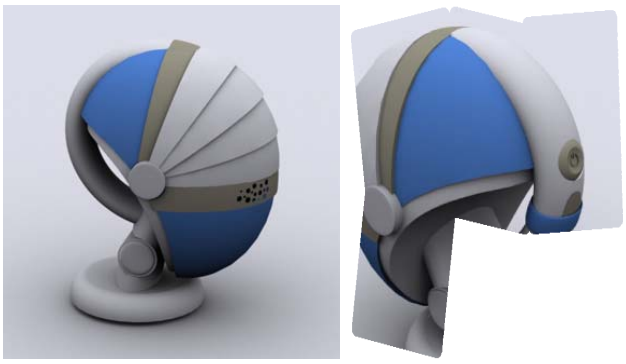

Fig. 10. The new design created in 3D Studio Max.

Inspired by the initial version of The Other Brother and integrating the additional functionality derived from the executed user tests, several different designs were made. This process finally lead to the selection of the object shown in figure 10.

After the creation of the new design, the iterative process continued by means of translating the design into several separate Solid Works structures allowing us to use 3D printing technologies in order to create the new physical object. While constructing the shape in Solid Works each part of The Other Brother was carefully adjusted in order to allow exact placement and encapsulation of the electronics, such as the stepping motor, camera, servo-mechanism, rotation switch (for selecting the object's functionality) and variable resistor (slider) to set the object's response sensitivity.

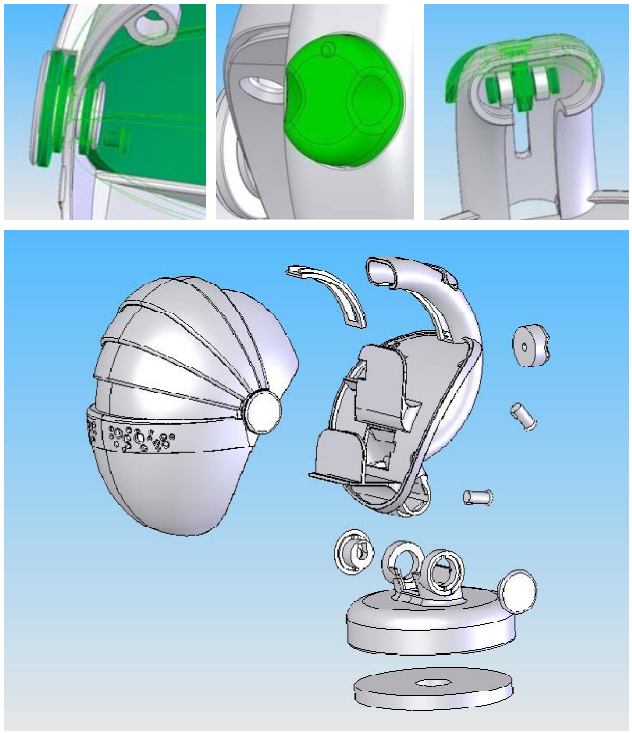

Fig. 11. The 3D modelled additional features and an exploded view of all the separate components.

After finishing and printing the final shape, all components were carefully put together resulting in the prototype as depicted in Figure 13.

Fig. 12. The integration of the electronics in the printed parts.

Fig. 13. The completely assembled final design.

FUTURE WORK

Although we have not yet deployed the final design, our aim is to investigate how this new object is treated in similar ways, or has a different impact from the previous designs. Key here may be the fact that we have integrated more control features in this last iteration as a result of the user study findings. Further investigation into the amount of control and level of serendipity, what the right balance is, and where these aspects of its design should be emphasized, seems a logical next step.

Perhaps even more interesting is the way in which The Other Brother has evolved from something where the initial focus was on serendipity of capture, into something which appears to have life-like qualities for the people who live with it. It seemed that The Other Brother had some very specific properties which made the object not only feel like it was part of the family, but also felt like there was an intelligent character present. In that sense, it is very interesting to reflect on how it transformed throughout the three main stages of the design process to try to get a grip on what it exactly is about this object that relates to concepts of "intelligence". We would like to further investigate these aspects within ongoing work.

CONCLUSION

We presented The Other Brother, a device which enables people to re-experience spontaneous moments from their domestic and social life. The design and evaluation of this prototype showed how it is not the quality of individual images or movie-clips that necessarily matters to people, but the ways in which these materials trigger the evocation of an atmosphere and a moment in time. The Other Brother showed that a single picture in which only perhaps half of your face is depicted, accompanied by food on the table and a relaxing tune in the background, can create for people compelling content that they enjoy looking back on. By capturing moments in time spontaneously and in a situated way, these materials can help people re-experience the ambience of the moment. Within the scope of our initial deployments, people were surprised and delighted by the captured fragments. Perhaps more interesting, they began to relate to The Other Brother in ways that were both unexpected and worthy of further exploration.

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