The Twins: Lighting Design Based on Rich Movements

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Abstract: Seeing rich body movement as a resource for interaction design as well as a meaning-making process itself, this constructive design research aims to explore the possibilities of developing movement-driven daily artifacts, for example, a novel interactive lamp. To probe the behavior of using lamp, we performed a series of activities. The findings were iteratively used as design resources to frame and reframe the design space of our concept and to inform our prototyping of interactive lamps. We researched through presenting an appropriate design, 'Twins', which not only gives light, but also accompanies a user through a lamp with composite functions in four different shape placements. Each placement individually presents a specific kind of lighting mode, including ambient mode, bedside mode, reading mode and silent mode. Another intention is to unfold an alternative form of social connectedness in terms of everyday practice, a pair of lamps. Observations of the interviews bring rich insight into how the core value is practically presented. In particular, our research emphasizes how this everyday practice provides us an aesthetic and pleasurable value and enriches lived experience.

Key words: Embodied Interaction, Interaction Design, Product Design, Tangible Interaction, Movement-Based Interaction, Aesthetic Interaction

1. Introduction

Over the last few years, there are an increasing number of interaction designs that have been widely discussed in HCI community. Most research focus on the functionality or usability, but the discussion of construction of meaning in interaction is rarely seen.

As novelists produce science fictions, interaction design researchers are capable of proposing several kinds of technology vision to imagine a future state. It is not a question of right or wrong as positivists concern. No matter what these design issues will be embraced, criticized or challenged, concrete outputs from interaction designers will provide a provocation of research in the future.

Seeing rich body movement as a design resource for interaction design as well as a meaning-making process itself, this constructive design research aims to explore the possibilities of developing movement-driven daily artifacts, for instance, a novel interactive lamp. Specific research questions are as follows. Is the GUI of an electronic product enough for providing information in our life? Moreover, we usually create layout of touch interface by putting all function keys on surface only and pretend that all of them are functional buttons. So, does a user really know how to use it? Instead of seeing people as cognitive and learning machine, overemphasizing visual objects, we intend to put more emphasis on the other abilities of human body, for instance, rich body movement. Baskinger and Gross [1] argue that the form of ancient tool influence human behaviors and people are intelligent enough to dialogue with these kinds of artifacts without learning. Second, in addition to making

communication with others through the social software, what possible interaction forms can designer provide to people in daily life? Based on the great potential of technology, we argue that social nature of people should be also taken into account to provide the technology vision in the future. Finally, we are curious about whether the statistical results of user satisfactions can really investigate the intended interaction in the life world, since there is no such thing as 'only and correct way' to use a product. Liang (2012) advocates that interaction researchers should see the interaction as a material and place interaction in a state of emergence [6]. Even more, user can always find their own usage of a product beyond its intended function that the designer deliberately enabled.

The next section will present the literature review, which is relative to our design issues. Then, we performed a series of activities and made several possible prototypes as the prior test. After reframing the design space, our design team had enough design resources and made design choices. Through elicited accounts of participants with a dialogical approach to meaning-making, research result illustrated what kind of social interaction we presented and what kinds of lessons we learned from this design with a brief summary.

2. Literature Review

To understand the body movement, we first study Laban Movement Analysis (LMA) [5] which encompasses a set of criteria for movement description. LMA is divided into four qualities that are Body, Effort, Shape, and Space Harmony. Among these qualities, Effort has four subcategories, each of which has two polarities, and could be used to describe the dynamic of movement. Our intention is to analyze the relationship between a product and rich movements, and thus we chose Effort, including time, space, weight, and flow, to explore possible dynamic qualities of movements in physical interaction.

Jensen, et al., [9] developed a set of forward design techniques, which with some projects supports the movement based interaction design.

Gibson [3] introduces the theory of affordance in 1977, and states that the world is perceived in terms of objects possibilities for action. Different from the signifier that is proposed by Norman, the affordance latent in the environment is what it offers the animal. In short, affordances don't have to be perceivable while they exist naturally.

Considering that human being lived in the real world are not actors lived in the context of human-machine interaction, ISH built by Hummels, et al., [4] is an interactive installation to generate knowledge, and it uses lots of tangible objects to explore the relationship between human mode, activity, and interaction mode. Hummels et al. argue that the world is meaningful and spiritual for us and we can physically interact with it through accessing the meaning and expressing the meaning.

In addition to the rich movement and affordances of objects, the aesthetic experience is a main category of interaction that is taken into account. Ross and Wensveen [10] present intelligent lamps to show the value of provoking human nature of helpfulness through Aesthetic Interaction. This design involves users' bodily skills much more than other traditional lamps and it also advocates human virtue. How Ross and Wensveen generated design implications related to designing aesthetic interaction is also a good example for our design.

The design framework and methodology of movement based interaction design presented by Loke and Robertson [8] offers designer various perspectives for exploring movement-related design concepts.

3. Design Approach

Since we intended to address explorative and critical issues to articulate the potential of expressive and aesthetic interaction, we did not follow a typical design process that places more emphases on user satisfaction. Instead, we followed the research through design approach (RtD) [11] to do research through presenting an appropriate design, 'Twins'. This approach stresses the design artifacts as outcomes that can transform the world to a better future. Based on RtD, the design process and the artifact itself become an exemplar to HCI research communities. In other words, the behavior that designers articulate their thinking through manifesting the artifacts is a design research. To evaluate our contribution, we also followed a set of standards, including *process*, *invention*, *relevance*, and *extensibility*. The *process* of designing Twins, including prototyping, mock-up makings, and sketches, as described in follow sections were recorded in detail for future study, and generated an aesthetic and domestic artifact that integrated wireless technologies to create a novel design. In addition, our design provided significant *inventions* that provide the HCI community with guidance on how to build. In terms of the product we presented, interaction design researchers will see an example how to integrate new technology into the social life of people. In designing an embodied interaction, the design team had the sense of *relevance* about what is real rather than focused on what is true within the real world and sought the appropriated prototyping by performing activities and workshops which had resulted in design understandings. Moreover, we conducted in-depth interviews to describe the phenomenon with a dialogical approach to making meaning in detail through deploying our design artifacts in the life world. Finally, we hope to formulate *extensibility* to HCI community through documenting the design process and research outcomes, and, this design research will be a significant resource for stimulating new embodied interaction in the future.

4. Design Work

To explore the behavior of using lamp, we performed a series of activities, including cultural probe [2], exploration of movement [10], participatory design, and interviews [7]. The findings were used as design resources iteratively to frame and reframe the design space of our concept and to inform our prototyping of interactive design.

4.1 Cultural Probe

We felt that the pattern of user's using behavior is valuable for our design practice. Thus, we invited 15 participants to describe their lived experience of using lamps in the different kinds of contexts. First of all, we divided the lamps to nine classes, including reading lamp, indication lamp, floor lamp, ceiling lamp, bedside lamp, table lamp, recessed light, and main lamp in the living room, and gave the post cards with lamp images as the stimulus to participants randomly. They could imagine and draw down how they use these lamps on the back of the post cards (figure 1.). We tried to elicit insights of using lamp and various possible activation ways. The gathered data were sensitively interpreted, carefully read, discussed in detail by researchers to understand what kind of context a lamp is used in. Thus, the preliminary design concepts were also found.
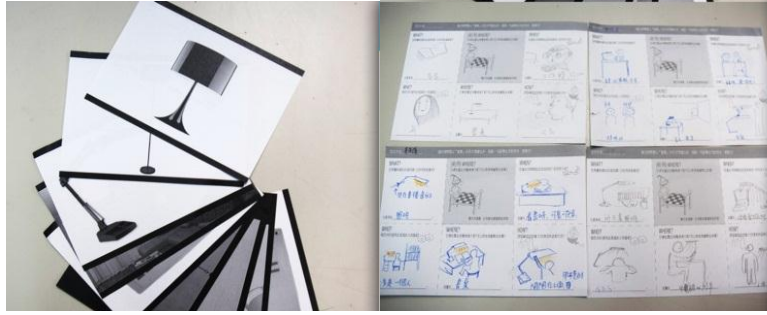
Figure.1 The toolkits for cultural probe

We classified the similar usage of lamps to a same group and focused on discussing its feature corresponding to different kinds of contexts. Among them, we found that the table lamp, recessed light, and floor lamp are designed for providing a warm atmosphere and highlighting the main feature of uses' room. When the participants saw the bedside lamp, they thought it created a peaceful atmosphere in their bedroom, and they would choose a bedside lamp to match their personal tastes. In addition, when we studied the case of reading lamp, there was interesting user feedback between probing and interview. Most of the participants wrote a definite answer for 'in which situation would they use it' on the post card. They thought it as a functional lamp and used for reading only. However, when we visited their working space, we observed that they seldom took the reading lamp as their lighting sources for reading; otherwise, every participant had their own alternative usage, such as, using it to warm the fish tank (participant 8). Besides, the indication lamp, ceiling lamp, and main lamp in the living room had the same features; for instance, they always were set up in the public area and had strong lighting mechanism.

Since our design aimed to produce a personal ambient lamp which can create special atmospheres in different kinds of contexts, researchers picked up the table lamp, the bedside lamp, and recessed light to prime the further conceptualization of the design. Several activation ways to turn on the light were full of imagination, and we were curious about if there were some activations of lamp through movement. Therefore, we prepared a workshop to explore body movement.

4.2 Explorative Workshop

Researchers sought to gain more understanding of the relationship between the affordance of shapes and the movement of participants. As a result, we invited 20 participants to join our explorative workshop (figure 2.). First of all, we let the participants to get familiar with and play 6 types of forms in hand, including orb, cube, triangular pyramid, cylinder, asymmetric organic form, and symmetric organic form (figure 3.). All the interactions were carefully set to evoke participants' creativity and imagination. Besides, we kept the record of workshop with video recorder, documenting, and photography seriously. After the workshop, in order to find some relevance of form-making in our design, we immediately analyzed the activity record of participants and saw whether the data were relevant or not. These data show that the asymmetric organic form provides the participants more imagination about live experience. This workshop also helped us sensitize the movement-related concepts and enabled designers to structure a movement based prototype. In contrast to the traditional manipulation way that always employs a physical input/output button to perform a task, seeing the object as the extension of body would stimulate designers to reconsider what kind of interaction is more intuitive with rich movement. Although the result could not give designers a solution of form-making precisely, we still got some understandings from this

workshop. To realize the possible ways of switching lamps, what we performed is another activity that stimulates the participants' creativity, curiosity, and exploration, rather than a specific or defined task.

Figure.2 The movement workshop and the participants

Figure.3 Six types of forms

4.3 Participatory Design

Through a series of exploration before, we decided to manifest a lamp with four composite functions, including ambient mode, bedside mode, reading mode and silent mode, and its form is compatible to turn to switch back and forth between these modes. Thus, we chose a square as its original form. Based on the data we collected from our workshop, the asymmetric organic form gives the participant more imaginary movements about the life experience. As a result, we transformed its form from square to an aesthetic, abstract, and organic form (figure 4.). In the process of decision-making in cutting angle, designers tried to develop and construct an abstract form that physically engages our body to use it. In addition to the cues of light, its form with different placements affords manipulation and guides interaction naturally.
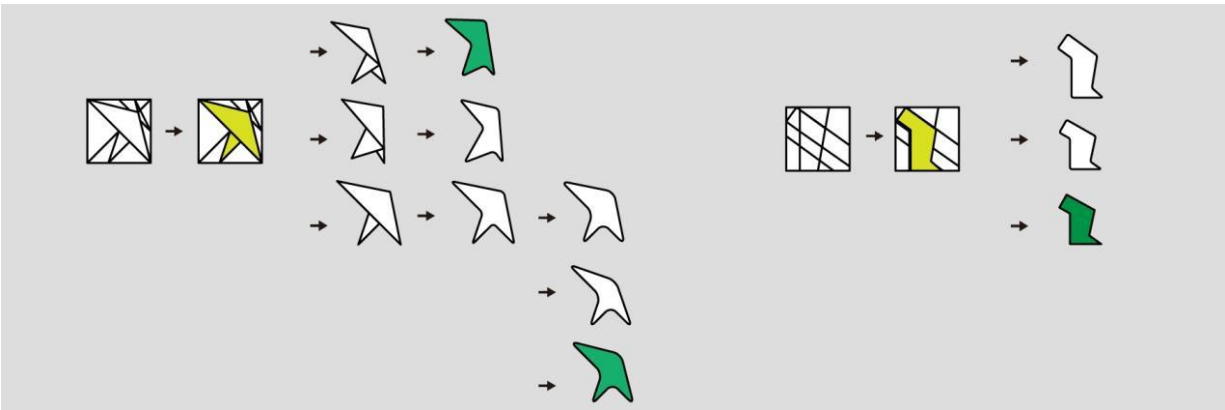

Figure.4 Form imagination and development

We concerned whether each placement would look significantly different to other sides, and therefore, we characterized each side and then did lots of mock-up models (Figure 5.) and actively involved 10 putative users in our design process in order to find a better way of design choice. Then, the designer prepared a semi-structured interview to elicit users' preference of these prototypes (Figure 6.). Among of these six prototypes, there are more discussions of form and proportion on the prototype B2, C1 and C2 than those on the others. Participants discussed which kind of prototype is more responsive and appropriate to their life. From the point of view of participant #4, the scale of Prototype B2 is very modern and fit the context at night. When they talked about prototype C1 and C2, they figured out some properties, including stability, rationality, and approachability. Further, the scale of prototype C2 is better than C1 to be placed on a desk. The participant #5 said that the form of prototype C2 created a working environment.

Considering the shape, size, affordance, companion, personification, and openness of its form, designers made the decision, and chose the prototype C2 as the final form.
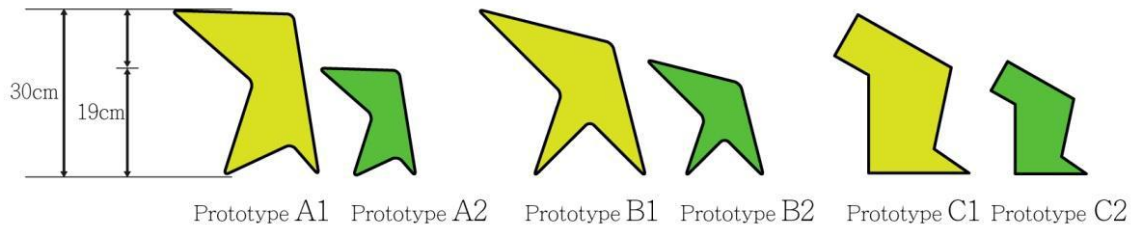

Figure.5 Six types of mock-up models

Figure.6 Semi-structure interview about the form

5. The Design Artifact

After deploying our design work, we got some understanding from users' feedback and iteratively fine-tune the proportion of Twins. For example, designers decreased the height, highlighted the curves, and adjusted the position of indicatory LED to endow the bionic and anthropomorphic to this product.

Our design artifact turned out to be very interesting in terms of functions and expressions. Twins not only gives light, but also accompanies a user through a lamp which has composite functions in four different shape placements.

These four placements individually present a specific kind of lighting mode, including ambient mode, bedside mode, reading mode and silent mode (Figure 7.), in different context of usage. Unlike a traditional household lamp with a fixed lighting mode, Twins displays light in an ambiguous way. We aim to arouse the personal experience of using lamp intuitively in an ambiguous form with rich body movements.

Figure.7 The functions from left to right are silent mode, reading mode, ambient mode, and bedside mode sequentially

Designers also want to unfold a possible form of social connectedness in terms of everyday practice, a pair of lamps, which provide ludic aspects ranging from embodiment to personal meaning and social meaning. While turning one lamp to a specific placement, the user on the remote side could see an indicatory LED lighting up in the corresponding position of her lamp, and feel connected coincidentally in different spaces (Figure 8.).
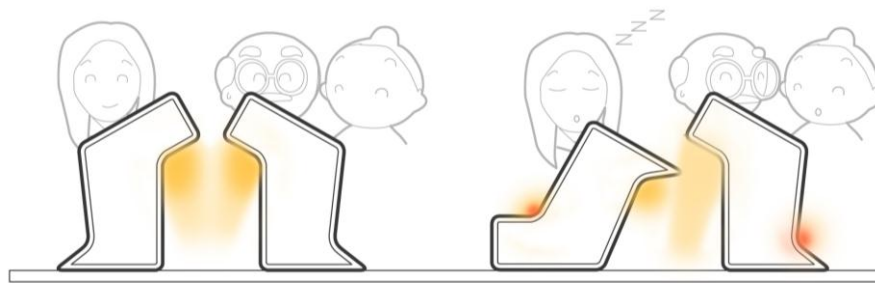

Figure.8 The interaction between Twins

To better integrate the technical components into Twins, engineers in our design team tried to use the USB and wireless modules to support its power supply and connection (Figure.9). Besides, designers thought that choosing wooden material as its surface may make people feel more like at home. By means of adopting emerging technology in the interaction, researchers could propose a vision that change perspectives in social interaction and provide a possible domestic future (Figure. 10). For an online demonstration movie, please visit http://goo.gl/xSpT4.
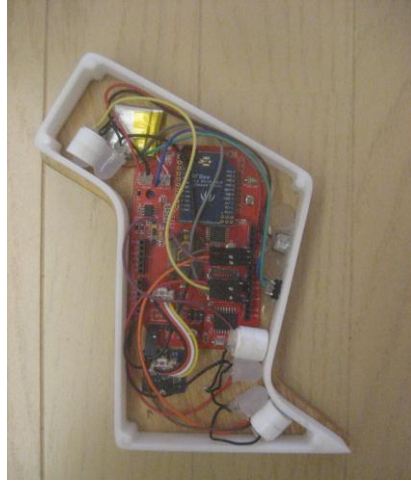
Figure.9 the components of Twins

Figure.10 Final design of the prototype

6.   Outcomes and achievements

We invited five groups of participants who were different kinds of relationship and hoped to investigate the phenomena of experiencing Twins with a dialogical approach to meaning-making in detail through deploying our design artifacts in the life world (Figure.11). Besides, we assessed their experience through retrospective diary to keep the record while using Twins. After participants lived with Twins for few days, we conducted in-depth interviews to present the lived experience of Twins. We were curious about what kind of interaction participants situated through a social lamp triggered by rich body movements.

Figure.11 Situated activities in the life world

Among five groups, we were interested in the group A and C. Group A included one parent and her son, and they were used to communicating with each other by mobile APPs. After experiencing Twins for few days, the light became a new way to communicate with each other, and provided an implicit way for them. For instance, in Group A, the parent worried about that too frequent calling might bother her son in the daytime, and thus, she put one part of Twins on the entrance to wait for her son at night and set the other part of Twins in her room (Figure.12). The indicatory lights on both sides showed their situation implicitly and indeed delivered a message to each other. Twins settled on the entrance seemed like a waiting expression and cares from parents; on the other hand, the son could inform his parents whether he was backing home or not, by means of turning Twins to another placement. Through rich body movements and the social function, people would find their own usage in this design.

Figure.12 The usage of participant A

Group C included a couple. They also gave us some rich insight, and their interaction is very different from other groups. In the pilot interview, we knew that the boy in group C is a Ph.D. student and his girlfriend is a graphic designer and they lived in different city. The Twins not only became a social role signifying that the other one gets along with each other in this relationship but also became a mediator that expresses the other one's emotion implicitly when they quarreled with each other and lost their temper. On the weekend, they met in the movie theater, and carried the Twins with them. Before watching the movie, they had a little bit quarrels, and they were embarrassed to say anything to each other. The boy said: "if you forgive me, please turn the Twins to the same placement, and I could see that the indicatory LED and main light might light in the same place". Within a

few seconds, the girl could not help but laughing for a long time. Beyond the tool of being used to communicate to the world, we argue that, Twins evokes the emergence of user experience in everyday life. Observations of the interviews give rich insight into how the core value is practically presented. The lessons we learned from creating and deploying the working prototype are described below.

6.1 The openness of the form

The openness of the form allows users to create meanings by themselves. Abstract form arises intensive imagination and makes personified association. There are lots of user projections around Twins: one is a dog craning its neck to look forward, another is a quiet duck, and the other is a posture of lying down. The ambiguous form allows users to create meanings by themselves. For instance, participants would draw patterns on the surface of Twins, indicating personal appropriation of this artifact when living with it in the domestic setting.

6.2 The ambiguity of the light

The ambiguity of the light won't be too intrusive. Unlike a traditional household lamp with a fixed lighting mode, Twins displays light in an ambiguous way. There are several kinds of color and intensity of one lamp, such as reading mode with straight forward white light, ambient mode with ambient yellow light, and bedside mode with diffuse sunset light. The ambiguity of twins allows users to create their own ways of usage. One can creatively place Twins in any life context. The indicatory LED shows the using mode of the remote Twins instantly. The corresponding indication won't be too intrusive, and can possibly evoke the user's attention implicitly.

6.3 Communication of the light

The communication of the light would be an alternative signal to implicitly inform what situation they are with each other. Our design itself is not a physical form used to light up only, but rather a perceptual medium to warm up the communication of users and their friends. After a couple lived with Twins for few days, it provided an alternative signal to implicitly inform how busy they are with each other. It would also be a simple care between parents and children, such as, a participant put Twins on the entrance to wait for her son and to communicate if she sleeps or not. It also provided an uncertain way for people. For instance, when not any one of my indicatory LED lighted up, I might be curious about how the situations of my friend are, did she really take rest or did she mind someone bothering her at this moment? Thus, this design initiated an ambiguous interaction between relationships.

6.4 Richness of the interaction

Unlike the traditional manipulation way that is always designed as a physical input/output interface to perform a specific task in a straightforward manner, we structured a movement based lamp that could be manipulated by changing the orientation of it. Moreover, Twins also present the richness that comes from the inter-personal relations that emerge.

7. Conclusion

The design concept of Twins is a lamp with composite functions through turning the lamp to the different shape placements. The fours placements individually present a specific lighting mode, including ambient mode, bedside mode, reading mode and silent mode, in different kinds of contexts.

Given the affordance of intuitively and quickly changing orientation, Twins provide implicit interaction between distant couples. They can feel connected coincidentally in different spaces, and have a conversation with each other implicitly. In addition to the regular lighting function of each mode, the indicatory LED would light up at the corresponding position to inform the mode of the remote device. Thus, it creates an imagination about the situation of his/her friend in an ambiguous way. Of particular concern is the coincidental phenomenon and lived experience between our users.

Our research emphasizes on how the everyday practice provides us an aesthetic and ludic value and enriches our lived experience. We would expect that our design could be an exemplar of embodied interaction. Further, this research should contribute to the understanding of embodied interaction to the HCI community.

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