A Behavioral Metaphor Oriented Product-Upgrading Design Model

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Abstract. This article presents a novel product-upgrading design model, which is specific from the aspect of behavioral metaphor functional innovation. Designers can upgrade the current product through observing and analysing the behaviors which relatives to the target product, extracting one or more behaviors, compiling the different behaviors according to their weightiness as well as current technology trend. A case study of E-toaster is also carried out with this model.

Keywords: E-toaster, BMP, Functional Innovation Product-upgrading

1. Introduction

The article introduces a product-upgrading innovation model from the aspect of functional innovation, which is based on the theory of metaphor. To upgrade target product, the Behavioral Metaphor-oriented Product-upgrading Model (BMP) extracts functional behaviors happening around target product, introduces metaphor theory as a basic method to combine the behaviors extracted and the target product. This paper also provides a toaster upgrading design as an application of BMP model.

2. Relative Works

2.1. Product-upgrading methodology

According to the global value chain governance theory, there are 4 patterns to transit and upgrade industry: the upgrading of manufacture process, the upgrading of product, the upgrading of industrial function, and upgrading of chains.[1].Among the 4 methods, product-upgrading method is a remarkable way to promote a company's innovation competitive.

Numerous experts and designers have done many works on how to upgrade current product. The overall MacPMR1 methodology of designing remanufacturable systems which consists of six tasks[2] (1, analyse the current product; 2, define potential upgrade scenarios; 3, develop potential product architectures; 4, develop potential RSC structures; 5, combine product architectures to RSC structurest upgrades scenarios; 6, assess concepts).

2.2. Metaphor and Design

Metaphor is a rhetoric method in linguistic field. Metaphor is to perceive, experience, imagine, and understand one object's psychological, language as well as cultural behavior under the hint of another objects. Three elements construct metaphor: object A, object B and the coherent between the two objects[3].

Metaphor was applied on graphic design on displaying pictures and icons to represent the functionality of particular tool. For behavioral metaphor, it is ubiquitous in digital devices like smart phones and pads, for

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example users can understand the new device and its functions by scrolling, flipping through pages, bookmarks, highlighting, button impressions, etc. There are also many metaphor applications in the interactive tangible field, such as the SpeakCup[4] designed by MIT and the Intimate Door Lock designed by Potsdam University of Applied Sciences[5]. There are various researches attend to invoke interaction metaphorically to disambiguate the users' interpretation of how to interact with the objects.

However, most of these designs focus on form of operate or visual cognitivation. Few pay attention on the functional innovation, which is closely associated with users' needs lurking in daily using behaviors. This's the original motivation of BMP model.

3. Model of Behavior Metaphor-oriented Product-upgrading Design

The BMP mold is to upgrade target product, by observing the behaviors happening around target product, extracting functions lurking in behaviors, and transferring it to target product. Fig.1 shows the process.
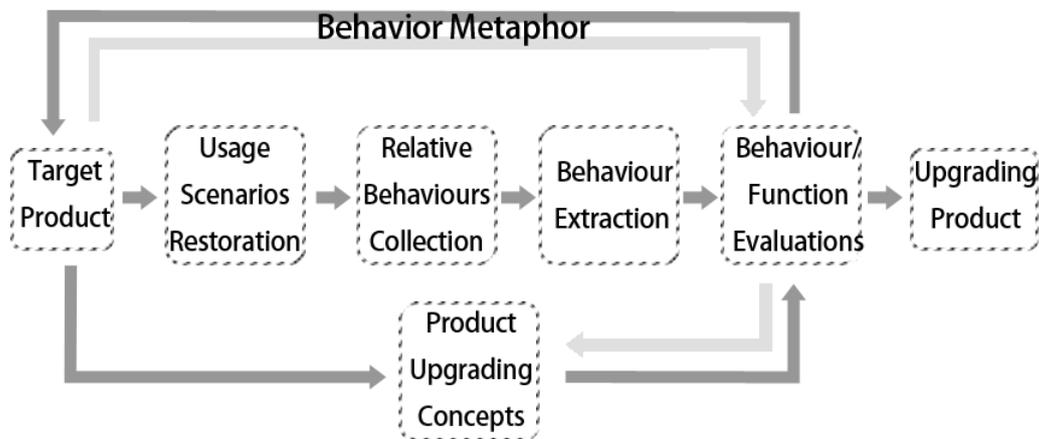

Fig. 1: BMP Design Process

3.1. Usage Scenarios Restoration.

Every product is used in one or several specific scenarios. Users have different needs in different scenarios. For example, the electric cookers used in kitchen and in office can't be totally the same in function. Clarify the usage scenarios would help designers to find the breakthrough.

3.2. Relative Behaviors Collection.

In this step, the behavior scop--when start and when stop, should be defined at the first place. And all the behaviors happening in the scope should be observed. Take electric cooker for an instance, the behavior scope is from preparing ingredient to meal over.

3.3. Behavior Extraction.

The extraction of behaviors is based on function. For instance, prepare ingredient is not a simple motion but also hide the functions of ingredient store, food cleaning and nutrition balance.

3.4. Behavior Evaluation.

The evaluation of behaviors extracted should be based on three indecies. And all the indecies should be measured in Likerttype[6] scale:

Behavior Presence. According to the Maslow's hierarchy of needs theory[7], only if one need is satisfied, it can't become the inspiration elements. Here we ask users to point which behavior is "more interesting "or "more likely to do". Users are demanded to rank the behaviors. The more interesting one behavior is, the higher its presence is.

- **Combination.** Considering the technical reliability and technology trend, the higher the score is, the function and the behavior it's behind are more considerable in design decision-making system.
- **Cost.** Compared with the current product price and cost, the cost to realize the behaviors extracted before should be reasonable. The more the cost is, the lower the score is.

However, the final decision should be made according to the market understanding as well as the product strategy. The three indices only provide a basic reference.

3.5. Product Upgrading Concepts

After evaluation, the behaviors selected would be metaphor-combined with the target product. In this process, the behaviors selected should be restored into some specific objects, and then reflects on the target product function system. In this way, the behaviors and functions extracted would be metaphor-connected with the target product. At last, the concepts should be brought into a iteration process to make sure design suits the technology trends, marketing as well as users' demands.

4. BMP Application on the toaster machine design

4.1. Toaster usage scenario restore

Design application is about toaster upgrading. There are 10 industrial designers (age from 22-27 years old) participating in the experiment. The toast usage scenarios were restored to be "Family Table", "Office" and" Picnic". For the limitation of design circle, "Family Table" scenario was selected.

4.2. Toaster relative behaviors collection

With the permission of observation and video record, 10 families were invited as participants, which used toaster as regular breakfast custom. Every family was given 50 RMB as payment. The behavior scope is from breakfast preparation to meal over. For the observation period, every family was assigned a designer to observation the breakfast behaviors. All the behaviors were recorded as videos.

4.3. Behaviors and Functions Extraction

After watching the vedio frame by frame, three behaviors were marked for its high frequency. They were **preparing and collecting tableware**, **reading newspaper** and **chatting**. Then the functions hiding behind behaviors were analysis. Fig.2 shows the behaviors and functions extracted from one family. And the function lurking in the three behaviors are **Basic Dietary Behavior**, **Information Obtain** and **Enmotional Communication**.

Fig. 2: Behaviors and Functions Extraction

4.4. Functional Behavior Evaluation

The three functions are evaluated from Behavior Presence(judged by 10 users), Combination(judged by 10 designers), Cost(judged by 10 engineers). Table.1 shows the evaluation results, which were comparated in Fig.3.

Table.1 Functions Evaluation Results

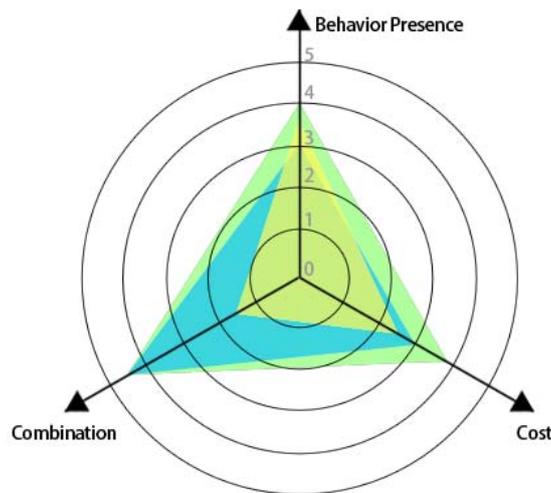|	Behavior Presence	Combination	Cost
▢ Basic Dietary Behavior	3.0	4.8	4.0
▢ Information Obtain	3.8	4.6	3.8
▢ Emotive Communication	3.6	4.6	2.5

Fig. 3: Functions Evaluation Comparation

It is obviously that **Information Obtain** and **Emotive Communication** weight more than **Basic Dietary Behavior**, and close to each other. So, for toaster upgrading design, **Information Obtain** and **Emotive Communication** were both selected as the design breakthrough functions.

4.5. Behavioral Metaphor Design Upgrading Concept and manipulation

According to the behavior analysis and function analysis, designers carried out the idea with the metaphor design method. Table.2 shows the design process.

Table.2 Metaphor Building , Technology&Design Solution, Functions of Upgrading Concept

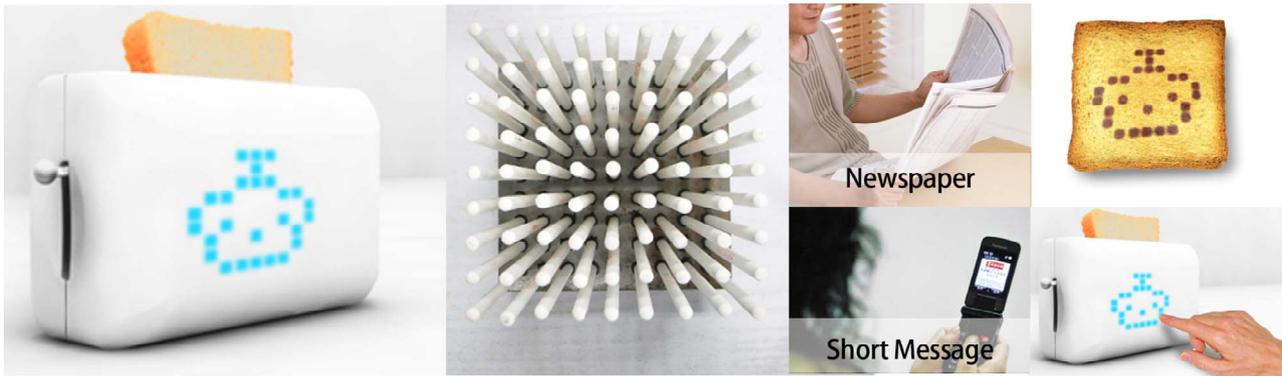| Target Functions	Metaphor Building		Technology & Design Solutions	Functions of Upgrading Concept
	Relative Objects & Behaviors	Target Product Relative Elements		
Information Obtain			Information RIP	• Matrix Toast • Networking • Matrix Picture/Information Receive • Matrix Picture/Information DIY
Emotive Communica-tion			Matrix Heating	

Fig.4 Concept Rendering and Functional Prototype

Besides the conceptual 3D modling and rendering, the concept was also implementated functionally. With the matrix ceramic heated rods control technology, the toaster would heat toast matrixly, according to the matrix information, such as the weather or messages from others through networking, or users' DIY.

5. Conclusion

5 veteran desiners assessed the upgrading toaster design. Besides the positive comments, some drawbacks were also pointed out: the upgrading concept may cost too much, compared to current toasters.

The upgrading toaster design and implementation proved that the BMP Design Model is effective to bring metaphor theory into functional innovation field. For the further research, the main top is how to extract and analyse users' behaviors more efficiencily.

6. Acknowledgement

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