METHODOLOGY FOR IDEATION OF INTERACTION DESIGN

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Abstract. This paper explores new methodology, tools, and techniques for ideation of interaction design. On one hand, our work takes a mixed approach to developing design methodology by integrating usability tests and ethnographic studies in the ideation process. On the other hand, parallel design with user participation is attempted to reduce interactive design life cycle. An interaction design example is drawn from *i-Awn* project, an activity-coordination and reminding system in smart homes. This example demonstrates our mixed approach and shows how a new methodology is developed for validating the quality of user experience in a critical process of designing. The objective is to get the right interaction and the interaction right, provoking new ways of thinking about usability evaluation in the ideation process. The social, cultural and emotional uses of interactive systems in smart homes are discussed.

Keywords: Interaction design; methodology; usability; smart space.

1. Introduction

There is a growing interest in developing human-computer interaction technologies for smart spaces of the future. Many recent studies have focused on interactive and ubiquitous computing systems that will automate many routine everyday tasks and assist people in controlling the systems with minimal

effort. For example, sensing technology has enabled a building to increase safety, improve work effectiveness, and reduce environmental impact. More recently, researchers are more cautious in predicting the future of the home. It has been argued that researchers should aim at flexible design methodology to explore social, cultural, and emotional uses of interaction design, rather than focusing on technology of interactive systems (Forlizzi, 2008; Dunne, 2005). Some questions quickly arise. What is the value of interactive design in smart space? In what context the interactive system is used so as to fit people's lifestyle? How do cultures adopt new technologies over time? What design ecology can improve the quality of user experience? These questions need to be answered in the future development of interaction design. Nevertheless, few studies have been done on developing a new methodology for interaction design. So far there are no appropriate methods, tools, and techniques for design and evaluation of interactive systems that can be socially and culturally situated in our everyday life. User feedback, participatory design, and experience prototyping become the key issues to get the design right and the right design (Buxton, 2007; Greenberg and Buxton, 2008).

To provide design ecology for better understanding of social use of interaction design, this work explores new methodology, tools, and techniques for design and evaluation of interactive systems. The objectives of our work are:

1) getting user feedback in ideation process to refine the design earlier;
2) exploring how cultures adopt technology over time using preliminary tangible and visible outcomes of design;
3) improving the usability of any particular design to explore more design alternatives; and
4) validating the quality of user experience effectively to reduce interactive design life cycle.

Traditionally, usability testing has long been used to validate the usefulness of the prototype. According to human factors, usability tests provide guidelines and principles mainly focusing on efficiency of accomplishing a series of tasks, not useful for creativity. Interaction designers benefit from usability tests to explore more design alternatives in a creative manner. Recently, human-computer interaction researchers use ethnographic methods to conduct cultural probes by which user requirements and social heavier are observed and analyzed. While these qualitative research methods may be beneficial to understand social behaviour, there is no methodology to integrate them together in the ideation process. Little knowledge is developed to help designers exploring design alternatives according to the complex social, cultural, and emotional context of product uses in the practice of everyday life.

2. Ideation in Designing Interaction

Ideation is the process of forming ideas through "reflection-in-action", a dialogue between designers and design works (Schön, 1983). It comprises simultaneous activities of understanding problems, generating potential solutions, evaluating solutions, and reframing the problem in order to avoid obstacles or capitalize emerging opportunities (Kalay, 2004). Designers project their imagines on media that carry external memory and negotiate with it. Problems are reframed and design is iterately refined through reflective conversation with materials of a design solution.

For interaction designers, lack of appropriate media to measure quality of user experience from immediate feedback of users' behaviour makes ideation a challenge. Although tools, like storyboard, scenario sketching may represent users' activities, designers cannot ensure that users will follow the proposed scheme. This deficiency has led to some critical problems. Oviatt (1999) summarized "10 common myths" that identify some misconceptions about multimodal interface, for example, does design of multimodal system guarantee users' behaviour of multimodal interaction? Are speech and pointing the dominant multimodal integration patterns? Comparing to easy-to-manipulate physical materials, users behaviour are more subtle, elusive, uneasy to capture or predict. Therefore, it makes interaction designers hard to get the right design and the design right.

To figure out the right idea in early stage, usability testing should be integrated in ideation procedure to validate early designs. Besides, usability evaluation methods need to be reconsidered when they are conducted. Traditional usability evaluation methods can render services in the area that measures system's performance; however its tools find less purpose when applied to the creativity paradigm. Nor do they fulfil designers' demanding of probing users' requirement. Moreover, misuse of it may hinder creativity, or even quash some fledging ideas that might be innovative through further development. At least, some deficiencies often occur if designers blindly follow the doctrines of usability testing (Greenberg and Buxton, 2008). Those are overrated efficiency, misconception of useful and usable, isolation from context, neglect of culture adoption, and overly dependence on users' demands that overwhelms designers' judgment (Norman, 2005).

Designers are facing a dilemma. Conducting usability evaluation in early stage prevents design from going astray and guarantees that design solutions meet certain constrains. It shortens design procedure, therefore promises the cost-effective benefit, but designers also take risk of sacrificing potential ideas. It is further argued that users are "shifting targets", so that too much focus on users' specific need might be harmful to interface design (Norman, 2005). As to user participation in ideation, can we develop a new method that conciliates

the trade-off between benefit of shortening design process, and the risk of its side effect? Can such methodology introduce user's creativity on ideation process?

For smart home designers, the demand for a new methodology would be imperative. There is a gape between indicators of usability evaluation and users' requirements of quality of life in different domestic environments. Interaction designers and researchers have to pay attention to qualitative design methods to understand how interactive systems are socially and culturally situated in our living environment.

3. Interaction Design Life Cycle

Ideation activities–identifying problems, generating alternatives, evaluation and modification–can be regard as an epitome of design life cycle. Design life cycle is the process of product and system development from inception to operation and maintenance. We identify three major phases of design: observation, development, and understanding. In observational stage, many alternative methods such as design critique, design alternatives, case studies, cultural probes, ethnographic research, and design rationale, have long been studied as alternatives in HCI academic community and practice. Besides, participatory design attempts to actively involve the end users in engaging in hands-on activities during the design process. Focus group, a form of qualitative research, incorporates a group of people to ask about their attitude towards a product, service, idea or concept (Kuniavsky, 2003). However, whether the result of user study can be applied to design concept remains questionable. Designers envision future, but user research discloses current state of "what things are", rather than "what things supposed to be". To drive creativity, the priority of "study first, design second" approach should be reversed as "design first" order (Norman, 2006).

The linear process of project development needs revision, in particularly in the context of interaction design. Some proposed the notion of "innovation through use" process. Open innovation, a concept related to user innovation, cumulative innovation, and distributed innovation, seek design opportunities outside the organization or laboratory for creativity and profits (Chesbrough, 2003). "Innovation Evolution Cycle" (Davern and Wilkin, 2008) suggested that designers should go "native" in order to understand how users interpret and appropriate the system. It implies the cooperative interaction between designers and users as equal contributors in driving innovation.

In summary, interaction designers should adopt the method of iterative design, with frequent, rapid prototyping and test, and play the role of a "couch" to encourage users' potential of creativity and interpretation. Furthermore, there

is a need to explore new design methodology by which we can validate the situation where smart products or spaces evoke social behaviour in domestic environments. Few studies have been done on activity-focused design methodology for design and evaluation of interaction design.

4. Design Methodology

We now turn to concerns regarding how to develop a new methodology to get the right design and the design right. In particular, we focus on the early design stage where design methods, if applied appropriately, can provide a roadmap for ideation of interaction design.

Traditional design process can be characterized as linear procedure, which starts from forming design hypothesis, step forward to discover users' needs by cultural probe, develop through prototyping, and finally checked by usability testing. If the prototype can be released prematurely, designers can conduct usability testing in parallel to the ideation process. The lead time from initiation of an idea to final production can be largely reduced.

We take a mixed approach to developing design methodology for reduction of design life cycle. Such an approach to ideation is open-ended and integrative. Traditionally, usability testing is the tool of validation at final stage. If a system falls on certain criteria of evaluation, mostly according to human factors discipline, it is supposed to afford operation requirements. However, ideation activity is more demanding. It requires designers to conduct problem identification, ideas generation, evaluation, and modification simultaneously. If designers get the right idea in early stage, they can put more resource on developing promising design ideas.

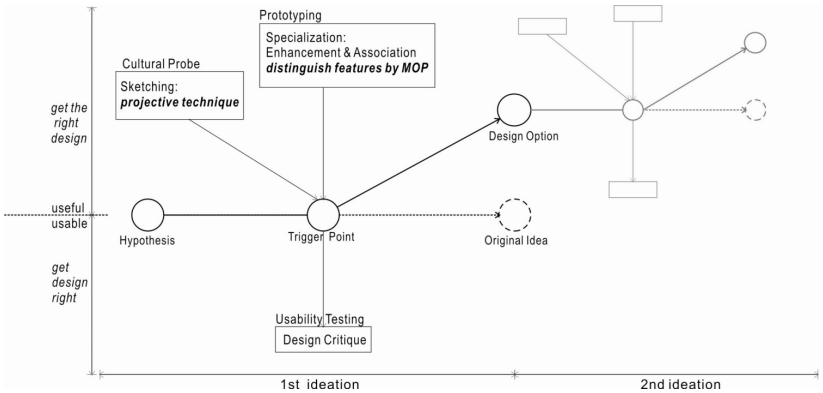


Figure 1. Integration of ethnographic study, design critique, and usability testing to the ideation process

To reduce design life cycle, we propose an alternative method to integrate different stage of ideation process, which conduct cultural probe, prototyping, and usability testing concurrently (Figure 1). In parallel process, designers are safaris who "seek opportunities". The shifting of "original ideas" toward "design option" is the result of "trigger point", which is determined by three design activities: sketching (as alternative to cultural probe), specialization (a new way of prototyping), and design critique (instead of usability). Each activity has its purpose:

1) *Sketching* can be regard as projective technique, a psychological method that identifies usefulness of a prototype in the real context or potential settings that suitable for its functions. It capitalizes users' mental capability to modify the original idea by exploring its affordances, associations, and functions. In short, sketching is an alternative way of ethnographic study that deals with fitness of an idea in product ecology to ensure its survival.

2) *Specialization* is to distinguish features of a prototype. It enhances function and contextual association by connecting users' memory organization package (MOP). MOP is determined by events and scripts of users' domestic life.

3) *Design critique* is to get design right by validating each explored functions and specialization. Users are required to evaluate the functions of the prototype and its manipulation.

Such "mixed approach" combines top-down and bottom-up design approaches. The former starts from a definite requirement which shapes certain constrain and figure out design solutions that fall on it. The latter comes up with existing alternatives and then seeks what they are able to achieve. When combining these two approaches in design process, a hypothesis emerges at the intersection point. It is examined further by rapid prototyping. If validated, designers further develop the concept, and end with usability evaluation.

To provide a mixed approach to top-down and bottom-up design, the process must release the premature result from ethnographic study as clues to forecast user requirements, and get feedback to perform design critiques, before the physical design is fully augmented. Conduct premature usability evaluation for validation of usefulness would help designers discovering alternative new ideas and refine current ones.

5. The *i-Awn* Project

To demonstrate the methodology, we applied the method to an interaction design project: Interactive Awn (i-Awn). I-Awn is a mixed reality art work designed for embodied interaction at home. It is composed of three elements: a digital writing tablet (input unit), i-Awn plant (control unit), and a multi-touch screen. The

swinging plant (Figure 2) placed on a 22' multi-touch screen signifies a virtual awn floating on the surface of the water. A ripple arises when i-Awn is triggered. Use digital pen to write a message on *Post-It*, then sake i-Awn, and the screen will present it (Figure 3). After receiving the message, close the window, and system will turn back to ripple-mode. Furthermore, ambient interaction affords participation of more than one user. Though the function is pre-defined, the requirement of the service system is vague and the location is open to discussion.

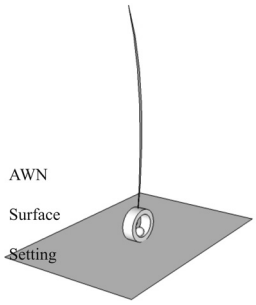


Figure 2. i-Awn elements

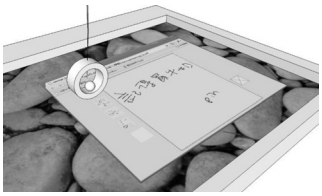


Figure 3. i-Awn placed on multi-touch screen

The purpose of manipulating i-Awn is considered in two aspects: functionally performs as an active reminder, and emotionally mediates aura of various ambient expressions. Connection of family members is the primary service of smart home. Digital media played the role of an active reminder. Function of the system was to service memory assistance: to remind oneself, to remind someone else, to coordinate family affairs, and to leave a message with no specific aims.

In i-Awn project, the requirement of top-down approach is the demand of message-reminding service mediated by information technology, assuming that human capability will be unlocked by extended memories distributed among the living environment. The existing bottom-up approaches begin with functions of i-Awn gadgets. We found current message in domestic environment was presented in a messy form. Multi-touch screen provides information when users demand it so that the side effect of overload information might be alleviated.

I-Awn development proceeded simultaneously with user study of 5 participants. It followed the "mixed-approach" which is composed of the following three design activities.

5.1 SKETCHING: EXPLORING USEFULNESS BY PROJECTIVE TECHNIQUE

Sketching probes users' requirements of family connection in the real context. Conducted at homes, it explores specific needs of different lifestyles which are shaped by holistic experiences.

I-Awn prototype was endowed with ambiguous character, and participants were required to reduce its ambiguity by projecting meanings on it. Individual differences were expected. We probed participants' metal models of i-Awn by a three-step questionnaire with the following results:

Step 1: Exploring Affordances

Affordance is the property of an object that determines or indicates how it can be used. Participants were asked to imagine what meaningful actions can be added when using it, and then specify their perceived affordances by drawing, image, or text description. Participant A replied:

Naturally I'd like to shake i-Awn one again. It occurs to me a light breeze blowing or the ornament of an aquarium. If the awn is tough, it can be use as a metronome place on the piano. The actions can be 1) Shake i-Awn, 2) Put i-Awn on the screen, 3) Move i-Awn on the screen, 4) Displace i-Awn.

Step 2: Exploring Associations

Participants were asked to interpret metaphoric meaning of manipulating i-Awn. What specific functions can i-Awn afford? How do these functions associate with events or activities of daily life? How does natural interaction of i-Awn associate with actual control behaviours? Participants were required to answer these questions by drawing, image, or text description. Participant A replied:

I-Awn can be used to switch the bed lamp or memory assistance. It should remind me of schedule such as dental appointments, vehicle maintenance, TV programme, or provide some information like address book. Shaking i-Awn can be regarded as an easy way to connect internet.

Step 3: Finding Usefulness

When functions emerged, participants were asked to explore three appropriate applications in domestic environment, and rank each of them according to its importance. Participant A replied:

If shaking i-Awn can turn off light before getting bed, I don't have to move my body. I-Awn can play the role of passive reminder by connecting panels like TV, mobile phones, telephone monitor, or role of active reminder by make sounds like an alarm clock.

5.2 SPECIFICATION: ENHANCEMENT AND ASSOCIATION

Specification is to distinguish i-Awn features by participants' memory of organization, which is shaped by specific events or activity scripts. Those are fundament elements of different lifestyles. Figure 4 illustrates how an open-mind process mediates i-Awn features: the awn, surface and setting. From S1

to Sn, each node represents a design alternative, and each stage of the process facilitates specification of i-Awn prototype. The inception stage of S1 is endowed with ambiguity, the low affordance, with primary function, leaving surface and surface undetermined. However, through iterative open-mind ideation, those two elements are gradually shaped.

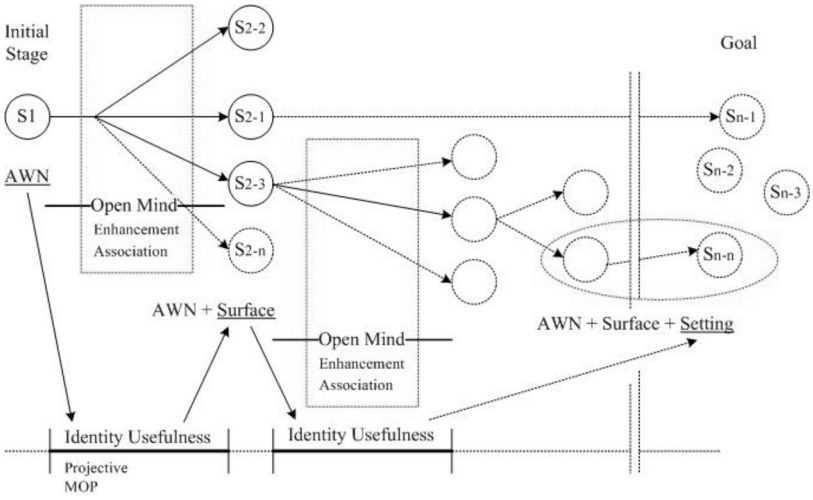


Figure 4. open innovation specification

5.3 DESIGN CRITIQUE

Instead of usability testing, design critique provides keen insight of i-Awn prototype. We placed i-Awn on the entrance of a home setting and held design critique. Participant B gave us the following suggestion:

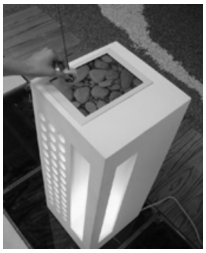
> *When entering home, firstly I'll seek a place to put on my key. Key is a symbol that represents one's identity at home, thus family members would be aware of others' presents. Besides, i-Awn signifies a specific member, so that others are able to know who leave the message on it.*

6. Finding and Conclusion

Final i-Awn project was the result of the mixed design approach. Within one week, we have gathered contextual data from five participants. That information helped discover how i-Awn interwove into life patterns. Through the open-mind ideation, users were incorporated in the forming process, and their feedbacks enriched the characters of i-Awn, far beyond a single designer's imagination. Table 1 describes a design option.

Our findings may appear to illustrate the open innovation technique to exploring users' needs in domestic environment. Moreover, it has contributed to forming the basis of open innovation methodology. Although innovation through use might probe usefulness, how it may connect events of different lifestyles is still undetermined. As the well-being of humanity is multifaceted, the next steps for ideation of interaction design research should involve more concern on social context of interactive system in smart homes.

TABLE 1. i-Awn specification and contextualization

Product / *Context*	*i-Awn* *Awn/Surface/Setting*	*i-Awn* *Function/Service*
Entry		■ Switch of ambient lighting ■ Controller of home appliances ■ Passive reminder ■ Active reminder ■ Avatar of family members ■ Computer mouse ■ Clock that shaking ■ Switch of ambient lighting ■ Ornament ■ Toy

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