國立交通大學應用藝術研究所

碩士論文

動態特質與脈絡於產品設計中的探討與應用

Enhancing the Interaction Experience –
Exploring and Applying Movement and Context in Product Design

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摘要

在當代社會中，許多產品皆是資訊溝通系統的一份子，並以螢幕與按鍵進行互動，飛利浦設計在動作語意工作坊中提出了一個假設：人與物的互動可以被物理性的與肢體涉入性的動作來加強。人與產品的互動就像跳舞一樣，藉著肢體動作與眼神接觸這類非口語的方式進行溝通並且互相配合。本設計創作以這個觀念為出發點，開始進行探索與設計。

本研究期望藉著了解肢體動互動的意涵與特質，配合脈絡設定，將這些特質融入於不同脈絡下的產品設計創作之中，並希望在提出設計創作的過程中，探討動作、脈絡與使用經驗三者的關係。

本設計創作將以書櫃為例，從探討人與書的互動開始，把書櫃當成一個服務提供者的腳色，試圖了解在這段互動關係中雙方的需要。同時進行概念發想，將動作的特質融入到書櫃的設計中，並提出兩項設計創作作為驗證。第一個是以翻箱倒櫃的尋找為脈絡的書櫃設計，第二個則是以科幻為背景的書櫃設計。

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ABSTRACT

In contemporary society, many products are part of information communication system and interact with users by screens and buttons. In the DeSForM Programme Workshop, the Philip Design proposed a hypothesis that the interaction between human and object can be improved by physical and body-involved movements. The interaction between human and products is like dancing. Exploring Communicating and collaborating in a non-verbal way, for example, body movements and eyes contacts, are the topic of this project.

In this project, by exploring the interaction and setting the context between human and product, we apply the attributes of movements into product design, and we want to explore the relationship among movements, context, and user experience.

The exploration is started from the interaction between human and book. In order to realize the need of each other, we consider the bookshelf as a service provider, and take two bookshelves designs for examination.

Key Words: movement, context, experience, tangible interaction, product design

誌謝

謝謝鄧怡莘老師對我的指導，我常常忘東忘西，研究與設計能力不出色，表達能力也不好，真的很感謝老師的耐心與包容。很慶幸自己當時沒聽老師的話換指導老師，才能從老師那聽到許多新奇且特別的想法，因為老師在談論設計的時候，就像愛玩的小孩一樣，總會出現一些大家想也沒想過的點子，聽老師說話很有趣。(不過每次討論的時候，在老師那間辦公室的時候懂 9 成，一出辦公室剩下 7 成，回到自己的位置回想的時候，已經剩下 6 成了，不知道那邊是不是有設了什麼結界。)

來到 IAA 三年，改變最多的就是看事情的角度，和以前很不一樣，這邊是一個年輕的環境，每個人都很善良也沒有什麼小圈圈，這段時間真的很快樂。謝謝老爸老媽，我快要回家陪你們了。謝謝鋼彈社社長熊貓人一直幫我一直陪我，雖然你很愛亂放歌，很壞。謝謝 Q 毛老大的幫忙，沒有你，我會變成台北新竹通勤族，我的作品也大概會且胎死工廠。謝謝阿酸的加油打氣，謝謝你的おかえり；謝謝精明又負責的冷豔憨那，下次誰再說你笨，我就罵他。謝謝溫淺恢常常陪衝刺班一起熬夜，去日本加油為國爭光，下次 FF 搞不好有人畫溫神降臨也說不定；還有雨虹 PP 神也謝謝你辛苦的報帳(拍拍)，謝謝你們夫妻的貼心小卡還有海尼根啤酒和有斬佛凱蒂貓圖案的維力炸醬麵。謝謝宅堯一直熱心的當獸王！謝謝 IAA 最佳推銷員 JIZZ 志常常和我一起討論設計順便推坑，有你的想法幫了我很多。還有課長精闢的見解也幫我修正了許多問題。謝謝偷吸貓和我一起 rock n roll，等你九月回台灣再來 rock 一下。謝謝國科會大家的 cover，讓我減輕了一些負擔。謝謝 IAA 的大家，能和你們在一起真的很棒。

謝謝你們！

CONTENT

FIGURE CONTENT

CHAPTER 1

INTRODUCTION

The general exploration backgrounds are introduced in this chapter. The main topic of this project is to utilizing movements to enhancing the interaction between human and objects by meaningful physical body manipulation and meaningful physical product feedback.

In this chapter, the exploration starts form the influences of electronic products. First, we start from how people recognize products to know our cognitive process toward a product. Second, the product semantics are discussed. It makes novel relationships among human, objects, forms, and meanings. Third, the topic goes to the tangible interaction issue (the tangible interaction will be introduced later in chapter 2). Fourth, a notation method is introduced to provide a general aspect for movement design. Finally, the motivation and objective are described.

1.1 Background

1.1.1 Making Sense

Making sense is a circular cognitive process that may start with some initially incomprehensible sensation, which then proceeds to imagining hypothetical contexts for it and goes around a hermeneutic circle during which features are distinguished in both contexts and what is to be made sense of and meanings are constructed until this process has converged to a sufficiently coherent understanding (Krippendorff, 1989).

Figure 1 the process of making sense (Krippendorff, 1989)

How do we make sense of products? In the article: Product Semantics: Exploring the Symbolic Qualities of Form, Krippendorff mentioned the four stages to realize a product.

Stage1: Product Identification

Require the user to merely look at a object from different perspectives and interpret relevant clues to judge what kind of object it is.

Stage2: Self-evident Operation

Additionally requires the user to handle an object, to move it about or alter its controls and obtain feedback from those actions. It also requires that the user experience operational success or failure.

Stage3: New Exploration of Forms

Invites the user to play with the object, acquire a working knowledge of it and perhaps invent novel applications.

Stage4: Coherence with the Symbolic Context

Concerns a user who interprets an object in conjunction with others and who may describe the whole arrangement in terms of personal style, individual expression, social attributes and aesthetic value (Krippendorff, 1989).

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1.1.2 Product Semantics

After World War I, the whole world was under a recession; with the trend of history, the functionalism proposed by modernism catered for and drove the development of industrialization process. During 1920 to 1950, functionalism was an important stage in the design history, and the key point of product design lied in physical function. The development of society and economics, the advent of consumption era, and the increase of wealth had changed people's demands for products; simultaneously, the over-exploitation and over-development on the earth in the 1960s caused a crisis on the global environment, and then environment design was proposed and implemented in every level of design. During this period, people started to value environmental function and the influence of industry on the environment. In 1980s, the communication of human and product was emphasized increasingly, and the design field had introduced many new disciplines: sociology, ecology, psychology, behavior theory, linguistics, and information theory; moreover, the emergence of electronic

products had cut the close and necessary connection between shape and function. The over-emphasis on function and over-negligence of form of modernism led to the coarseness, indifference and stiffness of industrial products, and some people even depicted it as a period of "mass production, mass purchase and mass consumption;" at that time "post-modernism" emerged, it valued spirit, context, symbol and meaning and had a significant influence on product semantics.

In the middle of 1950s, machinery products had changed to electronic ones and this caused "the disappearance of form." Electronic products cannot have the shape related to the functions just as machinery ones do, therefore people transcend recent regulations of design and request for a new principle and grammar of form. Product semantics is a solution to solve the problems of electronic black box and the difficulty of perception of electronic products, hoping to make them become easy to identify through the methods of analogy, metaphor and implied meaning and, allow users operate them correctly, and endow them with unique and differentiated shapes.

Product semantics is the study of symbolic qualities of man-made form in the context of their use and the application of this knowledge to industrial design. Through product semantics, designers can demystify complex technology, improve the interaction between artifacts and their users and enhance opportunities for self-expression. In field of product semantics, designers also have the risk to fall into the trap of over pursuing style. Product semantics does not a mean focus on pursuing demonstrating the new style. It is the guide line for designer to make the products close to human in the aspects of manipulation, experience, and aesthetic.

1.1.3 Design Examples in Product Semantics

Under the principle of product semantics, an outstanding design can fully apply the symbols to make function and form achieve unification. Not only embody the symbol meaning of the products and culture context, but also show the concern about the users. There are famous examples of applying product semantics to product design.

The telephone responder designed by American designers Lisa Krohn and Tucher Viemeister in 1987 was the classical example of product semantics. They combined a handset and answering machine into one unit, and make it look like a phone book. Through the new technology, they integrated recording, broadcasting, copying documents functions, and kept people's cognition to the function of the traditional telephone. Users can switch over different functions and contents by flipping the "pages". By applying a familiar image into product, users can achieve a decent emotion state and cooperate easily with the new technology while manipulating the product.

Figure 2 example: the phonebook

http://digitalwellbeinglabs.com/dwb/?p=269

In 2002, IBM introduced the new style laptop computer, " ThinkPad TransNote " which win the IF design award. The characteristic of the product users can conveniently typing, drawing, processing, saving, loading any files through this design.

Figure 3 example: the transnote

The TransNote consists of a largish leather-like "Endurimer" folio case that contains a full computer on one side and a standard paper notepad on the other side. Only, the computer isn't completely standard, neither is the notepad. In order for the computer to fit into such a confined space IBM designed a flat slate that contains all the electronics and the keyboard. The display lies folded flat on top of the keyboard, LCD side up. You can use it that way, as a tablet for browsing, writing, or drawing. More likely you'll flip it up so that you can use the computer more like a standard notebook.

1.2 From Appearance to Interaction

Product semantics provides meanings and stories of products to user, that is, it describes "what the product is". While it goes to the other stage, "how to use the product" and "how to create meaningful experiences" are the two important things that designers can consider with. Considering the cultures and life styles, movement factors can be utilized into manipulations and feedbacks. Users can experience, feel, and learn something with their bodies by utilizing movements into design process, and making a tangible interaction.

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Although the technology brought us many advantages and possibilities, the relationship between human and products had changed. Our engagement with consumer products diminishes gradually over the last decades, which causes considerable usability problems. To dissolve these problems, the designer's emphasis should shift from creating beautiful products in appearance to beautiful interactions with products.

The electronics used in such products are intangible, for example, they do not relate to our mechanical world. This implies that the functional parts of a product no longer impose a particular appearance or way of interaction. The 'intangible intelligence' resulted in products that place a heavy burden on the human intellect. For example, user has to learn how to program the thermostat and disaster comes to you if you accidentally change the settings of the balance from kilos to English pounds. Technological products cause considerable usability problems making manuals indispensable.

We should try to reinstate the engaging capacity of products and focus on the experience that users can have using a product. Instead of having to instruct a black box, the user should be seduced and supported to enjoy cooking, adjusting the temperature with all human senses and skills. A designer can evoke such an engaging experience by respecting all of man's skills, not only his cognitive, but also his perceptual-motor and emotional skills. A product can enrich our life and prevent or at least diminish usability problems.

By designing a 'context for experience' instead of merely a product, the focus shifts

from the result of interaction, for example, the weight or the warmth, towards the involvement during interaction, for example, weighing food, attaining the desired warmth. This means that the designer's emphasis should shift from creating a beautiful, pleasing product in appearance, to creating a beautiful, engaging interaction with a product. In chapter 3, we will demonstrate our concepts and start out design process from setting context and movement to make experiences and emotion while using the product.

1.3 A notation Method for Movements: Labanotation

Figure 4 a dancer

Labanotation can be regarded as an international way of communication. It plays an important role in the field of dance movement notation, just like the role of the staff in music field. The notation method itself can be seen as creating universal and easy-understanding symbols, and preserving the traces of dance movements. Labanotation keeps dynamic choreography in symbolize way as the template or reference for reconstructing the dance movements in the future. In other words, Labanotation is a systematized method of making notation that is used for explaining the ambiguous dynamic attributes.
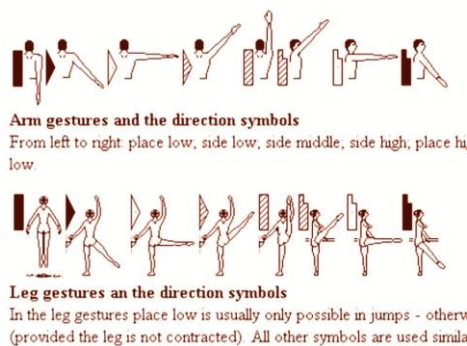
Figure 5 body movement notation

http://user.uni-frankfurt.de/~griesbec/indexe.html
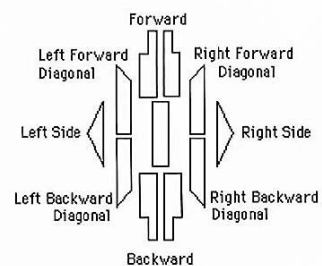
Figure 6 direction notation

http://www.edwardsamuels.com/illustratedstory/isc6.htm

Comparing two recording method: film and Labanotation, the difference is the objectives and demands. Take joining a concert and practicing an instrument for example. Film recording method concerns about the general aspect: how excellent of the concert and how the musician interpret the music, while Labanotion concerns about the definite and detail information: are musicians playing correct note?

If Labanotation is used in recording dynamic attributes of products, it seems to be reluctant and inadequate. In the case of recording the movement of products, creating new symbol frequently is needed because of enormous variables of product forms. Labannotation is related too heavily to the human form whereas we need a motion language that can be applied to differing forms. Labannotation is also very laborious and would never be employed in a design process due to the fact that in design we don't work with just one form.

1.4 Motivation and Objectives

Movement can not only be an additional channel between human and products, but also be another information carrier. Human can express ambiguous emotion, for example: confident or scared by body language, while products can also express operation, function, even emotion by movement. When using a product, people often look for the experience which reflect the past memory and emotion.

Fascinated by the charm of action figures, I decided to explore the topic about movement and emotion. In recent year, the development of toy design and manufactory, has already came to pursuing the joints flexibility. Keeping an aesthetic shape and proportion, and pursuing the high joint flexibility.

The join flexibility, mobility, means the active range of parts. In the case of action figures, mobility can also be the ability to imitate human action. Take this robot model for example, the machinery design of its leg is fantastic. The parts will interlock with each other when moving just like the muscle on human legs. Because of mechanic forms in harmony with biologic shape, make the aesthetic and impressive feeling. High mobility not only increase the variety of toys, but also increase the joyful and amazing experiences.

Additionally, people imagine scenes when they pose their toys and models. They also achieve fulfillment and happiness in posing the toys and models. It is a very interesting thing: movements they see and movements they act effect their emotion. In this case, how is the relationship between human and objects? How do people input information and how do products make feedbacks? What do people obtain from feedbacks? This project wants to know how to produce, enhance and build a much more meaningful, interesting, easy-experienced interaction, moreover, a physical to physical interaction.

1.5 Scope and Outline of Thesis

This project contains the discussion of product semantics, how people interact with products, body movements, product movements and context. There are several chapters that will be provided for achieving this project process, including introduction, methodology, result and discussion.

Chapter 1 Introduction

This chapter is going to introduce the background of this project, and the description

of project motivation, objectives, and scope.

Chapter 2 Literary Reviews

Material characters will be determined and explained here. These characters may be

the information needed when the material design is conducted later.

Chapter 3 Exploration and Application

This chapter contains the design process, task analysis, and mock ups etc. The chapter

is the foundation of the design outcomes in next chapter.

Chapter 4 Exhibition

The exhibition is recorded in this chapter. We will explain what the connection

between the project and the exhibition theme.

Chapter 5 Discussion and Expectation

After the exploration with analysis, producing and design process, this chapter is

going to discuss the differences of the result and objectives.

Chapter6 References

The list of references, including books, essays, and periodicals.
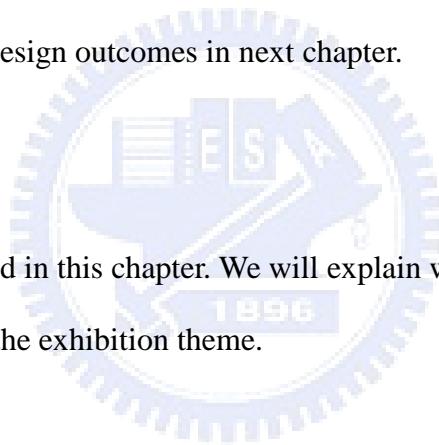
CHAPTER 2

LITERARY REVIEWS

Before applying movement to product design, literary reviews are made to figure out our topic. In this chapter, literatures are summarized and described in following content. First, the tangible interaction is explored, and it is a similar field to our topic. Second, the topic turns to movement-based interaction. Finally, the attributes of movements are summarized from literatures. These are the foundation to demonstrate the design process in next chapter.

2.1 Tangible Interaction: Improved Usability by Embodiment

The power of tangible interaction lies in embodiment. The concept of tangible interaction is attempting to utilize users' existing abilities at manipulating physical objects. These manipulations are possible and meaningful by knowledge people have learned through a lifetime of practice. People's innate motor abilities, sense of touch and texture discrimination, and their everyday experiences in grasping, gesturing and manipulation all contribute to the performance gains of tangible interaction.

A tangible user interface means a person interacts with digital information through the physical environment. tangible interaction relies on tangibility and full-body interaction, and gives computational resources and data physical form.

Ullmer and Ishii (Ullmer & Ishii, 2000) state 4 characteristics concerning

representation and control in tangible interaction:

(1) Physical representations are computationally coupled to underlying

digital information.

(2) Physical representations embody mechanisms for interactive control.

(3) Physical representations are perceptually coupled to actively mediated digital

representations.

(4) Physical state of tangibles embodies key aspects of the digital state of a system.

2.1.1 Tangible Interaction Design in Our Daily Life

Actually, there are many tangible design consumer products in our life. In this section,

examples are introduced to demonstrate tangible interaction in products. These are

examples of products that really make a difference by providing tangible interaction.

(Jasper, 2008) The object of mentioning these examples is to emphasize that the

importance of creating an joyful experience. Pursuing various functions is not the

only goal in digital environment, designer can find another way to make the

association of functions and manipulations more meaningful and engaged. These

tangible interaction have been around people and needed to be noticed.

Traditional Landline Phone: Straightforward Answering

People simple grab the phone receiver to enable the connection as simple as it can get.

In contrast, on mobile phones often users have to push a green button to start the

conversation, and another red one to stop it, which is less intuitive and need to learn.

(Jasper, 2008)

Guitar Hero Series

The controller for the Nintendo DS is being built which slides in to the BGA cartridge slot. What the controller does is adding four input buttons which allow you to jam away to guitar hero. When hitting the buttons on the guitar, users can use their other hands to strum the guitar strings on the touch screen.

Figure 7 guitar hero game controllers

http://www.nintendo.co.jp/

Figure 8 NDS game controllers

http://www.nintendo.co.jp/

Shake and Randomize the Content

The movement of Shaking something is quite a natural way of revealing a meaning: to mix and blend something. This meaning can be applied to music player. If user wants randomize the content, user can simply shake the device.

Figure 9 shake the w910i

http://www.sonyericsson.com

Open Lens Cover to Activate Camera

If user slides open the lens cover of the Sony Ericsson K800i, the phone switches to camera mode. Users don't have to dive into menus and subsequently.

Figure 10 Sony Ericsson k800i

http://www.sonyericsson.com

Open Our Laptop: the Motion Has Meaning

Open up the laptop and it will change the mode. This movement links the functions

and meanings: open it means starting to work, and close it means taking a rest. The

same case is opening and closing the folding mobile phone and answering a call. One

small complication with the latter situation: there needs to be a display on the outside

to be able to see whose calling and decide whether people want to answer the call.

Figure 11 the VAIO laptop

http://www.sonystyle.com.tw/vaio/#index

Canon Copiers: Extrapolating What the User Wants to Do

The copier will assume the content of memory card and the size of paper that users

put on it. If people put an A4 size paper on the copier, the device will assume that

people want to print by this size.

Figure 12 the Canon copier http://www.canon.com.tw/

2.2 Beyond Usability: Create Experiences and Meanings

Consumers were more interested in the pleasurable experience the product can offer than in the product itself (Hummels, 2000). The interaction with the product should therefore not only be designed to access the functionality but also to contribute to a beautiful and engaging experience.

If the objective of tangible interaction is decreasing user's manipulating burdens and increasing the usability, then the objective of movement and context based interaction is enhancing the interaction between human and objects by physical input and physical feedback. Movement and context design cares beyond the usability, and it also cares about expressing experiences and meanings through embodied interaction and engaged body movement.

The world is inherently meaningful for human (Hummels, 2006). The foundation for changing digital-based interaction to movement-based interaction is that people can perceive the world in terms of what people can do with it. By applying physical interaction with objects, people can access this meaning and express the meaning from the acts they performed and the reactions of the objects.

2.3 The Importance of Movement-based Interaction

Digital products have their limit, where electronic circuits and microprocessors have broken the intrinsic link between functionality, appearance and actions, thus offering designers the opportunity to create a whole new perspective on design (Hummels,

2006).

In order to overcome the limit of digital products, researchers and designers can try another solution: respecting all human mind and body movements by embodying and converting human behavior for creating meaningful manipulation and interaction, moreover, associating human minds and body movement with social context and culture to make a more involved relationship between people and products..

Hummels (2006) announced two reasons paramount in turning to embodied interaction.

(1) Balancing Human and Social Values by Embodied Interaction

After the modernist tradition with its passion for the function and logical, an new era that shows respect for a person as a whole (with a mind, heart and body) and utilizes human's abilities in cognition, emotion, and perception. Moreover, embodiment can help to shape people's engagement with reality.

(2) Interacting by Utilizing Information around People and World

movement-based interaction provides us with information about the world around us and ourselves (Hummels, 2006). This basic principle is rooted in Gibson's (1978) ecological theory of perception. Gibson (1978) states that the world unfolds itself in possibilities for action. We perceive the world in terms of what we can do with it. For example, a chair affords sitting to an adult person, and it affords stability to a small child who wants to stand up. Thus, the world is inherently meaningful for our body and by moving we can get access to that meaning. Interacting with products creates meaning for a user.

2.3.1 Choreography of Interaction

"*Choreography of Interaction*" (Klooster, 2002) can interpret well the process of design movements into interaction. In the design process, we can imagine how to interaction with products step by step. The interaction between human and product can be seen as dancing. Dancers must cooperate with each other, including the paces, tempos, eye contacts, and body movements.

Movement embodies the trinity of Physical Involvement, Dynamic Quality and Expressed Meaning. These three pivots, strictly speaking, cannot be separated; they are entangled and overlap.

lead to certain **dynamic** possibilities and constraints.

Physical Involvement
Physical characteristics offer possibilities and constraints to interact.

Dynamic Quality
(1) Spatiality
(2) course of Time

Expressing Message
Meaning is expressed through a certain kind of Physical involvement which is dynamic and qualitative.
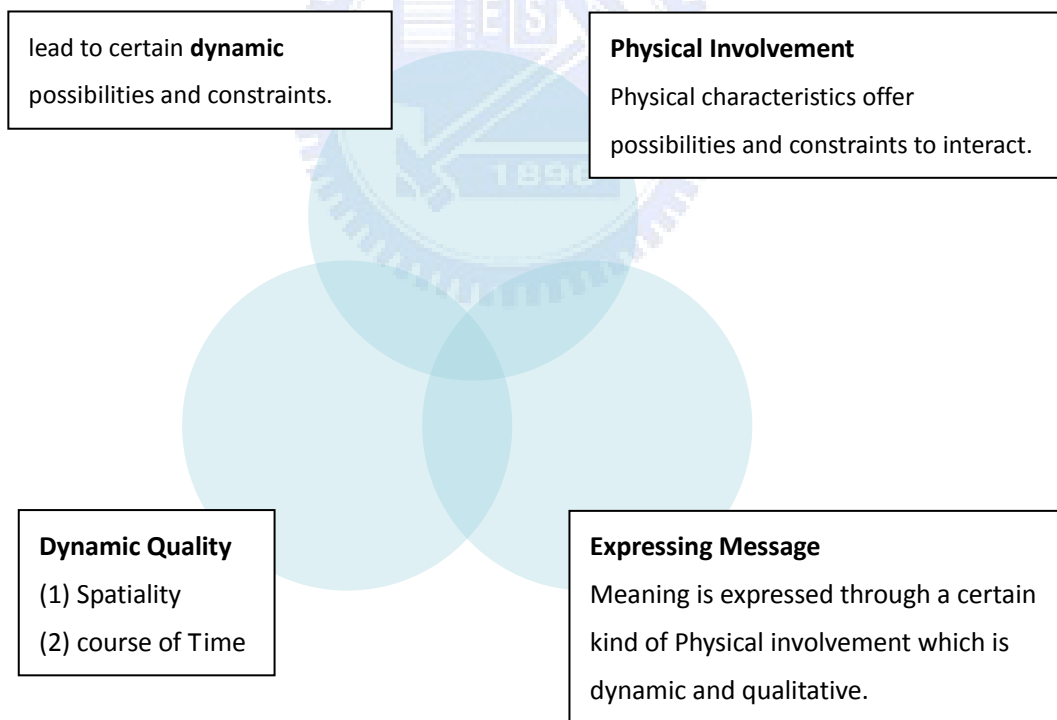
Figure 13 choreography of interaction

2.3.2 The Attributes of Movement

In order to understanding movements, realizing the compositions and attributes of a movement is the essential part. Any movement consist its own characteristics and attributes, for example, the quality and quantity of a stretch movement. Moreover, the time and spatial change are also occurred with movements. Feijs, Kyffin, and Young (Feijs, Kyffin, and Young, 2005), proposed four attributes for movement.

(1) **Path**: the line that an object movement follows

(2) **Volume**: the use of space by the object including scale change and kinesphere (the limits of an individual's reach into space without changing place or usage

(3) **Direction**: the direction in which the object moves; up, down, towards and away

(4) **Velocity**: the speed, acceleration and tempo of the object

The four variables formed the grammar of movements. Additionally, utilizing the four variables to construct a movement is considered as a process of creating meaning

2.4 Summary: Movement is A Continuous Process

There no so called start-point and end-point for the movement. It is very difficult to find that when the act started and when the act stopped. No matter the status is static or dynamic, we can take movements as a continuous process, and every status revealed and carried intensions and messages, including expectation to the continuous action. We can separate the continuous process, and analyze the motivation, reaction, and emotion in each phase. This concept provides us a basic thought to observe and

analyze movements.

"Interaction creates meaning" does not only hold for users during interaction but also for designers when generating ideas and developing concepts. In next chapter, we will begin to demonstrate the exploration and design process to applying movements into manipulation and product feedbacks.

Chapter 3

APPLICATIONS OF MOVEMENTS

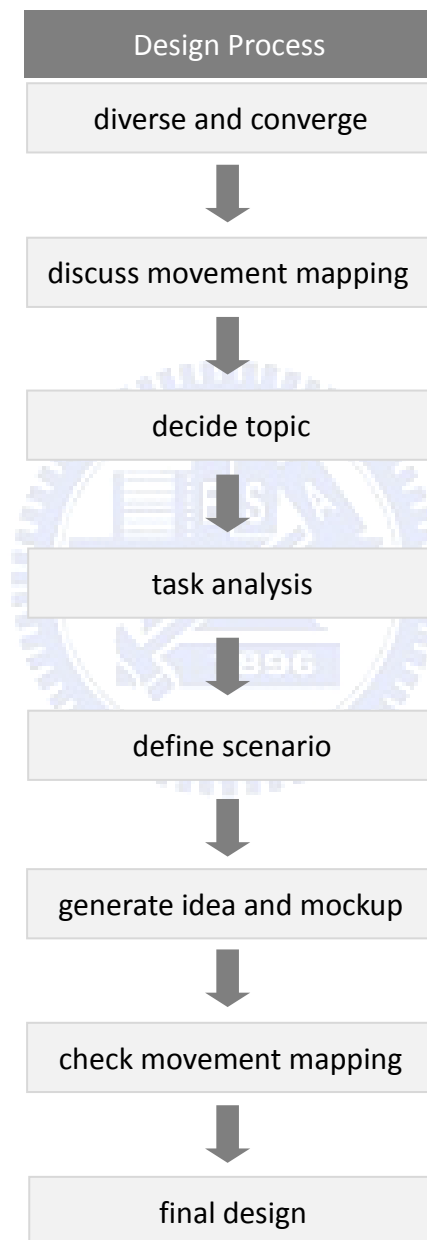After the literary reviews, the process comes to application.

Figure 14 design process

3.1 Generating Ideas from Movement

Diverse: Generating Ideas

In this section, the tasks are demonstrating the development and changing of our ideas: more and more engaged. At the beginning of the design exploration, design process started from generating ideas and sketches without much constrain. The only one important principle is that to keep movement, context and meaning mapping to each other appropriately.

Several interesting concepts are explored in this stage, for example, concept of locking and opening, balancing, searching, protecting, increasing, separating, and blending.
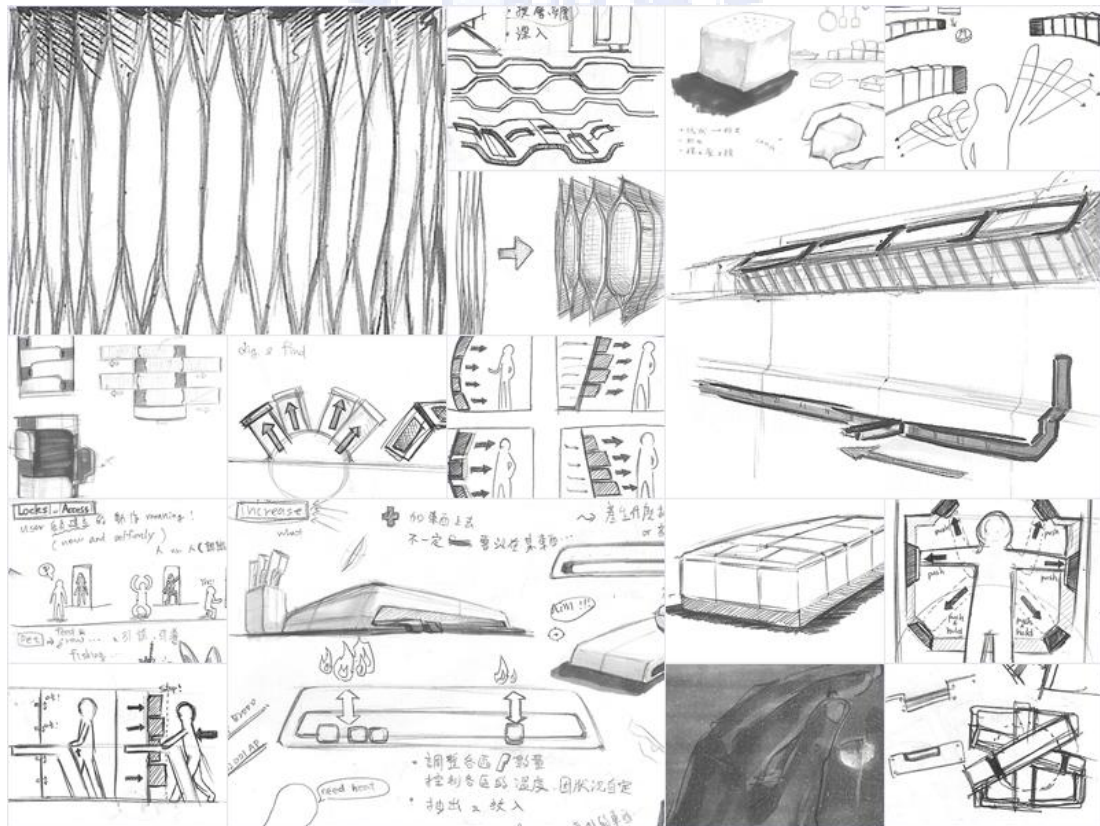

Figure 15 sketches during diverse stage

Converge: Choosing the Topics

After discussing, the topic has finally been chosen: "searching and obtaining information: design for a bookshelf". This topic is familiar to our daily life. People interact with books everyday: searching in the library, shopping in the book store, and looking for the recent famous books on internet. Therefore, an issue begun to be thought about how people interact with books and information they want to obtain. Then begin to arrange the basic task flow: how people interact with books and what services do they need.
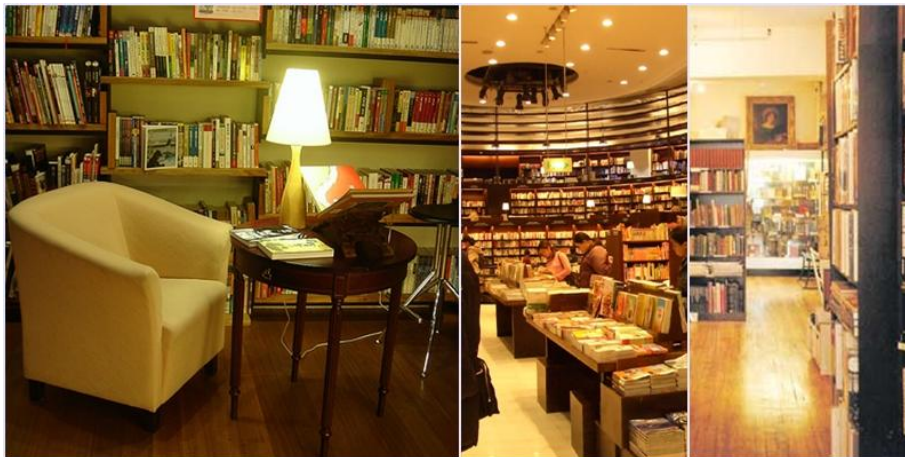
Figure 16 theme pictures

3.2 Task Analysis

In the design process, the bookshelf can be considered as a service provider and the task flow can also be analyzed for both sides: human and bookshelf. The task flow is demonstrated. Three parts are involved: first, user's task flow; second, the reaction of the bookshelf as a service provider. Third, movement involved in the task flow. By analyzing the task flow, it can be more clearly: what can designer do to improve the relationship between user and book, and how to create a beautiful interaction experience for users.

3.2.1 The Task Flow of Users

Several observations have been taken in school library and book store. The main objective is to know: how users interact with books, bookshelves, and clerks. After observing, the user's basic task flow has been summarized and illustrated from the observation results.
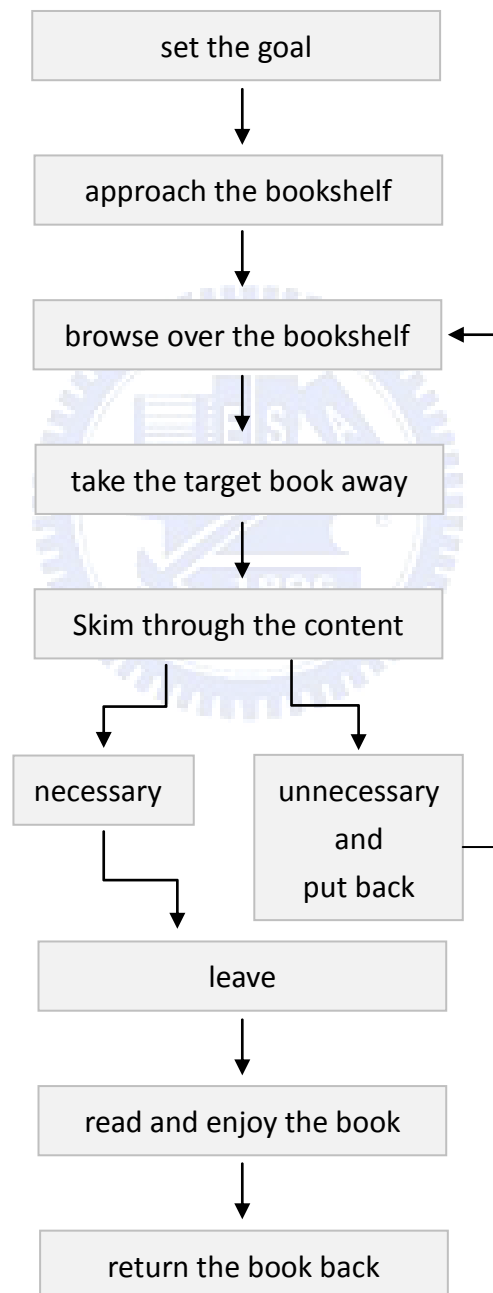
```
              ┌──────────────────────┐
              │     set the goal      │
              └──────────┬───────────┘
                         ↓
              ┌──────────────────────┐
              │ approach the bookshelf │
              └──────────┬───────────┘
                         ↓
              ┌──────────────────────┐
              │ browse over the bookshelf │ ←─────┐
              └──────────┬───────────┘            │
                         ↓                         │
              ┌──────────────────────┐            │
              │ take the target book away │        │
              └──────────┬───────────┘            │
                         ↓                         │
              ┌──────────────────────┐            │
              │ Skim through the content │         │
              └─────┬──────────┬──────┘            │
                    ↓          ↓                    │
         ┌──────────┐   ┌──────────────┐           │
         │ necessary │   │ unnecessary   │──────────┘
         └────┬─────┘   │ and          │
              │         │ put back      │
              │         └──────────────┘
              ↓
         ┌──────────────────────┐
         │        leave          │
         └──────────┬───────────┘
                    ↓
         ┌──────────────────────┐
         │ read and enjoy the book │
         └──────────┬───────────┘
                    ↓
         ┌──────────────────────┐
         │ return the book back  │
         └──────────────────────┘
```

Figure 17 user's task flow

24

3.2.2 The Reactions of Bookshelf

In this part, the bookshelf is considered as the service provider, and the book is considered as the service itself. Base on the user's task flow, the reaction of the bookshelf is constructed. It shows that what information the bookshelf should provide to the user during the interaction.
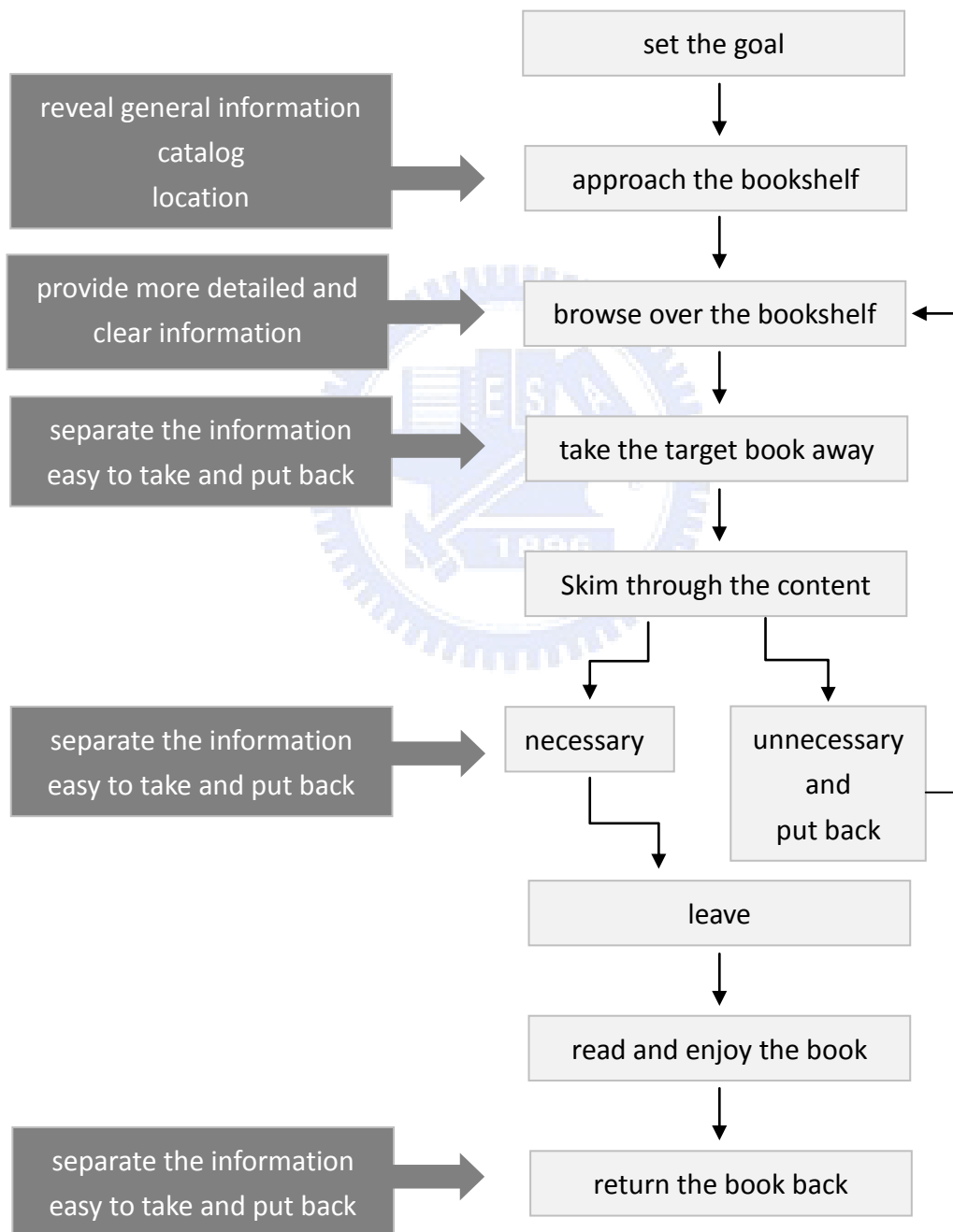

Figure 18 reaction of bookshelf
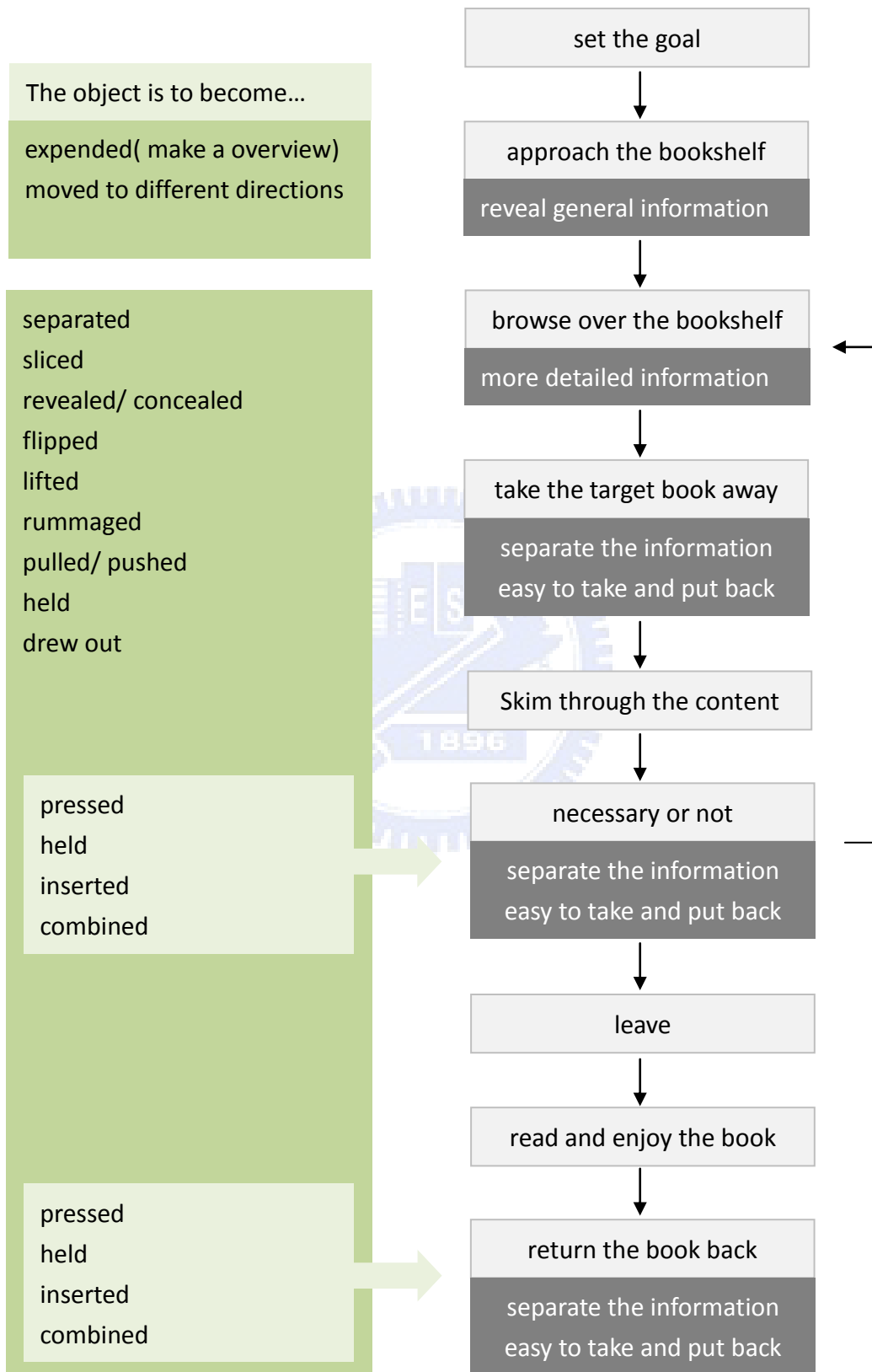
3.2.3 Movement Involved into the Task Flow

The object is to become…

expended(make a overview)
moved to different directions

separated
sliced
revealed/ concealed
flipped
lifted
rummaged
pulled/ pushed
held
drew out

pressed
held
inserted
combined

pressed
held
inserted
combined

set the goal

approach the bookshelf

reveal general information

browse over the bookshelf

more detailed information

take the target book away

separate the information
easy to take and put back

Skim through the content

necessary or not

separate the information
easy to take and put back

leave

read and enjoy the book

return the book back

separate the information
easy to take and put back

Figure 19 movement involved in

26

3.3 Set Scenarios and Features

Scenario A

Alex (27) is a counter in a bank. He orders magazines every year, for example, Times, Guitar Player, and Model Art. In the Sunday morning, Alex wanted to look for the 7th, and 8th Model Art magazines last year for references. Because of his habits, he already put all the overdue magazines in the storeroom, therefore, he walked into the storeroom and searched for the magazines. He saw lots of boxes, containers and books. In this situation, he didn't know where to start searching. He just repeated the process of rummaging books, pulling and pushing away boxes, and opening and closing containers to looking for the desired magazines. After a period, he finally found the magazines in the corner of the storeroom.

Key Features

archive, searching, database-like, stack, huge amount, incomplete information revealed (need a trigger)
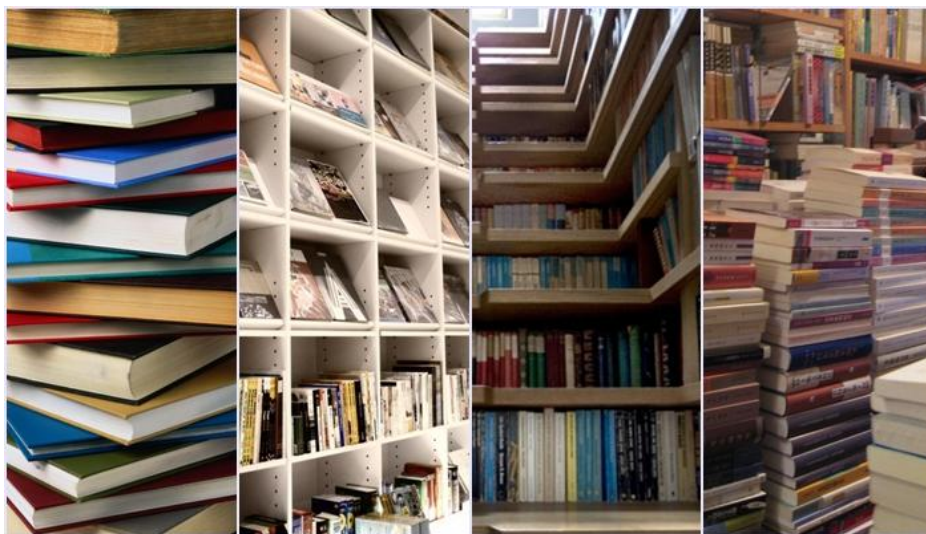
Figure 20 scenario for concept A

Scenario B

*Tom (20) is a university student fascinated by science fictional movies and animations.
He hopes that someday he can ride a space vehicle wondering in the space. He often
searches relevant information on the internet, then shares them in his blog. Tom also
likes to go to bookstore to read science fictional books. Additionally, he loves the
futuristic character design and scenery design, for example, robots and vehicles. In
Sunday afternoon, Tom wanted to by a new released and recommended concept art
books, therefore, he went to the bookstore and looked for books.*

Key Features

powerful, dazzle, fancy, mechanical, incomplete information revealed (need a trigger)

Figure 21 scenario for concept B

3.4 Making Mockups and Acting with the Object

It's very important that making mockup. It is absolutely worthwhile to create models which exist in the physical dimensions of the real world, not just 3D simulated in computer. The point is that the interaction takes place by the user's real body in a multi-modal way.
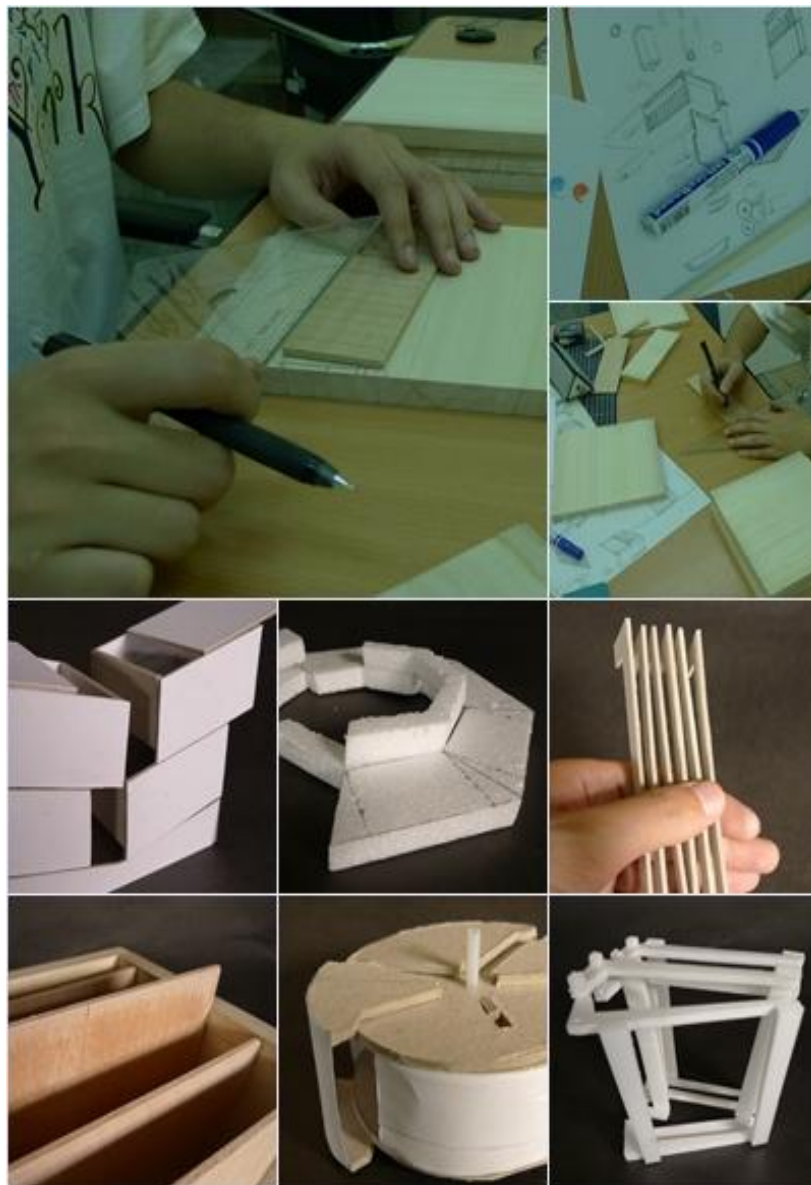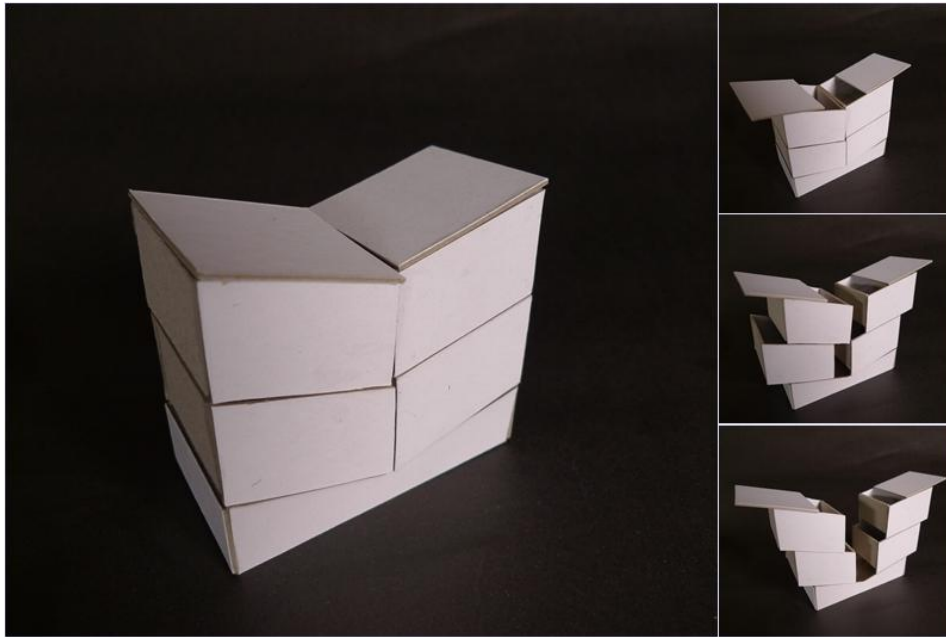

Figure 22 making mockups

Figure 23 mockup: ambiguous searching

Mockup Testing: Ambiguous Searching

Description

Under the concept of "ambiguous searching", this idea is derived from a digging

movement. User can move each container with an up-slant direction.

Requirements for User

(1) Digging body movement

(2) Down-up direction

Requirements for Object

(1) Slant container installation

(2) Set obstacles while browsing
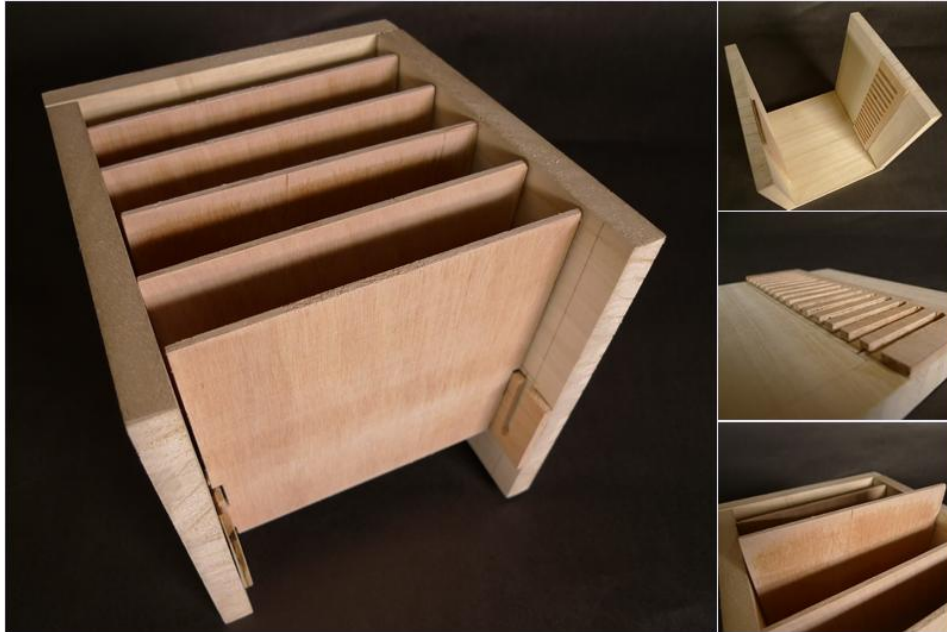
(3) Never show all the information in one time

Figure 24 mockup: lifting

Mockup Testing: Lifting

Description

Under the concept of lifting, this idea is cooperated with a browsing movement. The book will be lifted when people's hand move nearby the book. People can browse the book information and take the book more easily.

Requirements for User

(1) Browsing hand movement

(2) Horizontal move direction

(3) Slow move speed

Requirements for Object

(1) Lift the book when people's hand move to the book

(2) Lift all books like a wave when hands pass by them

(3) Never show all the information in one time
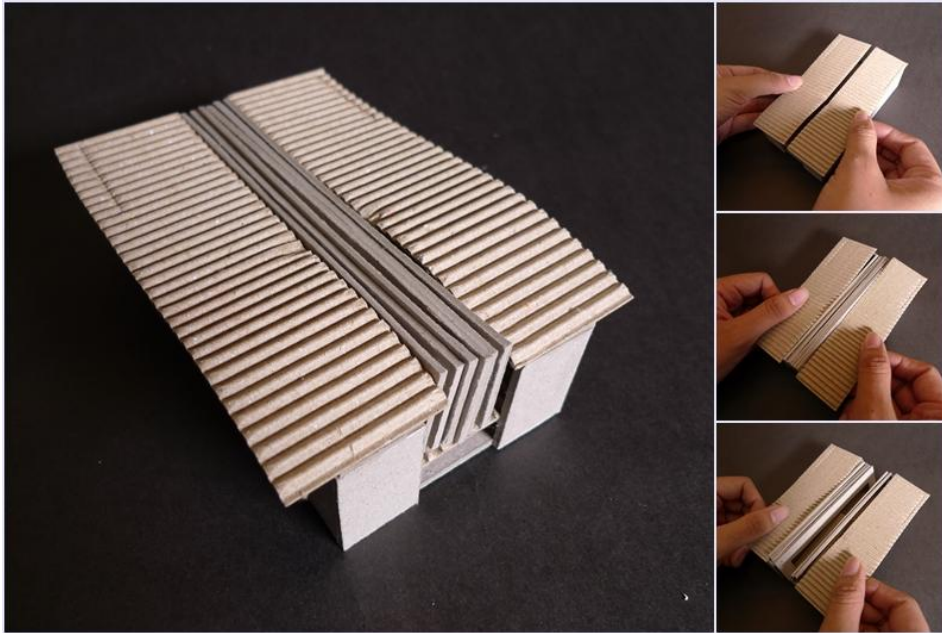
Figure 25 mockup: uncover

Mockup Testing: Uncover

Description

Under the concept of uncovering, the idea is derived from stretching and revealing body movement. The bookshelf reveals the information sequentially corresponding to the user movement.

Requirements for User

(1) Stretching and revealing body movement

Requirements for Object

(1) Move books to the front of people

(2) Set obstacles while browsing
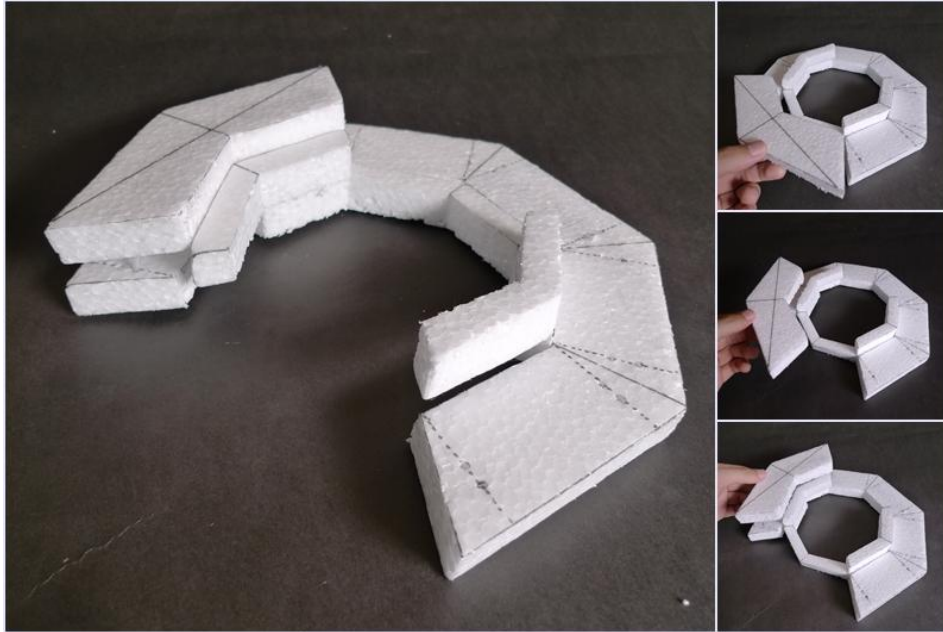
(3) Never show all the information in one time

Figure 26 mockup: planets

Mockup Testing: Planets

Description

Under the concept of "planets", this idea is enhanced by revolve and sweep body movement. The bookshelves are like two rings covered each other, therefore, people can not see all the book in one time. They need to do some actions to reveal the books..

Requirements for User

(1) Revolve and sweep body movement

(2) go into the central space of two rings

Requirements for Object

(1) Revolve smoothly

(2) Set obstacles while browsing

(3) Never show all the information in one time

Figure 27 mockup: searching in the storeroom

Mockup Testing: Searching in the Storeroom

Description

Under the concept of "searching in the storeroom", this idea Is collaborated with rummaging, pushing, and pulling body movement. Additionally, all the boxes are interlocked with each other, and reveal operation hints step by step.

Requirements for User

(1) rummage, push, and pull movement

(2) reveal boxes step by step

Requirements for Object

(1) provide operation hint step by step

(2) Set obstacles while browsing

(3) Never show all the information in one time
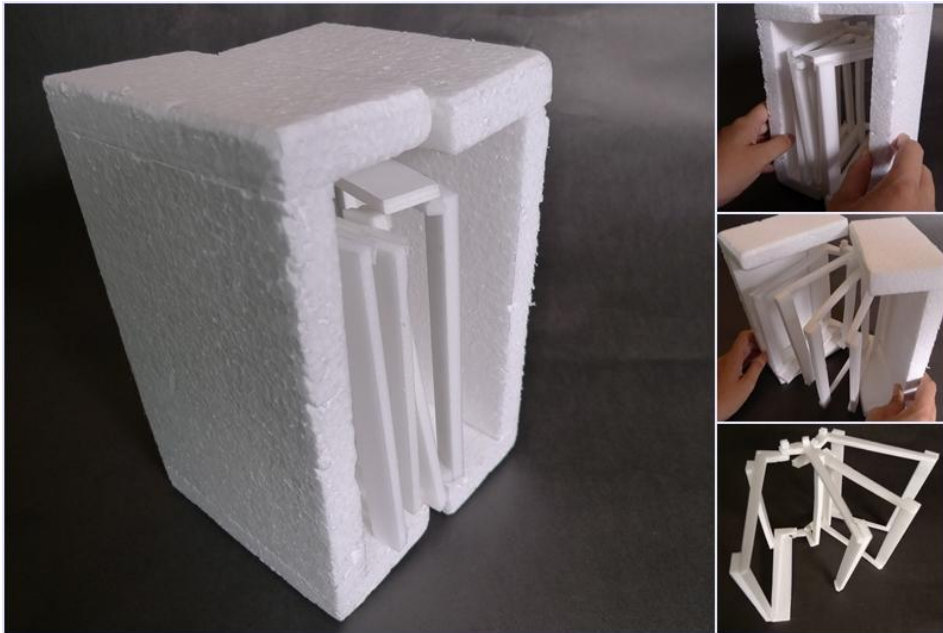
Figure 28 mockup: bursting

Mockup Testing: Bursting

Description

Under the concept of "burst", this idea is collaborated with rotating, pressing, and pulling body movement. This container consists of shells and rotating shelf. People must unleash the shell and rotate the shelf to get books.

Requirements for User

(1) rotate, press and pull movement

(2) reveal boxes step by step

Requirements for Object

(1) extend the part of shell like burst

(2) never show all the information in one time

3.5 Summary

After making mockups and discussing, some design advises were described. These advices can be helpful to next process: detail development.

3.5.1 Risk Is Involved: Joy and Laboring

There are some risk existed in taking body movements as manipulations. If the users feel meaningless to the body movements and need to learn the movement, in this situation, users may feel confusing, boring, and laboring. They neither know why they do that action, nor how to continue.

3.5.2 Imitate the Real Environmental Factors and Make Some Constrains

Imitating the real environment and making appropriate constrains are the important points in this project. In order to get information and the hints of following manipulation steps, users must do something to "active" them by physical body movement.

3.5.3 The Simplicity of Choreography of Movement

Complicated choreography of movements is not necessary in movement design. If a movement is too complicated, it will add a heavy burden to a user. A user may have to practice and remember a movement he's never acted before. Therefore, the objective for designers is to create meaningful and simple movements for both users and products.

3.6 Detail Development

Concept A

Applying the "searching" body movements, for example, rummage, rotate, lift, push, and pull, the feedback of the object has been designed: lifting books to users when users start searching. It is easier way for users to make a general browse and take target books. The sketches and short descriptions are shown. The figure shows the interaction between human and products.
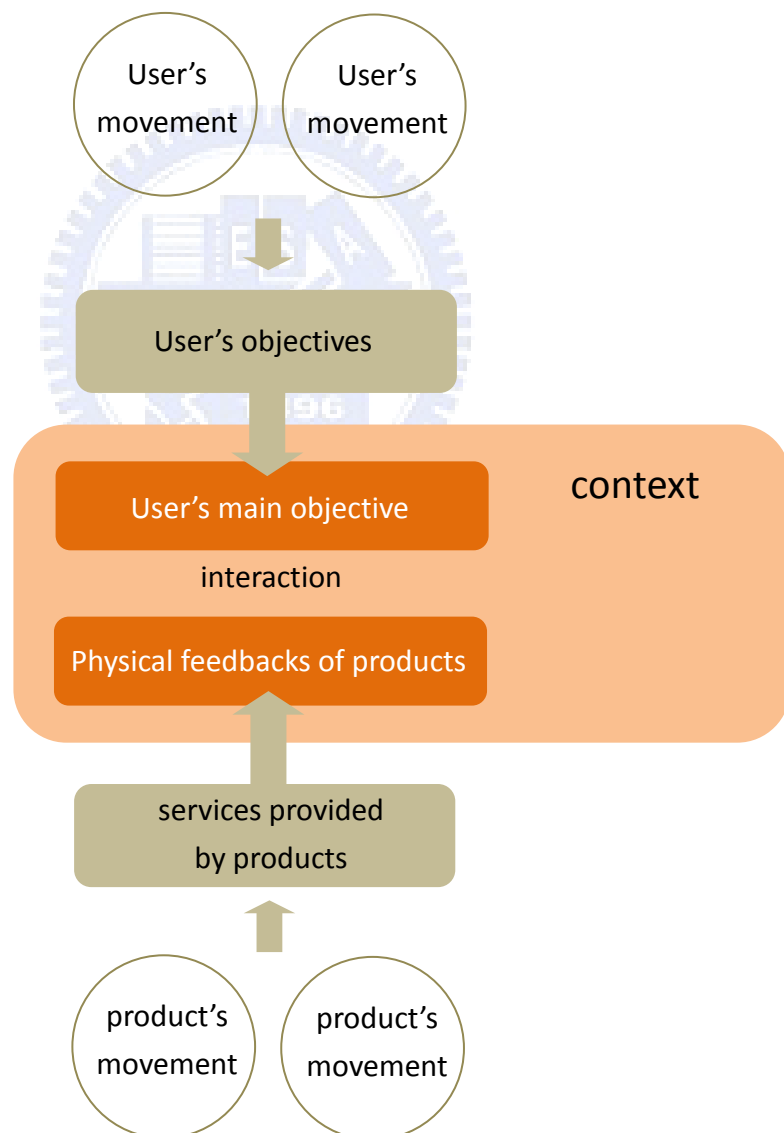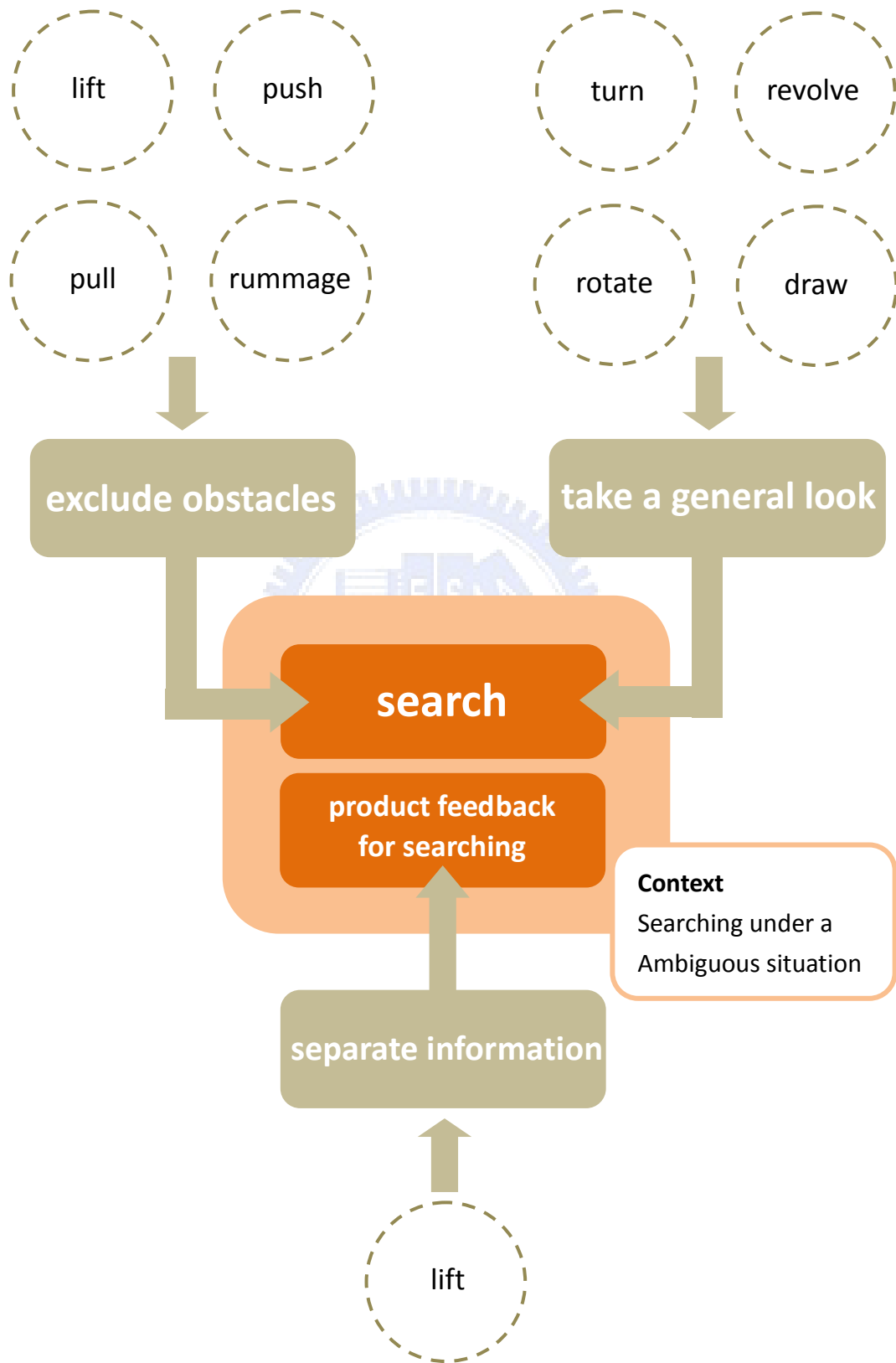

Figure 29 interactions demonstration

Interaction Between Users and Objects

Figure 30 interactions demonstration for concept A

Required Movements

In concept A, the required movements are rummage, rotate, pull, and push. The four

movements comprise a general concept of searching. Collaborating with the context,

these movements have been applied into the bookshelf design.

Rummage

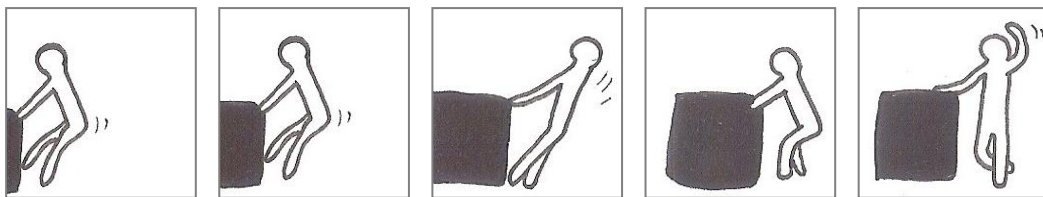a thorough search made by turning things over in a disorderly way
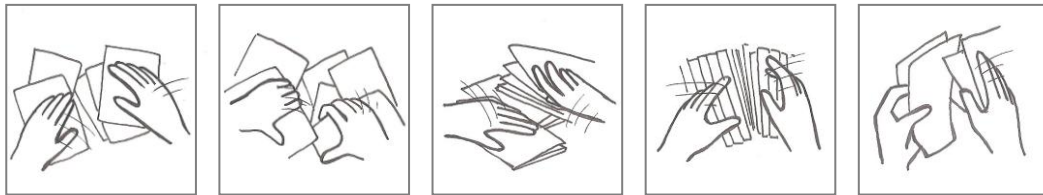
Rotate

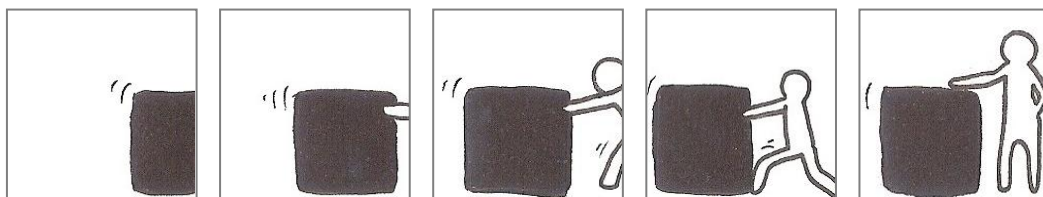to turn around its own center or axis

Pull

to draw out from objects

Push

to cause to move or move away from something

The form of box is decided to use in order to show a stackable image. Collaborating with the movements we assigned before, the design details were developed.
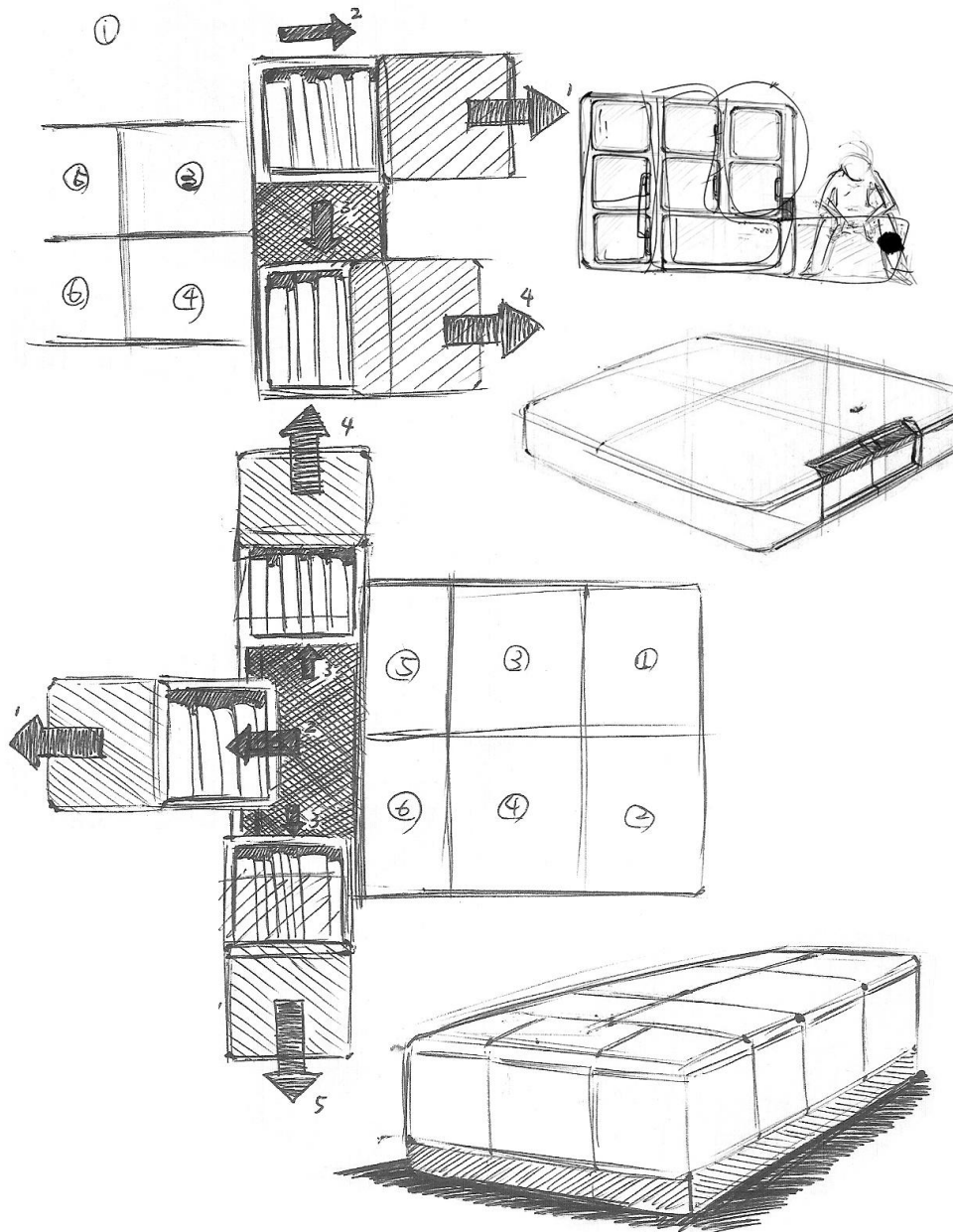

Figure 31 concept sketches: develop ideas

This sketch talks about how to make books be lifted? Some solutions are tested, for example, repulsiveness of magnets. It's very difficult to achieve because of the heavy weight of books.
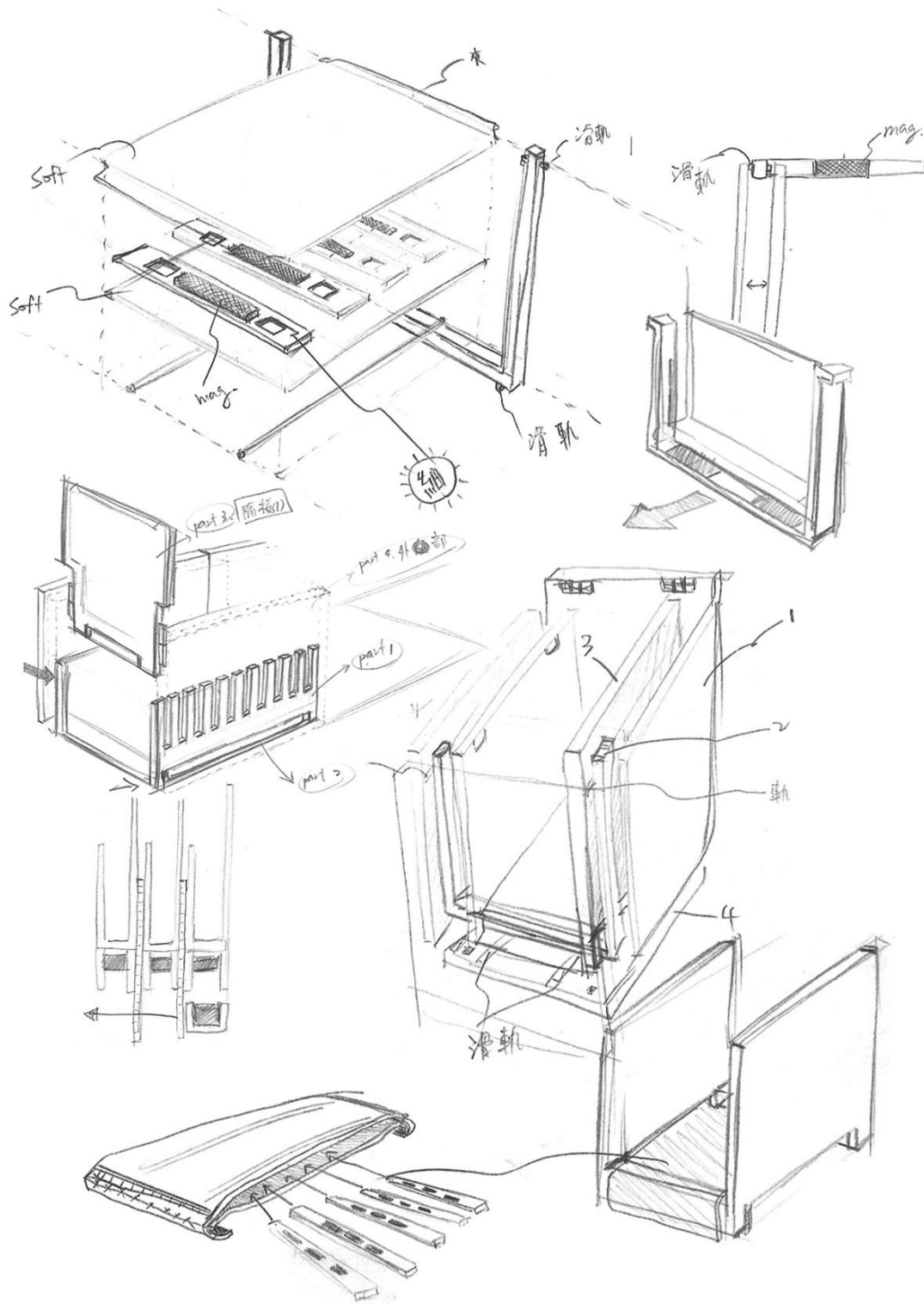

Figure 32 concept sketches: considering how to lift books

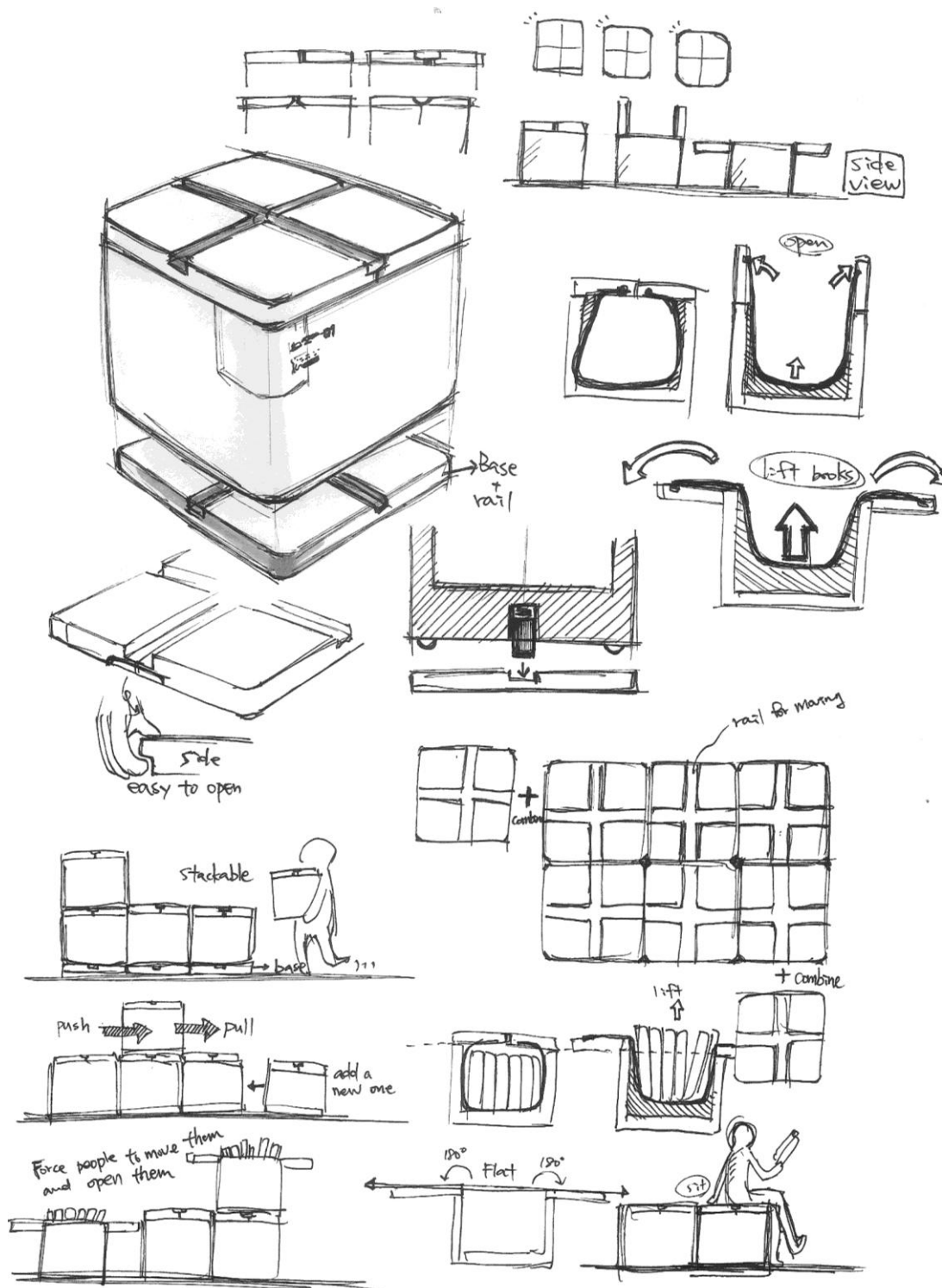This sketch provides an idea: using cloth to lift books.

Figure 33 concept sketches: final parts

Concept B

Applying the powerful, directional and stretchable body movements, we designed the feedback of the object: act like a cockpit, embrace the user who walks in this space. After a applying powerful manipulation body movements, users can see all the information on it and begin to browsing what they want for. The sketches and short descriptions are shown, and we simplified the form in the final design, in order to decrease the noise of a over complicated form. Collaborating with the movements we assigned before, the design details were decided.
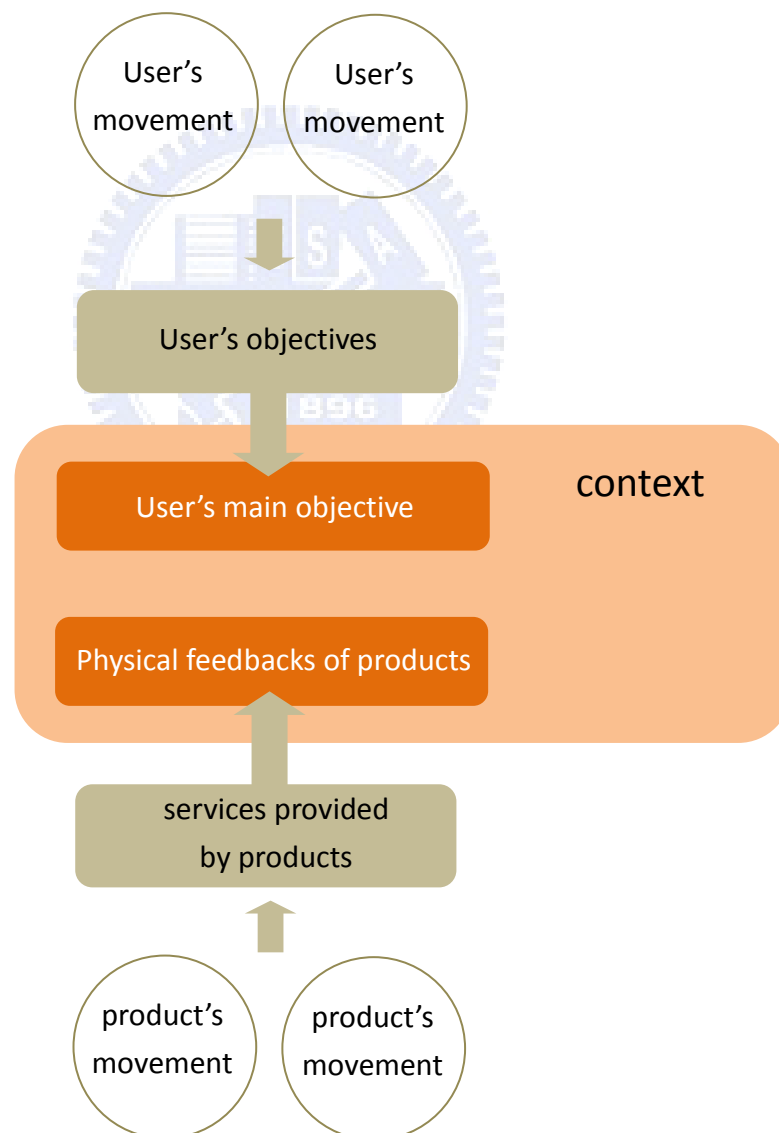

Figure 34 interactions demonstration

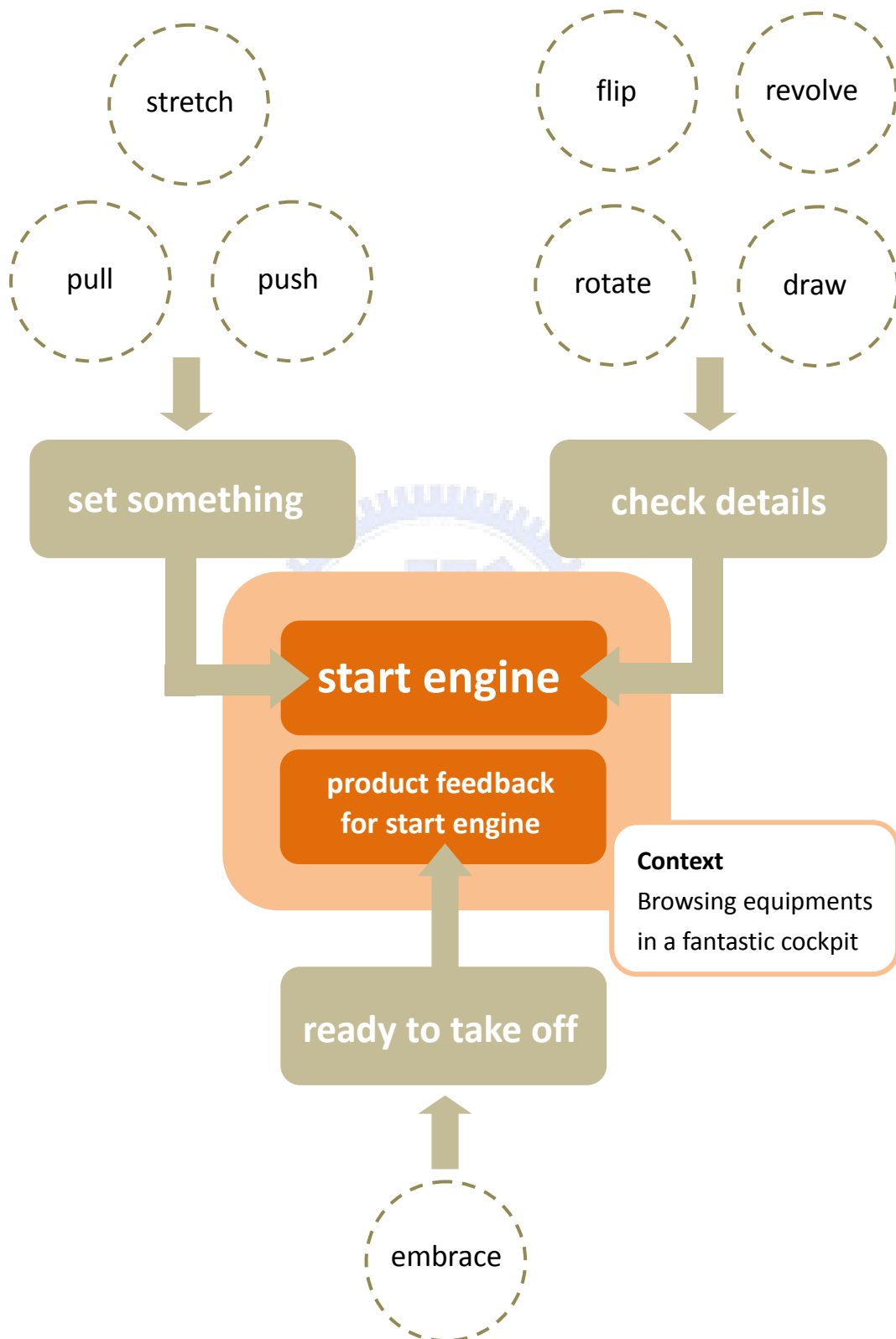**Interaction Between Users and Objects**

Figure 35 interactions demonstration for concept B

At the beginning, the forms are complicated.

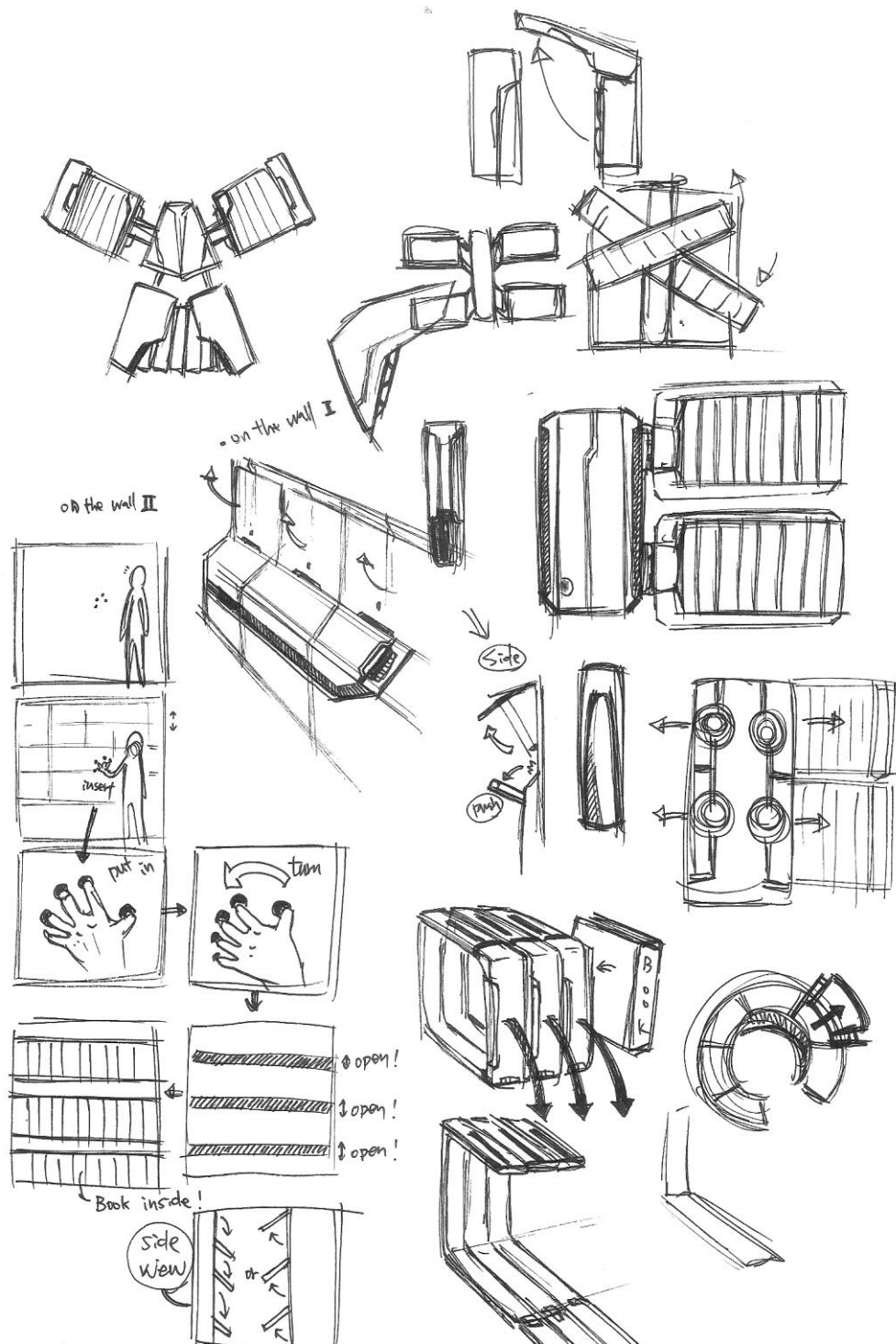Figure 36 concept sketches: considering how to achieve science-fiction style

General structures are discussed: one main base and two shelves. How the two shelves move is also very important.
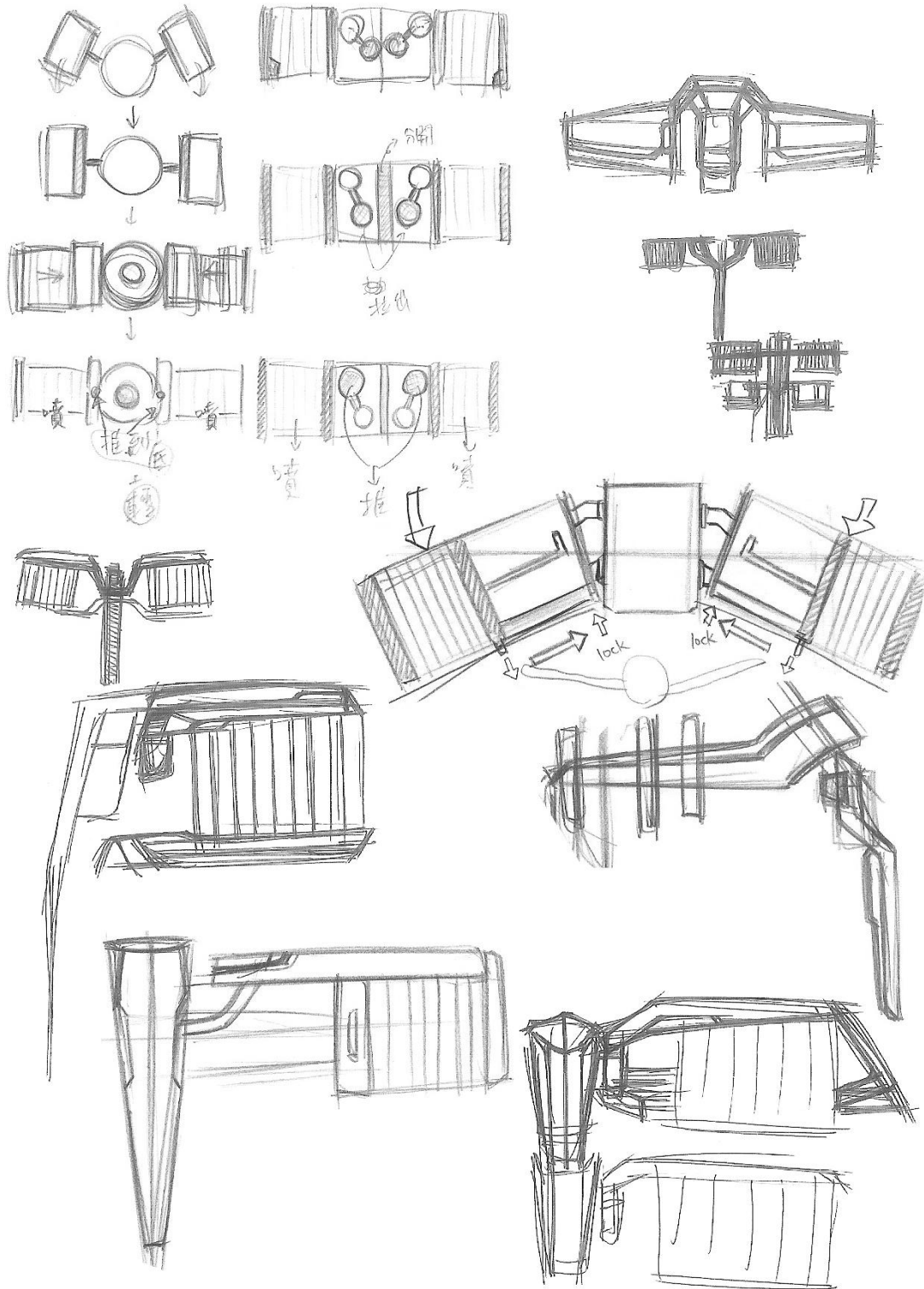

Figure 37 concept sketches: more detailed

Forms are simplified in this sketch. A too complicated form may interferes the machinery and blurs visual effects.
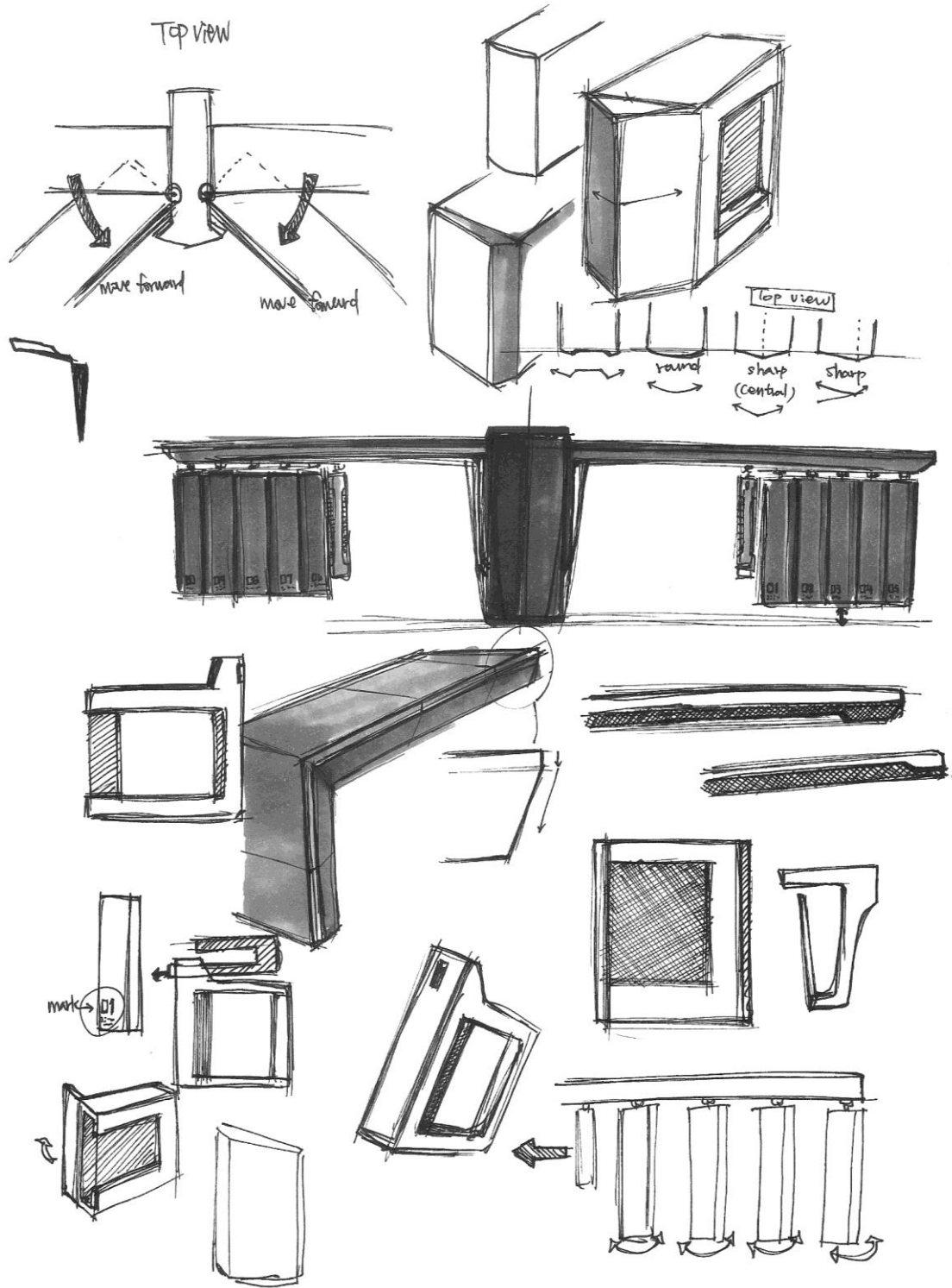
Figure 38 concept sketches: develop the shape

Discussion and Making Working Prototype

After ascertaining the details, we discussed with the master craftsman to confirm and communicate our ideas. It is very important to make a clear understanding between designers and craftsman. In fact, we met many problems, for example, overweight parts led to replace the bigger hinge and effect the original form. Additionally, because of the ready-made hardware size, we must change the design to fit the hardware. In this period, we almost stayed in the factory, in order to communicate and revise our design.

Figure 39 days in the factory

48

CONCEPT 01
倉庫番

Collaborating rummage, rotate, push and pull, open and close movements to interpret the interaction between people and books. Every single movement has phased purpose and meaning, and represents different searches at different levels: extensive browse or deep-going seeking as well. As people open the covers, products also react to the movement of searching and lift the books to make it easier for people to seek and take.

Scenario

Alex (27) is a counter in a bank. He orders magazines every year, for example, Times, Guitar Player, and Model Art. In the Sunday morning, Alex wanted to look for the 7th, and 8th Model Art magazines last year for references. Because of his habits, he already put all the overdue magazines in the storeroom, therefore, he walked into the storeroom and searched for the magazines. He saw lots of boxes, containers and books. In this situation, he didn't know where to start searching. He just repeated the process of rummaging books, pulling and pushing away boxes, and opening and closing containers to looking for the desired magazines. After a period, he finally found the magazines in the corner of the storeroom.

Figure 40 theme of concept A

Demonstration in Exhibition
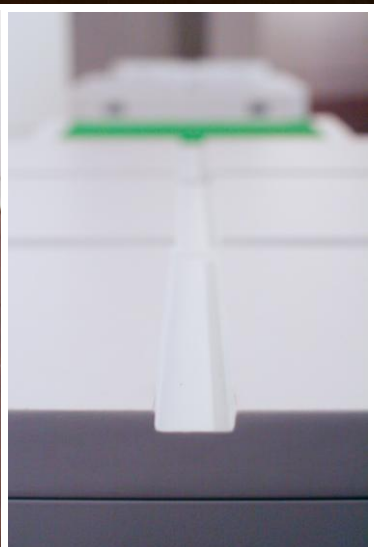
Figure 41 demonstration in the exhibition

The Key Physical Feedback: Opening and Lifting

When users open the top, the cloth will lift books in the box. Lifting books to users makes a easier way to browsing, flipping, and searching books. In general case, we can achieve more information by watching covers of books. By lifting books, we can create some spaces between crowded books because of slanting of books.

Figure 42 the key manipulation: open and lift

CONCEPT 02
アムロ、行きまーす
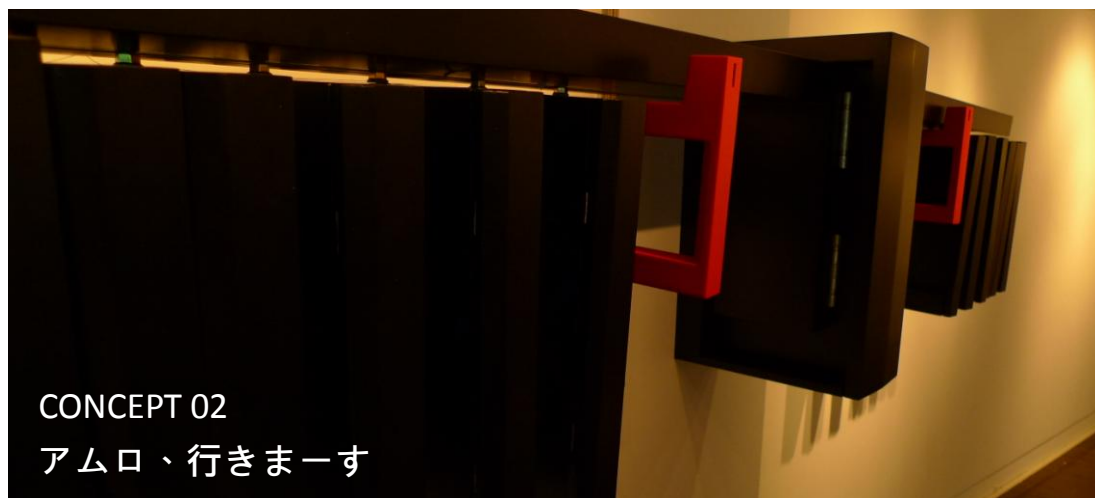
Are you also fascinated with the scenes and machinery showed in science-fiction books, films, and animations? In the context of science-fiction themes, the bookshelf is presented by stretchable, directional, and powerful movements collaborating with the design concept of wrapping space of cockpits. On the bookshelf are the Top 20 bestsellers of this month. The goal is to let readers in the bookstore to browse and acquire information by meaningful manipulations: the pilot-like movement, and to enhance user experiences of browsing information by the connection between manipulations and previous reading contents.

Scenario

Tom (20) is a university student fascinated by science fictional movies and animations. He hopes that someday he can ride a space vehicle wondering in the space. He often searches relevant information on the internet, then shares them in his blog. Tom also likes to go to bookstore to read science fictional books. Additionally, he loves the futuristic character design and scenery design, for example, robots and vehicles. In Sunday afternoon, Tom wanted to by a new released and recommended concept art books, therefore, he went to the bookstore and looked for books.

Figure 43 theme of concept B

Required Movements

In concept B, the required movements are stretch, pull, push, and draw. Additionally, the directions of the four movements are the key point in this design. Powerful and central-moving movements are needed to representing the fancy context.

Stretch

to draw out to a greater length or width
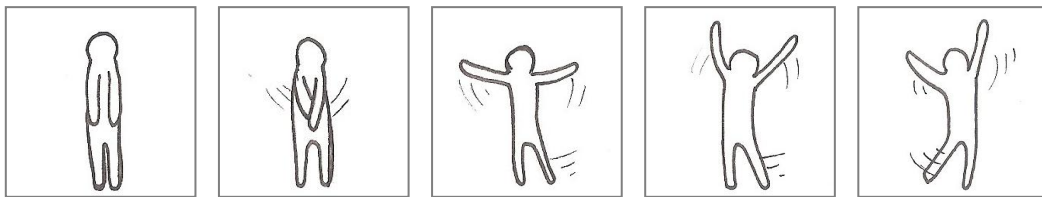
Pull

to draw out from objects
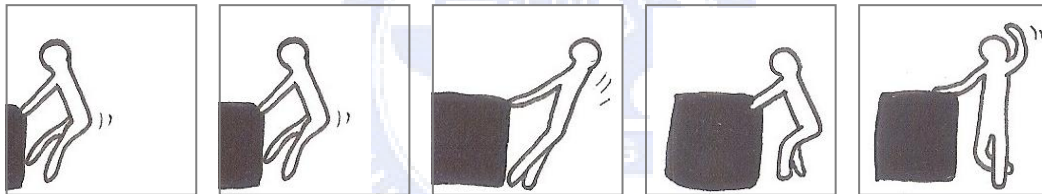
Push

to cause to move or move away from something
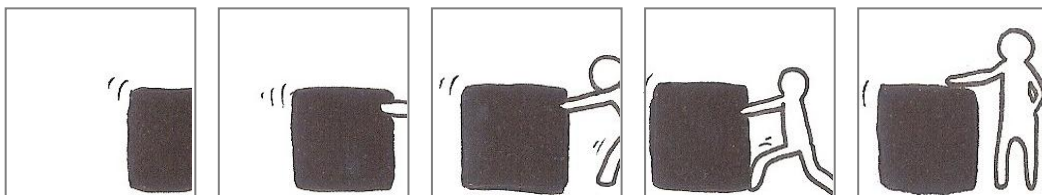
Draw

to pull or haul along
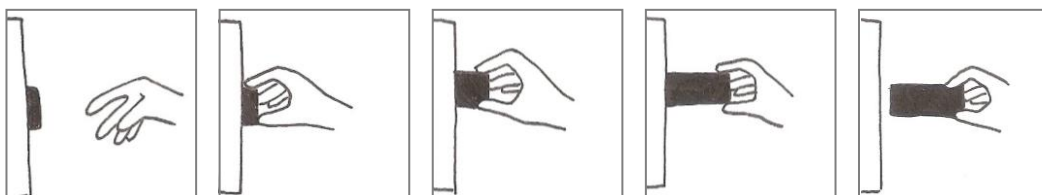
Explanation of the Title: アムロ、行きまーす

We must explain why we use the title: アムロ、行きまーす. It is a classic character's line in the famous robot animation. This Japanese sentence means: I am ready to take off, and it not only fits our science-fiction topic, but also recalls our memory to the animation scenes we've watched before.
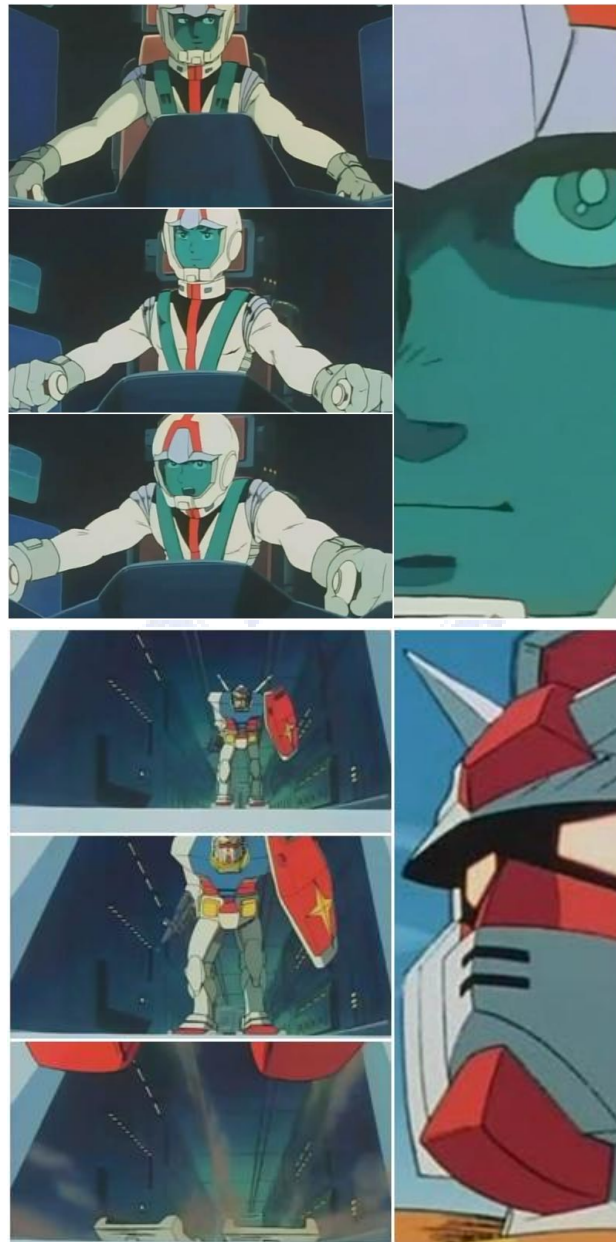
Figure 44 pilot in animation

Key Manipulation: Stretch and Pull to Create a Special Space

Holding the handle and pulling, the two "wings" will move forward and embrace the user. The product movements can create a special space for the user. There are black cases arranged in order, just like a kind of machinery instruments and control panels around the user.

Figure 45 the key manipulation: pull, push and stretch

Key Physical Feedback: Moving Forward and Embracing

The product's feedback is meaningful to users and the product itself. The two "wings"

of this bookshelf move forward, and "embrace the user. These movements not only

create a surrounding space effect to users, but also reveal a message: I am ready.

Users can check each book container for information.
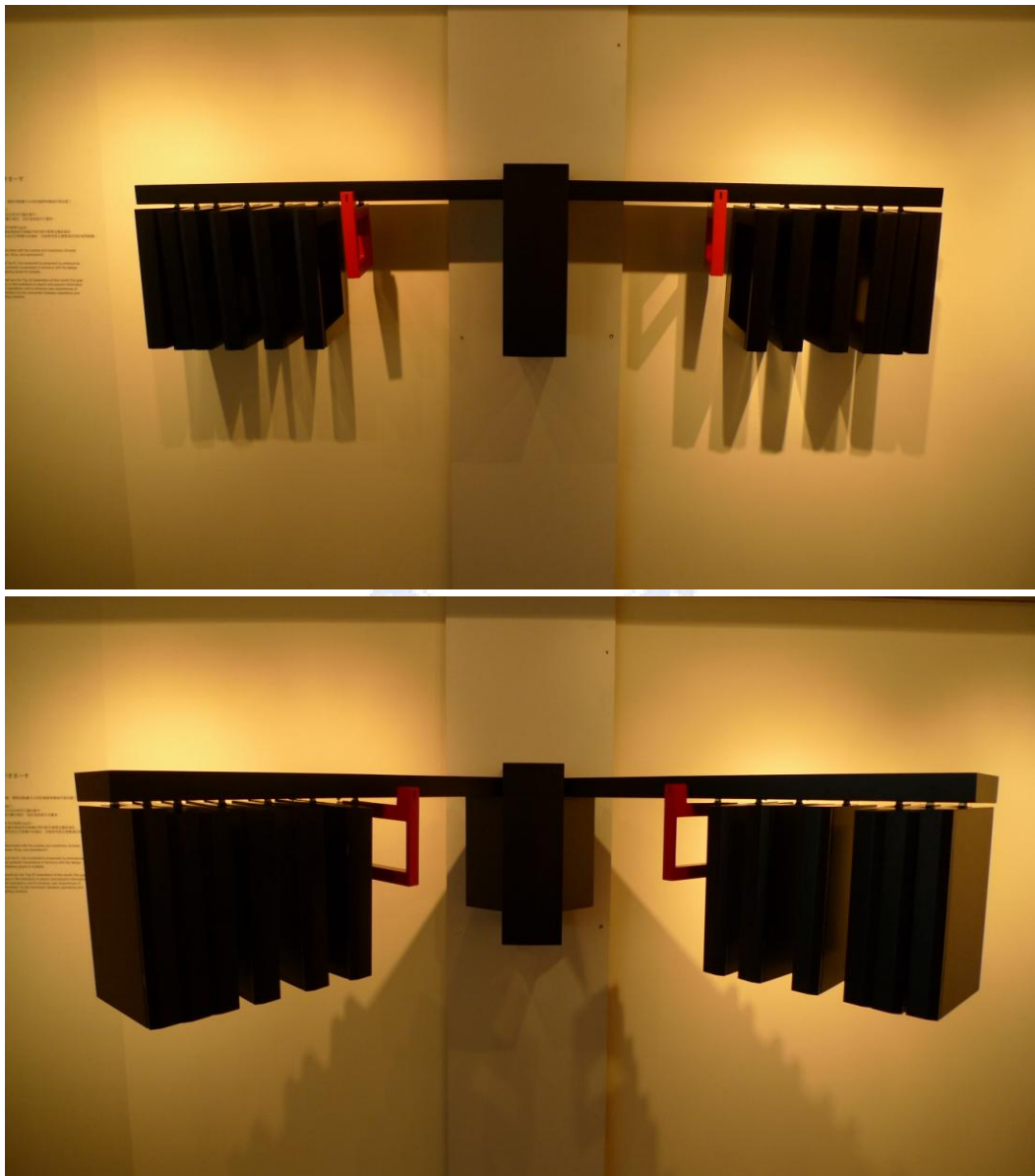
Figure 46 the key feedback: move forward and embrace

CHAPTER 4

EXHIBITION

Figure 47 the exhibition post: city and sky

SWITCH

How can all downcast faces turn into smiles?

How can those depressing people turn into delights?

I see traffic looks like floating clouds, drifting slowly.

I see smog winds like the light mist in the morning.

How do you think?

Why not observe the world upside down?

Nothing accustomed; nothing taken as a matter of course.

Figure 48 the exhibition post: grass and sky

4.1 Exhibition Theme

To switch the viewpoints is the theme of this exhibition. Different attitudes toward the world can generate different thoughts and outcomes.

Take this project for example, it's a new attitude toward the interaction between users and products. The ideas come from movements including human body movements and product movements. We can consider the interaction process as the choreography. How about dancing with a friend? How about dancing with a product? In this way, a more meaningful interaction can be created.

Figure 49 the opening of the exhibition

4.2 Exhibition Period

Figure 50 the opening of the exhibition

Figure 51 explain and demonstrate the two project

Figure 52 explain and demonstrate the two projects for kids

CHAPTER 5

DISCUSSION AND EXPECTATION

After the exploration with research, analysis, producing and design process, this part
contains discussion of thinking, potential or feedback found during exploration
process and exhibition. This discussion may help designers think more when reading
or doing similar design process.

5.1 Movement-based Design and Wii

Speaking of Movements, we must talk about the Wii. Wii has created a new interact
style in playing games: what you act is what you play. Many games have been
released to market, especially the sport games. These games have created a fad. They
capture typical movements of each sport, for example, wave to strike balls by a bat
and throw balls are typical movements in playing baseball.

Figure 53 Wii demonstration: act and play http://www.nintendo.tw/

Here is a example to explain the relationship between movement-based design and the "Wii style". We can consider movement as a input language, while a keyboard is a input device. If people switch the input method, they can communicate with the whole world by typing words on a keyboard (if people have learned that language). One fact is that the reason why people can communicate to each other is that they can speak the language, while there's no significant effect matter what kind of the keyboard they use.

People interact with the screen by the devices through movements. Even the different contents of games, the input devices are basically the same in this case. Some case add forms to the devices, for example, a form of racket, and forms can enhance the involved experience during playing games.

Figure 54 the shape of Wii controllers http://www.nintendo.co.jp/

In the different aspect, this project cares about physical to physical interaction. People and products both communicate through movements, therefore, transformation in product parts and outfit are necessary in this project. It is a big challenge to both achieve a beautiful form and workable machinery.

5.2 Laboring

During the exhibition, there were some problems in the concept B: some people didn't know why they do that action to active the bookshelf. Therefore, the set of movements may become laboring for users. The main reason is that the science fiction context and movement we've set was too narrow to be realized. As the project mentioned before, we create some constrains to make users do something. How to make these constrains reasonable is a big challenge for designers.

5.3 The Difficulties in Mechanical and Form

Under the topic of applying movement to design, I took the experiments with deigning bookshelves. There are a many difficulties in making a aesthetic form and workable machinery. Lots of physical restricts do exist, for example, aesthetic, weight, size, and stability and safety of the machinery, must all be well considered. It is a very complicated process.

It's necessary to present workable designs under the topic of movement interaction. It is challenge for designers to solve problems of endurance, safety, and stability. In this exhibition, the two design works were available to every audience. Some problems occurred in the exhibition, a audience said that concept A would cause hands damage when closing the container. It was a actual problem in that design, and ascribed to my incomplete consideration in the design process. In order to maintain capacity and forms, some machinery had to be renounced. It is a good experience for me (Fortunately, there was no one hurt by the containers).

5.4 Obstacles in Bookshelf Design under the Movement Topic

The major point is how to apply meaningful movements into the interaction between human and products. At the same time, the implied meanings and joys are both emphasized. Choosing what object to apply movements in is also very important. Book shelves are collection and demonstration spaces for users. In the design process, problems occurred in every phase from designing a experimental prototype to designing a real product. Some problems are contradictive, while some problems are contradiction-free and can be considered as the references in design process.

Time Duration

In the situation of experiment design and exhibition period, the interaction duration is short, experiences and impressions toward the designs will be positively or enhanced or negatively weakened by demonstrating some impact and attractive factors. Moreover, changing interaction ways according to the contents of books, searching, storing, demonstrating and taking books can be fresh experiences in daily life. Take these two designs for example, once the interaction time duration is extended, the experiences will be changed. Users may no longer feel interesting in manipulating these book containers and shelves. This situation becomes uncertain whether users still willing to pay their time and labor to do these movements. The relationship and interaction may be deteriorated in long term. From experimental level to product level, the usability problem will be more and more important and necessary in design process.

Efficiency

The efficiencies of the two projects are discussed in the long-term case. In book shelf design, efficiency is an important factor. Users can easily get books by a good book shelf. Take the first design project for example, there are two problems occurred: the first problem, users can't easily and efficiently find what they want to read at the beginning because of the opaque containers. They can't see the books inside until they open the top of the container. In the original consideration and concept, an opaque outfit is a constraint that makes people acting like they are something. This constraint is over-converted and became a obstacle to users. The second problem, once each container is full of books, are users still willing to move these boxes? If users are not willing to move the containers, this concept is failed.

In another case, we take the second project for example, there are four big range movements in this design, and these may be a problem. The movements and the results after acting these movements, in other words, the manipulations and the outcomes, are not efficient in long-term interaction. Users may pay too much labor to achieve their goal (read books).

Actually, it's very difficult to set the movement-involved level, an appropriate level. After making this project, one thing is certain: make the interactions and movements simplified. A too complicated interaction way will make users feel laboring in long-term use.

5.5 Short-turn and Long-turn Outcome

Is the object meaningful? Is the movement meaningful? Is the experience meaningful? These are very subjective questions. People determine these questions by what they have experienced and learned before. In a general aspect, it's a appropriate and novel way to interact with objects by movements. On contrary, it is a wired interaction way if the topic is too specific.

Take the concept B for example, the movement comes from the cockpit in animations: lift and launch. There are three kinds of audiences' reactions. First, for audiences who have watched relative animations (and they love robot animations), it can be positive feeling. Second, for audiences who have no particular preference, it can be ordinary feeling. Third, it's the most interesting one: the audience has no particular feeling at that moment, but after he has watched the relative animation, he came to me and said: "I finally realize what you want to talk about in that design work."

5.6 Expectation

Designers can use movements as design elements to enrich the interaction and impression Movement can be a seed for creating experience and meaning. Once people act, the action will leave a trace in people's mind. It will germinate at next time when people encounter similar action and experience.. Even there may exist usability problem for movement-based products in long-term use, movement-base design provide designers a new direction and thinking.

REFERENCE

Ann Hutchinson Guest. (2005). *Labanotation – The System of Analyzing and Recording Movement (4th ed.)*. New York : Routledge.

Chao, P.Y., Cimen, I., Lancee, W., Offermans, S.A.M., & Veenstra R.. (2004, June). *Exploring Semantics of Movement in Context. Proceedings of the conference on Dutch directions in HCI.*

Djajadiningrat J.P., Wensveen S.A.G., Frens J.W. & Overbeeke C.J. (2004). *Tangible products: Redressing the balance between appearance and action*. Accepted for the Special Issue on Tangible Interaction of the Journal for Personal and Ubiquitous Computing .

Djajadiningrat, J.P., Overbeeke, C.J., Wensveen, S.A.G.. (2002, June). *But how, Donald, tell us how? On the meaning in interaction design through feedforward and inherent feedback*. In: Macdonald N (ed). *Proceedings of the conference on designing interactive systems* (DIS2002), London, pp285–291

Frens, J.W., Djajadiningrat, J.P., Overbeeke, C.J.. (2003, Oct). *Form, Interaction and Function, An Exploratorium for Interactive Products. Proceedings of the 6th ADC, Tsukuba.*

Frens, J.W., Djajadiningrat, J.P., & Overbeeke, C.J.. (2004). *Rich Interaction: Issues*. P. Markopoulos et al. (Eds.): EUSAI 2004, LNCS 3295, pp. 271–278.

Feltham, F. G.. (2008, December). *Do the Blocks Rock: a Tangible Interface for Play and Exploration*. OZCHI 2008, Cairns, QLD, Australia.

Hummels, C., Overbeeke, C.J.. (2000, May). *Actions speak louder than words: shifting from buttons and icons to aesthetics of interaction*" S. Pizzocaro, A. Arruda and D. De Moraes (Eds.). *Design plus Research*. Proceedings of the Politechnico di Milano conference, pp. 284 - 290.

Hummels, C., Overbeeke, C. J., (2007). *Move to get moved: a search for methods, tools and knowledge to design for expressive and rich movement-based interaction.*Pers Ubiquit Comput 2007, p.677–690.

Kyffin, S, Feijs, L., & Djajadiningrat, J.P.. (2005). *EXPLORING EXPRESSION OF FORM, ACTION AND INTERACTION*. Springer Boston.

Loke, L., Larssen, A.T., Robertson, T.. (2003). *Labanotation for Design of Movement-Based Interaction. Proceedings of the Second Australasian Conference on Interactive*.

Overbeeke, C.J., Djajadiningrat, J.P., Hummels, C., Wensveen, S.A.G.. (2000). *BEAUTY IN USABILITY: FORGET ABOUT EASE OF USE!* Department of Industrial Design, Delft University of Technology.

Wensveen, S.A.G, Overbeeke, C.J., & Djajadiningrat, J.P.. (2000). *Touch me, hit me and I know how you feel. A design approach to emotionally rich interaction. Proceedings DIS2000*.

Wensveen, S.A.G., Overbeeke, CJ., Djajadiningrat, J.P.. (2002). *Push me, shove me and I know how you feel. Recognizing mood from emotionally rich interaction*. In: Macdonald N (ed). *Proceedings of the conference on designing interactive systems (DIS2002)*, London, 25–28 June 2002, pp 335–340.

Wensveen, S.A.G., Overbeeke, C.J., Djajadiningrat, J.P. & Kyffin, S. (2004). *Freedom of Fun, Freedom of Interaction*. Interactions Sept./Oct. pp. 59-61.

Canon (2009), Printer. Retrieved July 28 2009, from http://www.canon.com.tw/

IBM (2002), the TransNote. Retrieved July 2 2009, from
http://www.pencomputing.com/frames/ibm_transnote.html

Krohn and Viemeister (1987), the phonebook. Retrieved July 2 2009, from
http://digitalwellbeinglabs.com/dwb/?p=269

Labanotation (1928), body movement notation. Retrieved July 2 2009, from
http://user.uni-frankfurt.de/~griesbec/indexe.html

Labanotation (1928), direction notation. Retrieved July 2 2009, from

http://www.edwardsamuels.com/illustratedstory/isc6.htm

Nintendo (2007), Guitar Hero. Retrieved July 27 2009, from http://www.nintendo.co.jp/

Nintendo (2004), Guitar Hero on Nintendo DS. Retrieved July 27 2009, from

http://www.nintendo.co.jp/

Sony Ericsson (2008), w910i. Retrieved July 28 2009, from

http://www.sonyericsson.com/cws/home?lc=zh&cc=tw

Sony Ericsson (2008), k800i. Retrieved July 28 2009, from

http://www.sonyericsson.com/cws/home?lc=zh&cc=tw

Sony (2008), VAIO laptop. Retrieved July 2 2009, from

http://www.sonystyle.com.tw/vaio/#index