

The Emotional Design by Combining Interactive Technologies and Imaginations

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Abstract. *In product design domain, designers have to deal with not only the interface between human and hardware, but also the emotions while using products. However, imagination is an important ability in all design stages. How designers could combine interactive devices and emotions with their imaginations is the main problem of this research. At the end of this paper, the result will demonstrate an interactive and emotional design by combining some sensors to receive the usage from people, and some reactions to express products' emotions. By wiring photosensitive resistor, pressure sensor, red LED, speakers, and programing in ARDUINO, this study assembled an emotional alarm, which can express his angry emotions by different levels of noise, lighting, and shocking. In this study, we conducted a workshop not only for combining interactive sensors into products, but also for expressing emotions in viewpoints from products. During this workshop, students have to trigger their imaginations for conceiving emotional products, which they have never seen and thought of.*

Keywords. *Imagination; product design; emotional; interactive design; ARDUINO.*

INTRODUCTION

The most typical fantasy of imagination is day-dreaming, which is not for solving and understanding problem or creation, and not help to change the reality (Huebner and Lawson, 1990). However, in terms of human behaviour research, imagination is a process of an individual with creative and infinite visions in mind at anytime and anywhere for reaching objectives (Tsai, 1990); moreover, another definition of imagination is a work with objectives for solving and understanding problems, or creative interests, and devoted to trigger a possible solution that has not yet presented (Zhang, 2003). In design domains, imagination acts as a crucial role; for instance, the Bauhaus School of Architecture encourages the combination between Engineering and Fine Arts. By doing so, students could conduct design by applying imagination from different design domains.

Another example, painters depict the world with viewpoints from their imaginations. In the domain of product design, imagination of designers is also a crucial ability for whole design processes. There are many studies exploring imagination from various perspectives, such as personal characteristics, psychological cognition factors, external environmental factors, and social values...etc.

On the other hand, when people use a product, there is a process of using "an interface" to communicate between people and product. "The interface" means that upon the connection between software and device, intermediary operates or interacts with the computers. It is called user interface (Houston, 1992). Broadly speaking, it is the message, information or symbol in the interaction between product/computers and users (Jones, 1993). In other words,

user interface is the media between human beings and hardware/computer. Moreover, the tangible user interface (TUI) extends the benefits of Graphic User Interface (GUI) to emphasize the interaction between users and interface. In order to obtain the instant feedback from users, there are several physical hardware or devices to detect human behaviors during the interacting with the interface. The design of interface, proposed by Ishii in 1997, is that the combinations between human bodies and interaction systems to archive more intuitive operations. Moreover, Ullmer, Ishii and Jacob (2005) addressed two fundamental elements in the physical computing interface. The first is the physical device, which is the interface for manipulating digital data or information in computerized media; the second is virtual system for representing virtual objects, which will be operated by the physical devices. Thus, the TUI will connect physical human behavior to digital information between physical and virtual environment. In this TUI environment, people could interact with digital objects or environments intuitively by their native behaviors (Arroyo, Bonanni, and Selker, 2005).

In product design domain, designers have to deal with not only the interface between human and hardware, but also the emotions while using products. However, as mentioned, imagination is an important ability in all design stages. How designers could combine interactive devices and emotions with their imaginations is the main problem of this research. Thus, the objective of this paper is to demonstrate the process for combining the interactive sensors and imaginations to emotional products in an imagination workshop.

RELATED WORKS

Imagination

The basic vocabulary corresponding to imagination is not image, but imaginaries. The value of an image is determined by the scope of imaginaries, by the help of imaginaries, and imagination is essentially open and uncertain. The human mind theory asserts that imagination is openness to new experiences.

William Blake, the British poet (1757~1827), further described imagination as not a status, but human existence (Zhai et al., 2009). The theory of imagination by Bachelard does not lie in physical image, but in imaginaries.

The deformation capability of imagination is that of associating individual subjective feelings to change the appearance of things through imagination; thus, imagination capability is the capability of subjective, internal feelings. Therefore, imagination capability has no direct relation to objective experience and logic thinking of generally established knowledge, but a product that belongs to the mental, spiritual world. On contrary, Baudelaire, the French poet, considered imagination to provide a sacred source, meaning that imagination is a gift, a near demigod capability (Peng, 2006). Thus, imagination capability is not a rambling aimless fantasy, but a positive constructive value from which new sights and visions emerge.

Childhood is considered the most imaginative stage, because the thinking model of children is not yet formed, and has fewer restrictions and rules on imagination than adults. Therefore, the quality and quantity of imagination in children is very rich. As previously mentioned, images are so-called image symbols, symbol functions, and sometimes also called appearance functions (Lin, 1994). According to the definition of symbol function by Piaget, the illustration in a picture book is a symbol emerged in children two to three years old. Its representation type can be divided into token and symbol. To every child, the meanings these symbols represent have different interpretations according to individual experiences. Picture description exercises can examine the significance of childhood life experiences. The theoretical basis and empirical methods of cognitive psychology include studies of perception, attention, and memory; such theories can explain preliminary thinking behaviour, which form the theoretical background of this study, including visual behaviour theories of visual attention, and mental image.

In the visual cognition domain, people perceive everything on the retina, but cannot simultaneously conduct behaviours of response, thinking, association, etc. on everything. However, because they can conduct searching within a certain scope, people will selectively pay attention to something, and further proceed with cognitive activities. The visual behavior of sight can be divided into two processes, "controlled" and "automatic. The automatic process can be conducted at any time, while the controlled process is orderly; "seeing" one thing and then "seeing" the next one (Schneider and Shiffrin, 1977). Therefore, a study further identified that the process of human visual cognition is first generated from "pre-attentive perception" to "stimuli," then selects objects through "voluntary control," and further focuses most attention to the object to generate a decision and response (Palmer et al., 1997).

Through the visual cognition process, the brain conducts the imagination process to recognized things, as described by Li (1996). The imagination level from low to high classification is divided into three types: re-creative imagination, creative imagination, and fantasy. People conduct re-creative imagination with experienced things, including text, drawings, or melodies, etc. For instance, to interpret various presentations of a literature process requires a certain ability to understand the literature and a rich memory of symbol knowledge. Based on the level of visual stimuli for classification, Teng (1997) proposed "perceptive imagination," indicating that after perceiving an object, a previous mental image emerges naturally, and the imagination process forms a new image. The new image differs from the perceived object. However, there are similarities to the original features of a perceived object. Therefore, such an imaginative image cannot be self-generated without a visual object. The second type, "creative imagination," conducts imagination without experienced objects.

However, the creative imagination process requires matching with other factors such as prototype enlightening, positive thinking, or inspiration. The creative imagination raised by Teng (1997) is

not restricted by perceived visual objects, but from an internal mechanism such as feelings that trigger previously stored mental images, or recalling completely unrelated things to conduct re-combination and permutation. The third type, "fantasy," is rambling, which involves no objectives, no process, and no results, but only empty thinking. However, similar to the previous two types, it requires a triggering media to trigger imagination.

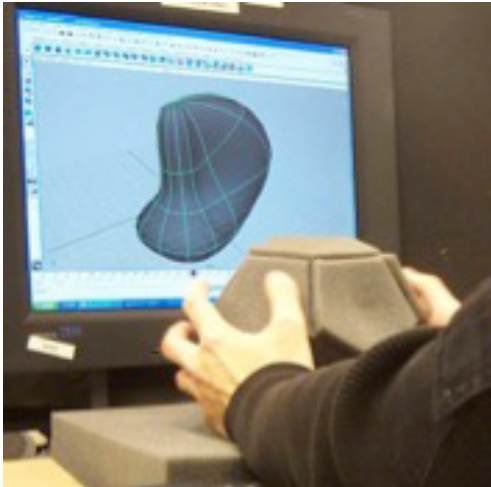
Interactive interface between emotion and product design

In the field of information, "interface" means that upon the connection between software and device, intermediary operates or interacts with the computers. It is called user interface (Houston, 1992). Broadly speaking, it is the message, information or symbol in the interaction between computers and users (Jones, 1993). Powell (1990) suggested that user interface refers to the communication between the programs and users. Moreover, the tangible user interface (TUI) extends the benefits of Graphic User Interface (GUI) to emphasize the interaction between users and interface. In order to obtain the instant feedback from users, there are several physical hardware or devices to detect human behaviours during interacting with the interface.

The information processing of these interfaces is circular, and presented by operation. Generally speaking, operation of user interface includes input and output. For instance, keyboards and mice of the computers are input devices whereas monitors are output ones. Interface refers to intangible interaction and it is "intermediary" which connects the users, people and objects. The design of interface, proposed by Ishii in 1997, is that the combinations between human bodies and interaction systems to archive more intuitive operations. Moreover, Ullmer, Ishii and Jacob (2005) addressed two fundamental elements in the physical computing interface. The first is the physical device, which is the interface for manipulating digital data or information in computerized media; the second is virtual system for representing virtual objects, which will be operated

by the physical devices. Thus, the TUI will connect physical human behaviour to digital information between physical and virtual environment. In this TUI environment, people could interact with digital objects or environments intuitively by their native behaviours (Arroyo, Bonanni, and Selker, 2005).

For instance, the project of iSphere, shown in Figure 1, is a physical 12-face sphere, which has sensors responding to the positions of fingers and operating by hands. The input sensing devices of iSphere are the capacitance to detect the distances between human hands and face of iSphere. By detecting the distance from 1 to 6 inches, the sensor will recognize as pulling; on contrary, the distance from 6 to 1 inch will be regard as pushing. Moreover, it will be detected as pressing when the distance is less than 1 inch. By doing so, people could transform a 3D digital model in virtual environment by controlling the distances between hands and capacitance sensors (Lee, Hu, and Selker, 2006).



Another example, proposed by Huang and Ho (2010), is combining the display of Virtual Reality and RFID (Radio Frequency Identification) Reader to allow the users to select the exhibits and appreciate and learn from the exhibits by instinctive operation.

In their study, the results indicated that the years, series and materials of the exhibits are the information people intend to acquire with regard to this exhibition. In the exhibition, the digital sculptors could be classified in terms of different periods, years, and materials.

Emotional designs

In 2002 Donald Norman proposed that the functional usage of product is the major consideration during the design process in his famous book, titled "The design of everyday things". However, next book, "Emotional design" in 2005, addressed that considerations of good product designs are not only paying attentions of functions, but also focusing on the psychology feelings from users emotions. Therefore, there are various researchers focusing on the studies related to emotions of difference senses, such as vision, acoustic, touch feeling, smell...etc. A study, for example, proposed a model for estimating the emotional impact of music on an unknown individual by using the individual's profile information. The results of this research showed that the profile models achieved the highest accuracy for unknown subjects. (Iwatsuki, Sako, and Kitamura, 2012).

On the other hands, some researches investigate on Emotional Intelligence, which proposed how emotions can be expressed or understood by others (Mayer, Roberts, and Barsade, 2008). And others believe that the abilities of senses are depending on people's intuition, which are the way to make sense of the world, to transform it, and to cater for ethics (Sennett, 2008). Moreover, Lévy, et al. (2012) proposed the "Sensual Dynamics" designs which could be able to sense one person and to behave upon their presence to invite for movements enhancing the perceptive experience. In their research, they presented a kansei design approach to design for perceptive experience in interaction, considering the senses' qualities as the starting point (Lévy, Deckers, and Restrepo, 2012). In the product evaluation, by using the "Kansei Design", the Department of Toyota Motor Europe (TME) defines the identity territory of future hybrid vehicles in order to make

Figure 1
The interface of iSphere (Lee, Hu, and Selker, 2006).

them more coherent with this new technology. Their study focuses on perception and on the cognitive, affective and behavioral responses of the participants to specific stimuli that they have to put in relation with the concept of hybrid vehicle. It presents a research methodology involving stimuli referring to 4 human senses, such as vision, touch, hearing and smell, and details the experimentation realized with a panel of 42 participants (Gentner et. al, 2012).

Human being is one sort of animals who has different emotions, such as excited, frustrated, happy, upset...etc., in various surroundings to express their psychology conditions in daily life. How about products? Do products have their own emotions? If cups feel vary happy because you use and clean them everyday; on contrary, if they feel angry due to your disregard and careless. Or they could express their emotions to attract your attentions. In this paper, furthermore, we attempt to think from other meanings of emotions from imaginations. If products in our daily life could have their own feelings or emotions, how will we deal with them? In terms of product designers, how designers could design interactive products, which could sense their conditions and express their emotions? Therefore, the imaginations of designers have to be triggered for solving this design problem.

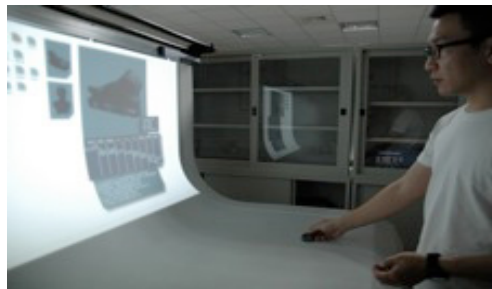


Figure 2
The FRID interface of Virtual Reality (Huang and Ho, 2010).

METHODOLOGY AND STEPS

In order to investigate the process of combining interactive technologies and emotions, we conducted a workshop, named “The emotional cup!?” First, by

re-experiencing our daily life, designers will analyze some conditions of products, which are used by different users or habits; then, they have to imagine what emotions those products will express on themselves, such as angry, upset, frustrated...etc. Finally, by introducing some interactive sensors and communication technologies, designers will develop sensitive products, which could “know” how people use them, and express “what” emotions they have.

In order to achieve the aim of this paper, there are several steps in this workshop: 1. Experiencing the processes and results of some products in our daily life; 2. Analyzing the cause and effect of products and imagining different emotions from them; 3. Observing the operation patterns from people, and figuring out the using process; 4. Making products feeling some conditions by utilizing interactive sensors and communication technologies; 5. Finally, developing the sensitive products to express different emotions.

Idea development

By following the main topic of this workshop, related to emotions and interactive devices, students develop divergent ideas by several of method, such as brainstorming, KJ method... It is an easy way to explore several of concepts by utilizing brainstorming. During the idea generating stage, students write down what they thought, regardless of reasonable or practicable, on stickers on the wall. After a period of time, they categorized and discussed their concepts, and then, generated new concepts, iteratively. During their idea development process, some interesting concepts had to form out, such as rolling telephone, pressure sensitive pad, and characteristic trashcan... After discussing and evaluating all concepts, the “emotional alarm” had come the final concept for further developing details, emotions, and sensitive devices.

Sketches

In the idea sketches, the main concept is to express the emotions of an alarm, such as angry, shocking, calming down, and the user have to interact with

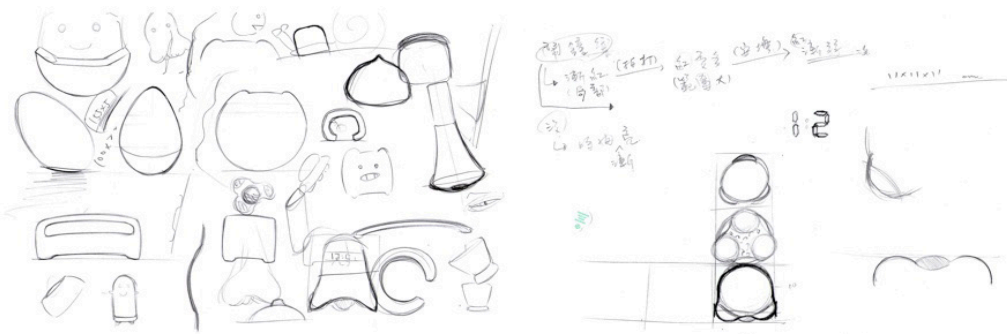


Figure 3
Left: sketches of idea development; right: final idea.

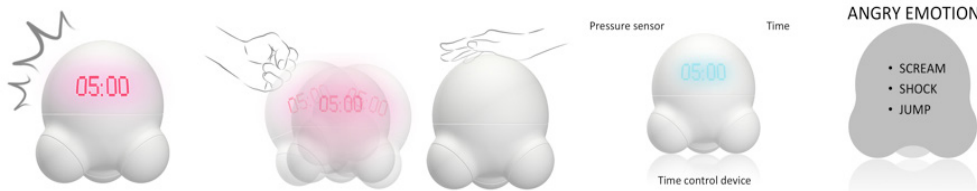


Figure 4
Scenario of the final concept.

it by suitable reactions, such touching, padding slightly.... Therefore, the forms of the concept are based on some simple shapes, like egg, ball, and bell (Fig. 3, left). By doing so, different levels of emotions of the alarm will be easier to express to users, and they will have more understanding for emotions, expressed by the alarm. Eventually, the final shape of the emotional alarm is combined by 3 small balls, and 1 main ball, shown in the sketch of Fig. 3, right, based on the consideration of manufacturing processes.

The scenario of the final concept is that we gave some emotions to an alarm. Similar to human beings, the normal condition of the emotional alarm are resting or sleeping, but the time of alarming is his time for awaking to work. When waking up, the alarm will be angry at everything, like some emotional people. Therefore, if people were rudely padding the alarm and trying to stop him, he will be getting angry, getting louder, and shocking with red lights, to express his angry emotions. Instead of padding the alarm angrily, people have to touch him

gently and smoothly, and he will go back to sleep status. Then, the alarm is clamming down. By doing so, in this study, we are giving emotions on the alarm by some interactive technologies, and trying to respect him as a person who has his own emotions (Fig. 4).

Final modeling

After setting up the scenario and emotional functions, students are making up the model to demonstrate the emotional alarm by two main parts: the physical model and wiring interactive devices. The first part of this alarm is the form, which had been shown in fig.3 right, combined by one big acrylic ball and three small balls. After cutting and gluing them, students are coding the physical model by white silicon, shown in Fig. left. The second part, wiring interactive devices, is compounded of photosensitive resistor, pressure sensor, red LED, speakers (Fig. 5, middle). All interactive devices are programed and controlled by the ARDUINO. Eventually, the emotional and interactive alarm with a panel is demonstrating in the exhibition (Fig. 5, right).

Figure 5

Left: physical model with white silicon; middle: assembled with sensory devices; right: the final model and panel.



RESULTS AND DISCUSSION

At the end of this paper, the result will demonstrate an interactive and emotional design by combining some sensors to receive the usage from people, and some reactions to express products' emotions. By wiring photosensitive resistor, pressure sensor, red LED, speakers, and programming in ARDUINO, this study assembled an emotional alarm, which can express his angry emotions by different levels of noise, lighting, and shocking. This emotional alarm cannot be turned off by regular usage, such as patting the button on it. Instead, it has to be touched gently on some particular area, like touching some pets, smoothly.

In this study, we conducted a workshop not only for combining interactive sensors into products, but also for expressing emotions in viewpoints from products. During this workshop, students have to trigger their imaginations for conceiving emotional products, which they have never seen and thought of.

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