Enhancing the Life of the Elderly -
An Application of Design Thinking

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Abstract. Design thinking is a mindset to find a solution for a real need using an iterative method. Its fundamental philosophy is to empathize and reframe a problem so that one can innovate faster using systematic methods. In this study, we illustrate the use of design thinking to enhance the life of older people. A total of forty students from two universities spent 2 days talking and playing with senior citizens to evaluate and understand their daily activities, likes and dislikes. Based on observations, systematic interviews, and storytelling, a series of innovative products were designed. In this manuscript, two of them will be described. The first was an entertainment system called Memo-TV for those with short-term memory loss and the second, Shadow Play, was a means to enhance their upper body strength using an innovative and interactive game.

Keywords: Design thinking · Design · Elderly · Internet of things

1 Introduction

Successful products need to provide the necessary functions, offer acceptable return on investment, generate enthusiasm in the market and meet global standards related to environmental sustainability. However, the success of a product cannot depend only on its technical merits. The usability and aesthetically pleasing appearance is much sought out today leading to more important user-centered or empathy-driven design. Designing products by identifying a problem, reframing the problem, ideating, prototyping and testing is known as Design Thinking (Fig. 1) [1–4]. Rather than make products based on a company's capabilities, the design thinking process starts with the user. It is an effective methodology to use when designing products for older people as many of them have physical, cognitive and emotional needs. There are different versions of this methodology such as inspiration, ideation, implementation; dream, design, do; discover, dream, design, deliver; discover, interpret, ideate, experiment, evolve; discover, define, develop, deliver and so on. Even though these may appear to be different, the basic concept is essentially the same with a different emphasis in the various steps involved.

Most of the older people experience a negative mood due to differing reasons. They may be sad because they are in their last stages of their lives or because they miss their family or belongings. Human intervention is one way that these elderly can gain some
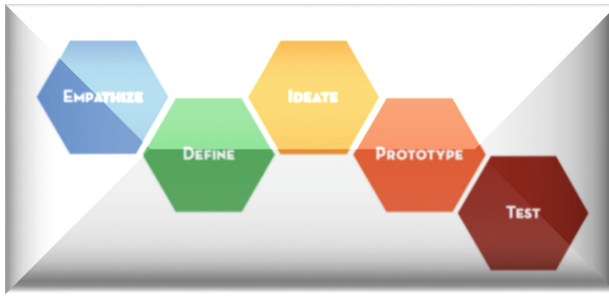
Fig. 1. The design thinking process of empathize, define, ideate, prototype and testing. (Adapted from Stanford d-school)

solace. However, that is not always possible. Equipping care centers with intelligent technology to drive the elderly towards more positive experiences will bring added value to their health and well-being [5]. The living environment plays significant role in the quality of life of the elderly. It is sometimes more effective than pharmacological treatment. The question we set out to answer was how we can help the elderly using technology that is concealed so that what is visible maps to the mental model of the elderly. In other words, what is required is invisible technology. The emphasis was primarily on the conceiving and designing of products that would be of benefit to the elderly.

Older adults live in a variety of settings known as, "the housing continuum for persons with dementia" [6]. They start from living independently at home and then transition into living institutionally if their health drastically declines, although, most elderly prefer to "age-in-place" [7–10]. The transition from home to a care facility or a day-care center mainly occurs when severe behavioral disturbances make it difficult for caregivers to take care of elderly patients. It also depends on the public care services provided and the availability of family care. In unfamiliar environments, people with dementia can easily become confused, agitated and stressed. They may even behave quite aggressively in some situations. This is related to their "sense of identity", and the "sense of belonging" in the place where they live. The sense of belonging, which is intrinsic in every individual, is generally sought when individuals move from home to a new living environment (e.g., care facility). It not only represents a personal sense of being part of a certain context, but also the feeling of being accepted as an individual with unique needs for personal space and companionship. The lack of a sense of belonging in a living environment, causes anxiety and stress in people with dementia. These feelings are expressed through purposeless wandering, aggressive and suspicious behavior, agitation, vocalisms, repeated movements, and other "unusual" behaviors. The result is decreased well-being and poor quality of life. The aim of what is reported here was to change the life style of the older people so that they are engaged in activities while maintaining their physical and mental health.

2   The Process

The intellectual domain of product design is rather fragmented among different disciplines because there is no common foundation to address the design issues from the differing perspectives leave alone any interaction or discussion among professionals of the different disciplines. To address at least some issues and generate worthwhile interactions, we proposed to have a design thinking course with one of the finest Art and Design institutions in China, the China Academy of Art (CAA) in Hangzhou. The intention was to offer a unique one-month summer course as a platform for students to train up their 'Design Thinking' mindset and resolve constraints arising from technical, aesthetic and human factors, as well as business concerns. This course offered a student an opportunity to work in a multi-disciplinary team comprising designers and engineers to design and develop a real product.

The course was aimed at providing the basic concepts of design thinking and design methodology. The goal was for students to be able to apply the concepts of design thinking by integrating their knowledge in the various disciplines to construct a tangible product. This involved building and leading an innovative team as well as working within a group situation comprising different individuals from diverse backgrounds and cultures in order to achieve a common objective. To cater to the differing mental models of students in art, engineering and design, we had to use various formats of teaching to generate an environment that was conducive to divergent and disruptive thinking. Guest speakers formed an integral part of the course to focus on some specialized topics. However, we did have some basic concepts taught in a not so ideal lecture format as well.

A total of 20 Hong Kong University of Science and Technology (HKUST) students, together with an equal number of students from CAA were selected after a rigorous interview process to establish their suitability to design and develop products for the elderly. Students from HKUST were drawn from the School of Engineering, School of Business and the School of Science; CAA's students were from the School of Intermedia and School of Industrial Design. Over the 4-week period, all 40 students spent two weeks at each of the two universities. They certainly benefitted from the multi-disciplinary academic exchange and received instruction in areas of design with a special focus on both physical and affective design. Students had to structure problems, create new ideas, be innovative in problem solving, evaluate alternatives and construct product prototypes. Students learnt how to resolve constraints arising from technical, aesthetic, human factors and business concerns to make a successful product. The project deliverable was a product prototype demonstration, a presentation and a public exhibit. They participated in a series of workshops on topics such as principles of design and what design means for each discipline; techniques for idea generation, divergent thinking method and many others. Besides the various workshops, the students were required to work on a project in groups of four with two from each institution. An added constraint was that no two students could have the same background or major. They generated and tested their project ideas and then developed the final prototypes. Students gained hands-on experience by broadening ideas and combining all the technology, for example, software programming, and art elements through the design process.

During the first few days the two groups of students familiarized themselves as it was a mix of science, business and engineering students with art and design students. A series of ice-breaking exercises were carried out to get-to-know each student in the class. On the second day, the basics of empathy and empathizing techniques such as fly-on-the-wall, interviewing and contextual inquiry were taught and practiced [11]. Empathy, which is understanding what another person is experiencing from their perspective is a key component in design thinking. A field trip to an elderly day care center and an elderly home to meet elderly people was the highlight for the rest of the week. During this time, the students experienced elderly care living, their environment, how they spent their day and most importantly mingling and talking to the elderly. This was one of the highlights for the students as many of them had no little or no knowledge about elderly living. Based on the field visit, each student in the class had to identify at least three problems they had seen or heard. Each of these problems were written on a post-it-note sheet and displayed for all students to view (Fig. 2). Of course, there were some that overlapped or were similar. Those were eliminated. Affinity clustering was the next step (Fig. 3). Thereafter, methods for disruptive innovation were introduced. The main idea was to be able to solve the problem with innovative thinking. There is no one single method for this process. Students were encouraged to try differing methods to match their thinking and analytical capabilities [12–15]. Students were encouraged to work by themselves at first, followed by group discussions (Fig. 4). An example storyboard that was generated is shown in Fig. 5.

Fig. 2. Listing and understanding problems faced by older people living in care facilities.

At this juncture, it was important to consider the motivation al level of elderly and their capabilities prior to embarking on any ideation [16]. The students designed and fabricated many different products. Two of them will be described here.
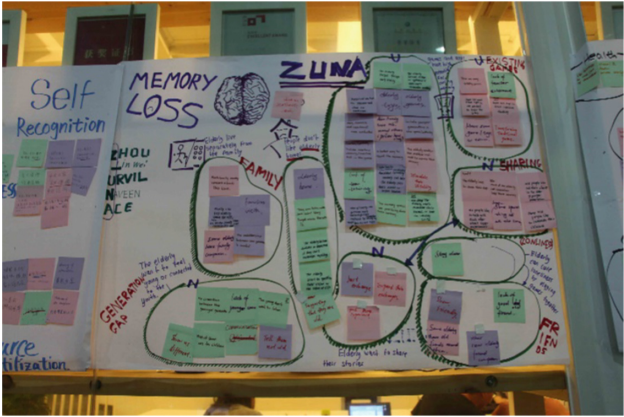
Fig. 3. Problem clustering.

Fig. 4. Group interaction and ideation after the problem to be solved was reframed.

Fig. 5. The first storyboard and related comments by others on post-it-notes.

3   Products to Enhance Living

3.1   Memo-TV

Memory loss is a common problem with older people. In Hong Kong, approximately 8 out of every 100 persons above the age of 65 suffer from dementia. Even though there is no way to prevent dementia, it was hypothesized that cognitive stimulation and reducing boredom may help lower the risk of being diagnosed with dementia. The process workflow for this product is illustrated in Fig. 6.
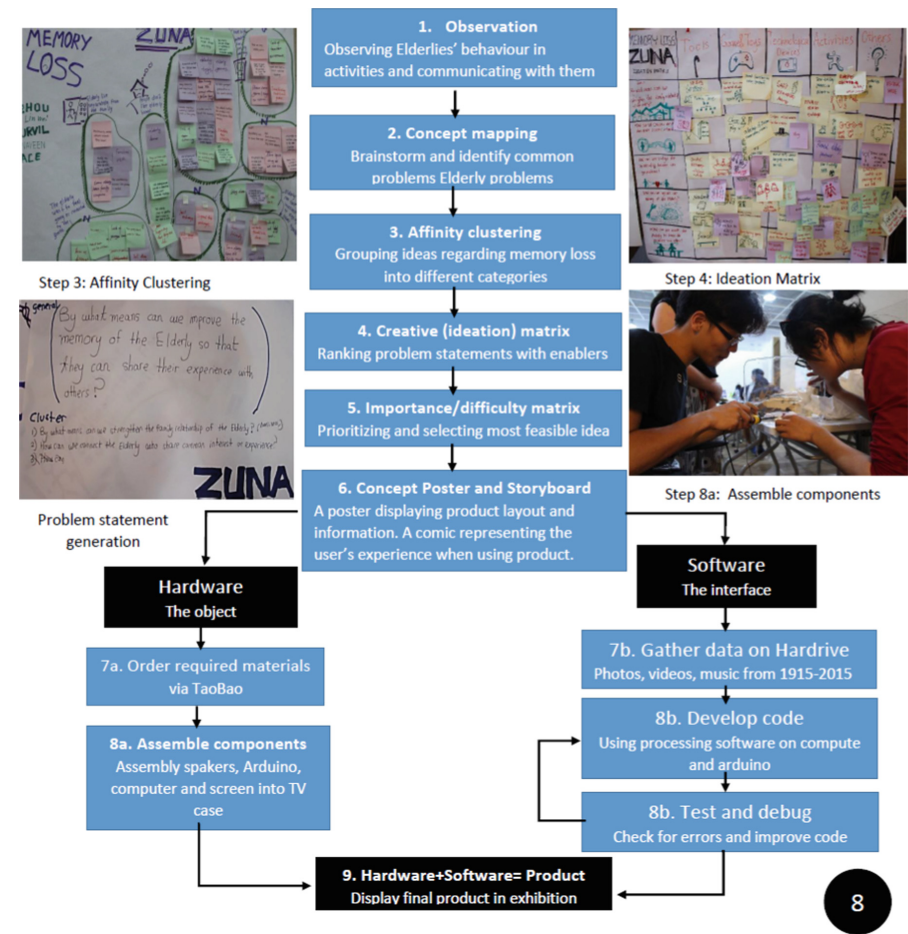

Fig. 6. The design methodology for the development of the memo-TV.

Most elderly people tend to avoid technology and they have to be comfortable when using such a device. This is where the Fogg motivation-ability curve was helpful [16]. A TV of the 1940s was purchased and only its outside casing was used for the

project (Fig. 7). Even though the TV was old, it was modified to contain the latest technology. An LED display, a computer and an Arduino board formed the basic framework for the unit. The final product was the memo-TV that was capable of displaying past photos of various sights in Hong Kong, videos, news clippings and music of any chosen decade from 1915–1925 to 2005–2015. The two knobs were used for controlling the decade and the type of entertainment (i.e., new, videos, music or images). The testing was conducted with over 40 elderly participants at a gathering at the HKUST campus (Fig. 8).
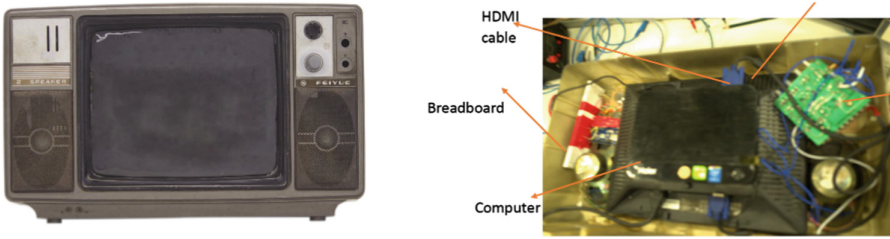

Fig. 7. The "ancient" exterior and the state-of-the-art technology in the interior.

Fig. 8. Testing the memo-TV with elderly people.

3.2   Shadow Play

To maintain their physical strength, the people in the care centers are requested to perform pulling and pushing exercises on a regular basis (Fig. 9a). These were deemed to be quite boring and the engagement was rather low. The product developed was a two-person interactive game to maintain their upper body physical strength. With a wheel and a pair of resistance sliders, the two players can control the "old lady on a cart" projected on to a screen safely travel on a path (Fig. 9b). Rewards and "animals" were randomly presented on each track such that the players should either grab the reward or avoid the animal to gain the highest score. One person controls the speed the cart travels by rotating the hand wheel. The higher the wheel speed, the faster the cart will travel. The other person controls the direction of the cart by pulling down on the

left or right resistance weights. The two players have to collaborate to gain as many points, adding fun to the originally boring exercise routine. The game can be customized too by selecting an optimum speed to change the level of difficulty.

(a)

(b)

Fig. 9. (a) The existing and (b) proposed physical exercise system components: wheel, sliders, visual interface

4 Conclusions

The design thinking process was very effective to design and develop new products for the elderly. The empathizing stage of the process revealed the need for new ways of approaching an old problem of changing the mood of the elderly so that they can feel a sense of belonging in the environment they live in. The product testing did show that further improvements were possible. Given the 4-week time period to determine the needs, ideate and fabricate, the students did perform creditably. The products had great appeal with the older people when tested.

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