

Digital Music Therapy System Design for the Mild Cognitive Impaired Elderly

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Abstract: Aging is not an avoidable phenomenon and supporting the elderly is becoming important. Korea is facing the aging society seriously. There are worldwide growing interests in dementia and mild cognitive impairment (MCI). A research team was composed with neurologists, ergonomists, designers, music therapists and conducted a project to develop digital music therapy system for the elderly with MCI. Design research was carried out and design preference and lifestyle of the Korean elderly was identified. Intellectual property right was investigated and image positioning was implemented. In-depth interview and infinity diagram led to building a hypothetical persona. Various design concepts were achieved for the set top box and music instruments. Critical dimension of the keyboard, key size, was determined using anthropometry. Usability engineering lifecycle design process was employed to produce user interface design. A prototype was finally produced after conducting user test. In this study, the design process of music therapy system development was mainly introduced.

Index Terms: The Elderly, Mild Cognitive Impairment (MCI), Music Therapy, Product Design.

I. INTRODUCTION

Aging is now a significant worldwide phenomenon and seniors with cognitive impairment can be supported better by usable design [1]. The aged persons have problems in their activities of daily living (ADLs). Seniors especially with dementia or mild cognitive impairment (MCI) experience more difficulties in using daily products.

22% of Korean seniors are estimated MCI patients and the number of Korean aged people with MCI is approximately 1.5 million in 2017 [2]. Korean Dementia Management Act established 17 metropolitan dementia centers recently in Korea. Two hundred twenty seven dementia counseling centers were founded in the local health centers.

Cognitive training and stimulation can be more effective than pharmacological treatment for the elderly especially in early stage of dementia [3, 4]. Non-pharmacological therapy is actively studied for its effectiveness such as cognitive training, cognitive stimulation and cognitive rehabilitation [5]. Music and art therapy is major non-pharmacological treatment for the cognitively impaired elderly [6]. Serious games are also actively developed for the elderly with neurological diseases [7].

We conducted a 3-year project to develop a music

therapy system for the elderly with MCI. The project team was composed with neurologists, ergonomists, electric engineers, product designers and music therapists.

Product concept was developed in the first year of project. The music therapy system is planned to be composed with set top box and two music instruments. Marketability assessment, bench marking and consumer survey was conducted for designing the product concept. Seniors behavior was studied and main software was developed. Clinical research environment was prepared in cooperation with a dementia counseling center.

Working prototype was developed after content and user-interface was decided in the second year. Usability test was performed by 3 usability specialists. 12 week clinical experiment was conducted in the dementia center.

In this study, design issues and development process of the project would be mainly introduced.

II. PRIOR DESIGN RESEARCH

A stakeholder survey was conducted in Gijang-gun dementia center and Inje University Haundae Paik hospital for 121 (37 men and 84 women) seniors with MCI. Their ages ranged from 75 to 80 and Fifty eight participants reported having experienced cognitive training. They evaluated music therapy was most satisfactory among various therapies (music, exercise, art, occupation, play, gardening and cognitive training therapy) offered in the center.

Another survey was conducted for 103 Korean seniors (55 men and 48 women) aged 65 and over. Most popular leisure activities for the elderly were walking and jogging (17.4%), movie (10.3%), TV (9.2%), golf (7.1%), and hiking (6.7%). 94.2% of respondents answered owning smart phone and 24.3% of them searched information and played game using their smart phones. Main devices for playing game were smartphone (82.1%) and computer (12.5%).

Intellectual property rights for the cognition enhancing games and music based games were surveyed and related patent was searched in Korea, USA, Japan and Europe. Intellectual properties of serious game for music therapy especially enhancing cognitive ability were rarely found.

Image positioning was implemented in four forms such as shape, size, color and texture. 5 professional designers participated in the image map process (Figure 1).

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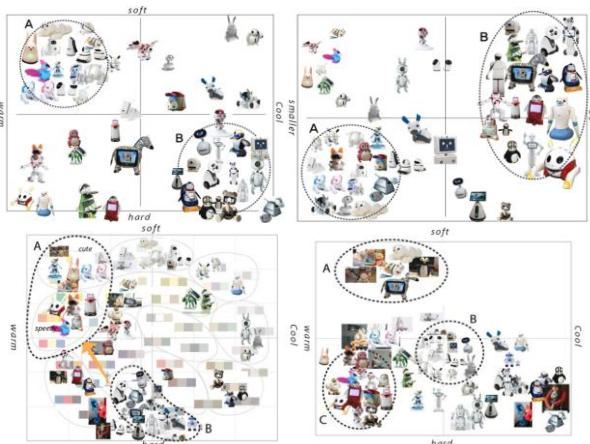


Figure 1. Image Maps

In-depth interview was conducted for the potential customers and affinity diagram method was employed to decide design strategy. A persona was created after the in-depth interview and infinity diagram (Figure 2) and three important design principles were generated: 1) Easy operation, 2) interaction between the system and user, 3) proper size and weight.



Figure 2. Hypothetical Persona

III. DESIGN CONCEPT DEVELOPMENT

Professional designers and ergonomists conducted workshops to determine the design concepts. 3 design concept candidates (pet, humanoid, normal product) were selected for the setup box of the system (Figure 3).

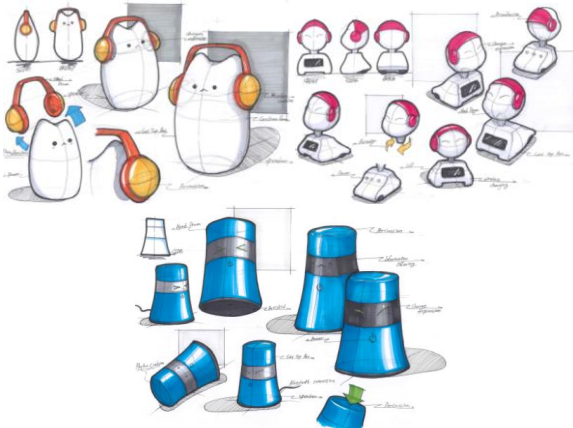


Figure 3. Design Concept for the Set Top Box

Percussion and keyboard were chosen for the music instruments. Their design concept drawings are illustrated in Figure 4.



Figure 4. Design Concept for the Music Instruments

IV. ERGONOMIC DESIGN

A. Anthropometry

We decided to develop a keyboard first and important dimensions were determined using Korean anthropometry data. Proximal index, middle and ring finger breadths are related to the key width (Figure 5).



Figure 5. Proximal Index Finger Breadth

The elderly users might play the keyboard with single finger such as their index, middle, ring finger or combination of the fingers because of their inaccurate finger movement and weak finger muscle strength. The age range of the keyboard users was expected from 60 to 75 and the sum of 95th percentiles of the users' index, middle and ring finger breadth was 5.3cm. Therefore, the specifications of the key was fixed as 5.3cmx 15cm.

A prototype was prepared by 3D printer and used for usability test (Figure 6).



Figure 6. Usability test

B. Usability Engineering Lifecycle Design

We visited music therapy classes for the elderly with MCI two times and other classes were recorded by the music therapist. No significant difference between the normal older adults and the elderly with MCI was observed in playing skill. Neurologists and music therapists working at the dementia center also agreed the result.



