포항공과대학교 산업경영공학과 | 삼성서울병원 | SEED Technology | 휴머노피아 Humanopia

Development of a **Musical Brain Fitness Program** for **Social**, **Physical**, **Emotional**, and **Cognitive** Capabilities of Seniors

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  - ✓ Research Objectives
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  - ✓ Development Process
  - ✓ System Features
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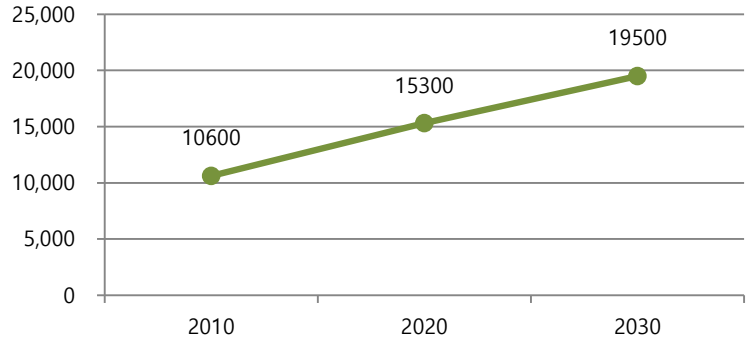
- Discussion

Seniors & Dementia

Increase of seniors

(Unit: 1000 people)

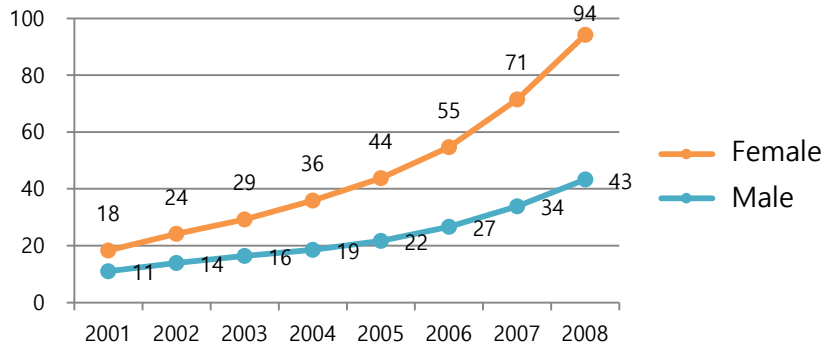


(Statistics Korea)

In **2011**, **10 million** of over **55 years** old people
In **2030**, **20 million (doubled)**

Increase of dementia

(Unit: 1000 people)



(2009, Hankook Ilbo)

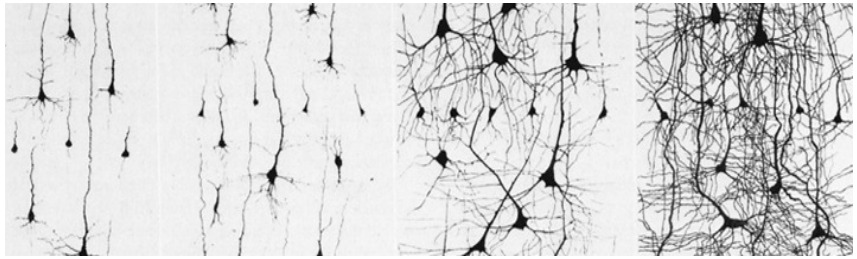
137,000 dementia patients in **2008**
25%/year⇑ for the past **7 years**

The social demand for dementia is gradually increasing.

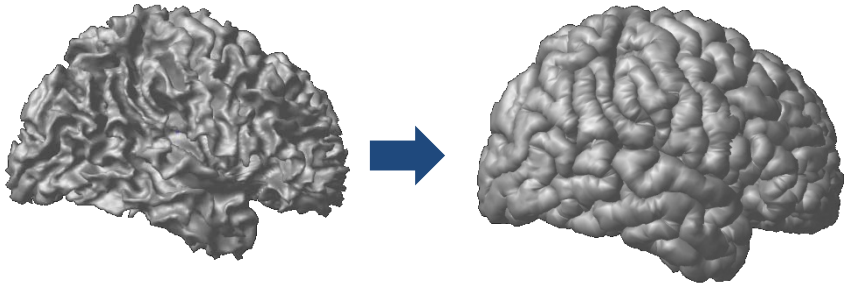
Dementia is a concern of our parents and ourselves as well.

Prevention of Dementia

- **Brain activation by brain fitness**



Increase of networks between brain cells by brain fitness



Increase of the thickness of the cortex

Increase of brain cell networks and the thickness of the cortex

⇒ Improvement of brain health

- **Social, physical, emotional, and cognitive activities have been found effective for prevention of dementia**

Social activities

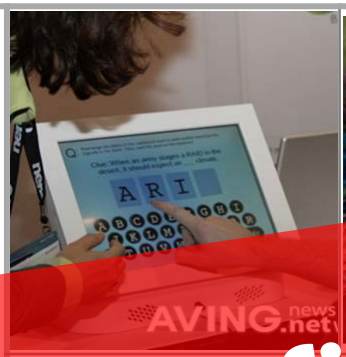
Physical activities

Emotional activities

Cognitive activities

Brain Fitness Games

Brain fitness program



BAKIM

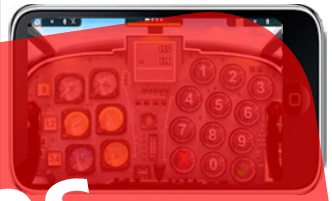
- Easy to control
- Complicated settin

Insight

- Game-like graphic
- Key and mouse u

Brain academy

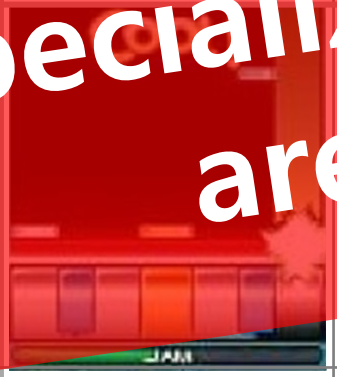
- Multi-player
- Complicated setting



ibrainfit

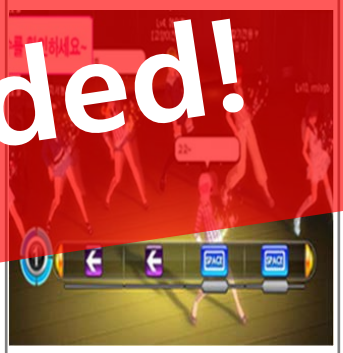
- Mobile
- Complicated UI

Music game



O2Jam

Pop stage



Love beat

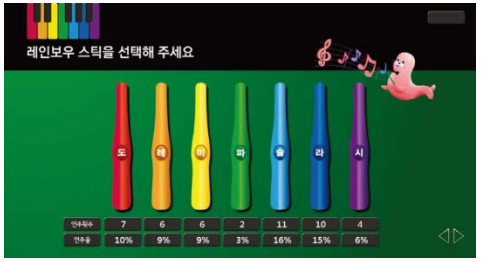
Band master

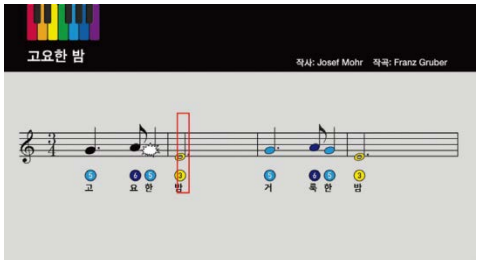
- Play a music focusing on the timing of a moving target
- Fancy UI focused on young people → visual burdens for seniors

Brain fitness games specialized to seniors are needed!

Overview of Smart Harmony

- A musical brain fitness program for seniors to prevent dementia by playing music
- Can be played with electronic sticks by up to 7 people providing senior-familiar songs with realistic music notes





Development Procedure

Needs Survey → Bench -marking → Idea Development → Prototype → Usability test & Commerciali-zation

<Field research>

- ✓ Understood brain fitness activities of seniors
- ✓ Surveyed needs of seniors

<Expert interview>

- ✓ Identified current use of brain fitness programs by music therapist
- ✓ Surveyed needs of music therapists

<Brain Fitness Programs>

- ✓ Analyzed strengths and weaknesses of existing brain fitness programs

<Music Games>

- ✓ Identified requirements for music game development
- ✓ Analyzed user interfaces preferred for seniors

Needs Survey

- **Visited a welfare center and surveyed needs of seniros by questionnaires**

음악을 이용한 두뇌체조 프로그램 개발을 위한 요구 조사

나이 : 71 세
성별 : 여

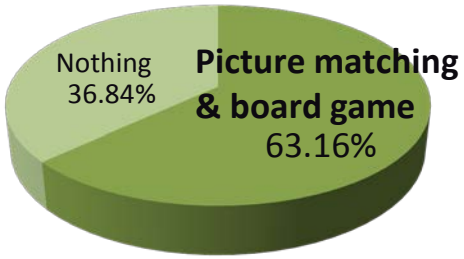
본 설문은 "**음악을 이용한 두뇌체조 프로그램 개발**"을 위한 사용자의 요구 사항을 조사하기 위하여 작성되었습니다. 설문 답변 시 예상 소요 시간은 **약 10분**입니다.

각 문항에 대해 체크(✓)를 하시거나 간략한 서술을 하여 주십시오.

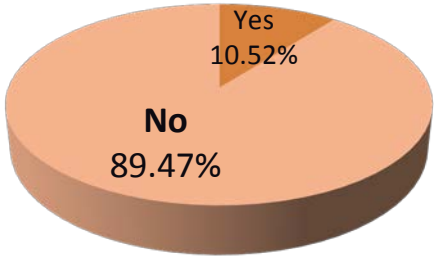
1. 평소 **머리를 쓰는 놀이**를 하십니까?
(예: 고스톱, 장기, 바둑, 오목, 레크리에이션 등)
① 예 ☞ 1.a 문항에 대해 답변하여 주십시오.
② 아니오

1.a **현재 하고 있는 놀이**를 선택하여 주십시오. (중복 선택 가능)
☑ 고스톱 ☐ 장기 ☐ 바둑
☐ 오목 ☐ 레크리에이션 ☑ 기타 (아래에 써 주세요)
윷놀이

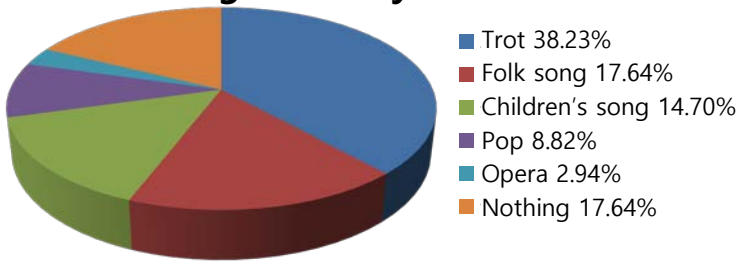
What do you do for fun?



Can you play a musical instrument?



What music genre do you like the most?



Benchmarking

- Surveyed existing brain fitness programs and music games and identified important features for benchmarking

Brain Fitness Programs for Seniors

Easy to Control

Game-like Interface

Source : http://kr.aving.net/news/view.php?articleId=132871
Source : http://www.positscience.com

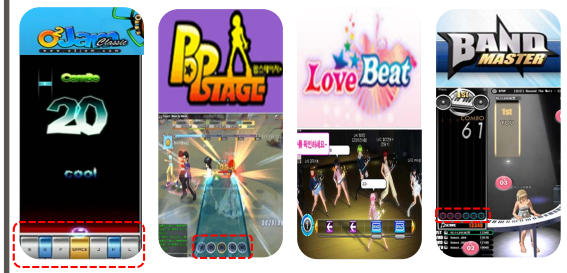
Brain Fitness Programs for Younsters

Up to 8 players

Accelerator Sensor

Source : http://www.nintendo.co.kr/Wii/software/brain_classroom/sub02.php
Source : http://www.ibrainfit.com/

Music Programs



Play the sound when a note is arrived at a certain point.

Source : http://o2jam.nopp.co.kr
Source : http://pops.mgame.com
Source : http://lovebeat.game.daum.net
Source : http://music.com2us.com/brand/musician

Patent Analysis

- **Analyzed patents of brain fitness programs and music games and prepared a basis of developing new ideas and patents**

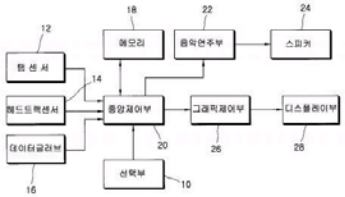
1. 특허 방향

2. 특허 가능성

2001-0027179 치매 방지용 교습구
2009-0077151 노인용 학습지
2008-0014606 학습용 게임 장치
2007-0000393 신종 포커 카드 게임 (바둑이 게임)

특허 가능성 ↑

- ***요약: 사용자의 동작에 따라 미디음을 생성***
- 구성 및 역할
  - ✓ 선택부: 선곡, 탭센서: 입력
  - ✓ 음악 연주부: 선택 곡의 반주 생성 및 제어
  - ✓ 디스플레이부: 영상 출력
  - ✓ 중앙제어부: 음악 연주부와 디스플레부를 제어



- 효과: 디스플레이되는 그래픽 화면에 따라 연주곡의 멜로디에 맞추어 사용자가 탭을 두드림으로써 멜로디에 따라 자동으로 반주가 출력되어 해당 곡을 손쉽게 연주할 수 있으며, 연주되는 곡의 빠르기와 볼륨, 멜로디 음의 높이 등이 각 객체로서 입체적으로 시각화되어 나타남으로써 보다 흥미를 갖고 연주할 수 있다

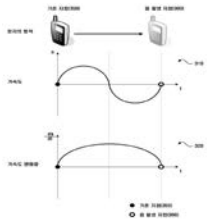
<Patent analysis>

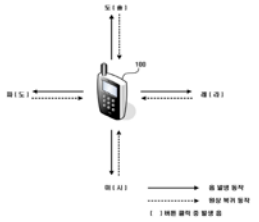
1. 센서를 이용한 가상 연주 장치 및 그 방법
(Virtual musical performance apparatus and method there of using sensor)

2. 동작에 따른 음을 발생하는 장치 및 방법
(Apparatus and method for generating musical tone according to motion)

3. 움직임과 사용자의 조작을 이용하는 입력 장치 및 이에 적용되는 입력 방법
(An input apparatus using motions and operations of a user, and an input method applied to such an input apparatus)

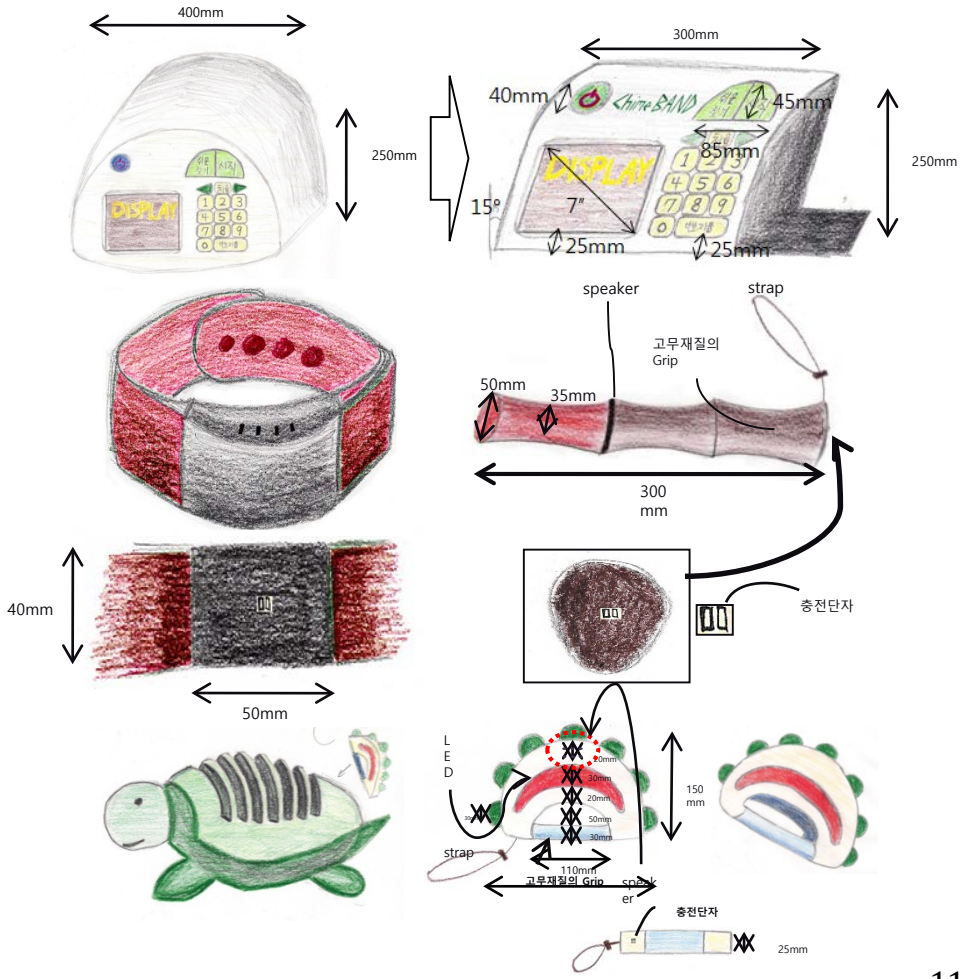
- 요약: 동작 센서에 의해 감지된 동작이 특정 방향에 대한 동작인 경우 특정 축에 대응되는 음을 출력하는 동작에 따른 음을 출력하는 장치 및 방법에 관한 것
- 효과
  1. 소정의 동작 센서에 의해 감지된 동작이 특정 방향에 대한 동작인 경우 특정 방향에 대응되는 음을 출력함으로써 낮은 정밀도에 의한 동작에도 다양한 음을 출력할 수 있는 장점이 있다.
  2. 동작 센서에 의해 감지된 동작을 음 발생 동작과 원상 복귀 동작으로 구분하여 원상 복귀 동작에 대해서는 음을 출력하지 않도록 함으로써 연속적인 음을 출력할 수 있는 장점도 있다.

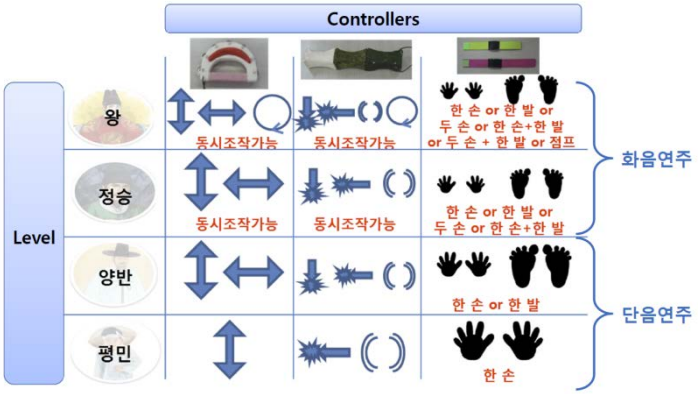




Idea Development

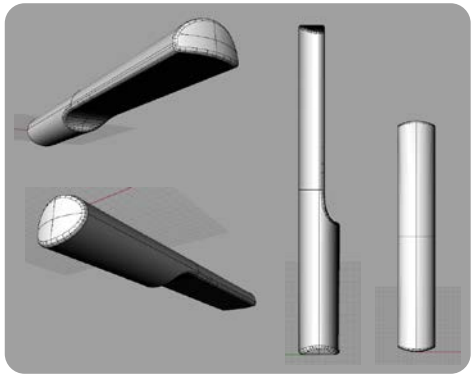
- Generated, screened, and selected, and refined ideas for a musical brain fitness program

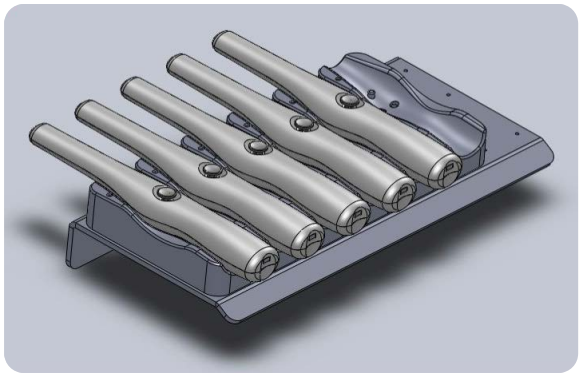




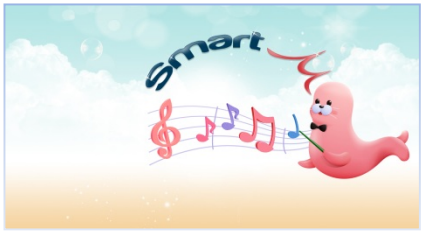
Prototype

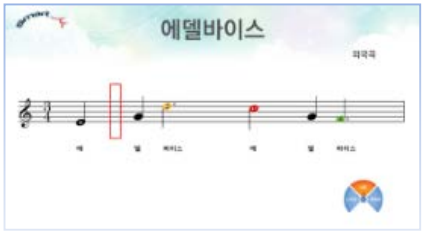
- **Prototyped hardware by CAD**





- **Prototyped software by programming languages and graphic design tools**

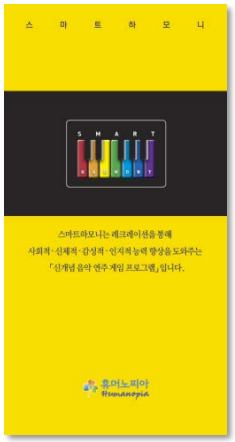




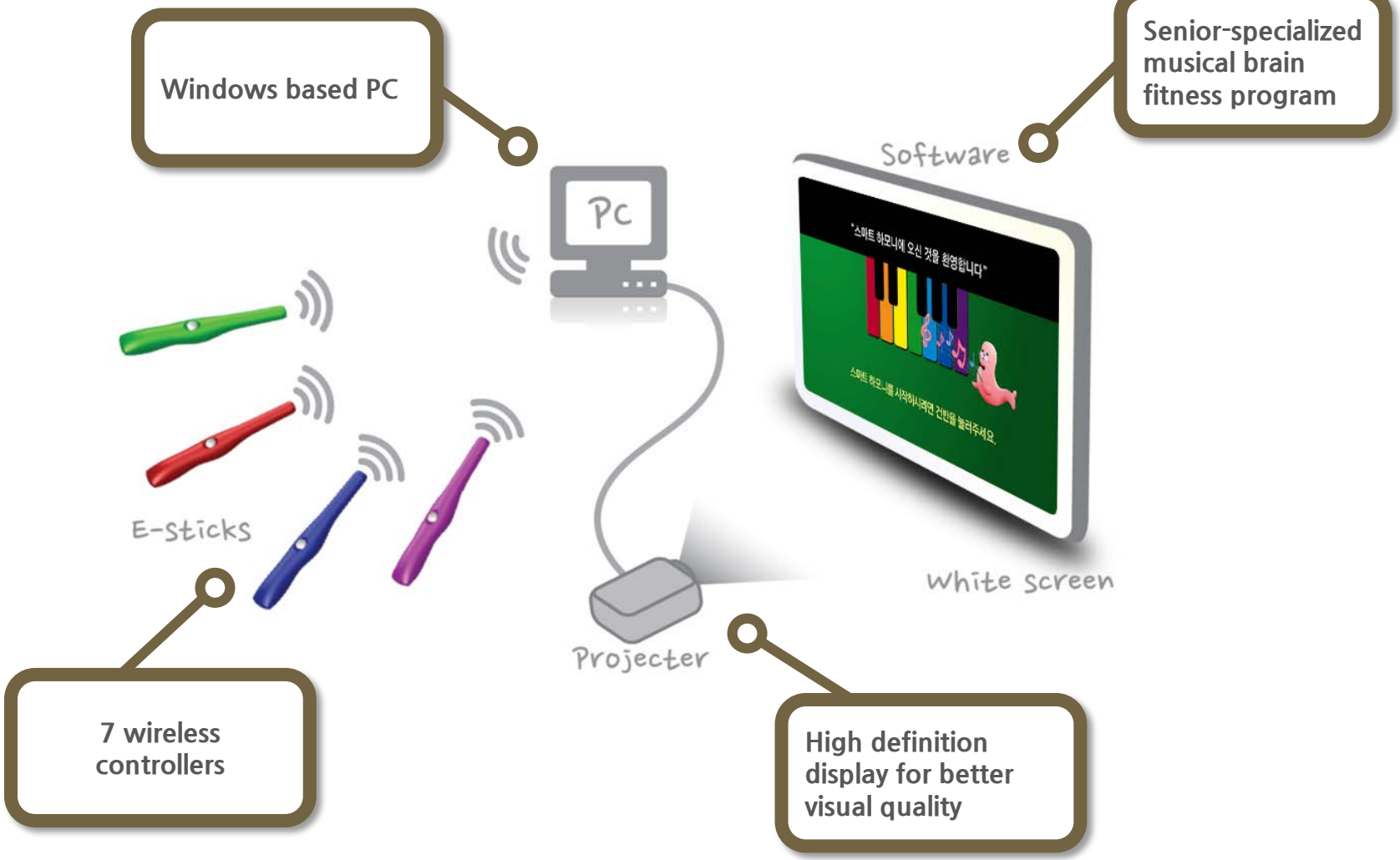
Usability Test & Commercialization

- **Usability test** at Gangnam-Gu center for Dementia and POSTECH

- **Commercialization** by Humanopia Co., Ltd.



System Overview



Features

1. Social Benefits
Play the music by collaborating, not competing, with each other in a group of up to seven players.

2. Physical Benefits
Play the music by shaking the rainbow stick in any direction when the timing bar comes to the musical note in charge.

3. Emotional Benefits
Have fun, gain a sense of accomplishment, and feel fellowship by playing Smart Harmony together.

4. Cognitive Benefits
Requires close attention to the timing bar moving at a selected speed and musical notes colored in the seven colors on the digital sheet music.

5. Musical Sophistication
Provides eight musical instruments (piano, xylophone, flute, harp, guitar, saxophone, trumpet, and violin) and numerous favorite songs for selection.

6. Universal Design
Designed for all ages including children, adolescents, adults, older adults, and people with disabilities.

7. Ergonomic Design
Provides various user-friendly features such as graphic menus and a colored and numbered music notation system for ease of learning, operation, and playing the game.

8. Affective Design
The modern, high-quality icons and colors give feelings of comfort, friendliness, and excitement.

9. Novel UX Design
Provides a differentiated user experience including fun, physical exercise, brain fitness, and socialization.

10. Multidisciplinary Fusion
Developed by a multidisciplinary group of experts including ergonomists, neurologists, product designers, electrical engineers, mechanical engineers, and music therapists.

Demo

Discussion

Social
Increase of social capability and sense of achievement by playing ensemble

Physical
Increase of physical capability by swinging rainbow sticks

Emotional
Emotional stimulation by music play

Cognitive
Increase of cognitive capability by visual, auditory, and tactile activities

SPEC → **Prevention and delay of dementia**

- **Planning a clinical test to verify the effect of Smart Harmony**
- **Modifying for disabled people**
- **Cooperating with Silbot (cognitive training robot) developed by KIST**

Q&A

Thank you!