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

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

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

<table>
<thead>
<tr>
<th>Brain fitness program</th>
<th>DAiM Insight Brain academy</th>
<th>ibrainfit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy to control</td>
<td>• Game-like graphics</td>
<td>Mobile</td>
</tr>
<tr>
<td>• Complicated setting</td>
<td>• Keyboard &amp; mouse use</td>
<td>• Complicated UI</td>
</tr>
<tr>
<td></td>
<td>• Complicated setting</td>
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</tbody>
</table>

### Music game

<table>
<thead>
<tr>
<th>Music game</th>
<th>O2Jam</th>
<th>Pop stage</th>
<th>Love beat</th>
<th>Band master</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Play a music focusing on the timing of a moving target</td>
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<td></td>
<td>• Fancy UI focused on young people → visual burdens for seniors</td>
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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
- **Field research**
  - Understood brain fitness activities of seniors
  - Surveyed needs of seniors

Bench-marking
- **Brain Fitness Programs**
  - Analyzed strengths and weaknesses of existing brain fitness programs

Idea Development
- **Brain Fitness Programs**
  - Analyzed strengths and weaknesses of existing brain fitness programs

Prototype
- **Music Games**
  - Identified requirements for music game development
  - Analyzed user interfaces preferred for seniors

Usability test & Commercialization
Needs Survey

- Visited a welfare center and surveyed needs of seniors by questionnaires

What do you do for fun?

- Nothing 36.84%
- Picture matching & board game 63.16%

Can you play a musical instrument?

- Yes 10.52%
- No 89.47%

What music genre do you like the most?

- Trot 38.23%
- Folk song 17.64%
- Children's song 14.70%
- Pop 8.82%
- Opera 2.94%
- Nothing 17.64%
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

### Brain Fitness Programs for Younsters
- Up to 8 players
- Accelerator Sensor

### Music Programs
- Play the sound when a note is arrived at a certain point.

Sources:
- Brain Fitness Programs for Seniors: [Source 1](http://kr.aving.net/news/view.php?articleid=132871) and [Source 2](http://www.positscience.com)
- Brain Fitness Programs for Younsters: [Source 3](http://www.nintendo.co.kr/Wii/software/brain_classroom/sub02.php) and [Source 4](http://www.ibrainfit.com/)
- Music Programs: [Source 5](http://o2jam.nopp.co.kr), [Source 6](http://pops.mgame.com), [Source 7](http://lovebeat.game.daum.net) and [Source 8](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

- Music (음악)
- Brain Fitness (뇌 피트니스)
- Musical Brain Fitness (음악 뇌 피트니스)

2. 특허 가능성

- 요약: 사용자의 동작에 따라 미디음을 생성
  - 구성 및 역할
    ✓ 선택부: 선택, 탭센서: 입력
    ✓ 음악 연주부: 선택 곡의 반주 생성 및 제어
    ✓ 디스플레이부: 영상 출력
    ✓ 중앙제어부: 음악 연주부와 디스플레이부를 제어
  - 효과: 디스플레이되는 그래픽 화면에 따라 연주곡의 멜로디에 맞추어 사용자가 탭을 두드릴 수 있도록 멜로디에 따라 자동으로 반주가 출력되어 해당 곡을 손쉽게 연주할 수 있으며, 연주하는 곡의 빠르기와 볼륨, 멜로디 음의 높이 등이 각 객체로서 입력적으로 시각화되어 나타남으로써 보다 흥미를 갖고 연주할 수 있다

<br>

**<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
● Prototyped hardware by CAD

● Prototyped software by programming languages and graphic design tools
- **Usability test** at Gangnam-Gu center for Dementia and POSTECH

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

Windows based PC

7 wireless controllers

Senior-specialized musical brain fitness program

High definition display for better visual quality

Software

White screen

Projecter

E-sticks
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.
Discussion

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

**Emotional**
Emotional stimulation by music play

**Physical**
Increase of physical capability by swinging rainbow sticks

**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
Thank you!