



# BCI (Brain Computer Interface) Serious Game Introduction

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# EEG, BCI (Brain Computer Interface) Core Technology

## 1. U-Health Care EEG measurement device, S/W → technology with lowest price

- Unipolar method, 2 channel EEG measurement Device
  - Using medical silver thread(銀絲) electrode, removing unnecessary sound and noise to maintain performance of hospital equipment
  - Emphasis on the convenience of the user, and lowering the price
- EEG analysis and operational S/W
  - EEG signal measuring device measures 256 signals per second → Analysis and digitalization on real-time concentration, relaxation and on balance of left & right brain

## 2. BCI Serious game production technologies and techniques that improves brain function

- Games are played as user think→ Provides next generation UX/UI→ Generate "Fun + Concentration"
  - Improvement in brain activation and brainwave (SMR-wave , Alpha-wave, etc.) occurrence
  - Improvement in concentration, cognitive function, and stress reduction, etc.
  - Play with fun, Brain Fitness (Effective in preventing the ADHD & Dementia)

**First in the world to develop simultaneously,  
Device, S/W and Contents**  
→ **Product Innovativeness/ Diversity of games**

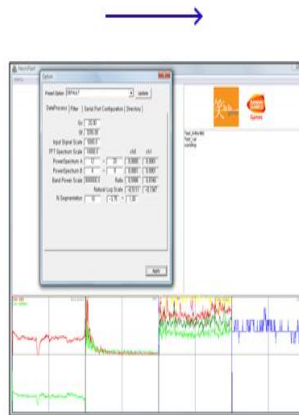
# U-Health care 2 channel EEG measuring device "BRAINNO"

**□ Unipolar method 2 Channel : performance of hospital equipment, Focused on the users' convenience and lowering the price**

- Developed medical silver thread(銀絲) electrode → Gained performance of medical device with improved performance of EEG measure
- EEG board and schematics compact化 → Focused on the users' convenience and lowering the price



일반용 Gel-type



뇌파 분석 / 해석 Algorithm



Goggles 2채널

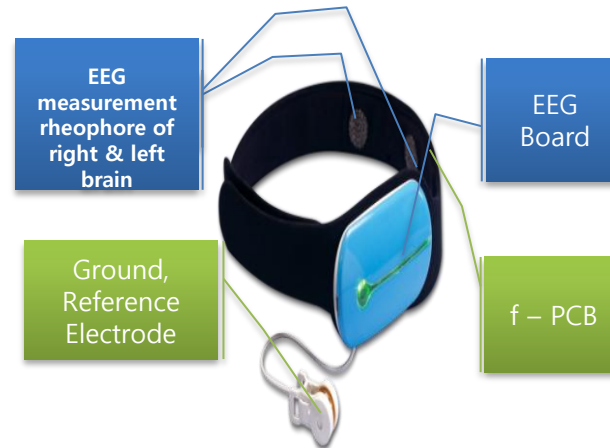
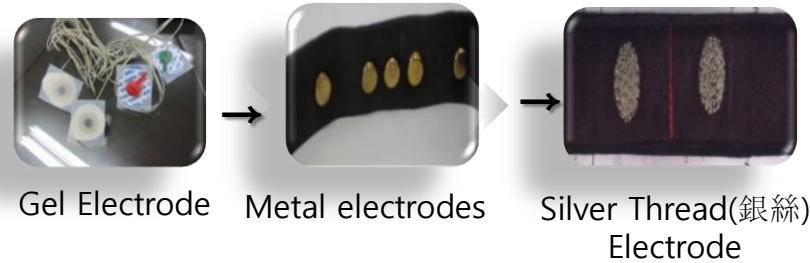


UniPolar 2채널



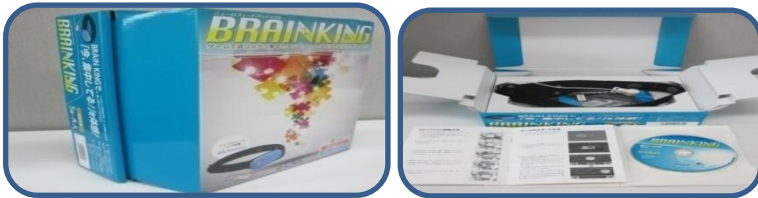
BiPolar 2채널

• EEG measure electrode

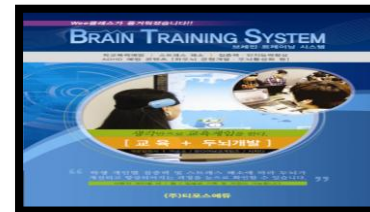
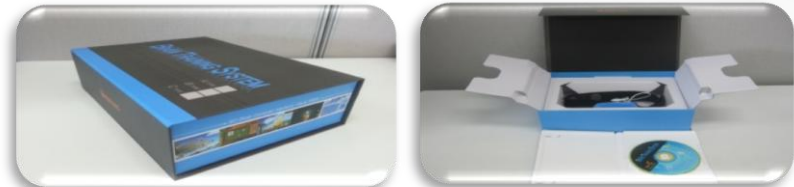


## BCI &amp; BMI Serious Game / Console

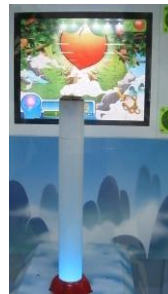
## ○ 日 SHICHIDA Sale "Brain King"



## ○ Domestic Wee Class Sale "Brain Training System"



## ○ BMI Arcade Game, "Brain UPUP"



## ○ BMI Tabletop Game, "Smart Brain"



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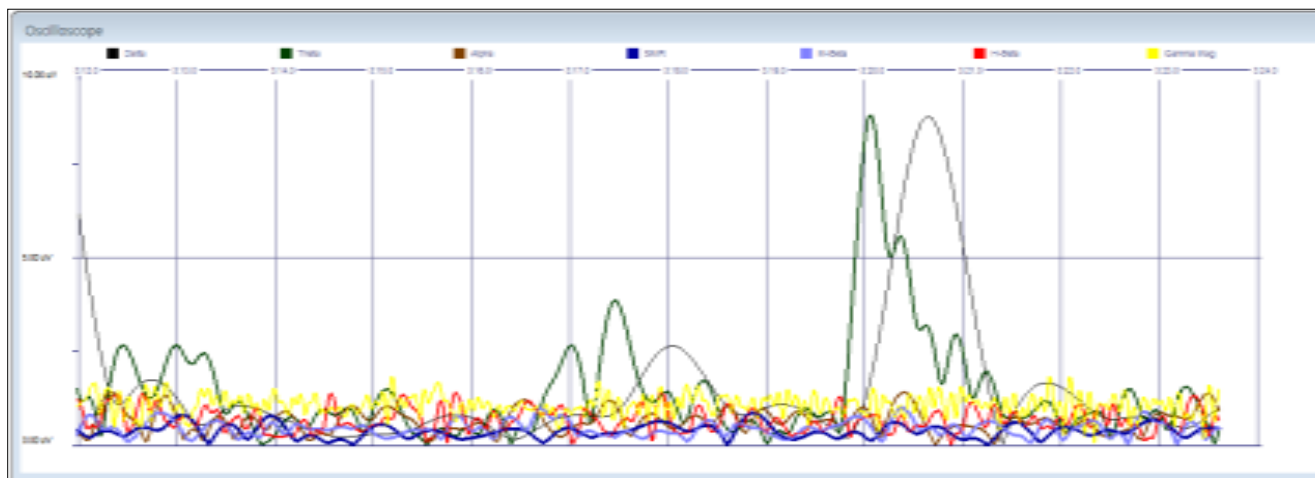
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# EEG (Electroencephalography) Introduction

## ○ EEG characteristics by frequency

| EEG        | Frequency | Characteristics  |
|------------|-----------|--|
| Theta wave | 4 ~ 8Hz   | Sleepy or sleeping, Occurs when in the deep meditation.                              |
| Alpha wave | 8 ~ 12 Hz | Relaxation, meditation and etc. State of relaxation.                                 |
| SMR wave   | 12 ~ 15Hz | When attention and concentration is high and when there is no stress occurred        |
| Beta wave  | 15 ~ 30Hz | Generates during business (little stress), activity status, anxiety and tension.     |
| Gamma wave | 30 ~ 50Hz | Occurs when in the state of extreme excitement, tension, agitation (a lot of stress) |

## ○ EEG waveform by spectral analysis

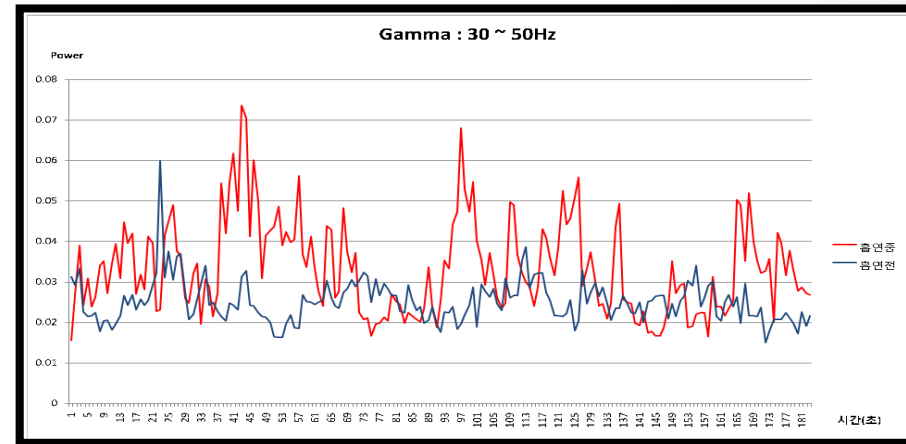
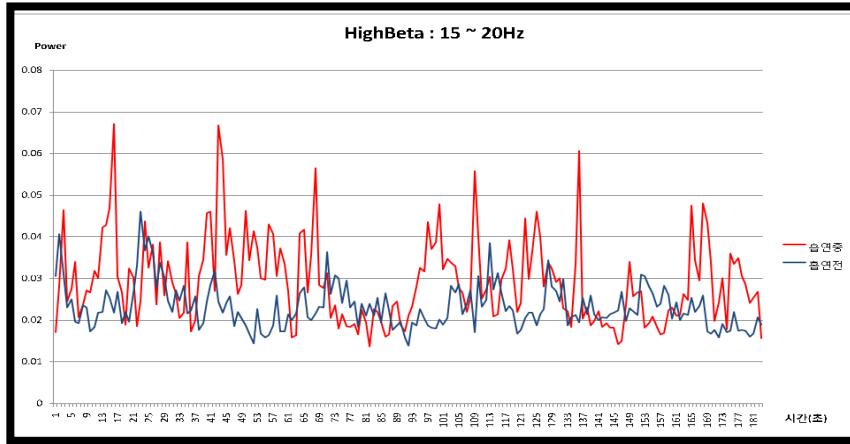


- Delta wave
- Theta wave
- Alpha wave
- SMR wave
- M-Beta wave
- H-Beta wave
- Gamma wave

# EEG Characteristics Comparison 例

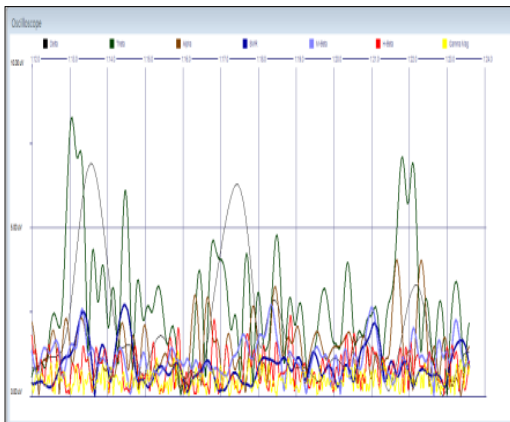
○ EEG characteristics while smoking : H-Beta, Gamma wave surge occur -> Similar with game addiction

— Before Smoking  
— While Smoking

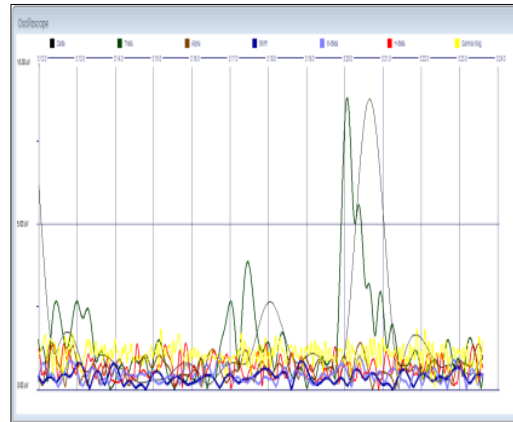


○ Compared EEG between children with ADHD and normal children  
- ADHD Children->Theta, H-Beta wave generates more than normal children

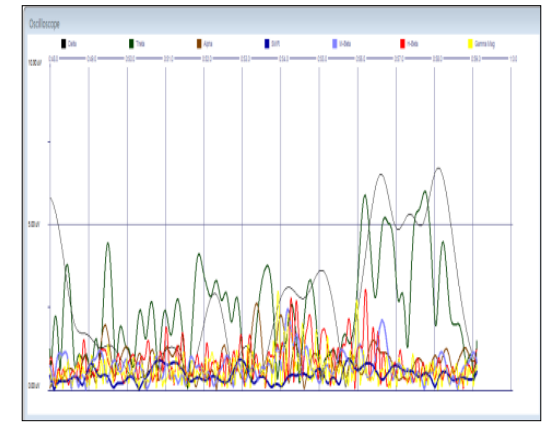
— Theta wave  
— H-Beta wave



EEG of children with early stage of ADHD



Normal children EEG

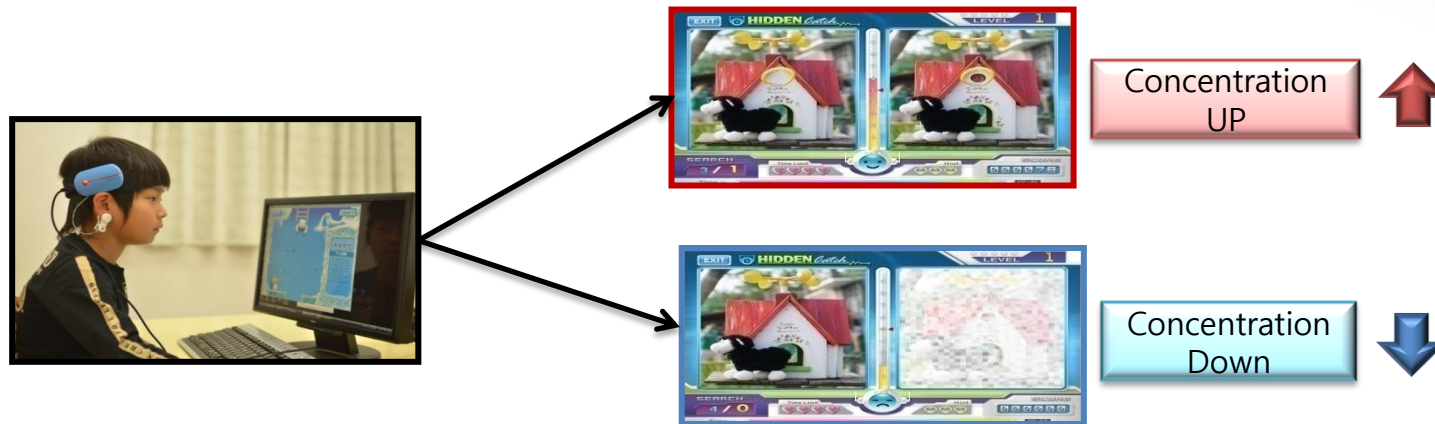


ADHD children with severe EEG

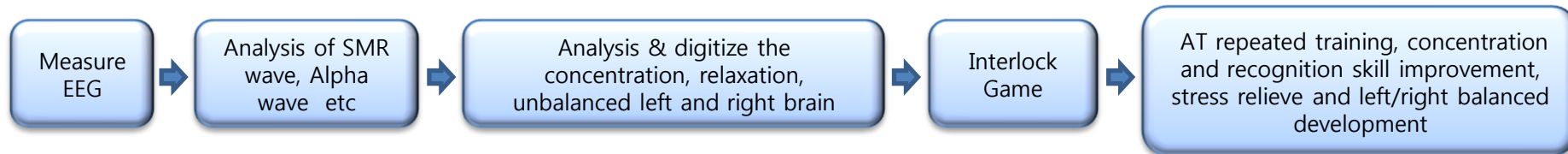


# Principle and effect of BCI Serious game

- Principle of BCI game : Measure 256 EEG per sec -> Analyze and quantify state of concentration and relaxation -> Interlock game (Progress in the game, interference and compensation)



- **Effect of BCI Serious game : Fun, relieves stress, improves cognitive function and Brain-Fitness while playing EEG games**



\*\*Neuro-Plasticity : brainwave training → Neuron, synapse increase → Activates brain

Neuro-feedback training: Most advanced medical service that prevents and give treatments through BCI game training .

Currently used in hospitals to prevent and treat ADHD, Dementia and Melancholia

- Normal Game: Violent, provocative → increasing H-Beta wave, and Gamma wave→ increasing stress / Scale, impulsive anger and violence

\*\*BCI Game : frontal lobe stimulation → SMR wave, Alpha wave increased → No stress and increase concentration  
→ Increase the learning and working effect.

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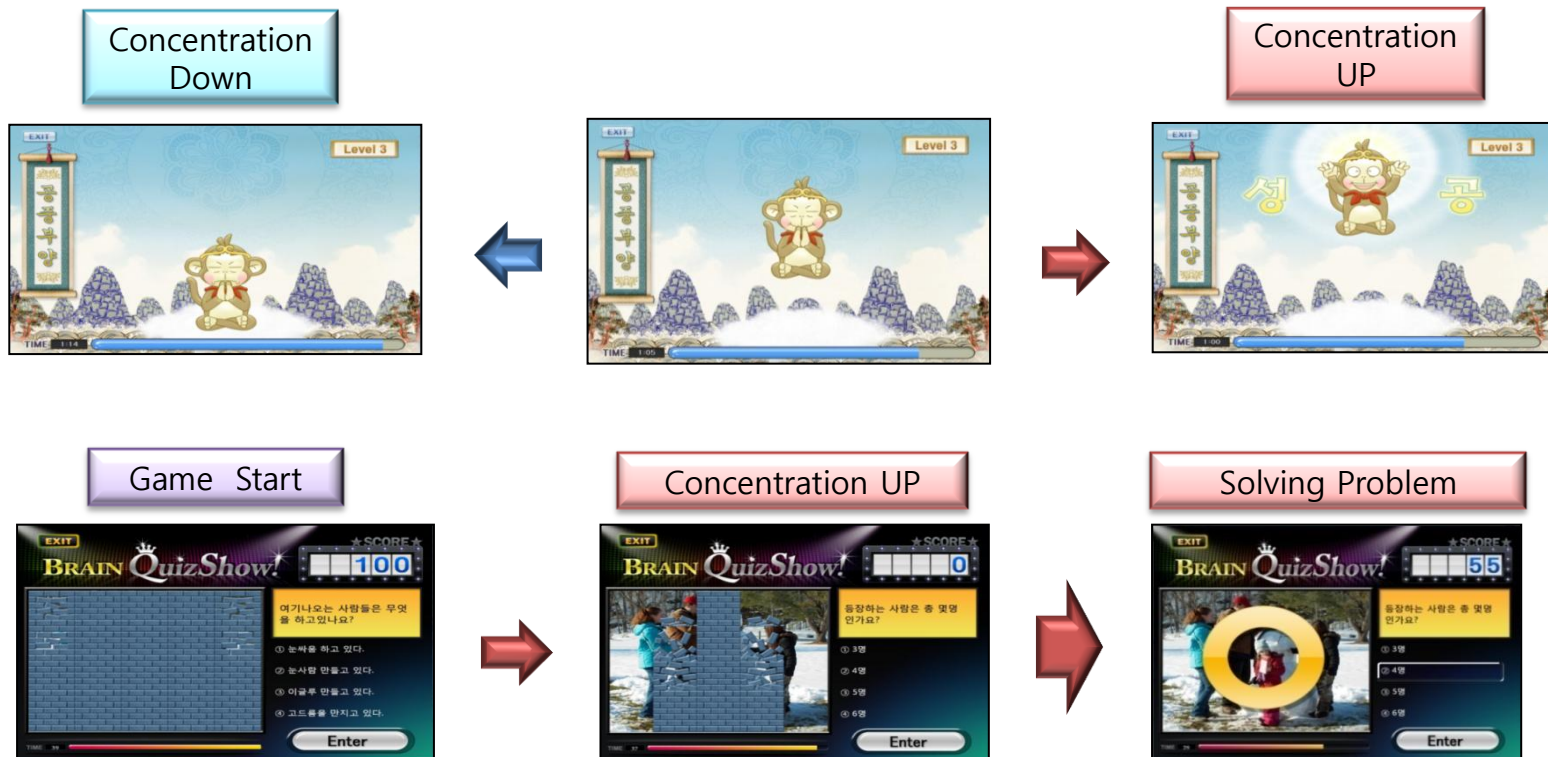
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# Improving concentration, cognitive function BCI Serious game

○ SMR(Sensory Motor Rhythm) wave occurring improves and improves concentration

|  |   |   |                           |
|--|---|---|---------------------------|
| EEG characteristics during poor concentration  | ⇒ | EEG suppression occurring                       | EEG improvement occurring |
| Theta wave and H-Beta wave increases occurring |   | Theta wave ( 4-8Hz ) ,<br>H-Beta wave (20~30Hz) | SMR wave (12~15Hz)        |

※ SMR wave : Used in year 1980 USA NASA spaceship pilots to improve concentration and for training purposes, currently used in the hospital to prevent and treat ADHD, Dementia, and Melancholia

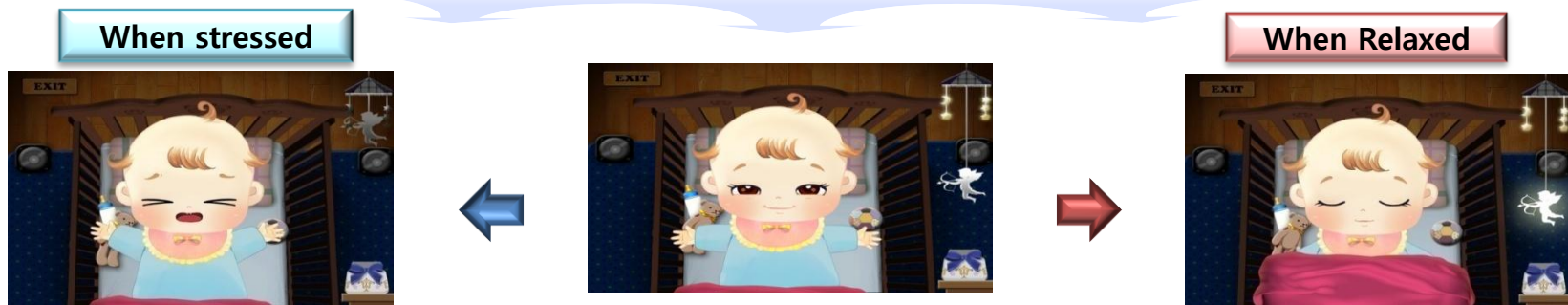


# BCI Serious game that relieves stress and prevents game addiction

- Increase in Alpha wave caused, relieves stress and prevents game addiction

|  |   |                           |                           |
|--|---|---------------------------|---------------------------|
| Characteristics of EEG during excessive stress | ⇒ | EEG suppression occurring | EEG improvement occurring |
| Alpha wave < H-Beta wave                       |   | H-Beta wave (20~30Hz)     | Alpha wave (8~12Hz)       |

- Analysis of individual stress conditions while playing the game
  - > Utilizing videos and sounds, providing individual healing service according to the stress conditions



Healing image and music therapy depending on the condition of the user → Maximize the effect of stress relieve



# BCI Serious game for balance development of left and right brain

○ Too much games and TV → violent, visual stimulation → left-brain-oriented activation → unbalanced left & right brain development → excessive agitation, anxiety → ADHD, Dementia occurs/ worsens



Imagine calculation problem → generate left brain activation



On both brain activated



Generate the right brain activation

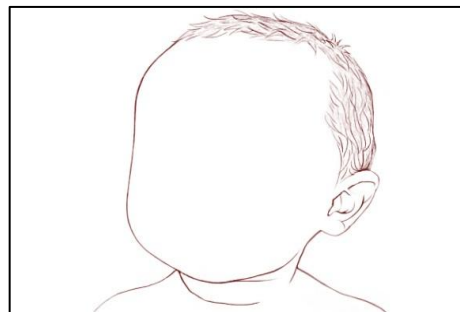
※ 80% of children has right brain inactivated compared to left brain

**Right brain activating BCI game - Imagination repeating training → right brain stimulation/activation → lead to left/right balance development**



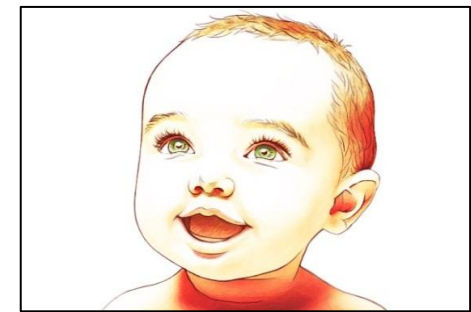
Result of right brain inactivation

After 20sec.



Imaging smiley baby face

After 20sec



Result of right brain activation

# Educational + BCI Serious game

- Concept: "Reading story book+ BCI Game" : First read the story by illustrations, among the stories, there are 3 ~4 images made into BCI serious game
  - \*\*日本 "MOMOTARO" story contents例 \*\*



(BCI Game, showing the background of the birth)



(BCI Game where the main character saves his friends)

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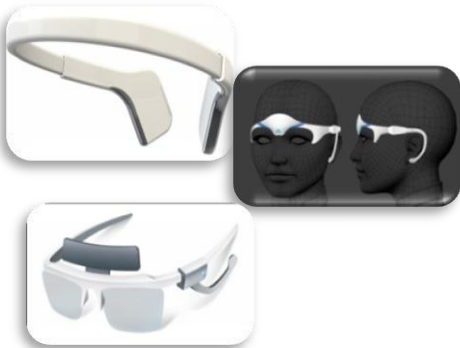
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# VISION

## ○ Concept Design



Gesture  
recognition  
technology

Voice  
recognition  
technology

Multi Touch  
Technology

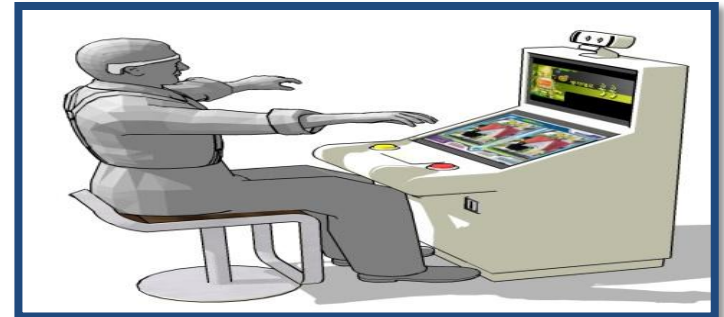
① **Increase in users convenience**  
(Wireless, Compact, etc)

② **Improve Performance**  
(Simultaneously measure  
biological information)

③ **Sensibility engineering design**



Smart media emotional UI / UX



Next generation convergence arcade games



Medical, ADHD / dementia Prevention and Treatment





Thank you!

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