

A Study on Serious Game Technology Based on BCI for ADHD Treatment

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Abstract. ADHD (Attention Deficit/Hyperactivity Disorder) is a common disorder of childhood, which exhibits symptoms of hyperactivity, impulse, having difficulty in concentrating, and being easily distracted. These symptoms lead many difficulties in childhood if left untreated, and last in adolescence and adulthood in some cases. This paper analyzes serious game technology based on BCI for ADHD treatment. BCI technology is implemented by acquiring EEG via device and sending commands into input-output device by signal processing. In order to apply serious games based on BCI, it requires building a database with relevant resources of analysis and study of ADHD infants and children behavioral patterns first. Based on it, it is suggested to design and develop serious games that are well balanced in fun elements and functional elements on the consideration of levels of difficulties.

Keywords: ADHD, Serious Games, Game Technology, Game Engine.

1 Introduction

Attention Deficit/Hyperactivity Disorder (ADHD) is a common disorder of childhood, which shows symptoms of hyperactivity, impulse, having difficulty in concentrating, and being easily distracted. These symptoms lead many difficulties in childhood if left untreated, and, in some cases, last in adolescence and adulthood.

ADHD children have difficulties in concentrating by stimuli and hardly correct behaviors by instruction. Therefore they are easily distracted in class and have difficulties in focusing on something constantly. They are also hyperactive like standing up from their seats without permission, run around in class, and fidget. They tend to act rather than to think and have excessive actions and words. They hardly control themselves in acting out although they recognize and understand rules.

In early childhood, it can appear to be repetitive behaviors or habits rather than symptoms. They have problems in sucking breast and eat several times in small amount, and also get too little sleep or have broke sleep. They whine, snatch, fidget, suck their fingers excessively, bump their heads, or shake their body back and forth. When starting to crawl, they tend to scratch about constantly and have irregular

routines in sleeping and suckling. In a suspected case of ADHD in school age, prior behaviors in early childhood must be considered.

ADHD requires to be tested in the light of differential diagnosis or coexistence with depression, anxiety, bipolar disorder, and learning disabilities throughout elaborate psychiatric consultation and psychological exams.

This paper attempts to help designing and developing serious games based on BCI throughout analysis of serious game technology based on BCI for ADHD treatment.

2 Concept of BCI (Brain-Computer Interface/Interaction) Technology

Brain-computer interface (BCI) means info-communications of brains and computers. In other words, brain activities are entered to computers directly and communicate without input devices like computer mice or keyboards. This technology is useful for who suffers from apraxia and suggest a new paradigm for people. It can be realized to develop technology that measures what activities are wanted in specific areas of the brain, and quantifies and analyzes the brain activities, and, in addition, to develop protocol of brains and computers. This paper attempts to analyze technology to apply BCI for serious games [6].

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3 Typical Types of Serious Games

Serious games can be defined as beneficial games in various aspects that have elements of fun games.[1] In serious games, functionality and entertainment are not mutually exclusive concepts. Serious games are differentiated from entertainment games in aspect that they don't only pursuit fun in process and from edu-contents in aspect that they don't focus only on learning effects as results. Specific purposes and fun elements of games combine and have great synergy effects.

Long before 1970s when a serious game was first defined, games were already utilized functionally and the first case of them aimed at military training. In Western countries, war games that had been simply developed from chess were used for mock battles in the 17th century. The development of digital-based technology had these mock battles realistic, and simulated exercise, so-called simulation is the most important factor in serious games that provide the most similar experience with reality.[2] Success of 'Virtual U', university management simulation released in 2002 and 'America's Army', developed for US army recruitment caused serious games to attract attentions and form communities.[3] 'Woodrow International Center for scholars', nonprofit organization, headquartered in Washington D.C. in 2002, launched 'Serious Game Initiative'. It is the beginning of serious game community, and the most important moment in serious game history. 'Serious Game Initiative' held a seminar called 'Serious Game Day' in Washington D.C. in December, 2003

and the first ‘Serious Game Summit’ started during Game Developer Conference (GDC) held in San Jose in March, 2004. Since then communities like ‘Game For Change’ and ‘Game For Health’ were formed and have led to develop various serious games [4].

Typical types of serious games are for health, education, psychological therapy, military training, etc.

Serious Game for Healthcare. These serious games provide health care and prevention of disease, and expand effects of exercises by applying computer game elements to sports equipments and expressing exercise results in to games. In addition, participants can acquire knowledge of health in process.

Educational Entertainment. Edutainment (a combination of education and entertainment) has entertainment value content that is designed to educate as well as entertain. It has little or none of simulation elements that test risky situations on behalf of players, and otherwise focuses on maximizing educational effects, which is based on educational theory rather than data or situational reproduction. Among entire serious game fields, edutainment is most frequently utilized.

Psychological Serious Game. It aims at raising learning abilities and concentration rather than achieving educational effects directly. Leading to meditation, it helps psychological healing and cure, and relieves stress.

Game for Therapy. In medical aspect, preventive games have participants acquire effective behaviors to prevent disease and emergency response in the context of simulated conditions or situations. Also there are some games to treat intractable panic disorder using simulation technology.

Military Simulation. Developed on purpose of simulated military training, military simulations apply for all the fields such as army, air force, navy, etc. Factually flight simulation games have been often used and developed, as it costs millions for special hardware or complete facilities to use[5].

Table 1. State of Main Serious Games

Categories	USA	Japan	Europe
Agent Sponsor	& Non-profit Organization (MIT,CMU,MSU)	Game Company (Nintendo)	Public Organization Such As Regional Development Cooperation
Aim	Innovation	Casual Game	Aims for accumulation of Regional Industries
Characteristic	Apply serious games even for the areas of state-invested public services such as social changes and disaster recovery plans	Games in areas of learning, intellectual educational practical learning games	so-called games, Educational-industrial cooperation

4 Conclusion

ADHD is a common disorder of childhood, which exhibits symptoms of hyperactivity, impulse, having difficulty in concentrating, and being easily distracted. These symptoms lead many difficulties in childhood if left untreated, and last in adolescence and adulthood in some cases. This paper analyzed serious games using BCI for ADHD treatment.

BCI technology is implemented by acquiring EEG via device and sending commands into input-output device by signal processing. In order to implement serious games using BCI, it requires building a database with relevant resources of analysis of ADHD infants and children behavioral patterns. Based on it, it is suggested to design and develop serious games that are well balanced in entertaining and training on the consideration of levels of difficulties.

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