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Design and Implementation of VR-ADHD Digital Therapy Using VR Games

[1]Dae-Won Park, [2]Han-Byul Kang, [3]Sang-Hyun Lee

[1,2]CEO, Darwintech Co,. Ltd, Gwangju, Korea
[3]Associate Professor, Department of Computer Engineering, Honam University, Korea
[1,2]{leegiseok, gweeet}@gmail.com, [3]leesang64@honam.ac.kr

Abstract

In this paper, we design and implement an ADHD diagnostic rating scale algorithm and virtual reality-based digital treatment by combining virtual reality technology that enables multiple access based on specialized medical data. The VR ADHD digital treatment to be implemented is intended to be applied directly to diagnosis and treatment of child/adolescent ADHD by applying various psychiatric treatment technologies. In order to evaluate the usability of the digital therapeutic agent developed in this paper, an expert group consisting of 2 males and 12 females "targeted counseling psychology majors at the Asian Dementia Center once a day for 3 weeks, ADHD VR-based digital therapeutics for children Experienced and usability evaluation conducted. As a final result of this thesis, it was possible to develop attentional concentration ability, working memory improvement ability, and impulsive control ability in four games of digital therapy, and it was possible to confirm significant results that can be expected to have ADHD therapeutic effects.

Keywords: *VR-ADHD Digital Therapy, ADHD, Virtual reality, Healthcare*

1. INTRODUCTION

Attention-deficit hyperactivity disorder (ADHD) or hyperkinetic disorder (HKD) is a disorder mainly characterized by distraction, hyperactivity, and impulsivity. It is a very important disease that causes problems in various areas of functioning, such as school and school. The global prevalence of ADHD has been reported as 5.96%, and in Korea, a high prevalence of around 13% in elementary school students and 7% in middle and high school students was reported in a 2006 study in Seoul using a structured interview tool. Currently, non-drug treatments for attention deficit hyperactivity disorder (ADHD) include education, behavioral therapy, working memory training, and neurofeedback, among which behavioral therapy appears to be the most effective.

Non-pharmacological treatment is less effective on the core symptoms of ADHD than drug treatment, but it is used very effectively for accompanying symptoms that do not improve with drug treatment alone. Therefore, drug therapy and behavior therapy are seen as complementary to each other, and like drug therapy, behavior therapy can be less effective when treatment is not performed. Currently, even among ADHD experts, there is a split between the view that drug treatment with the most effect should be given first, and the view that it is better to try non-drug treatment such as behavioral treatment first.

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Corresponding Author: leesnag64@honam.ac.kr
Tel: +82-62-940-5285, Fax: +82-62-940-5285
Associate Professor, Department of Computer Engineering, Honam University, Korea

Here, 1) when the symptoms are mild, 2) when the child is very young and before going to school, and 3) when the resistance to drug treatment is strong, behavioral therapy can be considered first [2].

Due to the rapid development of the IT field, ADHD patients are currently using a technology called digital therapy, which is premised on treating patients based on software. The digital therapy market is a new trend in the fast-growing medical technology market, positioning itself as an entirely new field that has yet to be fully established [3]. Currently, various technologies are being introduced in the healthcare field around the world, but cases where they are applied to actual treatment processes are limited. Digital therapies for medical innovation could be new opportunities [4][5].

In this paper, based on specialized medical data, we combine virtual reality technology that allows multiple access to design and implement a virtual reality-based digital treatment using an ADHD diagnostic rating scale algorithm, HMD, and auxiliary display. Various psychiatric treatment technologies were applied to the VR ADHD digital treatment product, and it was developed to be directly applicable to diagnosis and treatment of childhood/adolescent ADHD.

2. DESIGN OF VR ADHD DIGITAL THERAPY PRODUCT

As a method for using the digital therapeutic agent in this paper, first, it is prescribed under the doctor's judgment after consultation with the doctor, second, the patient registers the patient through the patient-only website, and third, the hospital through the hospital website by issuing a unique code to the patient, the patient can use the digital therapy product.

Here, the patient can log in by putting on the VR HMD, a digital therapeutic device owned by the hospital, and entering the OTP number after receiving it from the patient's web page.

As shown in Figure 1, the digital therapy provides an ADHD status diagnosis questionnaire and 4 types of ADHD treatment games to provide treatment. Patients accumulate data by using digital therapeutics according to the diagnosis schedule, and doctors proceed with ADHD treatment through the accumulated data.

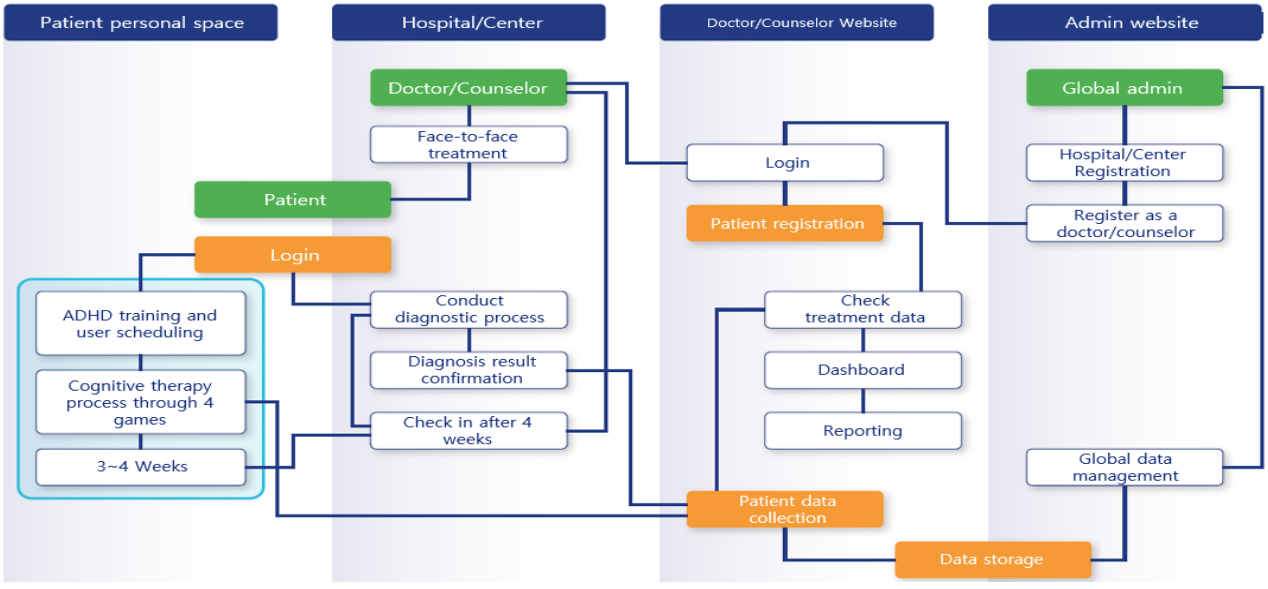

Figure 1. Overall composition of digital therapy

2.1 Module for questionnaire to diagnose ADHD

Figure 2 shows the process of diagnosing child ADHD through controller manipulation in VR. When the diagnosis is started, the user selects whether the respondent is the child or the guardian and starts the diagnosis.

Figure 2. Diagnosis process for digital therapy

The process in Figure 2 proceeds as follows. If the respondent selects, the contents of the four diagnostic rating scales suitable for the respondent are retrieved from the DB, saved, and then applied. After answering a survey using the controller, you can move to the previous or next question, and you cannot move to the next survey when you do not answer the question. When the rating scale course survey is completed, the user's response data is stored in the DB, and when all four types of rating scale questionnaires are completed, the main screen returns.

2.2 Development of children's ADHD-specific treatment VR game contents

For ADHD-specific treatment using VR, as shown in Figure 3, we developed four VR game contents such as "Archive at the right time", "Exploring Antarctica", "Shopping according to the list", and "Drumming to the rhythm", based on cognitive behavioral therapy. As a result, different psychiatric treatment techniques were used to achieve a therapeutic effect. The scores of the four games are stored in the DB and can be viewed by the administrator.

Figure 3. Developed 4 types of VR game contents for ADHD-specific treatment

3. USER EVALUATION METHOD

To evaluate the usability of the developed digital treatment, an expert group consisting of 2 males and 12 females was formed targeting counseling psychology majors at the Asian Dementia Center. In the form shown in Figure 4, an expert group conducted a usability evaluation by experiencing children's ADHD VR-based digital therapy for three weeks.

Figure 4. Expert demonstration for VR digital therapeutics usability evaluation

In the self-written usability evaluation centered on counseling psychologists, whether system menus can be accessed while wearing an HMD, whether terms used in menus or icons are consistent, whether or not 3D graphic elements are used based on actual size, received very positive evaluations on the 4 items of shortcut key function support.

In addition, attention ability, working memory improvement ability, and impulsive control ability can be developed in the four games, and ADHD therapeutic effects can be expected. In addition to hospital treatment, it was confirmed that significant results were available for daily treatment.

4. CONCLUSION

In this paper, we implemented a virtual reality-based digital treatment platform that can be implemented with an HMD by using ADHD diagnosis rating scale algorithm in virtual reality technology. In addition, various psychiatric treatment techniques were applied to improve the quality of implementation, so that it could be directly applied to diagnosis and treatment of ADHD in children/adolescents.

In the four games of the developed digital therapy product, attention ability, working memory improvement ability, and impulsive control ability can be developed, and ADHD therapeutic effects can be expected, which means that continuous hospital treatment after ADHD symptoms appear is economical. In addition to hospital treatment, it was possible to provide daily treatment to family members who could be burdened, and significant results were confirmed.

However, in order to use it as a digital treatment, logical grounds from scientific clinical trials are required, and for registration of a treatment, it must be registered according to the procedures of the Ministry of Food and Drug Safety before it can be used as a digital treatment. Therefore, it seems that research is needed to apply digital therapeutics to various healthcare fields through the advancement of virtual reality technology and treatment technology before launching them as digital therapeutics.

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