A Framework for Treatment of Autism Using Affective Computing

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Abstract
It is known that as many as 1 in 91 children are diagnosed with autistic spectrum disorder. Since the children with autism usually do not express their own emotional status, it is needed to develop a novel technology to sense their emotional status and give proper psychological treatment. This article presents a framework of the treatment system for children with autism using affective computing technologies.

Introduction
The children with autism, which is also called as a pervasive developmental disorder, show problems in social relationships and interactions such as difficulty in verbal expression-understanding, limited interests in activities or play, and difficulty in mixing with other children (Zager, 1999). The well known effective and relevant for treatments of autism in children include educational programs, reinforcement of mutual communication, diet control, auditory training, behavior modification, medication, music therapy, physical therapy, occupational therapy, sensory integration, and vision therapy. Finding the most relevant treatment for a certain child with autism, however, is not easy since the autistic children need personalized treatment according to the types and the severity of symptoms.
Recent affective computing technology, focused on emotional interactions between humans and computers, can provide one of the most promising treatment methods for the children with autism, since it enables the emotion recognition through bio-sensors and it can provide the children with effective virtual training scenarios using virtual affective agent and haptic technologies. Thus, this article presents a framework of the treatment system for children with autism using the affective computing technologies.

A Framework for Treatment of Autism
Figure 1 shows the framework for the treatment system of children with autism using bio-sensors and affective computing technologies. Immersed in virtual treatment environment with the head mount display, a child with autism controls his or her avatar using haptic devices. Agents in virtual environments give the composition of the stimulus, which includes physical stimulus simulated through the haptic devices, to the virtual avatar according to the treatment scenario to cause a particular emotional situation. The stimulus is determined based on the affective model to express emotion generation process of human. The emotional status of the child is recognized through the series of processes of measuring bio-signals such EEG (electroencephalogram), ECG (electrocardiogram), BVP (blood volume pulse), respiration, SC (skin conductance), EMG (electromyogram), and SKT (skin temperature), noise filtering, feature extraction, and pattern matching. The treatment system aids a clinician to diagnose whether the child is emotionally disturbed by presenting the statistical analysis results compared with expected normal emotional states.

The proposed treatment system for the child with autism consists of three components.
1) Virtual interactive environment component. The virtual interactive environment component is intended to implement the treatment scenario for the avatar that interacts with virtual agents in a hypothetical situation. As each virtual agent has its unique affective model, the treatment scenario changes dynamically according to the interaction between the avatar and the virtual agents. This dynamic change helps the child with autism improve interaction with people in real world.
2) Bio-sensing component. The bio-sensing component consists of hardware for sensing bio-signals such as EEG and ECG, and software for signal processing. The emotional status expressed by the user is recognized through the bio-sensing component.
3) Virtual environment interface component. The virtual environment interface component is intended to enhance the immersive realization in virtual environment. It includes hardware such as HMD (head mounted display) and haptic interface device, and control software.
In figure 1, a video tape records the non-bio-signals such as the voice, behavior, and facial expression of the child with autism during the treatment and is reported to the clinician. It is used as an auxiliary mean to diagnose the treatment.

Discussion
This article presents a new affective computing system framework for treatment of children with autism. The proposed method provides the treatment environment for autism by combining virtual reality technology, which has already been applied in the field of psychotherapy (Rizzo, et. al, 2005), with the emotion recognition through bio-sensing and virtual agent modeling technologies. Through this framework, objective diagnosis and continuous treatment in one’s daily life for autism will be possible if the bio-sensing system becomes compact and the emotion recognition is reliable.
References

Illustrations

![Figure 1. The system framework for treatment of autism using affective computing](image-url)