Available online at www.elixirpublishers.com (Elixir International Journal)

Computer Science and Engineering

Elixir Comp. Sci. Engg. 51 (2012) 10788-10791

ISSN: 2229-712X

Innovative Assistive Technology used in Analysis and Treatment of Autism Spectrum Disorders

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ARTICLE INFO

Article history:

Received: 21 August 2012;

Received in revised form:

20 September 2012;

Accepted: 4 October 2012;

Keywords

Autism,

Discrete trail training,

Applied behaviour analysis,

Voice output communication aids.

ABSTRACT

This paper discusses the potential of using technologies in the diagnosis, study and intervention treatments of autism. The first part of paper introduces background information on autism spectrum disorder. The second part deals with review of literature survey. The third part summarizes our proposed research work on the connected topic. The fourth part concludes our work as whole.

Introduction

The present paper addresses various innovative assistive technology used in diagnosis and treatment of pervasive developmental disorders such as autism. Autism is a developmental disability that is usually noticeable the present paper addresses various innovative assistive technology used in diagnosis and treatment of pervasive developmental disorders such as autism. Autism is a developmental disability that is usually noticeable in the early stages of life preferably in the age groups of one to three years.

The common impairments found in the autistic communities are social interactions, communication, controlled interests and recurring behavior, etc. The cause for autism is still mysterious. Scientists are working to find out various factors that cause autism. Some of them believe that the changes in environment and genetics might be the key cause.

Till now there are no suitable medicines or treatments to cure autism, but using appropriate therapies such as applied and verbal behavioral analysis the impairments of autistic children could be eliminated or reduced to an extent.

Related Work

In this subsection, a list of related works will be briefly described.

Gregory D. Abowd, Julie A. Kientz[1] working at Georgia Tech has paying attention on sustaining persons with autism and their caretakers by means of computing tools. They have designed two applications to assist a group interact with autistic kids. The first tool called CareLog, which is a portable application for recording behavioral information in familiar location that allows caretakers and teachers to grasp moments on tape.

Children's with autism may show signs of certain behaviors that might be troublesome or dangerous to themselves or others. To understand the cause of these behaviors they have introduced a mechanism called Function Behavior Assessment (FBA). Generally caregivers note down behavioral incident of a child with autism for few weeks, later these data is analyzed by behavioral specialist to determine the behavior function.

But incident might occur at unpredicted times and place, so caregivers may feel difficult to note down these behavior. To help caregivers document and analyze unpredictable incidents, a prototype model is designed by Julie A. Kientz & their colleagues called CareLog.

For detecting the self-stimulatory behaviors of autistic child they have used wireless body worn sensors. Caregivers provided with a wireless key to activate archiving.

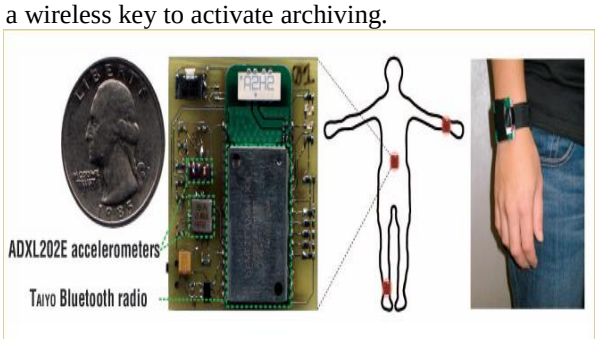

Fig. 1 A Placement of wireless and sensors [1]

Abaris is another tool designed to support Discrete Trail Training (DTT) therapists. Using this tool therapist can produce graphs and correlate them with data sheets without human interventions. Here therapist provided with an Anoto digital pen to capture data. By means of this tool, therapists can point out inaccuracies and problem areas to caregivers. These tools assist therapist and caregivers in data collection and analysis of individuals with autism.

Philipp Michel [5] provides an outline on the exploit of technology in autism study. He spotlight mostly on devices and methods that openly interface with patients for assessing diverse theories of autistic growth. Using video-based approach as a treatment method, he explained that the conversational skill of autistic children is improved.

He argues that gene analysis technology made available for diagnosis of autism in early stage. At a standstill the genetic

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research in autism a challenging endeavor because genes may be one of the causes for autism. He discussed imaging technique has been used to find out the substantial properties of the brains of patients.

He describes few methods of supporting comprehension skills such as visual schedules, activity schedules, etc. To improve the child's expressive communication skills, he explained Picture Exchange Communication System (PECS) is an effective one.

He showed mid technologies such as inexpensive electronics devices are useful in the treatment of autism. Using Voice Output Communication Aids (VOCA) interaction between the caretakers and autistic children increased considerably.

Fig. 2 Different styles of Voice Output Communication Aids [5]

He elucidate that use of computer technology in teaching atmosphere increase autistic child skills. Also it considerably reduces disrupting behaviours and increase observance with instruction.

He explained about various traditional softwares such as mind reading software, talking word processing software which is useful for autistic kids for teaching behavior in social situations as well as increase reading and communication skills

Matthew Goodwin [6] articulated the benefits of developing innovative technologies for autism. He has discussed various issues faced in delivering health care to families with autism. Also he suggest that by developing secure online environment using telecommunication technology we can provide health administration and clinical healthcare by allowing professionals in the world to access it.

He recommends virtual reality technology has a low cost technique, which is adapted to teach various skills to individuals with autism. He stated that information system technology enabled care takers of individuals with autism to provide environmental and behavioural data for research studies by means of the internet.

Vimitha Manohar [2] have discussed about a variety of assistive robots used in the therapy of autism. He studied that using robots Playtest, ESRA (Expressive System for Robotics Animation) & Pleo in diagnosis, the social behavior of an autistic child has significantly increased. Also he examined whether a robot without human behaviors can attain successful interaction with autistic children.

He analyzed various programming interface methods which are useful for non-technological experts to easily program robot behaviors. To program custom behavior myskit, choregraphe used for pleo & Nao robot.

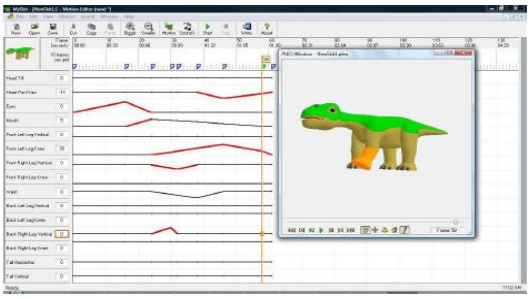

Fig. 3 Myskit interface with Pleo

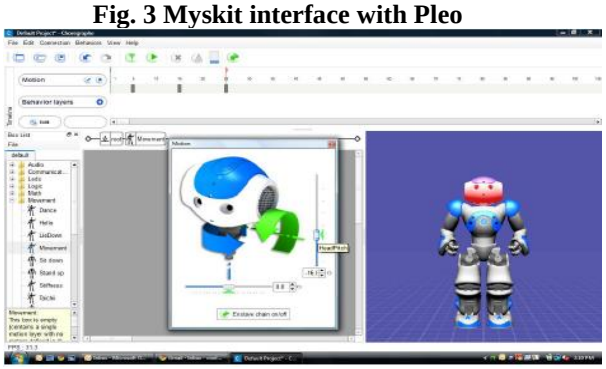

Fig. 4 Choregraphe interface with Nao

Kerstin Dautenhahn [7] discussed the use of interactive environment in teaching and learning for individuals with autism. He stated about the affective social quotient project, were embedded technology is used in learning social – emotional cues. Here a child can pick up a doll based on the emotional video clips shown on the screen. He also pointed out various socially intelligent agents such as KISMAT and ROBOTA which can be used as interactive toys for teaching an autistic kid. He guesses that autistic children are attracted more to robots, so the robots are used in teaching complex forms of social interactions similar to human-human interactions.

He studied that children above 4 years are paying attention to autonomous robots. So he assumes autistic kid can recognize mobile robot as social agent.

Fig. 5 Autistic kid interacting with Labo-1 robot

He suggest by using virtual environment as a learning environment the activities of autistic kid can be examined. The environment can be customized by caretakers based on individual diversity.

Ben Robins, Kerstin Dautenhahn, Paul Dickerson [8] investigates how to encourage and break the isolation of children with low functioning autism using minimal expressive humanoid robots. Here they used KASPAR, a minimally expressive robot for their experiment. From their observations they argued that interacting with KASPER, children can demonstrate some important interact ional competencies. They conclude that simple, low-budget, minimally expressive robots can make possible interactive 'social' games that benefit the children and the wider social environment.

Fig. 6 Minimal expressive KASPAR robot

Megan Davis, Nuno Otero, Kerstin Dautenhahn, Chrystopher L. Nehaniv, and Stuart D. Powell [9] developed a picture based software game particularly for children with autism to improve their understanding of narrative. They investigated about the performance of autistic children using torchstory. They have discussed various design issues such as high visual, high sensitivity to noise, etc. during the development of torchstory software.

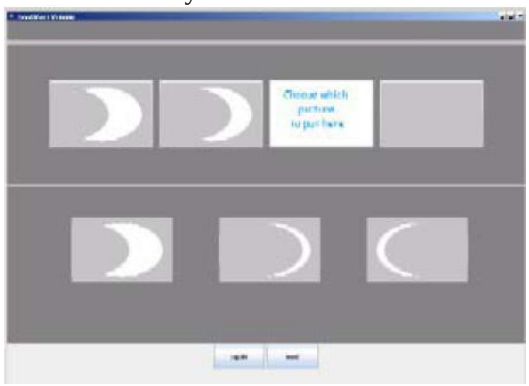

Fig. 7 TorchStory Interface

Proposed Work

Our research work focused on developing healthy and realistic interactive systems that support the rehabilitation of children with autism. At present there is no therapy for autism, but therapists, doctors, and teachers are trying their best to spot, effects of the disorder. To make diagnosis process simple and efficient we plan to design various software tools. Also we focus on developing virtual learning environment to improve various skills of an autistic kid such as learning skills, conversational skill, paying attention, etc. Mostly therapist and caretakers doing paper work for data collection and analysis of autistic kid, we plan to design a tool that reduce the paper work and increase the data accuracy.

Currently we are working on two modules. The first module is focused on developing diagnosing tools which may be useful for doctors to diagnose child's behavior. Also we are in process of developing various teaching aids and games for autistic kids.

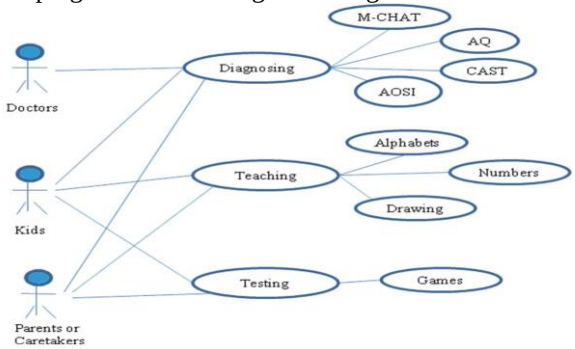

Fig. 8 Module One – use case

The second module is destined for caretakers. The care takers can teach certain behaviors and emotions to their autistic kids using our Robotic interface software tool. Since care takers are non technological experts, we have designed our system in such a way that they can easily create an event by drag and drop. No need of any programming knowledge. Our software interface tool provides an aid to caretakers who can teach their autistic children how to react for different situations.

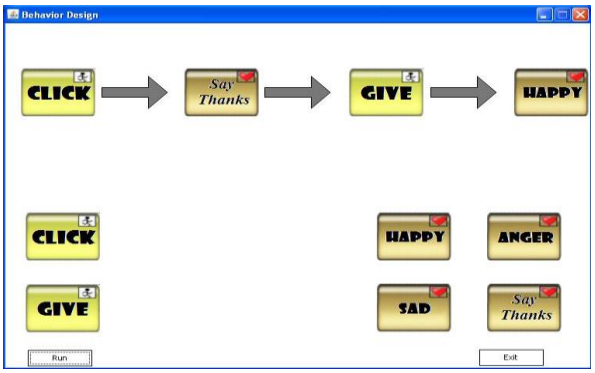

Fig. 9 Software Robot interface

Conclusions

In this paper we studied various innovative technology used in the diagnosis and treatment of autism spectrum disorder. We have explored different software tools and simple expressive robots that are used in the therapy of autism spectrum disorder. We investigated programming interfaces used to program robot behavior to express emotions. We believe that computer assisted innovative technologies will provide a fulfilled and satisfying life to the autistic community.

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