VISUAL PERCEPTION DIAGNOSTIC TOOLS FOR AUTISM CHILDREN: VI-PER GAMES

[a]Faaizah Shahbodin
[b]Helmi Adly Mohd Noor
[c]Zareena Rosli

[a]Department of Interactive Media, Faculty of Information and Communication Technology, Universiti Teknikal Malaysia Melaka, Malaysia
[b]Malaysian Institute of Industrial Technology, Universiti Kuala Lumpur, Johor, Malaysia
[c]Kolej Politeknik Merlimau, Melaka, Malaysia

[a]faaizah@utem.edu.my

Abstract: *Early identification and diagnosis are the solutions to get students on the right road in dealing with the problems related to autism and overcoming them. The objective of this paper is to share the development of autism diagnostic tool using games method as a tool for special education teachers to diagnose visual perception problems among autistic students. The diagnostic tools known as Vi-Per Games was developed based on the ADDIE model. These diagnostic tools show that it can assist and help teachers to diagnose their autistics students without the needs for teachers to have some experience and knowledge of diagnosing visual perception. This prototype will be a high-tech solution to diagnose visual perception problems designed for autistic children.*

Keywords: Autism, Serious Games, Special Education, Visual Perception Problem

INTRODUCTION

According to Howlin P., Goode S., Hutton J., and Rutter M. (2004), the number of diagnosed autistic children is increasing. Autism is undetected from birth (Wan and Hisham, 2013) and only when the child is around 18 months of age a brain disorder could be detected (Kanner, 1967). Autism means a condition that causes children to concentrate in their own world. Autism interferes with mental development of children incorporating speech, communication, social interaction, thinking, behavior and emotions. Autism Spectrum Disorder (ASD) is a distributive developmental disorder within individuals in numerous degrees of impairment (Sicile, 2004). For example, although these autistic people look well, their gross motor control is lacking, by and large, they loves to interact with technology and video games and become attached to a particular interest like dinosaurs, trains or outer space. Children with ASD symptoms had more learning problems and other developmental delays. The visual perception problem is very common in autistic children and they often have difficulty in recognizing, remembering, organizing and interpreting visual images. As a result, they are easily confused in situations that involve using written or pictorial symbols for learning (Kurtz, 2006).

This paper aims to review current serious games for autism proposing a new development framework and to describe the development of prototype Vi-Per Games. This paper has been divided into four parts. The first section deals with introduction, Section II describes the related works of serious games for autism and Section III presents the proposed development framework model. Finally, Section IV describes the development of prototype and the last section V concludes the paper and suggests future work for research.

Related works

Recently, therapy and education which include learning and training are the two main purposes for autism serious games development. Autism serious games for therapy have been done with the main purpose therapy for communication

skill, visual motor coordination, social skill, sensory integration, concentration and social behaviors. Teaching and learning process by using serious games for education will help educators and students.

Currently, there are not many research on serious game used as a tool to diagnose and assess visual perception problem for autistic children. Visual perception serious games will be a technological solution to diagnose autistic children's problems. The list of serious games for autism was proposed and adapted by Helmi AMN, Faaizah S, and Naim CP (2012a), Helmi AMN, Faaizah S, and Naim CP (2012b), and Helmi AMN, Faaizah S, Naim CP, Nur FY, Mariana Y, Khoo LMS, and Kamaruzaman J. (2013). Table 1 and Table 2 shows list of serious games for therapy and education for autistic children.

Table 1- Serious games for therapy of autistic children

NO.	PURPOSES/ OBJECTIVES	AUTHOR
1	E-learning environment	Artoni S, Buzzi MC, Buzzi M, Ceccarelli F, Fenili C,Rapisarda B, and Tesconi M (2012).
2	Teaching facial expression	Jain S, Tamersoy B, Zhang Y, Aggarwal JK, and Orvalho(2012).
3	Interaction skills measurement	Bartolome NA, Zorrilla AM, and Zapirain BG (2013)
4	Increasing intelligibility in speech	Sharmin M, Rahman A, Ahmed M, Rahman M, and FerdouS (2011).
5	Speech delays	Hailpern J, Harris A, and La B (2012)
6	Learning emotional and social skills	Yan (2011)
7	Teaching social conversation skills	Zancanaro M, Giusti L, Bauminger ZN, Eden S, Gal E, and Weiss PL (2014)
8	Exploring motion-based touchless games	Bartoli L, Corradi C, Garzotto F, and Valoriani M (2013)

Table 2- Serious games for education of autistic children

NO.	PURPOSES/ OBJECTIVES	AUTHOR
1	Teaching emotion	Abirached B, Zhang Y, and Park J (2012).
2	Social skills	Hourcade J, Bullock RN, and Hansen T (2012).

3	Teaching vocational and dail living skills	Bereznak S, Ayres K, Mechling L, and Alexander J (2012)
4	Teaching basic skills	Hulusica V and Pistoljevic N (2012).
5	Learning facial expressions	Hansen OB, Abdurihim A, and McCallum S (2013).
6	Learning emotion expression	Piana S, Stagliano A, Camurri A, and Odone F (2013).
7	Natural social engagement	Chukoskie L, Soomro A, Townsend J, and Westerfield (2013)
8	Developing social skills	Chen (2013)
9	Emotional learning environment	Bertacchini F, Bilotta E, Gabriele L, Vizueta DE, Pantano P, Rosa F, Tavernise A, Vena S, and Valenti (2013)
10	Facial expression and emotion	Schuller B, Marchi E, Baron-Cohen S, O'Reilly H, Pigat D, Robinson P, Davies I, Golan O, Friedenson S, Tal S Newman S, Meir N, Shillo R, Camurri A, Piana Stagliano AS, Bolte S, Lundqvist D, Berggren S, Baranger A, and Sullings (2014)
11	Learning words	Al-Khafaji N, Al-Shaher M, and Al-Khafaji M (2013)
12	Emotion training in the contex of financial decision-making	Jercic P, Astor PJ, Adam MT, Hilborn O, Schaaff K Lindley C, Sennersten C, and Eriksson J (2012).
13	Imaginative play	Bai (2012)
14	Imaginative skills	Porayska PK, Anderson K, Bernardini S, Guldberg K Smith T, Kossivaki L, Hodgins S and Lowe I (2013)
15	First Aid Learning	De Urturi ZS, Zorrilla AM, and Zapirain BG (2012)

Developmental Framework

The Developmental Framework was developed as depicts in Figure 1. This diagram shows the overall developmental framework model that served as a guideline to engage all the referred diagnosis method. This was adapted to the development of the prototype design and research question solutions based on the Vi-Per Games development phase.

Vi-Per Games is a name for Visual Perception Games. In terms of content, the prototype Vi-Per Games was developed based on the famous and well known multimedia development model namely ADDIE. ADDIE stands for Analysis, Design, Development, Implementation, and Evaluation. It consists of five-phase systematic model used to guide through the process of creating multimedia products for a variety of settings. Each phase of the ADDIE model is an important element of the

design process. In each phase, decisions, iteration and testing are made for ensuring the effectiveness of the game experience.

Prototype Development
a. Software
The prototype was implemented on the Multimedia authoring tools which required to design the user interface of visual perception games. In other words, the combination of various tools made the system more powerful. The software involved in this study was (i) Adobe Illustrator CS5 (ii) Adobe Photoshop CS5, and (iii) Adobe Dreamweaver CS5. Adobe

illustrator was needed in order to create and edit the needed image in visual perception games. These elements were then imported to flash. Adobe Dreamweaver CS5 was used in Vi-Per Games to design the web based environment. It delivers powerful new tools that support Hypertext Preprocessor (PHP) based content management system. The PHP is free software released under the PHP License and can be set up on most web servers. It is also a standalone shell on almost every operating system and platform for free. Scripting based on PHP also been uses to serve as games engine and main component in this prototype.
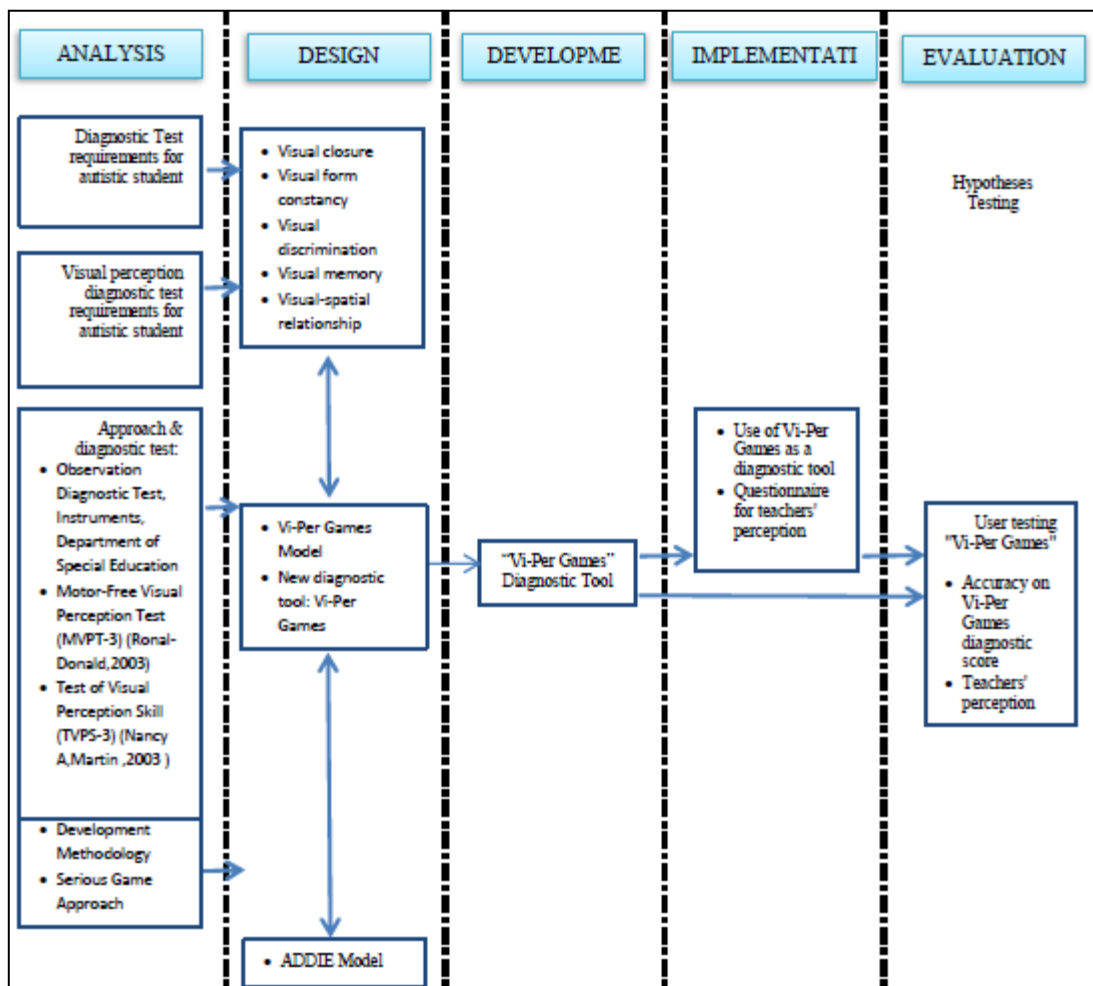

Figure 1- Development framework

b. Game interface

As the saying goes, a picture is worth a thousand words. Thus, it is essential to incorporate graphics in order to increase users'

understanding. In this project, two types of graphics were incorporated, vector and bitmap. Vector graphics or vector images define the curves and shapes in a picture and they are

stored as algorithms or a set of mathematics equations. Each game will start with the introduction montage (Figure 2). Autism student can view their diagnostic report after he/she completed their games (Figure 3). There

are five parameters to diagnosing visual perception problems from proposed by Chalfant & Schefflin (1969), namely visual closure, visual discrimination, spatial relationship, visual memory, figure-ground and lastly visual form constancy.

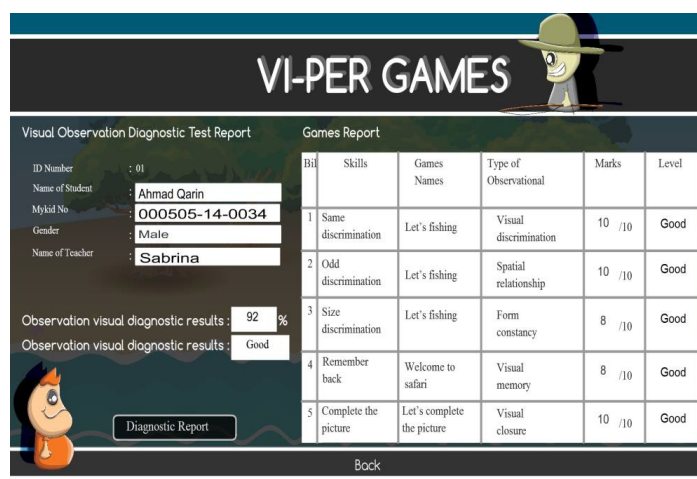*Figure 2- Let's go fishing game 1 exercise interface*

Figure 3-Diagnostic Report Interface

CONCLUSION

Serious game is relevant to help several problems such as autism. In this paper, a related work of current serious games for autism; a developmental framework model to diagnose visual perception problem for autism children and the development of prototype were discussed.

REFERENCE

Abirached B, Zhang Y, and Park J (2012). Understanding user needs for serious games for teaching children with autism spectrum disorders emotions. In the World Conference on Educational Multimedia, Hypermedia And Telecommunications. AACE, Denver,Canada: 1054-1063.

Al-Khafaji N, Al-Shaher M, and Al-Khafaji M (2013). M-learning application for autistic children using Android platform. In the Future Trends in Computing and Communication: 16-19.

Artoni S, Buzzi MC, Buzzi M, Ceccarelli F, Fenili C, Rapisarda B, and Tesconi M (2012). Designing ABA-based software for low- functioning autistic children. In the 2nd International Conference on Advances in New Technologies, Interactive Interfaces and Communicability (ADNTIIC'11). HuertaGrande, Argentina: 230-242.

Bai Z (2012). Augmenting imagination for children with autism. In the 11th International Conference on Interaction Design and Children. ACM, New York, USA: 327-330.

Bartoli L, Corradi C, Garzotto F, and Valoriani M (2013). Exploring motion-based touchless games for autistic children's learning. In the 12th International Conference on Interaction Design and Children (IDC '13). New York, USA: 102-111.

Bartolome NA, Zorrilla AM, and Zapirain BG (2013). Autism spectrum disorder children interaction skills measurement using computer games. In the 18th International Conference on Computer Games: AI, Animation, Mobile, Interactive Multimedia, Educational and Serious Games (CGAMES). IEEE: 207-211.

Bereznak S, Ayres K, Mechling L, and Alexander J (2012). Video self-prompting and mobile technology to increase daily living and vocational independence for students with autism spectrum disorders. Journal of Developmental and Physical Disabilities, 24(3): 269-285.

Bertacchini F, Bilotta E, Gabriele L, Vizueta DE, Pantano P, Rosa F, Tavernise A, Vena S, and Valenti A (2013). An emotional learning environment for subjects with autism spectrum disorder. In the International Conference on Interactive Collaborative Learning (ICL). IEEE, Kazan, Russia: 653- 659.

Chalfant, J.C., Schefflin, M.A., (1969). Central Processing Dysfunctions In Children: A Review Of Research (NINDS Monograph No. 9). Washington, D.C.: U.S. Department of Health, Education and Welfare.

Chen C (2013). Developing a tablet computer game with visual-spatial concept jigsaw puzzles for autistic children. Available online at: http://design-cu.jp/iasdr2013/papers/2197- 1b.pdf

Chukoskie L, Soomro A, Townsend J, and Westerfield M (2013). Looking' better: Designing an at-home gaze training system for children with ASD. In the 6th International IEEE/EMBS Conference on Neural Engineering (NER). IEEE, San Diego, USA: 1246-1249.

Clark CA (1970). Serious games. Viking Press, New York, USA.

De Urturi ZS, Zorrilla AM, and Zapirain BG (2012). A serious game for Android devicesto help educate individuals with autism on basic first aid. In: Sigeru O, Juan FDPS, Sara RG, Jose MM, Ana MB, and Juan MCR, (Eds.), Distributed Computing and Artificial Intelligence, 151: 609-616. Springer Berlin, Heidelberg, Germany.

Hailpern J, Harris A, and La B (2012). Designing visualizations to facilitate multisyllabic speech with children with autism and speech delays. In the Designing Interactive Systems Conference. ACM, New York, USA: 126-135.

Hansen OB, Abdurihim A, and McCallum S (2013). Emotion recognition for mobile devices with a potential use in serious games for autism spectrum disorder. In: Ma M, Oliveira MF, Petersen S, and Hauge JB (Eds.), International Conference on Serious Games Development and Applications, 8101: 1-14. Springer Berlin, Heidelberg, Germany.

Helmi AMN, Faaizah S, and Naim CP (2012a). Serious game for autism children: Review of literature. International Journal of Social, Behavioral, Educational, Economic, Business and

Industrial Engineering, 6(4): 554-559.

Helmi AMN, Faaizah S, and Naim CP (2012b). A review of serious game for autism children. In the International Conference on Computer Games, Multimedia, and Allied Technology: 90-95.

Helmi AMN, Faaizah S, Naim CP, Nur FY, Mariana Y, Khoo LMS, and Kamaruzaman J (2013). Developing a hybrid visual perception game using the ADDIE approach for autism.

Australian Journal of Basic and Applied Sciences, 7(3): 1-4.

Hourcade J, Bullock RN, and Hansen T (2012). Multitouch tablet applications and activities to enhance the social skills of children with autism spectrum disorders. Personal and Ubiquitous Computing, 16(2): 157-168.

Howlin P, Goode S, Hutton J, and Rutter M (2004). Adult outcome for children with autism. Journal of Child Psychology and Psychiatry, 45(2): 212-229.

Hulusica V and Pistoljevic N (2012). LeFCA: Learning framework for children with autism. Procedia Computer Science, 15: 4-16.

Jain S, Tamersoy B, Zhang Y, Aggarwal JK, and Orvalho V (2012). An interactive game for teaching facial expressions to children with autism spectrum disorders. In the 5th International Symposium on Communications Control and Signal Processing (ISCCSP). IEEE, Roma, Italy: 1-4. https://doi.org/10.1109/ISCCSP.2012.6217849

Jercic P, Astor PJ, Adam MT, Hilborn O, Schaaff K, Lindley C, Sennersten C, and Eriksson J (2012). A serious game using physiological interfaces for emotion regulation training in the context of financial decision-making. In the European Conference on Information Systems (ECIS). Barcelona, Spain: 207-221.

Kanner L (1967). Autistic disturbances of affective contact. Acta Paedopsychiatrica, 35(4): 100-136.

Kurtz LA (2006). Visual perception problems in children with AD/HD, autism, and other learning disabilities: A guide for parents and professionals. Jessica Kingsley Publishers, London, UK.

Piana S, Stagliano A, Camurri A, and Odone F (2013). A set of full-body movement features for emotion recognition to help children affected by autism spectrum condition. In the International Workshop on Intelligent Digital Games for Empowerment and Inclusion: 1-7. Porayska PK, Anderson K, Bernardini S, Guldberg K, Smith T, Kossivaki L, Hodgins S and Lowe I (2013). Building an intelligent, authorable serious game for autistic children and their carers. In: Reid D, Katayose H, and Nijholt A (Eds.), Advances in Computer Entertainment, 8253: 456-475. Springer Berlin, Heidelberg, Germany.

Schuller B, Marchi E, Baron-Cohen S, O'Reilly H, Pigat D, Robinson P, Davies I, Golan O, Friedenson S, Tal S, Newman S, Meir N, Shillo R, Camurri A, Piana Stagliano AS, Bolte S, Lundqvist D, Berggren S, Baranger A, and Sullings N (2014). The state of play of ASC-inclusion: An integrated internet-based environment for social inclusion of children with autism spectrum conditions. In the 2nd International Workshop on Digital Games for Empowerment and Inclusion (IDGEI '14). ACM, Haifa, Israel.

Sharmin M, Rahman A, Ahmed M, Rahman M, and Ferdous S (2011). Teaching intelligible speech to the autistic children by interactive computer games. In the ACM Symposium on Applied Computing (SAC '11). TaiChung, Taiwan: 1208-1209.

Sicile KC (2004). Autism spectrum disorders: The complete guide to understanding autism. Berkley Publishing Group, New York, USA.

Wan NWA and Hisham A (2013). Aku bersyukur anakku autisme. Telaga Biru, Selangor, Malaysia.

Yan F (2011). A sunny day: Ann and Ron's world an Ipad application for children with autism. In the the 2nd international conference on Serious Games Development and Applications

(SGDA'11). Lisbon, Portugal: 129-138.

Zancanaro M, Giusti L, Bauminger ZN, Eden S, Gal E, and Weiss PL (2014). NoProblem! A collaborative interface for teaching conversation skills to children with high functioning autism spectrum disorder. In: Anton N (Eds.), Playful User Interfaces: 209-224. Springer, Singapore.