

# INTERACTIVE GAMES USING KINECT 3D SENSOR TECHNOLOGY FOR AUTISTIC CHILDREN THERAPY

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**Abstract:** Autism children usually have problem with eye - hand coordination which vital in managing daily activities. The problem of eye - hand coordination in children with autism were caused by a lack of sensory and motor function that also complicates their daily activities. Generally, health therapy needs a lot of times and patience whether from the patient, therapist even their family. Most important feature in health therapy are motivation and interactive. However, conventional methods of therapy that is often seen in practice somewhat include less element of motivation and interactive. Autism children need to do repetitive activities every time therapy sessions been done. Repetitive activities cause children having less interest to participate ongoing therapy sessions. Other than that, the therapy process usually requires a long time to be implemented that cause the relatively high cost had to be paid by the patient's family. The use of technology is seen more effective and less boring for child with autism. However, the use of games technology require gamer to hold game controller. Autism children with eye - hand coordination problem have difficulties to hold the controller. In addition, the existing specifications of game also more concentrate in adult and normal children. Therefore, the objective of this study is to identify symptom of eye-hand coordination problem and develop serious game using Kinect technology as the solution for the problem faced by autism children. This technology provides a low-budget solution costs of therapy and games based on 3D sensor without the use of control equipment which must be held or touched by hand.

**Keywords:** Autism, eye-hand coordination, Kinect games, virtual reality

## INTRODUCTION

Autism occurs throughout the world regardless of race, religion, and country. According to a study, five out of 10 000 children suffering from autism and the ratio of boys than girls by four times (Naysrudin, 2013). Eye-hand coordination is visual processing of information to control the hand movement. Research shows that, apart from the cognitive and social problems, children with autism have a motor skills problem in terms of eye-hand coordination when pointing towards the target (Crippa et. al, 2013). Problem of eye-hand coordination in autism lead to negative feedback and refusal when they need to participate in daily activities such as writing and wearing clothes.

Development of technology nowadays leads to improvement in autism children therapy activities. Psychotherapy were introduced, where innovative use of computers as a way of therapy (Baranowski et. al, 2009). The use of computer games (psychotherapeutic) in therapy sessions have attracts the attention of children with autism and they are more likely to engage in conduct therapy sessions compared to conventional methods (Wilkinson et. al, 2008). In line with the development of computer games, games using virtual reality technology are now seen as one of the initiatives and positive stimulation therapy for children with autism (Maskey et. al, 2014). The latest virtual reality technology is Kinect. Kinect have sensor that can recognizes body movement, body posture and voices in three dimensions. Kinect games does not require players to hold or use any remote control, but instead it uses the information from the sensor to identify the position of player hands, feet and head then interpret it into the virtual world. In addition, the Kinect sensor, which also has the function of voice and facial expression recognition, enable user's picture taken and compared with the previous image so that, users can log in to the system and access a saved game only by let Kinect see them. Kinect technology is less costly than other 3D camera available that can reduced parents problems regarding therapy cost.

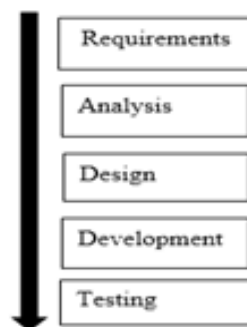
## METHODS

The guidelines on designing games for autism children are (Hocine and Gouaich, 2014):

- a) Customizability: Each child have different skills. Things that are rewarding to one individual may be unpleasant for another person. Therefore, the games should be created to address the unique capability and needs of each child that support high degree of customizability. The customizability elements such as modifying multimedia contents, reward, play times and body movements.
- b) Evolving Tasks: The game should have progression by increasing the complexity of games tasks of the similar activities and keep demanding in terms of motor, cognitive and social skills.
- c) Unique goal: The game should have a unique and focus goal. The game design should associated with one single task and a clear set of movements the child can afford (e.g. move hands to touch objects) to promote goal oriented motor actions development.

- d) Instruction: Understanding the game are important mostly for disability children. Using Picture Communications Symbols and iconic images on what movements they need to do also what body part to be used will help the children.
- e) Rewarding: For kids with disability like autism, rewarding a point or extra times might not value for them unless for a normal children. The positive motivator for them is an audio or video effects that entertaining and fun such as cheerful music, applause and funny cartoon character animation.
- f) Repeatability and predictability: Repeatability is important to see the level of mastery. It also give predictions of future task.
- g) Transitions: The time of restarting a sessions or switching to another level must be minimized to avoid children loss concentration during the meantime of transition.
- h) Minimalistic Graphics: children may be distracted by overly visual elements. Graphic elements should be clearly shape and not overlap. The use of color also should be reduce for some children that feel relaxed only with black and white images but nervous when dealing with many other colors.
- i) Clear audio: The same principles applied to sound like minimalistic graphics. The audio should be clear, simple cheerful, and functional to the game task and keeping children's attention.
- j) Dynamic stimuli: animations and and music should be provided along the entire game session to avoid children lose concentration.
- k) Serendipity: Enjoyment in games increase when there are surprise or wonder create by audio visual effects.
- l) Avateering: Avatar can be a usable features to attract children during the gameplay sessions.

Game prototype development methodology and research plan for this study are based on Agent-Oriented Software Engineering (AOSE) model that often used in the development of serious games (Rodriguez et. Al, 2011). Phase in the development of games based on this method is, Requirements, Analysis, Design, Development and Testing. This model was used because (1) the development of the game is based on descriptive methodology in which the objective (goal) is clear (2) the results of a phase output becomes the input for the next phase which supports effectiveness of each phase [15]. Figure 1 shows the methodology used in this research.

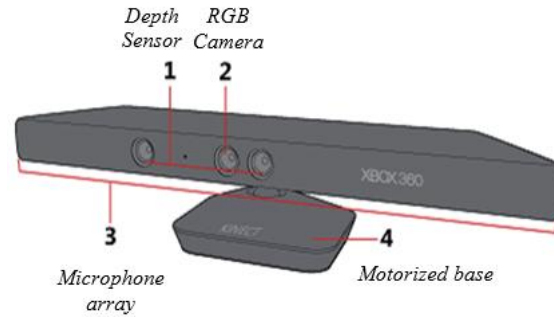


**Figure 1. AOSE Methodology model for game development**

The pilot study of this research are to analyze user reaction when using Kinect games for eye-hand coordination problem. The study conducted among autism children which are students at Special Education Centre, National University of Malaysia. 10 students take part and video recordings are held during the play time sessions and the reactions are record to analyze.

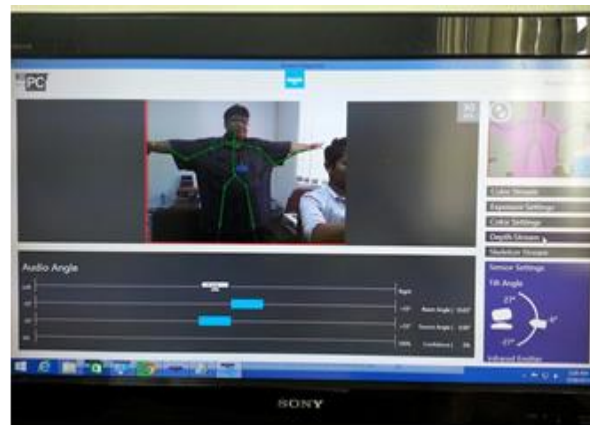
## **FINDINGS AND ARGUMENT**

The Microsoft Kinect (Figure 2) is a set of sensors developed as a peripheral device for use with the Xbox 360 gaming console. Kinect has an RGB camera and a dual infrared depth sensor with a projector and an infrared sensitive camera. Using image, audio and depth sensors, it can detect movements, identifies speech of users, and allows them to play games using only their own bodies gesture as the controller.



**Figure 2. Kinect Sensor Diagram**

In the beginning of Kinect released (for Xbox 360 in November 4, 2010), Microsoft did not initially release any drivers or SDKs to enable the Kinect to be used with personal computer. However, it attracts many developers to initiate open source projects to develop drivers, SDKs and APIs (Application Programming Interface) to be used with personal computers. Figure 3 shows the Microsoft Kinect viewer for Windows.



**Figure 3. Tracking skeleton movement**

Figure 4 shows the first door game prototype for improving student's memory and concentration skills. It is played by turning cards in an attempt to match pairs in as few steps as possible. At the start of the game, all the cards on the grid are face down. Now the player needs to click on one to turn it over, and then try to find the second card that matches it. Both cards will return to a face down position in case, the second card does not match. All the cards on the grid should be matched in the fewest possible steps. Here, the idea is to use player's memory to remember the location of cards after they are turned face down. Figure 5 shows another game developed for autistic children.



**Figure 4. A screenshot of the first door game prototype**

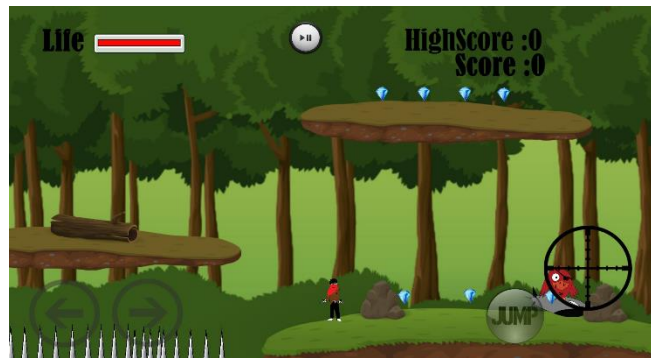


Figure 5. A screenshot of JUMP game

## CONCLUSIONS

This pilot study was conducted to analyze the effectiveness of Kinect game for eye - hand coordination therapy on autism children. Therefore, this study is expected to help autism children improve the eye-hand coordination skills for better adaptation in normal life. Games should be playable and accessible for a wide variety of autism's patients. It is important to involve as many patients as possible, as not every autism child can play a certain game, due to physical and/or cognitive limitations and this should not prevent them from playing the game.

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