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Detecting Dyspraxia through an Augmented Reality Serious Game (ATHYNOS)

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ABSTRACT: Emerging technologies and ICT have changed the lifestyle of society, all scientific areas are taking advantage of technology to get a real development. Dyspraxia disorders in children presents a comparative study between two therapies, one using a manual puzzle and other using ATHYNOS, an Augmented .Augmented Reality Serious Game(ATHYNOS) developed to help children with the Dyspraxia to improve their motor skills and hand-eye coordination. The analysis of data results showed that exist a significant difference between both methods, proving that children playing with ATHYNOS got less time in the activity execution and also better performance.

KEYWORDS: serious games; augmented reality; dyspraxia; ATHYNOS.

I. INTRODUCTION

Serious games are part of a new emerging field that focuses on computer games that are designed for non-leisure and often for educational purpose. Therapists realizes the benefits of using serious games as an assistive tool in Psychotherapy. Serious games acts as a learning therapy for kids having "DYSPRAXIA". Dyspraxia is a learning disorder that has two difficulties namely muscular coordination and organization. It affects around 55% of the population.

It is well known that each person inherits a significant amount of genetic information from their parents and as they grow up, their environment and experiences also shape their characteristics and development. There are more young people than adults with learning disabilities. Learning disabilities are quite common. These children need additional support at school to get the best chance to learn academic skills.

A learning disability is a consequence of a difference in the way that a person's brain is "wired." People, children with learning disabilities are as intelligent as their peers. But they may have difficulty reading, spelling, writing, reasoning, recalling and organizing information if left to figure things out by themselves. With the appropriate support and intervention, children with learning disabilities can succeed in school. Not all minds think alike in the world.

Learning disabilities are very variable from one child to another. One person could struggle with reading and spelling, while another loves books but can't understand math. Or maybe another child may have difficulty understanding what others are saying or communicating out loud. The problems are very different, but they are all learning disabilities. Some of the learning disabilities are Auditory Processing Disorder (APD); Dyscalculia, Dysgraphia, Dyslexia, Language Processing Disorder, Non-Verbal Learning Disabilities, Visual Perceptual/Visual Motor Deficit, Attention Deficit Hyperactivity Disorder (ADHD), Dyspraxia and Executive Functioning.

For this specific case study, the Dyspraxia disability was analyzed because of the effects that it produces in the attention deficit in children of scholar age. The Dyspraxia or motor difficulty refers to issues with movement and coordination whether it is with fine motor skills (writing, cutting,) or gross motor skills (jumping, running).



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II. LITERATURE SURVEY

1. Augmented Reality Game Development, Michael Lanham, says They have been around for a few years, but the release of Pokemon Go was a game changer that catalyzed the market and led to a massive surge in demand. Now is the time for novice and experienced developers alike to turn their good ideas into augmented reality (AR) mobile games.
2. Augmented Reality JavaScript Developers, Daniel Wise, Explains Augmented reality is the idea of mixing computer-generated media with someone's view of the real world. AR.js provides a framework and set of utilities to develop augmented reality applications efficiently just using web technologies.
3. Create Augmented Reality Apps using Vuforia 7 in Unity, Rithesh Kanjee, Practical Augmented Reality thoroughly considers the human factors of these systems, including sensory and motor physiology constraints, monocular and binocular depth cues, elements contributing to visually-induced motion sickness and nausea, as well as vergence-accommodation conflicts.

III. EXISTING SYSTEM

In the existing system augmented reality is introduced in which a camera based detection process used to detect the hand movement of the kids when selecting the image. The eye movement also being detected in which the response rate of the child is being analyzed.

Disadvantage of Existing system:

1. It uses computational analysis.
2. Produces Poor Performance.

IV. PROPOSED SYSTEM

In the Proposed system, Machine learning based AR system with ultrasound sensor based hand movement tracking is developed. The hand movement from left to right , right to left , confusion rate is being analyzed. The device is connected with the hardware circuit which enable the music playing module which will provide motivation for the kids. The therapy is applied for analyzing the learning capability of the children.

Advantages of Proposed System:

1. Used for Learning therapy for Kids
2. Designed with Embedded systems to reduce the eye effect by mobile phone
3. Improves the child learning capability.

V. ATHYNOS DESIGN PROCESS

For this , four stages were considered (analysis, design, development, and evaluation) on the software lifecycle. The analysis phase comprises the study of the requirements, taking into account the scenarios, pedagogical aspects, learning contents and playful. This process determines a set of stages whose primary objective is to identify the different elements of the production of the SG. In this phase several criteria were establishing :

- Goal for the game
- Fun add-ons (sounds, video, 3D effect, etc.)
- Rewards (for game progress and game success)
- Desirable child-centered content
- Randomness to provide surprise

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Concerning learning activities, five criteria were chosen:

- Organization of the learning material
- Formative feedback on learning
- Appropriate language (even as images)
- Consistency of learning presentation
- Interactivity (to increase engagement)

In the design phase, digital resources necessary for the creation of the SG must be created, including 2D and 3D illustrations, structured objects, sounds and music that reflect the analysis specifications. Also, it defined the interrelation between educational content and training. This stage emphasizes the relationship of the educational objectives and the challenges of the game, which are developed implicitly. It was defined the rules and mechanisms of play. Kinect enables players to control and interact, using a natural user interface with gesture commands.

The development phase describes the tools and software resources required to create the SG. For ATHYNOS, a desktop platform (Microsoft Windows) was established using Unity 3D as a powerful gaming engine, combined with the C# high-level programming language. It has excellent compatibility with Unity, and you can reach the widest audience with 25+ platforms across mobile, desktop, console, TV, AR, VR and the Web.

For the graphic design, Adobe Illustrator allowed the imagery development (characters, props, environments), Adobe After Effects software was used to implement/prototype animations and to optimize output presentation. Finally, Adobe Premiere Pro allowed editing professional videos. On the other hand, audition tools like Ableton Live permitted to create a music sequence, and Adobe Audition was used for audio post-production.

For the creation of Augmented Reality application, the Software Development Kit (SDK) Vuforia was selected, which enables that other devices consolidate the game's interfaces. Kinect for Windows SDK 2.0 was also used to combine all game elements through a natural user interface. All those tools, under an integrated development environment, using the best programming practices.

The SG evaluation phase is complemented by two roles: the end user and the expert, which consolidate the different aspects that were developed in the previous steps. In this process, goal validation, feedback, and testing technic were verified.

A. Game Characters

ATHYNOS has eight characters; each one is represented by an avatar of identification and completes actions. A scenario contains scenes and multimedia elements, which are part of therapeutic challenges. It is important to mention that characters are well-known personalities from Ecuadorian culture (Figure 1).



Figure 1. ATHYNOS characters.

B. How to play ATHYNOS

- [1] The therapist explains the procedure to start the game.
- [2] Each child has to login into the game through an avatar selection. There are six avatars, which represent children from Ecuadorian regions. Each child must choose one and then write his/her name using a natural interface.
- [3] A video is shown to explain the characters present in ATHYNOS.

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- [4] After that, a menu of scenarios is displayed, which contents different type of therapies. There are three levels (beginners, intermedium and advanced), the difficulty level corresponds to the skills and capabilities of the player.
- [5] The therapy showed in Figure 2 represents Shapes scenario. The goal of this scene is to match the character on the right side with the correct shape on the left side. Inside of the game, a database saves registers of time, success, and failures occurred during the play mode.



Figure 2. Screenshot of Shapes scenario in ATHYNOS.

VI. SIMULATION AND RESULT

The boxplot and the descriptive analysis of data confirm that the execution time of children's activities is longer when they work with manual therapy activities. Meanwhile, when children used ATHYNOS game, there was a significant decrease in the time used by children at the therapies. As a result, there was an improvement in their motor level and hand- eye coordination based on boxplot of performance. Also, it was observed that the variability of the times obtained by children was homogeneous in both cases, which shows that all children have similar abilities in both methodologies.

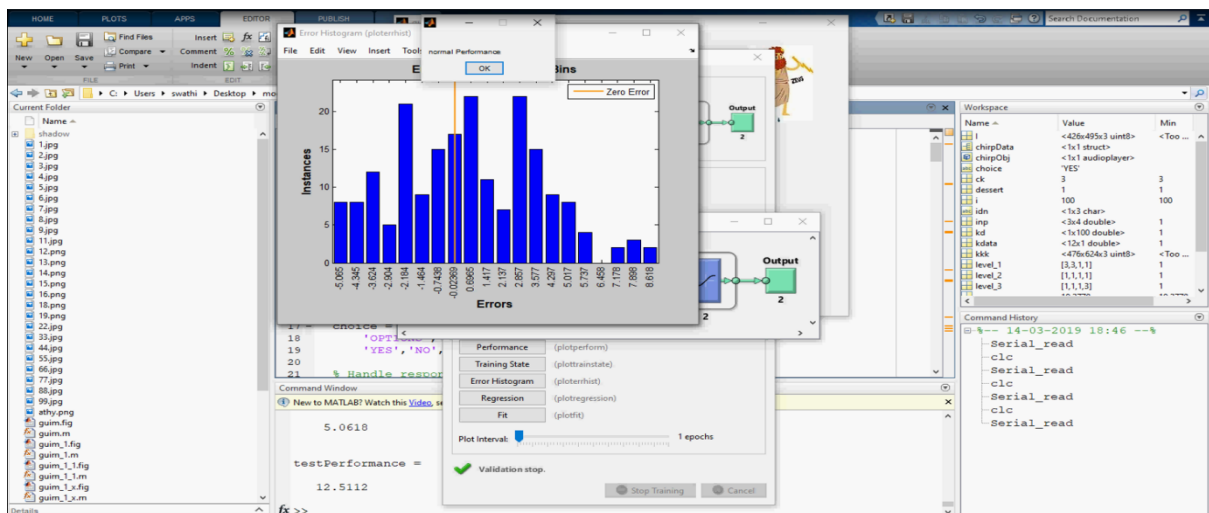


Figure 3. Result Screen



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VII. CONCLUSIONS

The primary goal of this study was to improve children motor skills through ATHYNOS game. It helps children to be more engaged in physical training and improving their bodily-kinesthetic intelligence taking into account that children are doing successfully. It is relevant since it motivates children to meet the challenges set in the game.

ATHYNOS Serious Game can be used as a good alternative in the age of the Information and Communication Technologies (ICT) and emerging technologies. Several studies have proposed interventions of therapies for different disabilities based on emerging technologies (AR) using natural user interface.

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