

The Use of Tablet Games in Cerebral Palsy Treatment

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Summer 2013

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Introduction

Cerebral Palsy is a motor condition that is discovered in those it affects at a young age. A prominent aspect of Cerebral Palsy is movement impairment, but along with that comes neurodevelopmental disabilities that do not pertain to movement. These disabilities can affect behavior and cognitive function; this is due to the nature of Cerebral Palsy. [Rosenbaum, 2006]

The area of the brain in question is the Cerebrum. Damage to the portion of the brain controlling moving is the culprit behind this condition; this damage can take place during pregnancy, birth, or after birth up to age three. If brain development goes awry and the brain does not function as it should or is not properly connected a myriad of problems can manifest. Cerebral Palsy is a non-progressive condition; the damage that causes the condition will not worsen over time, the brain may continue to develop but the underlying damage will remain the same.

Generally, but especially at a young age, the brain has a large amount of plasticity; it can change physically and functionally. When actions cannot be performed as was originally designed, over time the brain will adapt and find new ways to do those same tasks. The

treatment of Cerebral Palsy usually involves developing a person's motor skills as much as possible or finding ways to work around their lacking motor skills. [Hansen et al, 2000]. In an aim to help improve motor functions, this project focused on creating a game that would tap into arm movement. This runner style tablet game has easily accessible touch buttons for all players, but due to the erratic movement of some patients with this condition, touching the right portions of the screen at the right time could be difficult. A custom button system can be used to make game-play easier. The Fury Troll Island game (named for the native island creatures) makes use of the player's motor skills. It also requires the player to think out certain actions in the game to complete levels; this encourages the player to use and advance their movement and cognitive functions.

This game also has the potential to be played in conjunction with a robotic playmate. Romibo, the robot in question, can be assembled with plastic laser cut pieces that snap together. The mechanical parts can be screwed onto the plastic skeleton of Rombo. The addition of Romibo could help the children engage in the game and lead to greater improvement.

Approach and Methodology

This project aimed to incorporate as much arm movement as possible without over challenging the player. The game was made so that players could gain more control over how and when they move their arms.

The game engine Unity was used for this project with the programming language C#. For the objects in the game to perform actions, scripts, written with C#, house the code for the game. Fury Troll Island consists of three levels; Beach, Ocean, and Volcano. The background

world was created with flat planes or a special terrains. To have the character appear to run, it is set on a running animation while in an idle position. The world the character is in is then programmed to move beneath its feet.

There are a number of objects placed on the path in front of the character in one of three lanes. To collect the items the character must run through the items, and they will appear in an inventory on the left side of the screen. To control which lane the character is in the player must tap the “Left” and “Right” buttons. The current collectable items are energy items and weapon items. The weapon and energy items were created using cubes that unity provides. A collision function had to be added to the script attached to the items to make them respond to the character running through them. When the character runs through the items they are added to the inventory located on the left side of the screen. To use items, the player must select (tap) them from the inventory.

At the beginning of the game the character starts with a maximum energy of 1000, and as the game clock ticks, the current energy decreases. If the player has energy items in the inventory, they can be used whenever the player sees fit. Each energy item selected from the inventory will increase the current energy by three hundred energy points; however, the current energy will never exceed 1000. If the character runs out of energy, a button will appear on the screen that will restart the current level. The character’s health will remain the same and everything that was in the inventory when the character ran out of energy will still be there.

Weapon items have particular elements associated with them: water, grass, fire, and flying. The weapons are set up this way because there are four types of enemies a player can encounter in the game with the same four elements associated with them. However, enemies are affected differently depending on what type of elemental weapon was used against it.

Element Chart:

	Water Enemy	Fire Enemy	Grass Enemy	Flying Enemy
Water Weapon	Not Effective	Very Effective	Not Effective	Normal
Fire Weapon	Very Effective	Not Effective	Very Effective	Normal
Grass Weapon	Very Effective	Not Effective	Not Effective	Not Effective
Flying Weapon	Normal	Normal	Very Effective	Normal

All enemies start with their health levels at five. When hit by an element that is very effective against them, that enemy's health will decrease by two health points. An elemental weapon that imparts normal damage will reduce the enemy's health by one, and a weapon that is not effective will only take away half of a health point. Once an enemy's health has reached zero or less, that enemy will disappear from the game scene.

If the character is hit by an enemy, which will happen if any enemy has health above zero, ten health points will be subtracted from the character's health. When the character's health reaches zero the game will go back to the main title screen for the game and everything will reset. There is no way to regain health in any of the levels of the game and the enemies cannot be avoided; either they are destroyed or the character receives a reduction in health.

To generate enemies into the level, empty game objects are created. Empty game objects are the same as any other plane or cube or cylinder used to create an aspect of a game in unity, except that an empty game object is not a physical object. Scripts can be put on empty game objects and they can be moved around the scene, but it is a virtual object. An empty game object became an Enemy Spawner and has the enemy spawner script attached to it. The script will produce the designated enemies at the specified times. Most of the Enemy Spawners release three or four enemies every ten seconds, on average.

Fury Troll Island starts with a main menu screen with a play button. When the player taps the play button the first level, Beach, starts. The first level lasts for one minute and thirty seconds. In the first level the character is running towards the beach and once the character reached the ocean a button will appear that will take the player to the next level of the game, Ocean. In the beach level the character was set on a running animation. In the Ocean level the character is standing idle on a cube that is made to look like a floating crate. As in the first level, the crate and character are stationary and the Ocean move underneath them. Items and enemies are placed similarly in this level as they were in the previous one. The third level features a volcano. The character, with the running animation, is placed on a bridge situated above volcanic landscape.

Results

This game yet to be tested on children with Cerebral Palsy. When the time comes to present Fury Troll Island to children who could benefit from it, the level of difficulty will be examined. Also if the game is confusing or difficult to understand, watching a person from the targeted audience play the game will illuminate any problems. Because this game is for those with motor

impairment, watching for how well they can control the game will give clues as to how buttons and game objects should be set up. If the player is having trouble accessing the right elements and pressing the buttons at their disposal, then perhaps the game should be slowed down. Once the game is given to children to play and we record how often they run out of health, the percentage of items they pick up, and assess their feedback, the game can be adjusted accordingly.

Conclusion and Future Work

There are elements of this game that may require acclimation, so to make game play easier for the player an option for a tutorial could be beneficial. It would be accessible from the main menu and could be rewatched at the player's leisure. This tutorial would be a side scrolling screen that would display the enemies and weapon items; it would explain the health and energy system and which weapons work best on which enemies.

Currently the game is not connected with the Romibo playmate robot. Romibo would interact with the player physically and virtually. The game representation of Romibo would aid the character in the levels by helping defeat enemies and collecting items that could potentially lead to increasing the player's health points. The physical Romibo would mimic some of the phrases and actions on the virtual robot but would also give praise and encouragement to the player. Fury Troll Island in conjunction with Romibo could give children the motivation to enhance their motor and cognitive skills.

References

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