Networked Exercise Game for Preventing ACL Injuries.

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Introduction

When compared to male athletes, female athletes who participate in high-risk sports are 4 to 6 times more likely to suffer from anterior cruciate ligament (ACL) injuries. Studies have shown, however, that prevention programs that emphasize plyometrics, muscle strengthening and improved jumping and landing techniques can significantly reduce ACL injury rates. Despite having proven to be effective, these prevention programs have a notoriously low compliance rate. In this work, we evaluate the effectiveness of an interactive, networked exercise video game used as a prevention program for reducing the risk of ACL injury.

While few studies have looked at using video games as a preventative measure for muscle injuries, a number have looked at them for their potential in other fields, such as education, as a result of their typically high compliance rate among students. By examining the causes of this high compliance rate and the factors that lead to engagement in players, we can prepare a good framework for what a game needs to be an attractive option to both genders. Using this information will help to build an interactive game with a higher level of compliance than ordinary prevention programs.

Materials and Methods

In order to develop an interactive networked game it was decided that the Unity Engine should be used for game development. This would allow for the game to be developed on a variety of platforms quickly, allowing for testing to see which platform high school athletes prefer to use. Furthermore, the process of designing this game would produce a framework that could be used to easily and quickly build additional networked games using the Unity Engine.

The first networked game, Paddle, was built using the Unity Engine version 5.1.1 and Xcode version 6.4 with all of the scripting done using the C# programming language.

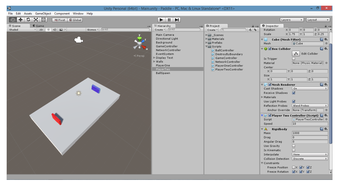

Figure 1: The game was built using the Unity Game Engine, making it easy to develop versions of the game for a variety of platforms.

Results

Using the Unity Engine, we managed to produce our first networked exercise game, Paddle. This game involves two players, each controlling an eponymous paddle that they move up and down inside of a box using leg lifts as an input. The game will generate a ball that moves in a random direction at a random speed that the players will bounce back and forth at each other using their paddles to reflect the ball's direction. A player is given a point if they can get the ball past their opponent's paddle.

Each player's paddle is controlled with a leg lift. In the mobile version of the game, this is accomplished by using the phone's accelerometer to recognize the proper movement. The resulting variable will produce a negative value when the player's legs are held together and a significant positive value when the player's legs are raised at the highest desired angle of elevation. Rather than have this variable control the paddle's position, which produced jerky and erratic movements, the control variable was tied directly to the paddle's velocity. This forces players to be able to hold their leg at a certain degree of elevation for a period of time before the paddle began to move to the desired position, giving them a better stretch.

The game makes use of simple client-server connections. One player starts a game instance which they host. Another player can then join the game as a client causing both players to transition to the game scene which waits for a ready signal from both players before starting the game. For a player to host a game, they simply have to give their game instance a unique name and set the number of players they want to allow to connect. For a player to join a game, they have to search through the list of currently running game instances and click on the one they want to join. While the game only supports two active players, it does allow for observers, clients who cannot interact with game objects but can observe a game being played. This serves a dual-purpose of allowing a player to observe the game being played on a screen other than their mobile device and allows their friends to watch them playing over the network.

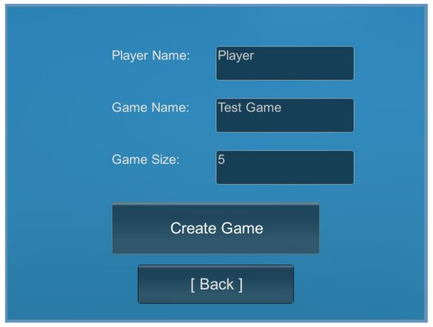

Figure 2: The game interface makes it easy to setup networked games against friends.

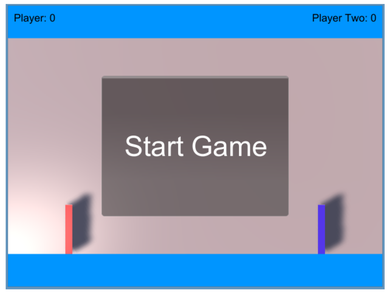

Figure 3: The game waits for both players to signal they are ready before starting play.

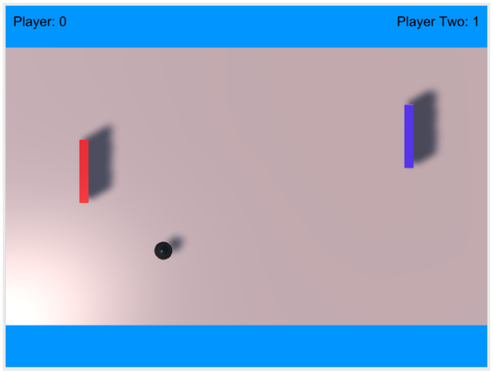

Figure 4: Once both players are ready, the game instantiates a ball and play begins!

Conclusions

With the first version of Paddle completed, testing can begin to gather user information to gauge the game's effectiveness as a preventative measure that can maintain compliance. This will provide feedback that can be used to produce better, more interactive games in the future.

Going forward, it would be helpful to validate the game control using a VICON marker system to gauge the effectiveness of the game as an exercise tool for muscle injury prevention. The data, combined with the project files, would serve as a useful framework for building better, interactive, networked games in the future.

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