

Exergaming: Video Games as a form of Exercise

Neehar Reddy Cherabuddi
Department of Computer Science
Brown University
Providence, Rhode Island – 02906

Project website: <http://www.cs.brown.edu/people/awilson/exergaming-home.html>

Abstract

Video Games have always been a source of entertainment for adults and children. Over the years, people have worked at making these games more than just a form of recreation. One such effort was targeted at making video games exercise oriented. Hence, Exergaming. Exergaming incorporates exercise into video games. Traditional interaction techniques, for a long time, have been restricted to various combinations of variations in button, directional pad and/or joystick placement etc. Exergaming, needs interaction techniques which are more physically demanding and such interaction techniques are not always cost effective. We are going to look at a more recent technology, the Wii Remote, a.k.a the “wiimote”, which provides for interesting interaction techniques with its unique accelerator and optical sensor technology. We make innovative use of this technology to create a first person Soccer game, “Wii!!! Soccer”. We use the wiimote’s Infra-Red capturing capabilities to track the player’s foot motion and recognize gestures such as kicking, passing etc.

1 Introduction

The field of Exergaming, a portmanteau of “exercise” and “gaming”, has become more and more prominent over the last few years. The first Exergames can be dated

back to the 1980’s, in the field of Virtual Reality, with games like the *HighCycle* and *Virtual Racquetball*. The *HighCycle* was an exercise bike that a user would pedal through a virtual landscape. *Virtual Racquetball* tracked the position and orientation of an actual racquet that was used to hit a virtual ball in a virtual environment.

One of the more memorable and successful Exergames “Dance Dance Revolution”, was released by Konami in 1998. It was highly effective - exercise-wise - and very cost effective and so it brought exergaming into the mainstream.

When Nintendo released the Wii in 2006 and the WiiFit in 2007, it became clear that the fusing of exercise with video games was successful and that a new appreciation was being developed for such games.

Since the release of the Nintendo Wii, wiimote technology has been used innovatively in numerous ways. The use of accelerometer and optical sensor technology has made the wiimote a widely popular device as an alternative source of input among many developers. We have seen Johnny Chung Lee of Carnegie Mellon University using the wiimote to build an array of applications from head-tracking and finger tracking to low-cost multi-touch whiteboards.

We are also going to use the wiimote technology innovatively to track the motion of the foot. We are going to have an Infrared light source attached to a player's leg emitting infrared rays and we will use the infrared cameras of the wiimote to capture the motion of the foot and recognize gestures.

2 Earlier Work

First Person Soccer was not the first game idea that we experimented with. A prototype was developed initially for a Tron like game. A player had to navigate through a maze-like arena, building walls in his trail and then had to force his opponents to crash into these walls. The player's velocity in the game was directly dependent on how fast he/she ran while playing. Though the prototype was based on the same technology, it helped us recognize the kinds of games that it could service.

3 The Game*

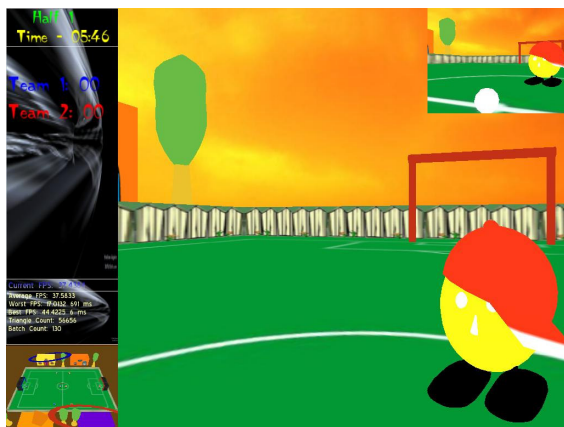


Figure 1: Screenshot from the Game . Notice all the user Interface Features

“Wii!!! Soccer” is a first person perspective soccer game which tries to simulate the experience of real soccer. By utilizing the

wiimote's accelerometer and optical sensor technology, we translate gestures in the real world and map them to actions in the game world. The player can therefore, walk, run, pass, shoot naturally using intuitive gestures.

4 Setup*

A player uses a nunchuck attached to a wiimote for navigation in the game. Ideally we wanted to use an Infrared Emitter, reflective tape and a second wiimote to track the reflected IR, to track the player's foot motion and gestures such as passes, kicks and acceleration. As we were unable

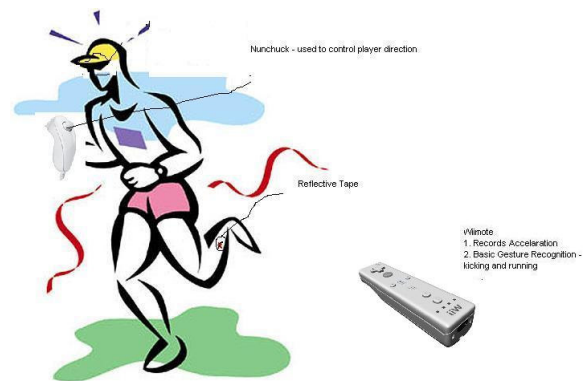


Figure 2: Basic Setup Of Our Game

to procure reflective tape of sufficient grade, we are currently using IR Sensor bars strapped to the player's leg.



Figure 3: Players were required to wear infrared emitters attached to their legs in order for the wiimote to detect motion and gestures

*For detailed information on the Game, control scheme, playtesting and feedback refer to “Exergaming: A Fusion of Exercise and Video Gaming”. Author: Ahmad Wilson, Brown University. 2008.

This kind of setup, as we expected, turned out to be quite uncomfortable for the players. It limited their freedom to move, as too much movement disoriented the Infrared sensor bars strapped to their legs.

It is also important to note that the wiimote, used to capture the IR emitted by the sensor bar, was calibrated to work best when the distance to the user was about 40-45 inches.

5 Controls *

5.1 Nunchuk

1. A user navigates through the game by using the analog stick of the nunchuk.
2. Holding the Z-Button of the nunchuk down allows the player to move at a constant velocity in the direction the player is looking.
3. Tapping the C-Button of the nunchuk allows the player to switch to a teammate closest to the ball.

5.2 Foot Tracker

1. Holding the Z-Button of the nunchuk and running increases the player's velocity. The faster the player runs, the faster he moves in the game and similarly the slower a player runs, the slower he moves in the game.
2. Executing a kick gesture to the players left (away from the wiimote), translates to a player passing a ball to a team mate in his direction. If no teammate is found in the player's direction, an aerial pass is executed in the player's direction. The force of the pass is proportional to the distance of the teammate from the player
3. Executing a kick gesture forward, translates to a kick in the game. The force

applied to the ball is proportional to the velocity of the kick.

5.3 Interface Features

1. An overlay to the left top of the screen is home to the game information such as game score, time remaining and current half. An overlay to the left bottom of the screen displays an overhead view of the field to help the player navigate and locate his/her teammates.

2. One of the major problems we encountered developing a First Person Soccer games was visualizing the ball's position when the player is too close to see it. We experimented with tilting controls, i.e, a player was provided with controls to look up and down, and found that given the pace of the game, this can turn out to be both frustrating and disorienting. Therefore, a second camera is placed at the user's feet. This allows the player to look at the ball, without any discomfort. If a player gets close to the ball, the foot camera pops up at the top right of his/her viewport, enabling him to have a secondary view of the ball.

3. The game also provides dual player support through split screen.

5.4 Play Testing

Our initial playtests have identified scope both for the game and improvements in the game.

The gestures for passing and shooting seemed to be pretty intuitive to players, but they seemed to have difficulty using the controls on the Nunchuk simultaneously. Also, we realized that there is need for a better calibration as players often move to and away from the Infrared capturing

*For detailed information on the Game, control scheme, playtesting and feedback refer to "Exergaming: A fusion of Exercise and Video Gaming". Author: Ahmad Wilson, Brown Univeristy. 2008.

wiimote while playing and this throws off the gesture recognition in the game.

Lastly, though the dribble camera was designed with the intention of assisting player's locate the position of the ball when the player is in close proximity of it, it's use was not immediately perceptible to the players. The dribble camera pops up without any warning or indication. Due to the fast pace the game, players', at times, do not realize that the dribble camera even came up on their screen. We think an animated compass styled overlay always pointing towards the location of the ball and also a text alert that pops up informing the player about the dribble camera would assist greatly.

6 Tools and Libraries Used

6.1 Ogre

Ogre (Object –oriented graphics engine) is an open-source cross-platform, scene-oriented 3-D engine written in C++. It abstracts all the details of using the underlying system libraries like Direct3D and OpenGL and provides an easy and intuitive interface for developers to produce applications utilizing hardware-accelerated 3D graphics. Ogre also provides excellent support for integrating with other open-source libraries, for example, libraries for physics, sound, AI etc.

This project utilizes Ogre for all its rendering, and uses Ogre's excellent integration features to integrate with libraries for Physics and Wiimote Input.

6.2 Newton

Newton Game Dynamics is an integrated solution for real time simulation of physics environments. The API provides scene

management, collision detection, and dynamic behavior.

OgreNewt is a library that wraps the Newton Game Dynamics physics SDK(software development kit) into an object-oriented set of classes that facilitate integration with the OGRE 3-D engine.

We use OgreNewt and Newton to handle all the physics by detecting and managing all our collisions.

6.3 WiiYourself

WiiYourself is an open-source library that is used to interface wiimotes with the computer. The wiimotes use Bluetooth technology to connect and communicate with the computer. WiiYourself abstracts all details of connection and provides an easy to use interface.

In our game, each player has a wiimote tracking his foot. The wiimote keeps track of the players' acceleration and recognizes gestures for kicking and passing. The wiimote has to be calibrated to the distance between the player and the wiimote. For our game, best performance can be achieved when this distance is between 40-45 inches.

6.4 Maya



Figure 4: A render of the Soccer Field from Maya

Maya is a high-end powerful, integrated 3D computer graphics and 3D modeling, animation, visual effects, and rendering solution developed by Autodesk.

We have used Maya to model the level, character meshes and to create character animations for walking, running and kicking.

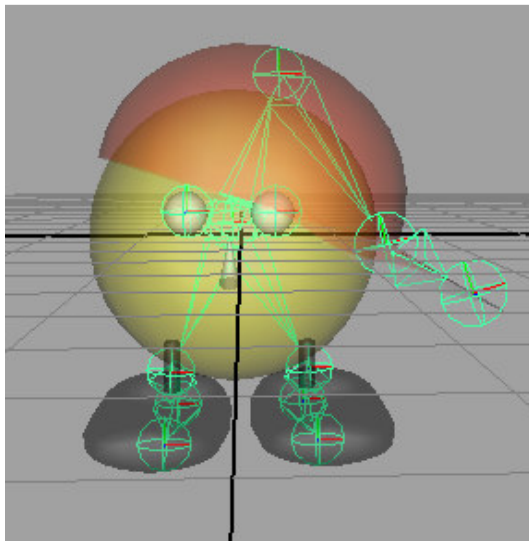


Figure 5: Character Mesh And Character Skeleton

6.5 LFA Scene Manager

The **LFA Scene Manager** is a tool to help Maya artists use the OGRE 3D graphics engine. It provides an easy to use interface to export content that artists create in Maya to formats that are readable by OGRE. The level created in Maya is exported into a DotScene format and the meshes for each object in the scene is exported into a .mesh format. These are loaded into OGRE using a customized DotSceneLoader. A DotSceneLoader is used to load a scene from a DotScene file into the OGRE rendering engine. Our DotSceneLoader is customized to

automatically attach physics objects to each of the loaded objects.

6 Conclusion & Future Work

Most games based on the Nintendo Wii use hand motion as input to the game. We think that this project is only a start and establishes that a variety of games can be developed by using the wiimote alternatively to track feet.

Wii!!! Soccer will add as a novel game to the field of Exergaming. It's initial playtests have shown us that players are looking for more interesting interaction techniques. It not only shows us the willingness of players to accept non-traditional but also their inclination towards more realistic techniques of interaction, which might be physically demanding. We believe that a further study focusing on the extent to which players are willing to get involved in the experience of a game, and more specifically how physically demanding a game can and should be, is required to validate such a claim. This project could serve as a starting point of such a study.

Weaknesses have been identified in both the controls and the user interface. Future work would be both on improvements in present features such as a better calibration system and a better gesture recognition with support for more gestures and on the addition of new features such as graphical overlays to assist in making the game more intuitive.

The game and the gameplay videos can be found on the authors' website and the authors will be glad to assist you with the game and related issues

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