Loading… The Journal of the Canadian Game Studies Association
Vol 6(9): 113-120
http://loading.gamestudies.ca

A Physiological Feedback Controlled Exercise Video Game

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The purpose of this study was to use physiological feedback in active video games to control the heart rates of players. Media consumption is increasing as is obesity and sedentary lifestyles. Use of active video games is on the rise. However, not many active video games provide rigorous exercise. Physiological feedback controls can be used to increase or decrease the physical demands of an active video game presented to the user. DanceBeat is introduced as a physiological feedback controlled active video game designed with the intent to control players' heart rates. The research examined whether DanceBeat is effective at controlling a player's heart rate. Furthermore, an attempt was made to see if DanceBeat's heart rate control can be used to keep players' heart rates in the zones classified by the ACSM for light and moderate intensity exercise. Participants were a convenience sample of students attending the University of Calgary. A repeated measures crossover design was used. Participants were exposed to two bout of DanceBeat, each with different desired heart rate range recorded. DanceBeat has the potential to be an entertaining and effective form of exercise. The program is open source code and will be made freely available. It is hoped that this research will motivate the inclusion of physiological feedback in the development of future active video games.

The Health Benefits of Interactive Video Game Exercise

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Cognitive and Functional Learning Laboratory, Physical Activity Promotion and Chronic Disease Prevention Unit, School of Kinesiology, University of British Columbia

The purpose of this presentation was to discuss the work currently being conducted at the Physical Activity Promotion and Chronic Disease Prevention Unit at the University of British Columbia. Dr. Bredin highlighted that the primary objectives of her research program in exergaming are to: 1) evaluate the effectiveness of interactive video games on indicators of health status in comparison to traditional forms of training, 2) determine which exergaming platforms elicit the greatest physiological benefits, and 3) examine the preferred activity choices of boys and girls. Her team revealed that interactive video game exercise can lead to greater exercise adherence and larger improvements in health-related physical fitness than traditional

cycling. Moreover, interactive video game cycling produced and maintained (across 6 wk) higher affective attitude than regular cycling (which directly mediated the differences in exercise adherence and health-related fitness). They also provided direct evidence for the potential of whole body interactive gaming to lead to increased metabolic demands in comparison to traditional exercise. She also highlighted that when given the choice young adults will choose to engage in interactive video games rather than traditional sedentary video games. These findings have important implications for health promotion through physical activities that incorporate whole body interactive gaming.

Committing to Physical Activity: How Women over Forty use Exergames

Lorna Boschman, School of Interactive Arts and Technology, Simon Fraser University

In industrialized countries, half the adult population fails to meet national recommendations for a minimum level of physical activity. Lack of time or interest are frequently cited as reasons for avoiding exercise. Exergames may play a role in combating inactivity, since they can be played in short bursts of time, can be scaled to accommodate diverse fitness levels, and are fun to play.

Presented at the symposium were preliminary results from a study of women over forty that use exergames. The larger study looks at factors in exergaming use, with an emphasis on learning more about the influence of co-exercisers in both a community centre setting and at home. At the beginning, mid-point and end of the study, participants are interviewed, tested for aerobic endurance, lower body strength and balance, and complete a weekly chart of physical activity.

Results show that younger participants were able to achieve a higher aerobic endurance score, even though their weekly physical activity total was less. Participants who practiced the Wii Fit Plus most frequently at home also tended to engage in more physical activity overall, and also achieved a higher aerobic endurance score. Many of the participants improved their standing balance and used the Wii Fit games to adjust their posture toward a more balanced stance. Profiles of participants representing four different approaches to physical activity were discussed: “Lulu” initiated a number of activities but prefers variety to a steady schedule; “Mimi” used the Wii at home and with the community centre group and had a direct approach – just do it; “Urban” disliked the Wii system and preferred to just get outside and move; and “SweetPuppy” used the Wii Fit Plus games to gradually increase her physical activity level. As more results are available from additional participants, a clearer understanding of the role of competition, goal setting, and commitment to physical activity for a lifetime will be discussed.

The Kinect Interface, SDK Development and Available Resources

John Bristowe, Senior Analyst, Microsoft Canada

The Kinect for Windows SDK beta is a programming toolkit for application developers. It enables the academic and enthusiast communities easy access to the capabilities offered by the Microsoft Kinect device connected to computers running the Windows 7 operating system. The Kinect for Windows SDK beta includes drivers, rich APIs for raw sensor streams and human motion tracking, installation documents, and resource materials. It provides Kinect capabilities to developers who build applications with C++, C#, or Visual Basic by using Microsoft Visual Studio 2010. The following resources are available to interested parties.

Resources:

* Kinect SDK: http://research.microsoft.com/kinectsdk

* CodePlex: http://www.codeplex.com/

* Channel 9: http://channel9.msdn.com/

* DreamSpark: http://www.dreamspark.com/

* Imagine Cup: http://www.imaginecup.com/

* Microsoft Faculty Connection: http://www.microsoft.com/education/facultyconnection/

Context in Motion – Motion Control Systems from the Atari to the Nintendo Entertainment System

Jerremie Clyde, Associate Librarian, Centre for Arts & Culture: Games and Related Media, University of Calgary

Motion control is not a new gaming trend, neither is the hope that home digital video game systems would encourage or enhance health. In 1983 the Atari joyboard appeared and Amiga's president heralded the new dawn of foot-controlled video games would lead to people getting more exercise. Around the same time DataSoft inc.'s LeStick provided a system of control not unlike the Wii's wii-mote, maybe more accurately its nun chuck attachment. Looking these and other innovations in motion control and exergames for home digital video games can help put current control schemes and expectations of them in perspective. It is possible that this early attempt at motion control suggests a natural progression in game peripherals in this direction, so that even if the current trend does not last one might reasonably anticipate there will be another attempt in the future. Looking at why it didn't work in the early 1980's can provide cautions to current developers and designers. The motion control devices in the early 1980's failed to provide the intuitive interface that users seemed to expect from a controller that was suppose be an extension of their own bodies. Both market response and popular culture references to the

devices also suggest the crucial importance of the peripheries integration with software; that the input device alone if it lacks compelling or engaging games is not enough. Finally external factors, a crash in the digital video game market brought on by such external factors as a glut of poor quality games on the market and the advent of home computers ended the early attempts to move into exergaming and motion control. The examination of the video game industries first attempts to develop motion control and exergaming systems provides a useful context to research and developers working with the latest iterations of these devices.

Design of an exergame promoting fitness and social interaction in children with Cerebral Palsy

Nicholas Graham, PhD, Professor, School of Computing, Queen's University

Children with Cerebral Palsy (CP) suffer decreased mobility as they enter adolescence, increasing their difficulty in performing traditional forms of physical exercise and in getting together with other children. In a collaborative project with Holland Bloorview Kids Rehabilitation Hospital in Toronto, we are developing a distributed, persistent world exergame for kids with CP. In this talk, I survey the challenges in developing such a game, including the design of an exergaming station that is physically safe and enjoyable for kids with CP to use, techniques for smoothing the input from a cycling ergometer, techniques for balancing games for people with different physical abilities, and techniques for making exergames engaging over the long term.

Exergaming and the Implications for Physical Literacy

Dwayne Sheehan, PhD, Assistant Professor, Mount Royal University

The development of fundamental movement skills (FMS) is at the heart of promoting physical literacy in children. The competence to perform FMS coupled with the confidence to try new activities could encourage children to embrace a positive attitude about being active for life. Balance is one FMS that can be specifically targeted for improvement and assessment.
This paper explores the school-based application of exergaming technology as it relates to balance. The written scientific content related to the construct of balance is limited with regard to elementary school aged children participating in physical education. A review of the literature also suggests there is very little written about FMS and a relationship to exergaming. Sophisticated electronic balance platforms are not usually available where an analysis of postural stability is required. This study has used a methodical approach to develop an inexpensive, reliable, and valid method of quantifying the postural stability in children. In this regard, the Balance Error Scoring System for Children (BESS-C) is proposed as a new assessment protocol. The intra and inter-rater reliability, as well as the concurrent validity of the BESS-C was

determined to be very good. The BESS-C protocol appears to be sensitive enough to the compensatory reactions of pre adolescent balance to be used as a functional alternative to a force-plate or balance platform.
Third and fourth grade students in this exergaming study improved their postural stability significantly over a 6-week period compared to a control group. The improvements in postural stability were also evident in a parallel intervention of children receiving more traditional training in agility, balance, and coordination. Gender did not have an effect on the changes in postural stability for either grade.
General observations of the students using the exergaming centre were categorized by organization and administration, curriculum design, and student participation.
Based on the results of this study, it is apparent that, for the purpose of improving balance in elementary school children, the use of exergaming is emerging as a practical option available to physical educators. Specifically, the Wii Fit™ has promising potential as an inexpensive and enjoyable tool for the development of balance.

Integrating Multi Game Interfaces on a PC

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Larry Katz, PhD, Professor and Director, Sport Technology Research Lab, Faculty of Kinesiology, University of Calgary

Abstract: Kinect Sensor has a large advantage over the other exergame interfaces, while there are several problems on the sensing by the sensor. The problems are: (1) occluded motion cannot be detected, (2) high speed motion (e.g. punch motion) cannot be detected accurately, and (3) motion that does not change distance from the sensor cannot be detected. In this presentation, an integration of multi game interfaces (e.g. Kinect Sensor + Wii Remote Plus) is proposed to solve the problems. As an example, a karate training system in a mixed reality environment using Wii Remote Plus is demonstrated, and then we describe that an addition of Kinect Sensor to the system makes it possible to build the mixed reality without any markers.

Design Considerations in Exergaming

Richard Levy, PhD
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This paper presents design issues that are central to the creation of exergames. Unlike games that are fantasy based, games created for sport or exercise must provide the player with an environment where objects behave as they would in reality. Before beginning this task, game developers must first consider if the intended game is for training a particular sport or supporting

an exercise program. In the latter case, the game needs to keep score and to calculate the performance of the individual but, may not require an environment that simulates reality. A most important aspect of this type of game is to provide motivation to the game player. In contrast, games created to simulate the play of a sport must mimic reality. For example, a tennis training game must have a ball the bounces off the court surface as it would at a tennis court. In addition, the surrounding space must provide visual clues that simulate the look and feel of an actual tennis court. Accomplishing this task requires special attention to the laws of physics. Newton's first, second and third laws provide the basis for any game that contains balls, pucks, and other projectiles which must be thrown or hit with a bat or stick. Ultimately, knowledge about the behavior of the materials that are used to make sporting equipment is critical to getting realistic behaviors from these objects. Such knowledge requires in depth material testing. Finally, these games must have a controller with actions that simulate actuate the action of a hand or a bat. Creating games that provide benefit to its users can be challenging, but if properly designed offers many benefit to the game player

The Motivation to Move

Andrea Oh, XRKADE Director, Performance Health Systems Inc. Northbrook, Illinois

Applying video game technologies can be applied so as to engage participants to become more physically active. Video games are a significant part of the lives of people of all ages and abilities. By introducing our younger generations to positive, motivating physical activity experiences, we can promote long-term involvement into adulthood.

Exergames can give adults alternatives to traditional exercise that are intrinsically motivating and entertaining and thereby increase compliance long-term exercise programs. We can also provide our aging population with activities that exercise their mind and bodies in functional ways that can help to promote better quality of life in their later years.

Programs can also be designed to provide social interaction and address the need to "belong" to a group or community, as well as promote communication between participants, encouraging teamwork or small group interactions. However, there are many challenges using retail active games and consoles in a commercial environment.

Exergame programs should focus on intrinsic motivation and fun, and should have both health and skill related components such as agility, balance, coordination, power, speed and reaction time, and spatial awareness, as well as increase brain fitness requiring the participant to exercise pattern recognition, system thinking, and patience.

Integrating the Kinect Sensor on a PC: Implications for Exergaming Research

Kazumoto Tanaka, PhD, Associate Professor, Department of Information and Systems Engineering, Kinki University, Japan

Larry Katz, PhD, Professor and Director, Sport Technology Research Lab, Faculty of Kinesiology, University of Calgary

Microsoft Xbox 360 Kinect has a novel interface called Kinect Sensor to capture player's motion for the game control. Advantages of the sensor are: (1) no need for holding controllers, (2) three-dimensional scene recognition makes it possible to build exergame in mixed reality world where mixed reality refers to the computer systems that combine the real world image with computer rendered virtual image, (3) low cost, and (4) software for developing application is opened to the public. In this presentation, two possibility considerations with integrating the sensor on a pc are described. The one is exergaming in mixed reality world. The exergaming has three advantages: (1) interaction by using player's own image in the world will promote the game reality, (2) mixed reality provides the third person point of view environment and promotes motor skill acquisition (Tanaka, et al., 2010), and (3) interaction with real peers can be realized and will promote trainee's motivation. The second consideration is a tailor-made exergame. The three dimensional recognition of player's motion makes it possible to select trainee's motion for the game control according to trainee's need. Furthermore, magnitude of the motion (e.g. joint angle) needed for the game control can be adjustable according to the trainee's condition.

Dance Dance Evolution: A look at the past, present and on possible future of exergame devices

Anthony Whitehead PhD, Professor and Director School of Information Technology, Carleton University

Abstract: In this talk, we will take a brief examination of past and present exergame devices and try to conceive the reasoning behind their eventual demise. This is followed up by an examination of our full body exergame system that encourages a more complete movement experience and therefore offers a better exercise opportunity. We will examine some test results and expose currently known issues that need research in such a system.

Controlling a Multi-Agent Simulation Environment Using the Microsoft Kinect

Jeff Wintersinger, Faculty of Science, University of Calgary

LINDSAY Composer is a component-driven framework for constructing agent-based simulations of biological systems. My work with Composer has focused on using the Microsoft Kinect to create a gesture-based user interface for interacting with simulations. Supported interactions include manipulation of one's perspective based on head position, control of one's

viewpoint inside the simulation using hand gestures, and the ability to move and rotate simulation objects using an on-screen cursor controlled by one's hand.

Composer also provides a visual programming language called SwarmScript, which allows one to control the behaviour of agents (e.g., single cells or organelles) simply by drawing connections between boxes on a 2-D canvas. By combining SwarmScript with data generated by the Kinect, non-programmers have the ability to create natural-UI systems utilizing the full power of Composer's graphics and physics engines. To illustrate this, I created a simple predator-prey game in an afternoon, in which the user's hand controls the prey, with the objective of evading the predator. The generality of Composer's toolset grants it value in domains outside biological simulation; taken alongside Composer's integration of Kinect sensor data, as well as the rich and extensible SwarmScript language, Composer promises to provide an excellent platform for prototyping exergame interactions.

Controlling the Yuck Factor

Hanan Yaniv, PhD, Associate Professor, Faculty of Education, University of Calgary

The 'Yuck' factor is the sum of energies that prevent us from doing. This paper addresses the portion of the population that doesn't do because the 'Yuck' is too high for them to do things that are important - like exercise or move. The following is a map of forces that divert the energy from 'Do' to 'Don't Do' and possible controls that might influence the balance. It is assumed that a range of personality profiles can be defined that can highlight the specific 'Yuck' control mechanisms for different profiles. This paper is an invitation to research these controls, measurement tools for each and expected behavioural changes as outcomes.