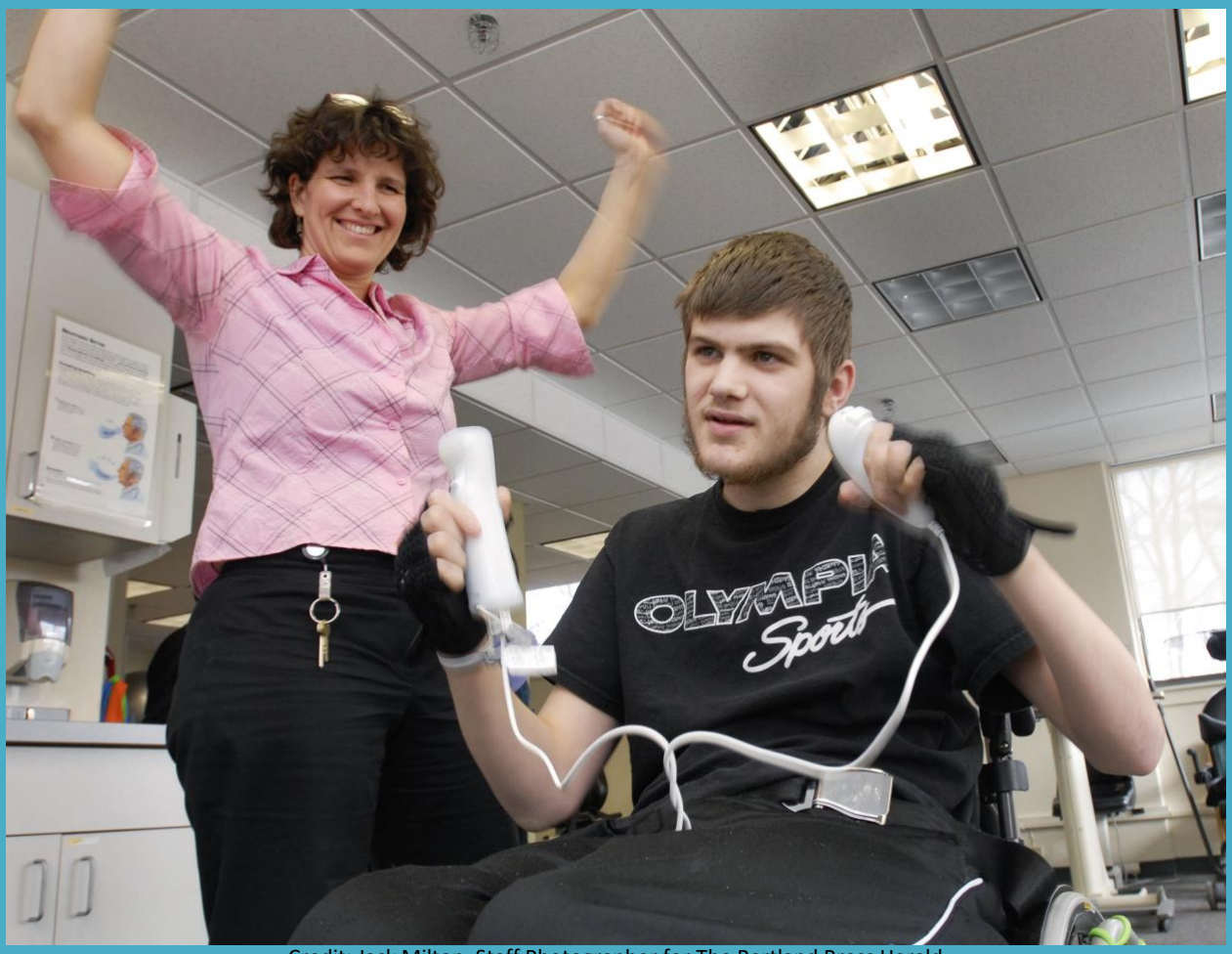
Using Video Game Technology for Healthcare

A Researched Proposal by Adam Saucier

August 2, 2012



Credit: Jack Milton, Staff Photographer for The Portland Press Herald

Table of Contents

Abstract

Video games have been a large part of popular culture since their emergence over 30 years ago. They have been used primarily for recreation and competition by dedicated players of all ages, genders, and ethnicities from around the world. With the recent popularity of motion-sensing technology used for video gaming, which Nintendo started with its Wii console and Microsoft and Sony quickly followed with their Kinect and Move devices, doctors and physicians have begun to see their potential as powerful tools for physical and psychiatric therapy. This proposal will look at the current uses for motion-sensing video games in healthcare and recommend additional methods, as well as compare the three most prominent devices currently on the market by taking their prices, technological potentials and overall values into consideration. Finally, it will recommend the best device, based on the above criteria, to be adopted in physical and psychiatric therapy centers.

Definition

A video game is defined as "any of various games that can be played by using an electronic control to move points of light or graphical symbols on the screen of a visual display unit."[1] Even though body movements are becoming a prominent way to control video games, they are still always converted to electronic signals using infrared sensors, cameras and/or Bluetooth 2.0 wireless technology.

Descriptions

Nintendo Wii

Currently, the most widely-used video game console for physical therapy is the Nintendo Wii, released in 2006 and updated with more accurate motion-sensing technology in 2009. The controllers, called the Wii Remote and Nunchuck (**Figure 1**), work concurrently with the Sensor Bar to pick up the player's position and the movements of the two controllers with infrared sensors. The most important components of each controller are described below in further detail.

Remote
The main device used for motion detection, the remote is held in the player's dominant hand. A cursor on the screen follows wherever the player points the end of the remote, which is made possible by an infrared sensor in the controller and below a television screen.

A Button
Used in conjunction with the Remote's pointer, pressing and releasing the A button with a thumb serves multiple functions within games, such as serving a ball in tennis, releasing the ball in bowling or simply confirming a choice in a menu.

Figure 1 – www.engadget.com

Nunchuck
Connected to the Remote via a 12-inch cable is the Nunchuck peripheral, which is held in the non-dominant hand. It also senses motion, but does not have the same pointer ability as the Remote. It contains the rubbery control stick, which is typically used for moving the player's on-screen character and is controlled with the thumb.

[1] video game. (n.d.). Collins English Dictionary - Complete & Unabridged 10th Edition. Retrieved July 26, 2012, from Dictionary.com website: http://dictionary.reference.com/browse/video game

Microsoft Kinect

The Microsoft Kinect, launched in North America in 2010, is a direct competitor to the Nintendo Wii. The sensor itself is a black plastic horizontal bar that is positioned above or below the television's display (**Figure 2**). It features an RGB (red green blue) camera, depth sensors and multi-array microphones that work together with an Xbox 360 gaming console to provide full-body 3D motion capture, facial and voice recognition[2].

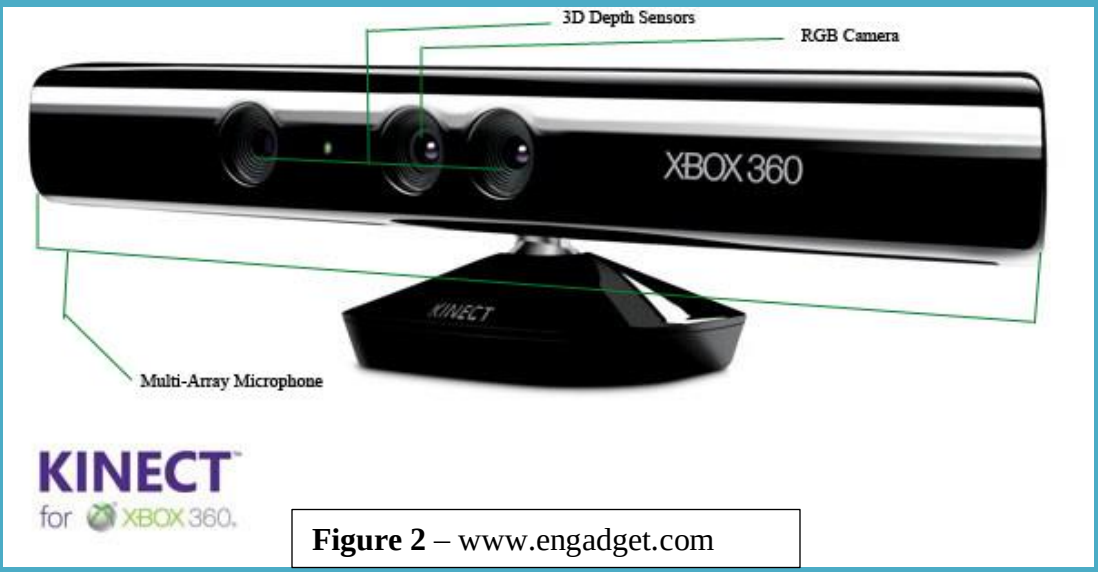


Figure 2 – www.engadget.com

RGB Camera

This standard RGB visible-light camera, similar to the webcams found on most modern laptops, is used for capturing the image of the player standing in front of it. It is useful for face recognition, capturing the environment that the player is standing in, and anything else on the visible-light spectrum that a specific game might require.

3D Depth Sensors

These sensors serve several important purposes. They judge the depth of field by emitting infrared radiation and calculating how long it takes for the light to "bounce" back at the device, telling it how far away the person is standing. In addition, they give the camera a three-dimensional perspective by constantly keeping its subject illuminated in infrared light that is invisible to the human eye.[3]

Multi-Array Microphone

The microphones on either side of the device pick up audio cues that are necessary for many games. They make it possible for the software to recognize a player's voice and specific spoken words, or other actions such as claps in a dancing game.

---

[2] Totilo, S. (2010, January 7). *Natal recognizes 31 parts, uses tenth of xbox 360 computing resources*. Retrieved from http://kotaku.com/5442775/natal-recognizes-31-body-parts-uses-tenth-of-xbox-360-computing-resources

[3] Carmody, T. (2010, November 3). *How motion detection works in xbox kinect*. Retrieved from http://citationmachine.net/index2.php?reqstyleid=2&mode=form&rsid=5&reqsrcid=APAWebPage&more=yes&nameCnt=1

Sony Playstation Move

Also released in 2010, the Playstation Move improves upon the ideas set forth by the Nintendo Wii. When connected to a Playstation 3 entertainment system, the Playstation Eye (**Figure 4**) works together with the Motion and Navigation Controllers (**Figure 3**) to accurately capture movement, distance, and spatial orientation of players. These main components are explained in greater detail below.

Figure 3 – www.amazon.com

Figure 4 – www.amazon.com

Motion Controller

The most important means of controlling games with the Playstation Move is the Motion Controller. Made of matte black plastic, it has inertial sensors built into it that sense motion on all three axes (up or down, left or right, and far or near). The distinctive rubber orb on top of the controller contains light-emitting-diodes (LED) that allow the Playstation Eye camera to distinguish it from its surroundings by altering its color instantly. [4] It is held in the player's dominant hand.

Navigation Controller

Though not mandatory for any games, the Navigation Controller adds the potential for more precise control.

Playstation Eye

The Playstation Eye is the camera that the Motion Controller must interact with in order to function. It also contains a microphone for voice recognition.

---

[4] Sinclair, B. (2010, March 11). *Sony reveals what makes playstation move tick*. Retrieved from http://www.gamespot.com/news/sony-reveals-what-makes-playstation-move-tick-6253435

Historical Background

The first commercial video game console came out in 1975. Called Pong, it was a simple game that involved moving paddles on either side of a television screen to prevent a ball from flying off. It was created by Atari and was met with huge commercial success. After that, a new gaming console was introduced every three to five years by major companies like Nintendo, Sega and Sony[5].

Starting with simple 8-bit graphics processors, systems like the Nintendo Entertainment System and Gameboy already had potential as devices capable of improving health. As the years went on and technology rapidly increased, graphics started to increase in detail, more colors could be displayed onscreen and methods of controlling video games became more complex and rewarding.

Before motion controls were introduced to video gaming, psychologists and therapists used video games primarily for psychiatric treatment. A study from 1986 describes a computerized version of a board game, called Busted, which increased juvenile offenders' awareness of consequences for their actions through simulated game play. Authors of the report stated that cooperation in the therapy process was improved.[6]

In 1987, young patients undergoing chemotherapy were instructed to play a video game for 10 minutes. They showed significant decreases in reported nausea symptoms when compared to children who were instructed to play with non-digital books or toys[7]. This showed that video games have the ability to absorb young patients' attention further than traditional forms of entertainment, distracting them from a painful procedure.

http://www.sciencephoto.com/media/253212/enlarge

When combined with the more recent advances in motion-controlled video games, this potential to distract from the negative aspects of one's physical or psychological problem makes video gaming a powerful tool in the rehabilitation and recovery process.

---

[5] *A history of video game consoles*. (n.d.). Retrieved from http://www.time.com/time/interactive/0,31813,2029221,00.html

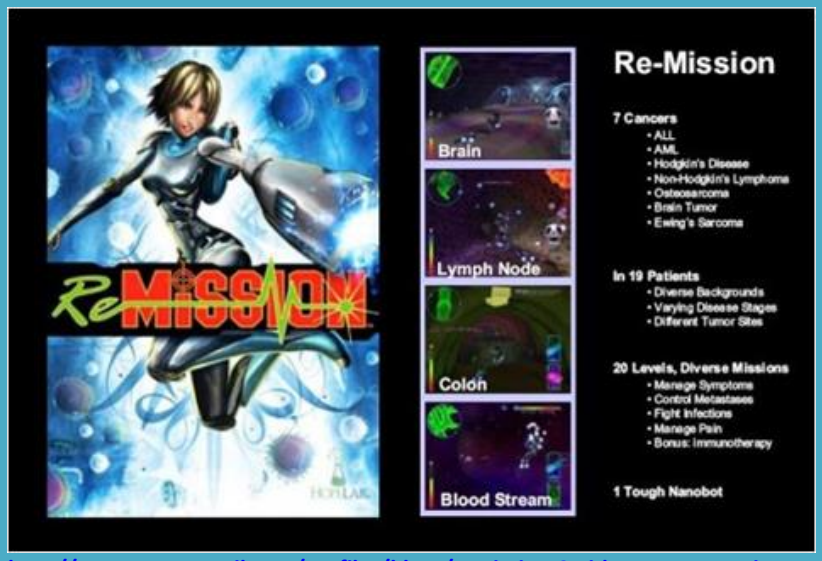
[6] Ceranoglu, T. A. (2010). Video games in psychotherapy.*Review of General Psychology*, *14*(2), 141-146. Retrieved from http://www.apa.org/pubs/journals/releases/gpr-14-2-141.pdf

[7] Redd, W. H., Jacobsen, P. B., DieTrill, M., Dermatis, H., McEvoy, M., & Holland, J. C. (1987). Cognitive–attentional distraction in the control of conditioned nausea in pediatric cancer patients receiving chemotherapy. Journal of Consulting and Clinical Psychology, 55, 391–395

Research

An article published in the *Review of General Psychology* in 2010 collects a variety of studies that prove the benefits of video games in healthcare[8]. These benefits include:

- Video games decreased the anxiety of children about to receive general anesthesia as effectively as medication.
- A study conducted on 35 patients with spinal cord injury allowed them to use their wheelchairs as virtual controllers for car and boat racing games. This caused an increase in the patients' hand-eye coordination and muscle control.
- A video game called *Packy and Marlon* was developed and used successfully to teach children how to manage their insulin levels.
- A video game made specifically for young people with cancer, called *Re-Mission*, taught players about the disease through direct interaction with a character on the screen. Players would fight virtual cancer cells and tumors with chemotherapy and radiation. The study found that patients who played this game took their prescribed medication more frequently than those who did not play it.



http://www.nanopaprika.eu/profiles/blogs/remission-2-video-game-now-in

The article also pointed out that video games can help train those who have jobs in the medical field. Simulations are effective at doing this, as they can serve as realistic yet safe environments for individuals to hone their skills in. *Burn Center* teaches triage and resuscitation in a simulated mass casualty disaster scenario. *Pulse* can teach both civilians and professionals more about clinical practices by simulating an actual medical center for trainees to practice in.

Another study, this time from the *Journal of Social Psychology*, found that playing prosocial video games had a positive effect on players' attitudes and social skills and decreased aggressive and negative thoughts[9]. This shows that appropriately themed video games can help fight depression, a common trait found in young individuals who are faced with severe physical or emotional problems.

---

[8] Kato, P. M. (2010). Video games in health care: Closing the gap. *Review of General Psychology*, *14*(2), 113-121. Retrieved from http://www.apa.org/pubs/journals/releases/gpr-14-2-113.pdf

[9] Greitemeyer, T., & Osswald, S. (2011). Playing prosocial video games increases the accessibility of prosocial thoughts. *Journal of Social Psychology*, *151*(2), 121-128. Retrieved from http://0-web.ebscohost.com.www.consuls.org/ehost/detail?sid=f9c74264-db3b-4282-86a1-8dba1ee99766@sessionmgr11&vid=5&hid=11&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ==

Current Situation

Dozens of success stories about video games in healthcare can be found with an Internet search. The Nintendo Wii has been adopted by rehabilitation centers around the world as a way to help patients both young and old.

Dr. Penelope McNulty, a neurophysiologist at Neuroscience Research Australia, currently uses the Wii to help stroke victims regain use of their limbs. In a radio interview, McNulty mentions a few aspects of video gaming that make them particularly useful for rehabilitation. "We can increase the difficulty of the games as [the patients] progress and they already know the games, so they don't have to learn something new."[10] The ability to repeat very simple movements over and over while giving the patients prizes and high scores to aspire to makes the treatment effective. She also stated that every single stroke patient improved their functional ability after using the Wii for a period of time. **Figure 5** below shows Dr. McNulty working with a stroke patient.

Figure 5 – www.smh.com/au

Another condition that motion-controlled gaming is working to treat is Parkinson's disease. Approximately 1.5 million Americans currently suffer from the disease and about 50,000 Americans are diagnosed with it every year[11]. Exercise can help ease the conditions of Parkinson's, which can include tremors and lack of balance. Game developers are now working together with scientific researchers to create special therapeutic games with the specific goal of improving the lives of Parkinson's sufferers. The greatest benefit of these technologies is that patients can use the video games as fun methods of exercise from the comfort of their own homes. They remove the risk of embarrassment and the uncomfortable feelings some sufferers have when exercising in public places that might deter them from treatment.

A physical rehabilitation clinic in Maine has been using the technology behind the Nintendo Wii to its fullest potential. One particular patient plays Wii Sports – a game that anyone can buy and play at home – to recover from a trampoline accident that resulted in him losing body movement from the chest down. He particularly enjoys Wii boxing, as it forces him to keep both of his arms in constant motion. He improved so much in a few weeks of using the Wii that he was able to move from an electric wheelchair to a manual one[12].

---

[10] McNulty, P. (2012, July 10). Interview by T. Cox [Web Based Recording]. Video game therapy for stroke patients., Queensland, Australia., Retrieved from http://blogs.abc.net.au/queensland/2012/07/video-game-therapy-for-stroke-patients.html

[11] Williams, T. (2010, March 29). *Best parkinson's disease statistics*. Retrieved from http://www.parkinsons-disease.org/best-parkinsons-disease-statistics/

[12] Goad, M. (2010, March 12). The wii way. *Maine Sunday Telegram*. Retrieved from http://www.pressherald.com/archive/the-wii-way_2009-01-20.html

Recommendations and Benefits

As successful as the Nintendo Wii has been in in treating patients with various physical ailments, I propose that physical rehabilitation centers begin using the Microsoft Kinect as their main device. The Kinect is capable of tracking the motion of a person's entire body down to individual finger movements, which the Wii and Move cannot do. When it comes to serious physical disorders like the symptoms that accompany Parkinson's disease or a stroke, the ability to track so many parts of the body could prove incredibly beneficial. The Kinect creates a digital skeleton of the player in front of it, making it possible to pinpoint exercises for specific parts of the body that need help.

Microsoft has begun to take notice of the Kinect's potential in the healthcare field and created a marketing plan called "Kinect-Effect". In it, professionals in the healthcare field tell their stories of success with the Kinect and Microsoft helps to spread the word, hoping that others will follow suit. They are allowing individual programmers to use their device and adapt it to their own uses that might not have anything to do with video games. This offers opportunities like the one explained in a video on the Kinect-Effect website, where a software development company in Spain is using the Kinect technology in operating rooms where surgeons can examine CAT scans and MRIs using only gestures[13]. This frees up their hands and removes the possibility of harmful bacteria entering the room.

Nintendo and Sony have acknowledged that their devices can be used for healthcare but have taken no additional steps to accommodate the growing interest in video game technology being used for that purpose. It would be beneficial to adopt a high-tech device like the Kinect from a company that focuses on more than just video games.

The Kinect does not require any additional peripherals to work. While the Move and Wii need remotes to sense motion, the Kinect reads what the player's limbs are doing with exact precision. That means any part of the body, including hips, knees, elbows and even feet, can be tracked without having to hold onto an extra device.

The same types of games that physical therapy clinics are currently using on the Wii -- like boxing, bowling, tennis, golf and baseball -- can still be played on the Kinect just as effectively, and the Kinect offers possibilities far beyond those. For instance, the Kinect device uses recognition technology to remember specific traits of a player's body and the way he or she moves. It stores that information and recalls it as soon as that player steps back in front of the device, making it easy for therapy clinics to use one device for multiple patients at any time.

[13] (n.d.). Retrieved from http://www.xbox.com/en-US/Kinect/Kinect-Effect

Costs and Conclusion

The costs of each device, including all of the main components needed to work, can be seen in **Figure 6** below. These estimates assume that the clinic already has a television to connect the console to.

Costs of Consoles and Peripherals

	Microsoft Kinect	**Nintendo Wii**	**Sony Playstation Move**
Console	Xbox 360 4 GB Console Bundle - $299.99	Wii Console w/Remote - $149.99	Playstation 3 16 GB Console - $249.99
Peripherals	N/A	Nunchuck - $19.99	Motion Controller - $49.99 Navigation Controller - $29.99
Software	Kinect Sports - $19.99	Wii Sports - $39.99	Sports Champions - $29.99
Total	**$319.98**	**$209.97**	**$359.96**

Figure 6 – All estimates obtained from Best Buy. Prices are before taxes.

While the Kinect is considerably more expensive than the Wii, its value is higher because of the stronger technology it contains. The Playstation Move also has more accurate motion-sensing technology than the Wii but its prohibitively high costs and similar restrictions to the Wii make it a useless upgrade.

The functions that it already serves, along with the limitless potential for future applications from both Microsoft and independent developers, make the Kinect the best choice for physical therapy centers. Whether it serves an educational or rehabilitative purpose, at home or at the clinic, the Kinect can usher in further developments in the healthcare field and make video game technology a fully integrated part of healthcare systems around the globe.