

7 things you should know about...

Wii

Scenario

Two members of the College of Music faculty worked with a team of computer science professors to develop an instructional tool based on the Nintendo Wii game system for teaching conducting. In their tool, the Wii controller, which features an infrared camera, is mounted on a stand. Student conductors wear special gloves with infrared LEDs in them; they also have the option of using a baton fitted with an LED. As they practice their conducting technique, the camera in the Wii controller “sees” where their hands—and the baton—move and sends that information to custom software on a PC. The software translates the information about movement and position into a digital representation of a person conducting, which is rendered on a computer screen, and into a 3D “map” of the movement of the person’s hands or the baton.

Andre is a second-year student in the Master of Music program, studying choral and orchestral conducting. Using the new system, which digitally records sessions, Andre can replay recordings of rehearsals, examining his conducting technique and how the musicians respond. Because the Wii-based system focuses on the movements of his hands, Andre can focus his attention on the patterns and variations that define his style. The 3D maps allow Andre and his instructors to see how consistent he is with his technique by overlaying different sessions and seeing how closely they match. He finds that at least on one level, the new tool is more beneficial to his understanding of the weaknesses in his conducting than the videotapes he has used before to review rehearsals.

Faculty members also record themselves conducting with the system, and they recruit other professional conductors to do the same. These recordings are made available to the students, who can review them as stand-alone artifacts, watching for patterns and elements that make each conductor unique or overlaying these recordings with their own to see how they compare. Andre knows that he must cultivate his own style, but he finds that being able to see clearly how his technique reflects (or differs from) that of other conductors sharpens his awareness of his motions and allows him to focus his efforts on small but important changes that improve his performance.

What is it?

The Wii is a video game system that uses a wireless controller capable of sensing position and motion, allowing users to interact with the game applications through physical movements. In Wii tennis, for example, users swing the controller (often called the Wii-mote) as if it were a tennis racket. Sensors in the controller transmit those motions wirelessly to the game console, which renders the player on the screen as a game character swinging a tennis racket in the same arc, with the same speed, sending the ball—hopefully—back over the net. The controller takes many forms, from a basic wand-like remote to golf clubs, fishing rods, or a fitness pad that senses the position and balance of a user standing on it.

Who’s doing it?

Since its introduction in late 2006, the Wii has been a favorite of the gaming community, which has praised the system for transforming the gaming experience into a physical activity. Retirement communities have adopted the technology to encourage residents to exercise, and the Wii Fit, which includes a balance board to simulate movements from hula-hooping to yoga, has been popular with some fitness professionals. Physical therapists have embraced the Wii as a tool to help patients regain balance, coordination, range of motion, and muscle tone through an engaging, fun activity.

The controller has also captured the interest of academic researchers and hackers, who seek to apply the technology to other uses. Using custom hardware and software he developed, a PhD student at the Human-Computer Interaction Institute at Carnegie Mellon University created an application that uses Wii technology to turn any surface into an inexpensive, interactive whiteboard. Faculty at the University of Illinois and the University of California, Berkeley, developed an application based on the Wii concept that allows choreographers to collaborate from a distance. The application senses the position of the dancers and renders those people on a screen, which simultaneously shows dancers at several locations, providing a shared, virtual experience. A professor in the department of biomedical informatics at Arizona State University has conducted research into the use of Wii games for training surgeons. He found that students who played a Wii game that requires hand-eye coordination and manual dexterity to move a marble through a series of obstacles showed considerably higher improvement in their surgical techniques than students who did not play the game.

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How does it work?

The Wii-mote includes an accelerometer, which discerns movement forces and speed, and an infrared camera that determines location relative to LED lights in a sensor bar, which it uses to triangulate its position. The Wii-mote transmits information about motion and position—as well as data about buttons that the user pushes on the controller—through Bluetooth wireless technology to the console. The console is connected to a display device, typically a television.

Many nonstandard Wii applications reverse the role of the sensor bar and the remote, fixing the location of the controller and its camera while allowing the lights to move. In this way, for example, a “pen” with an infrared LED is tracked by the infrared camera in a Wii-mote, allowing a user to “write” on a wall while the movements of the pen are transmitted to the console. Similarly, Wii technology has been used to develop head-tracking tools, which monitor the position of LEDs mounted on a user’s head relative to a screen, adjusting the image on the screen to create a highly realistic, 3D virtual environment.

Why is it significant?

Although computer games have proven to be effective teaching and learning tools in higher education, the significance of the Wii lies more in the potential it offers for creating new devices and applications based on the location- and movement-sensing ideas embodied in the system. A researcher at MIT, for example, is developing applications that use the Wii-mote as an input device for Second Life, which allows users to quickly and easily create virtual objects and determine how they function. This researcher is working with several corporations to develop virtual activities to train users in tasks such as inspecting homes for pests and mixing and applying pesticides. Being able to practice these activities in a virtual world, using an input device that depends on physical tasks, gives students a “safe” environment to hone skills that can be applied in the real world. Other applications are designed as training tools for workers at nuclear power plants and engineers building medical devices. In each case, the technology provides a highly realistic approximation of a real-life experience, letting students practice and learn in a low-cost, low-risk setting.

What are the downsides?

Some schools, particularly in K–12, use the Wii to teach traditional subjects, such as geography, math, and English, in nontraditional ways, using the technology to engage students in learning activities. Much of the potential benefit, however, lies in creating applications and devices that use Wii technology in novel ways, and these endeavors require developers to reengineer the way the Wii works and write new software for it. Although the hardware and materials for these projects are typically inexpensive, the other aspects of this kind of development are prohibitive for many users. Also, as with other computer-input devices, the Wii carries a risk of repetitive motion injuries, not to mention the (well-documented) risk

of injuries resulting from engaging in energetic, physical activity indoors. Plenty of Wii users have ended up with cuts, bruises, and black eyes from swinging their arms—and the Wii-motes—around rooms and into walls, furniture, lights, and other players.

Where is it going?

The success of the Wii has the potential to encourage the incorporation of Wii-like technologies into other areas and to broaden the scope of how various input devices are used. Apple’s iPhone, for example, includes a sensor that discerns orientation, allowing the device to render its display always right-side up. Whole-body, motion-based control devices could result in very different—more engaging, more interactive—interactions with applications such as PowerPoint, for example. Multi-touch interfaces are popular with users and show considerable potential, though their relatively high cost remains an obstacle. Wii-type control of an application interface offers most of the functionality of multi-touch for much less money. Clickers, too, have become commonplace on many campuses, and clickers could incorporate accelerometers and other sensors to allow students to use motions and gestures to interact with a clicker system.

What are the implications for teaching and learning?

For disciplines like physics, the Wii and its underlying technology can be important teaching aids, allowing students to interact with digital representations of physical objects and substances in ways that let students see how factors such as momentum affect the behavior of study subjects. The Wii can be used to create teaching exercises that approximate authentic physical activities for students. In medical training, for example, a Wii-based system could simulate intubation or chest compressions. Learning theorists are investigating ways in which kinesthetic learning and physical interaction with content influence understanding and retention.

The Wii offers researchers a simple, motion-based input device to test how various kinds of active learning exercises can benefit students with different learning styles. For some learners, and for some subjects, using a whole-body input device translates to higher levels of engagement and increased learning. In addition, users can customize their characters and store that information on their Wii-motes, allowing them to take their digital identities with them. To the extent that Wii controllers are used as input devices in learning settings—through clicker systems or virtual worlds such as Second Life or Croquet—allowing students to “bring their own identity” makes for a more compelling learning experience.