December 21, 2006

HOW IT WORKS

At the Heart of the Wii, Micron-Size Machines

By MICHEL MARRIOTT

EVEN before its release last month, Nintendo's latest video game console, the Wii, was getting a lot of attention for its wireless motion-sensitive controllers. Swing the controller and — crack! — hit a virtual home run in a virtual ballpark, for example.

One controller is shaped like a sleek television remote (sometimes called the Wii-mote); the other plugs into the remote with a short wire, creating a vague resemblance to the two-handled martial-arts weapon it is named for, the nunchuk.

And beneath the controllers' white plastic shells are an array of time-tested digital technologies working together in new ways.

The controllers communicate with the Wii console, a $250 box no larger than a child's lunchbox, with the wireless technology known as Bluetooth. It is the means commonly used to link cellphones with their wireless headsets. The Wii remote also uses infrared, the same technology that links television sets with their remote controllers, to track where the controller is pointed.

In this case, a sort of crude camera — an image sensor — in the forward tip of the remote (the primary controller) detects tiny light-emitting diodes in a "sensor bar" that must be set on or very near a television plugged into the Wii. This system helps players use the remote to point accurately at specific things on the screen, like the virtual buttons to begin or end a game, or aim a weapon in a game.

Actions like pressing the buttons on screen or firing a weapon are conveyed between Bluetooth chips in the remote and in the console. The remote also contains a rumble pack, a component that vibrates to varying intensities based on information the console draws from the game's programming and then passes to the controller.

But the controller's most-talked-about feature is the capacity to track its own relative motion. This enables players to do things like steer a car by twisting the remote in the air or moving a game character by tilting the remote down or up.

"This represents a fabulous example of the consumerization of MEMS," the tiny devices known as micro-electro-mechanical systems, said Benedetto Vigna, general manager of the MEMS unit at STMicroelectronics, a leading maker of the accelerometers embedded in the controllers. (Nintendo itself declined to talk about the controllers' inner workings.)

He said the motion sensors, using the technology that activates vehicle air bags, can accurately sense three axes of acceleration: up and down, left to right, and forward and backward.

This is mostly achieved within the MEMS, micron-size machines that depend on submicroscopic structures carved into the silicon. For example, one structure moves like a tiny diving board, stimulated by the actions of the game players.

The structures are enveloped in an electrical field, Mr. Vigna said. When the MEMS elements are moved, the electrical field changes and the MEMS chip is sensitive enough to detect the changes.

These accelerometers are so sensitive, Mr. Vigna said, because electrons — those subatomic particles that whirl around the nucleus of atoms like a video game in the making — can sense the subtle atomic-level movement of the silicon structures.