The Future of Entertainment, Interior Design, and Art Created Through the Fusion of Artists and Engineers

Sachiko KODAMA Laboratory

Sachiko KODAMA

Playing smart sports with a glowing ball

Behind the door was a narrow, fairly steep descending staircase. We proceeded down the stairs and came out to a wide empty floor, covered with a plain gray carpet. Associate Professor Sachiko Kodama extinguished the lights and fiddled with a computer in the corner of the room. Suddenly, a brown grid pattern popped up from the floor (see Figure 1). It looked like the surface of a shogi or Go board. A projector in the ceiling was projecting the computer's screen image onto the floor.

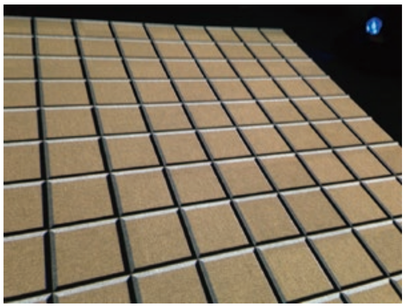

Figure 1: A grid pattern is projected on the floor. Although they look like squares, they are actually the surface of a game die.

Associate Professor Kodama picked up a glowing orb and held it like she was about to throw a bowling ball. She bowled the ball and it rolled across the grid pattern. The squares that the ball passed through spun and changed into pictures of animals. That's when I realized the grid was not flat, but a cube like a game die. Rolling the ball was like rolling a die.

Two types of LEDs were embedded in the ball: one type emitted infrared light and the other visible light. A camera mounted on the ceiling recorded the infrared light to determine the ball's position. The ball also contained an acceleration sensor, a sound sensor, a microcontroller, a wireless communication module, batteries, and other components. When the ball rolled, the wireless communication module sent the sensors' signals to the computer. The computer, in turn, controlled the computer graphics projected on the floor as well as the sound effects from the speakers.

Figure 2: Squares the ball passes through spin like dice and turn into either animal pictures or letters.

The floor dice had several types animal pictures — a dog, a horse, etc. Some squares were black with no picture. When the ball was rolled again, the squares with animal pictures turned to letters (see Figure 2). Brown squares (the squares in their initial state) turned to either animal pictures or black. After rolling the ball a few times, it became evident that the same animal pictures lined up either vertically or horizontally.

Associate Professor Kodama then explained the application was a crossword puzzle played by rolling a ball. When the squares with dogs on them were turned to spell D-O-G and the horse squares were turned to spell H-O-R-S-E, the game was over (see Figure 3). The black squares were the spaces between words. By rolling the ball again and again, you could complete the crossword. A completed word would stay displayed until the end of the game. While it was just a matter of playing with a ball, you had to roll the ball many times over to complete the crossword. It was a good workout.

Figure 3: The crossword puzzle when complete.

Elevating works, based on technology, into the realm of art

The system described above was created as part of the Bouncing Star: Smart Ball research project that Associate Professor Kodama's laboratory is working on. The application Associate Professor Kodama

Keywords

Media art, **Fine art**, **eSports**, **Games**, **Balls**, **Play**, **Amusement**, **Entertainment**, **Interactive art**, **Digital fabrication**, **Interior design**, **Tiles**, **Ferrofluids**

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Member	Sachiko Kodama, Associate professor

demonstrated is a 3D crossword called Sky Ball. The laboratory has developed several other applications in the project where players throw the Bouncing Star (see Figure 4 and Figure 5). Associate Professor Kodama is searching for business partners with the hope of turning these applications into commercial products.

Associate Professor Kodama, who leads the laboratory, is the creator of Media Art, and is known as a media artist. Media art is art based on computers and other digital technologies. Unlike works of art that use traditional media, media art is gaining attention because the audience can interact with it and because it is a means of expressing images in real time.

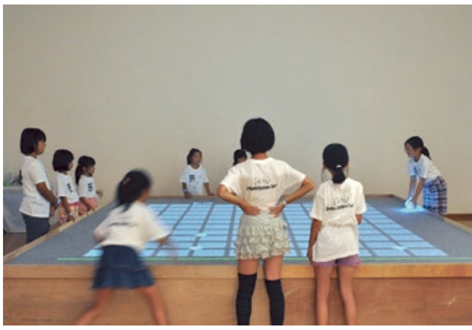

Figure 4: Children playing with the bouncing star ball (taken at Hamada Children's Museum of Art).

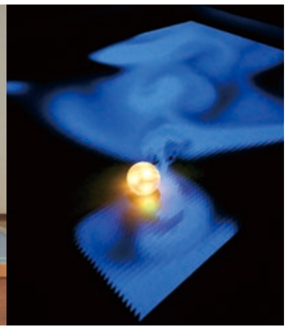

Figure 5: Smoky graphics spread out from the shining ball. This could be used in sports production (taken at Hamada Children's Museum of Art).

Nevertheless, even as the laboratory works on media art, it is not an easy task to elevate it into the realm of art. Media art creations, while based on knowledge of science and technology, must be refined to a point where they earn the admiration and enjoyment of all kinds of people. If the knowledge of science and technology is pushed too far into the foreground, the creations will be nothing more than curiosities. Such works may be lionized for a short time, but they are unlikely to pass the test of time.

Associate Professor Kodama will not compromise on this point. "Appearance is everything," she stated. "The production must be flawless" and "details are critical" when displaying a work to the public.

Wall tiles change their radiant colors to match the color of flowers

Associate Professor Kodama's research can be divided into three main themes. The keywords for the themes are spiral, circle (sphere), and complex systems. For example, circle (sphere) is the keyword of the Bouncing Star: Smart Ball project (see Figure 6).

The primary shape themes at the Kodama laboratory

- **Spiral**
  - Morpho Tower (started in 2005, announced as a ferrofluid sculpture)
- **Circle (sphere)**
  - Bouncing Star: Smart Ball project (started in 2007)
- **Complex systems**
  - Protrude, Flow, a ferrofluid art project (started in 2000 and continuing to the present)
  - Living Surface (2004, real-time computer graphic texture that applies complex systems)
  - Blooming Space tile project (started in 2010)

Figure 6: The primary shape themes at the Kodama laboratory. The themes are represented by three keywords.

The newest of the three projects is entitled Blooming Space, with the keyword complex systems. This project aims to apply digital fabrication to construction and architecture, in such fields as space design and interior design. The basic building block is tiles with built in visible-light LEDs, photo sensors, and wireless communication modules (see Figure 7). Works are created by joining these tiles together.

An example of how these tiles can be used is to imagine a flower vase placed near the installation. The tiles detect the color of flowers put in the vase and change their radiant colors to complement the flowers. Key to an installation like this is the communication and interaction between adjacent tiles. A change in radiant color by one tile must be propagated to the adjacent tiles and the tiles adjacent to those tiles. The system's strength lies in this bottom-up architecture: it is flexible enough to permit adding tiles and rearranging the tiles.

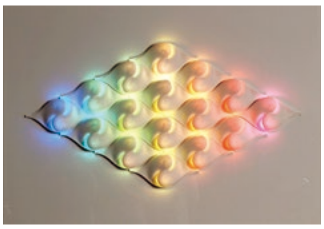

Figure 7: Three-dimensional tiles with built-in LEDs. The colors are controlled wirelessly.

Protrude, Flow — the advent of ferrofluid art

Protrude, Flow is the oldest project at the Kodama laboratory and the project that made Associate Professor Kodama famous in the media art world. Working from the keyword spiral, this art project uses ferrofluids. Started in 2000, this art project has already run for more than 10 years.

Ferrofluids consist of miniscule ferromagnetic particles with diameters on the scale of ten nanometers (a hundred-thousandth of a millimeter) suspended in a carrier fluid, usually water or an organic solvent. A surfactant is included to ensure the ferromagnetic particles are uniformly dispersed in the carrier liquid. Ferrofluids are blackish brown in color.

When a magnetic field is applied to a ferrofluid, the ferrofluid will change shape in response to the magnetic field's strength and orientation. Using this property of ferrofluids, Associate Professor Kodama has created never-before-seen three-dimensional objects whose shape continually changes.

The shape characteristics of ferrofluid art are described by the keywords in the project's title: protrude and flow. The ferrofluid's sharp needles stick out looking like a pin holder, and they flow and disappear as if they have melted (see Figure 8). The needles can be made to appear like an animal's feelers or like the ocean's surface doggedly thrusting up into the sky.

Expertise and tenacity are the sources of quality

Associate Professor Kodama's work as a media artist changed radically after encountering ferrofluids. As Associate Professor Kodama tells it, she was involved as a graduate student in research about solid-body expressions through computer graphics and holograms. Around the time she was bemoaning a lack of expressiveness in objects, she realized the potential of three-dimensional shapes created with ferrofluids, and their lively material nature, through the works of Japanese artists that treat objects as the expressions themselves.

Saying this, handling ferrofluids is not easy. It took Associate Professor Kodama many months and years, and countless experimentations and improvements, to finally get the ferrofluid to move as she wished. Most difficult part was designing the electromagnets to control the ferrofluid precisely, beyond just basic movements, to the point where the piece can ultimately stand as a work of art. The professor claims this design knowledge is a closely guarded secret. Furthermore, the process of adjusting the ferrofluid's movement with a computer program was long and laborious, since the fluid's motion had to be checked by eye. The finishing touches, which rely on human eyes, hands, and brains, are what determine the eventual quality of the artwork. The expertise of an engineer and the tenacity of an artist. Together, these traits produce artworks that stir people's souls.

[Interview and article by Akira Fukuda (PR Center)]

Figure 8: Morpho Tower, a featured artwork that uses ferrofluid. The ferrofluid flows up the grooves of the drill and then pushes out needles. After this, the ferrofluid needles droop over the drill's grooves and disappear as if they have melted. All that is left at the end is a pool of jet black liquid.