Things that Think, Spaces that Sense, and Places that Play

Ellen Yi-Luen Do
Design Computing & Human Centered Computing,
College of Architecture & College of Computing
Georgia Institute of Technology
Atlanta, GA 30332-0155, USA
ellendo@gatech.edu

http://www.cc.gatech.edu/~ellendo

1. SMART LIVING OF TOMORROW

It's seven o'clock in the morning. Your eyes open to the sunshine that was carefully let in by the window blinds. Your pillow notices that you have gotten up and talks to the coffee maker to make a fresh brew. The bathroom mirror gives you the traffic report and the meeting schedule of the day while you brush your teeth. Then your slippers blink lights to indicate that you have just received a love note in your email inbox. You open the refrigerator and happily discover that your refrigerator has already ordered fresh milk and orange juice for you. Before you sit down, the breakfast table had prepared a plate of two eggs, sunny side up, just the way you like them. While you are reading the dynamically displayed local news on the kitchen wall, the house slowly turns off all the climate control in all other rooms knowing that you will soon leave the house and go to work. The story goes on…

It is like a lullaby. We all have heard it many times in the popular media or product commercials. There are plenty of imaginary worlds depicted in science fiction with the theme of how computer technology is going to help us save time, and to be more efficient. At the same time, we are also concerned that using intelligent information appliances and smart houses might make us less intelligent, or become more isolated from the society. We all want a good life. The idea of a futuristic smart living space is therefore enticing. It will probably involve all sorts of engineering innovations. We can definitely solve the technical problems. However, the real question is not what we can do with technology, but what kind of life do we want to live?

Not surprisingly, I have a vested interest in the future of smart living spaces, because I plan on living there. We have a once in a lifetime opportunity to truly integrate computing and architecture to create wonderful environments for future generations to enjoy. The remarkable opportunities are here now. The 21st century would be the era for the designers, the architects, and the engineers who have vision to make beautiful imagination a reality for the world.

Let me try to sketch that imaginary picture for you. I may be able to convey to you a compelling vision of what the world will be like tomorrow. Alan Kay is quoted as saying said that "the best way to predict the future is to invent it." I believe the process of inventing the future is also a process of observing the present, and seeing the challenges and opportunities to innovate. What we are seeing today is that information is moving out of traditional computer setups and into the world around us. This world had evolved from the industrial society into the information society. Then from the information society we are now in the communication society, and heading toward the creative society.

2. TECHNOLOGY AS MAGIC

It was magic when Watson first heard Bell's calling through the electric instrument. To see for the first time a horseless carriage with an internal combustion engine moving on the road is magic. To hear musical melodies coming out from a black box or watch tiny persons talking and dancing behind a glass plane is certainly magic. We can look to the history of technology to see how innovation such as books and recorded music, central heat, electric light and the telephone were designed, redesigned, and gradually assimilated. All this magic has faded into the fabric of life we now take for granted.

Technology is like magic. An advanced technology often appears to be indistinguishable from magic. When technology is smart and close enough to people it then disappears. The mechanism and user interface in a good mechanically designed bicycle or piano are so closely integrated that we cannot distinguish the form and function. We can use them easily without thinking about them as technology or even thinking about them at all. A technology becomes invisible when we stop noticing it. Invisibility should be the goal for technology. What if the computers disappear and our built environment and our world become our interface?

3. UNVEILING MAGIC

As a researcher and educator, I have been working with people to do magic. I have engaged people in topics on human-computer interaction, tangible interface, physical computing, smart toys, and home of the future. We worked on creating "not-in-your-face" ubiquitous and pervasive computing. It's not just about having computing anywhere and everywhere, but to make it intuitive, invisible, and unobtrusive. We have attempted to create magical moments for smart living space by using sensing-based technology to support human-centered creative work.

Let me first tell you the spirit of our work before showing you a collection of projects. I should like to call what we are doing as "fun computing" in that we create "playful inventions" for people. The "play" component as an essential facility for design is pretty much described in Paul Rand's article "Design and the Play Instinct" [1]. We explore bridging the digital and physical worlds. We combine personal passion and intellectual pursuits. We encourage people to use our senses to make sense of the world around us.

3.1 Navigational Blocks

Navigational Blocks [2] is a tangible user interface that facilitates retrieval of historical stories from a multi-media database. Each face of each block represents a subcategory. For example, the Who block has a face representing the "founding fathers," and another face "the merchants." A face of the What block represents an historical event and a face of the Where block represents a location. Orientation, movement, and relative positions of wooden blocks provide a physical embodiment of digital information through tactile manipulation and haptic feedback. Electromagnets embedded in the Blocks and wireless communication encourages rapid rearrangement to form different queries into the database.

Figure 1. Navigational Blocks as query interface to multi-media database of historical stories

3.2 FlexM

FlexM is a hub-and-strut toy for making and manipulating geometric models with computer models and simulations. Sensors and microprocessors embedded in the hubs determine the topology and geometry of the model the user assembles. With flexible joints on the hubs, the designer can make models that transform dynamically. The hubs transmit parametric information to the computer, which renders the model on the screen in real time. This allows the designer to create complex forms with the fun and directness of playing with a toy.

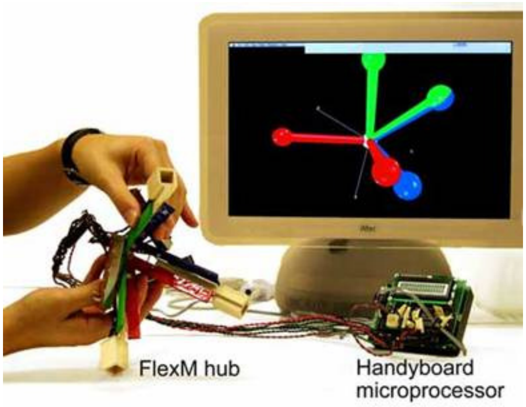

Figure 2. FlexM is a computationally enhanced hub-and-strut construction toy

3.3 Computational Books

A paper pop-up book with light sensors embedded in its pages is linked to a desktop computer. When the reader operates the pop-up features (by pushing or turning a strip of paper), one of the light sensors is exposed to ambient light in the room. The microcontroller in the book notices this, and relays the information to the desktop computer, which augments the story on the pop-up book page with a video or audio supplement.

3.4 MouseHaus Table

MouseHaus Table is an interface to pedestrian movement simulation. It uses a video camera to capture images of paper cutouts representing urban elements on a table, as collaborating designers add, remove, and rearrange them to propose configurations of buildings, streets, and parks. A visual simulation of pedestrian behavior is projected on top of these arrangements, allowing the designers to understand the effects of their proposed arrangements. Instead of using a structured editor to input urban elements, users of MouseHaus Table cut out colored papers with scissors and arrange them on the table to see real-time simulation feedback.

3.5 Window Seat

Window Seat is a chairware interface to control remote camera motion. This project uses the rock and swivel of a chair as an interface for a pan and tilt camera. A rocking chair controls the up/down tilt and a set of pressure sensors to control the left/right pan. A tiny camera is placed inside an architectural model, and a projector mounted inside the chair and a mirror displays the camera's current viewpoint on the wall in front of the chair. The chair's occupant can visually occupy a scale model or remote space.

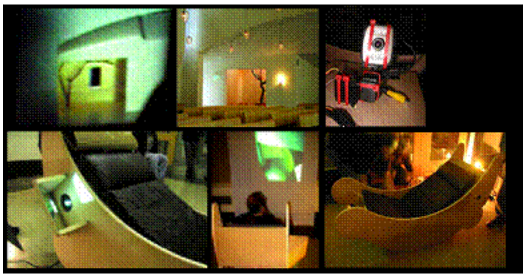

Figure 3. Window Seat rocking chair's up/down and left/right motion controls a remote camera.

3.6 LEDerman’s jacket

The LEDerman’s Jacket directly introduces light and interactivity to fashion design. An LED matrix on the back of the jacket responds to the wearer’s actions, pictorially reflecting everyday choreography. The actions of the jacket’s stimulate programmed responses from the light emitting diode network on the jacket. Inherent jacket actions—hands in pockets, raised collar—light up various patterns of LEDs.

3.7 Laser Space

Laser Space uses low power laser light to create the sensation of a bounded but nonphysical space. A DC motor spins an angled mirror to reflect a laser beam, forming a cone made visible by a fog machine. A break-beam sensor composed of a laser (visible as a red line of light) and a photocell "opens the door" when a person approaches. A servomotor interrupts the cone with a wedge to create a visible entrance.

3.8 Plant Tiles

Plant Tiles translate people's movement on the floor into control of video playing. A six by ten foot platform sits in front of a rear-projected screen showing time lapse video of plant growth. When you step onto the platform, a projected video sequence plays to a key frame. Walking toward the screen plays the sequence forward; walking backward reverses it. Side to side movement triggers different video segments.

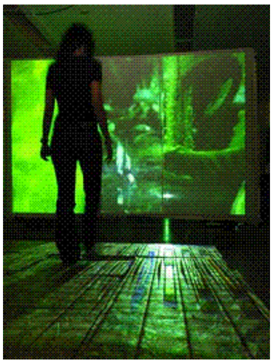

Figure 4. Floor tile sensors create an interactive platform space in PlantTiles.

3.9 Alphabet Paint Space

Alphabet Paint Space uses people's motion as “brushes” to create a painting. A video camera captures images (15 frames per second) of people moving through the space. The processed images, which depict an abstraction of the movement, then project onto a large screen at one end of the hall. The resulting light-painted mural traces movement that fades slowly over time. The traces disappear so that the mural constantly evolves, reflecting the current state of the space. To encourage movement, four-foot high letters populate the space, each containing a photocell. As people pass in front of a photocell, its letter appears at the bottom of the movie screen, as if writing an abstract title for the abstract painting created by the image processed video.

Figure 5. Interactive mural created with people's movement in the Alphabet Paint Space

4. CURIOSITY DRIVEN RESEARCH

Yes, we are having serious fun. We have a studio laboratory that is equally concerned about mission critical and need based research as about curiosity driven research. Learning happens when it is needed.

We hope a vision of a future living space can emerge from this effort to become much more responsive, accessible, and expressive, and delightful. We want our living space smart, but also wise.

Reading about magic is like reading about food. There is no substitute for the real thing and real experience. We hope many of you would join us in this magic making adventure!

5. ACKNOWLEDGEMENTS

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6. REFERENCES

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