Ambient Dialogue

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Physical interfaces for interpersonal communication over distance.

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This book is dedicated to Wan Ju, my love in life.

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Abstract

My thesis explores forms of interpersonal communication over distance through physical objects and ambient information.

We live in a three-dimensional world, but have limited means to communicate with people across physical distances. How can we extend this communication to include the more tactile, subtle and sensual ways? We have developed sophisticated skills for sensing and receiving ambient information—light, sound, movement—in the physical environment. However, most of these are not employed in digital interpersonal communication.

My thesis projects explore how to take advantage of these technologies to create rich and meaningful communication through nonverbal, non-screen-based experiences across distances.

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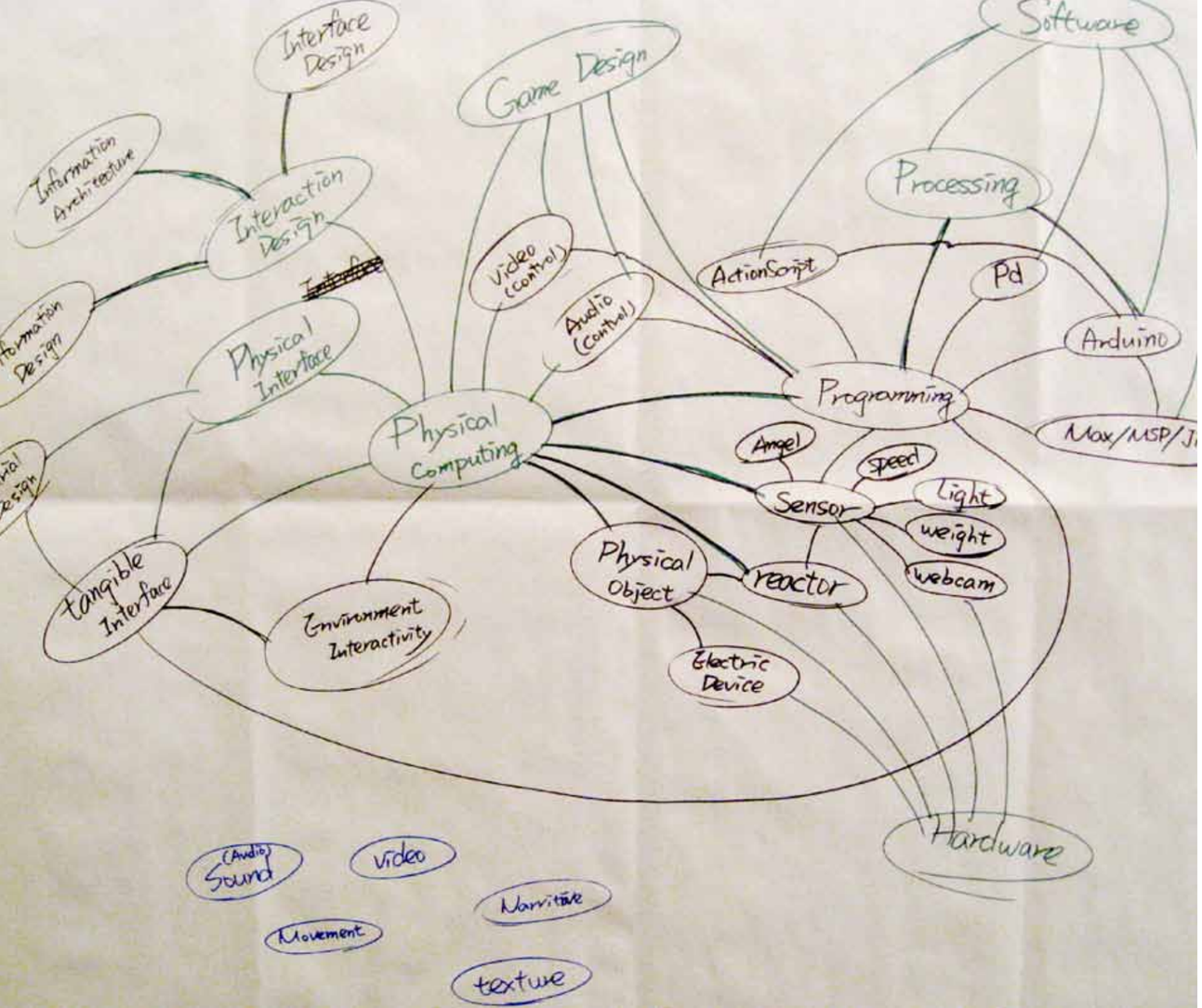


Introduction

My Background

From Economics to Industrial Design

Five years ago I studied Economics at ChengChi University in Taiwan, which gave me business skills and the ability to understand market-trends. One day before I graduated from school, I walked the street and thought about my future. At that time, I didn't know what I could do or what I would like to do. I walked into a fancy designer store and saw a figure model made by the Japanese artist Yoshitomo Nara from his illustration. I wanted it! But it was over my budget (almost my monthly income).

It was gone when I passed by the store two days later. This experience started me looking at the designer product market, which I thought would become a niche market in five years. At that time, consumers looked for functionality first and aesthetics second. I thought like a businessman and realized that the aesthetics of functional products would become more important to the consumer in the next five years. Why can Philippe Starck sell his juicer for a hundred dollars? It doesn't serve any function other than making orange juice. The reason is the design—the metal body and alien shape make the product stand out. I saw a potential market and I wanted to have a place in that market when it grew up.

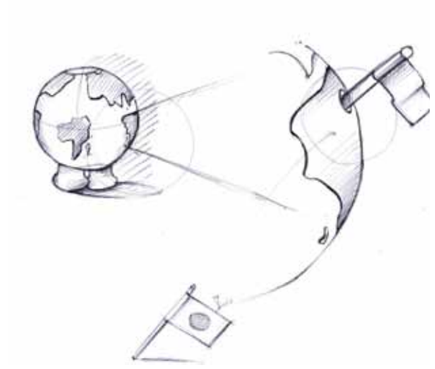
I knew I wouldn't be able to succeed in this business if I didn't have the knowledge—so I came to the US and studied product design. I figured that once I knew how to make a product, I could do a better job marketing those products. Moreover, I could sell not only other designers' products but also products I designed. Or so I thought at the time.

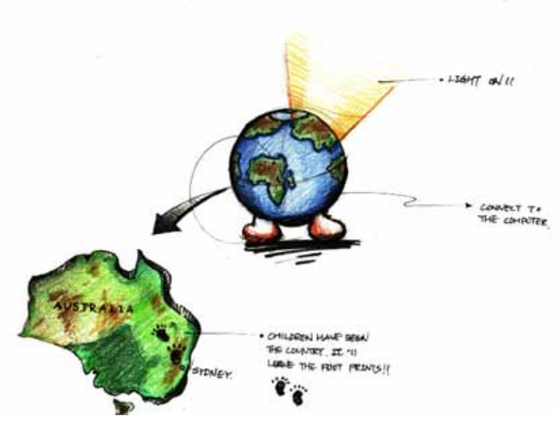
Figure Model made by Yoshitomo Nara

KIZTOYS
reinventing the toy.

From Industrial Design to Interaction Design

Change is always difficult. The training in Industrial Design was harder than I thought it would be. After countless sleepless nights, I finally arrived at graduation. The degree project I worked on was an interactive toy design, a collaborative project with Kiz Toys, Inc. located in Atlanta, GA. The concept of my interactive toy was to combine a physical toy (a figure model) with an online game. Take a car racing game for instance: a model of a fancy car comes with the game. Children play, controlling a virtual vehicle by manipulating the physical car model. In other words, the car model was not only a physical toy but was also the gaming controller. It was a relatively new idea in late 2008 and early 2009. This was my first time thinking of an object as an interface, not just a final product. It was a shock. Before this interactive toy project, I thought product design meant considering user needs and aesthetics, then making a product. The toy car project showed me that physical objects can also be an interface. This new interest led me to apply to the Dynamic Media Institute at Massachusetts College of Art and Design to study interaction design, especially physical interface design. That's why I am here.





"Pack Up" is a new type of toy that combines a physical object with a virtual game. The entire toy is a video game controller. This toy is designed for children who love to explore the world. It provides an opportunity for children to experience different lives and cultures through the process of game playing.

My Thesis Topic

The Story

I was born in Torrance, CA but grew up in Kaohsiung, Taiwan. I went to college and worked in Taipei, Taiwan then attended graduate school in Savannah, GA and Boston, MA. I have lived in different cities for almost half of my life. My family and I communicate through technology: emails, Skype, and instant messages. You can imagine that I spend a lot of time sitting in front of a computer checking my mailbox to see if there is any mail from my family, and launching MSN or Skype to communicate (typing, voice chat or video chat). Turning on the computer and sitting in front of it for hours like this is tiring. Technology is convenient and can reduce physical distance but it steals time from my life. Communication becomes easier because of technology, but at the same time I feel the lack of the warmth (quality) of interpersonal connection.

Why should I be chained to the computer for communication? I sit for so many hours, always looking at the same 15-inch screen in the same way. Why does this communication have to go through the screen, the computer? Is this the only way I can communicate with people over distance? Why not break away and carry a system that can extend my senses, and augment my vision?

The Moment

My wife and I have a friend who visited us from London. We turned the front-door light on to show him the way to come into the house. Suddenly a question came to my mind—could a light not only light up the environment but also convey extra information at a same time? It reminded me of how my mother always left the light on when my father came home late. She told me this was to make my father feel there was someone waiting for him at home, even though we would already be in bed. At that moment, the light was not just a product to light up the environment, it was a container and an interface to convey "welcome home—you are not alone." I was fascinated by that moment. I realized a simple everyday object could make life different by attaching an interpersonal connection to the light. How would life look if everyday objects could simulate other kinds of communication and relationships? Could there be a way to use ambient information such as a light or sound to enrich our communication through time and space?

The Goal

My goal for this thesis is not to replace current products or services used for communication over distance, such as email, instant messaging, or Skype. My goal is to provide a subtle and sensual shared experience of connected space in daily life for people who live apart.

Context of Physical Object and Ambient Information

Five Senses

As human beings, we use five senses to perceive the world and describe our daily lives: hearing, sight, touch, smell, and taste.

When we look at the action of eating, it is not just about taste. Before we enjoy food, we first see it and smell it. We taste it with our eyes and noses and see if it looks good enough and smells good enough to eat. Then we taste it with the tongue. Sight, smell, and taste combine together to create the experience called flavor. Our senses define and guide us through our world.

The Definition of an Object

An object is a tangible and a visible entity that can cast a shadow. From something as small as a pen to something as big as a building, are all objects. The Oxford Dictionary defines an object as "a material thing that can be seen and touched," while Merriam Webster defines an object simply as "something material that may be perceived by the senses."

By sight, we know the presence and form of an object. By touch, we experience the quality of an object, its texture (physical appearance or character), its weight, and its material.

Consider the many different balls in a sports store. You can tell they are different by looking at their size and color. A basketball is red or dark-brown and is bigger than a baseball, which is white with red stitching. You can distinguish whether a ball is for practice or for a real game by touching it to see if it's covered with man-made or real leather.

Ambient Information

Ambient information is the message that surrounds us. It comes in the form of sound, air pressure, motion, light, smell, and other stimuli that trigger the full range of our human sensory capabilities. Ambient information exists in the periphery of our senses, where it provides continuous information without interruption, but you can catch it immediately when you pay attention to it. For instance, you may be subconsciously aware of the weather outside your window. If you hear thunder, you can sense that a storm is on its way through your peripheral attention. You can then choose to look outside the window or continue working without distraction.

Affordance

The concept of affordance was developed by the perceptual psychologist James J. Gibson in his seminal book *The Ecological Approach to Visual Perception*. The concept was introduced to the human computer interaction (HCI) and design communities by Donald Norman in his book *The Psychology of Everyday Things* (also published as *The Design of Everyday Things*) in 1988.

Norman defined affordance as a design element that suggests how an object should be used—a visual clue to its function and use. This is commonly called perceived affordance. Norman writes:

"Affordances provide strong clues to the operations of things. Plates are for pushing. Knobs are for turning. Slots are for inserting things into. Balls are for throwing or bouncing. When affordances are taken advantage of, the user knows what to do just by looking: no picture, label, or instruction needed." (Donald Norman, *The Design of Everyday Things*, 1988)

Norman also defines an affordance as something of both actual and perceived properties. The affordance of a ball is its round shape, physical material, bouncability, (its real, actual properties) and the information of how the ball should be used (its perceived properties). When actual and perceived properties are combined, an affordance shows a relationship between an object and a person who acts with it.

A designer cares more about what actions a user perceives to be possible than what is true. In product design, where one deals with physical objects, there can be both real and perceived affordances, and the two sets need not be the same. Norman gives an example of the act of approaching a door you will walk through. The door and the way it faces a wall allows you to open it by pushing it from its closed position. When you approach the door, you see a flat plate fixed to it at waist height on the "non-hinge" side. Without thinking, you understand the door is meant to be pushed open, and you do so. This "perceived affordance," triggered by the sight of the plate, is identical to the door's actual affordance. As Norman notes, the affordance is neither the door nor the plate, but the property of the door and its hunch.

My works are half product, and half interaction design. Their affordance shows users how to interact without requiring separate instructions.

Symbolic Object

An object has its own symbolic meaning as well as affordance. Objects are part of our daily life. They preserve our day-to-day experience and memories, and become something meaningful and symbolic. Some objects are commonly used as symbols, for instance, a four-leaf clover symbolizes luck and flowers on Valentine's Day symbolize love.

The word "symbol" comes from the Greek "sýmbolon", from two root words: syn meaning "together" and bol meaning "a throw." The approximate meaning of "sýmbolon" is "to throw together".

Initially symbols were used to shorten messages, and one sign carried a lot of information. Sometimes a symbol can have more than one meaning, all of them closely related to the language that is used by the sender/receiver of a communication.

A symbol is something that stands for something else. It can be a sound, gesture, or written character that represents an object, action, event, or idea. Generally, symbols are figurative, meaning that they compare or merge two unlike things. A symbol is the marriage of an abstraction to a concrete expression.

The objects I design are symbols of interpersonal connection, standing in for people with whom you communicate over distance.

Context of Physical Interface (Tangible User Interface)

What is Physical Interface?

"... a user interface that augment the real physical world by coupling digital information to everyday physical objects and environments." By Hiroshi Ishii (Tangible bits: towards seamless interfaces between people, bits, and atoms. In: Proceedings of the CHI'97 conference on human factors in computing systems, Atlanta, Georgia, March 1997, pp 234-241)

A physical interface, sometimes called a tangible user interface (TUI) is an interface in which a person interacts with digital information through a physical environment. One of the pioneers of tangible user interface design is Hiroshi Ishii, a professor in the MIT Media Laboratory who heads the Tangible Media Group.

Tangible user interfaces provide physical form to digital data and computation, facilitating the direct manipulation of information. TUIs are built on the skills that people have developed for sensing and manipulating their physical environments, situating and embodying digital information in physical space.

Imagine an abacus, the simplest form of a digital computation device. All of its information is represented by an array of beads, so users can directly touch, manipulate, and feel its data. This coupling of manipulation and control is very natural for a physical device, but in the digital domain, the graphical user interface introduces a divide between pixel representations of information and controllers like the computer's mouse.

Another important feature is the affordance. When I grabbed an abacus as a kid, it immediately became a musical instrument, an imaginary toy train, or a backscratcher, and I could really feel and enjoy the beads. The abacus also served as a medium of awareness. When my mother was busy doing the accounting in our small apartment in Tokyo, I could hear the music the abacus made — it told me that I couldn't interrupt her or ask her to play with me. Knowing other people's state of mind through ambient sound, suggests an important direction for the next generation of user interfaces. (TUI example: Abacus, Hiroshi Ishii, *Designing Interactions*, 2007: 529)

TUI vs. GUI

Interaction with digital information is now mostly confined to a graphical user interface (GUI), an interface that allows users to interact with electronic devices via images rather than text commands. A GUI represents the information and actions available to a user through icons and other visual indicators on a screen. The actions are usually performed through direct manipulation (see, point, and click interactions) of the graphic elements. High adoption rates of iPhone, iPad and other touch sensitive technologies are quickly making GUIs more common.

Interactions with pixels on GUI screens are abstracted from our interactions with the rest of the physical environment in which we live. The GUI, tied as it is to the screen, windows, mouse, and keyboard, is separated from interactions that take place in the physical world. When we interact with the GUI world, we cannot take advantage of our skills for manipulating diverse physical objects. Tangible user interfaces take advantage of users' haptic interaction skills, giving physical form to digital information, a significantly different approach from the GUI. Physical forms can serve as both representations and controls for their digital counterparts. TUI lets us manipulate digital information directly with our hands, and perceive its physical embodiment through our peripheral senses.

About My Four Case Studies

I came to my thesis with a strong interest in physical interfaces, inspired by my interactive toy project, "Pack Up!" I'm also interested in exploring the combination of ambient information and physical interface, and how this combination can help and improve interpersonal communication.

The following four case studies are experiments with different combinations of ambient information and physical interface. Each case study is focused on specific ambient information, such as light (Case Study 1, 2, 4), sound (Case Study 3, 4), and motion (Case Study 3, 4).

1. Case Study 1: C Lamp

"C Lamp" is an interactive color-mixing light as well as an information visualization device. "C Lamp" takes in text-based emotional content online, and visualizes this content through color and brightness.

2. Case Study 2: LightOn

"LightOn" is a pair of network-connected lamps that indicate a users' presence by turning on or off. This project is designed for family members or friends who live apart. Two "LightOn" lamps connect and respond simultaneously when either lamp in the pair is turned on and off. LightOn is a symbolic message saying "I am here," and a vehicle to convey messages, such as "I am missing you," by the simple action of turning a light on or off.

The combination of an object (lamp) and ambient information (light) creates a new type of interpersonal connection and relationship.

3. Case Study 3: Knock

"Knock" is a pair of networked woodpeckers designed to call attention to people from various locations in a network. This project substitutes for the normal ways people get each other's attention on the Internet, e.g., jumping icons, songs or phone rings, pop up windows, with a more playful and physical prompt.

4. Case Study 4: LightMate

"LightMate" is a pair of interconnected lamps capable of conveying a number of emotions through physical action and movement. It was born in pairs for interpersonal communication, connecting family members or friends who live apart.

An experimental project that explored the relationship between texture, light and shadow.

C Lamp

Case Study One

C Lamp final prototype

Project Overview

C Lamp is an interactive color-mixing lighting device, which is a container of, and conduit for, online digital information. It is designed to facilitate an exchange of emotional content between people separated by physical distance. The C Lamp uses wireless technology to send and receive the digital equivalent of text-based information. C Lamp transforms the information it receives into a mix of red, green, and blue light, using tricolor (RGB) LED with the brightness of each color determined by specific information.

Objective

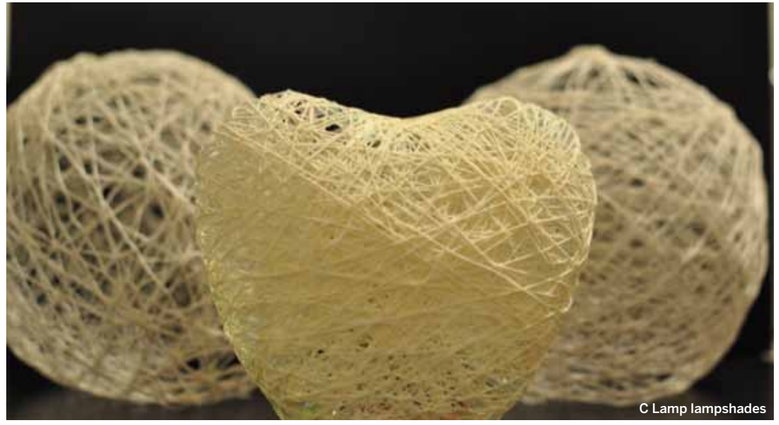
The goal of this project was to use the lamp to communicate interpersonal messages visually by varying the brightness and color of light and shapes of lampshades. For example, C Lamp represents messages (email contents or blog RSS feeds) between lovers with romantic colors (pink or light purple). It represents arguments between people in bright red, showing that a fight is happening. The message can be specific or general, based on a user's choice.

I chose a lamp as the physical interface in this project because it is an everyday object. A lamp is an especially significant object in our daily lives. It lights our world when the sky goes dark. We live in its light for at least a third of the day. There is a connection between a lamp, its light, and an intellectual experience. For instance, when we see a light on in a room, we know there is someone in the room. Light becomes a symbol for someone's presence. This functional and symbolic experience is what I am interested in for this project. A lamp is a visualization platform for interpersonal messages. The lamp stands for the person you have conversations with and the status of light (color, brightness) stands for the conversation between you.

Physical Form

The C Lamp is about 8 x 8 x 8 inches, depending on the dimensions of the lampshade. My lampshades are handmade from cotton thread and India paper or a similar textured material.

Handmade objects are always unique and special. Each handmade object is the only one in the world. So is interpersonal conversation. Each conversation is unique, secret and personal. Both of them share the same characteristics. Therefore handmade lampshades are important in this project. Every shape and every texture of the lampshades stand for every unique conversation and experience between family members or friends.



C Lamp lampshades

Inside the C Lamp is a microcontroller driving LEDs, connected to either a wired or wireless network.

Technology

The concept prototype is built on the Processing and Arduino platforms. Processing analyzes text-based information received from the Internet, sends that data to an Arduino microcontroller, then the Arduino makes the data visual through the colors of LEDs.

This project gave me a strong foundation in programming and allowed me to build more complex projects like "LightOn" and "Knock" where I began working with physical interaction through sensors and motors on the Arduino platform.

Process

The design process was broken into two phases: research and visualization. Most of the research phase was spent collecting text-based information from the Internet. During this time, I discovered two resources I wanted to visualize—email content and blog articles (RSS feed). We email everyday anytime. Email is more useful than phone calls or text messages for those who live in different time zones or countries. Therefore, I chose these two types of communication as sources for this physical visualization project.

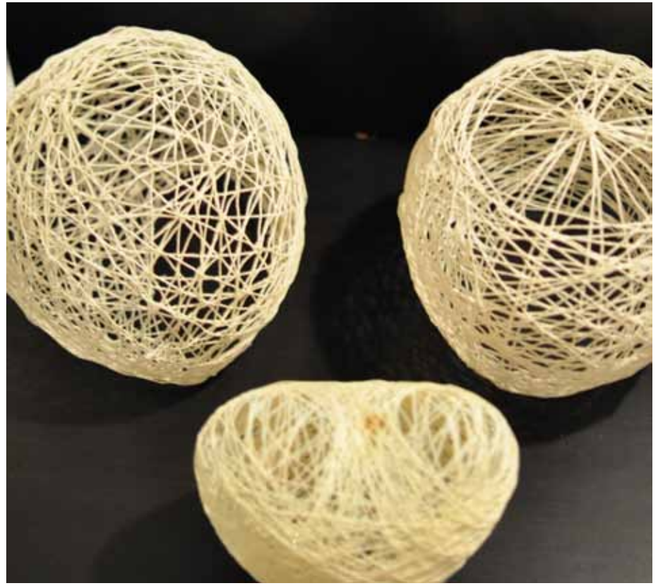
Most of the visualization phase was spent soldering electronic components to make the LED module and making cotton thread lampshades. I made eight different lampshades to explore how the lampshades would affect the experience.

Conclusion

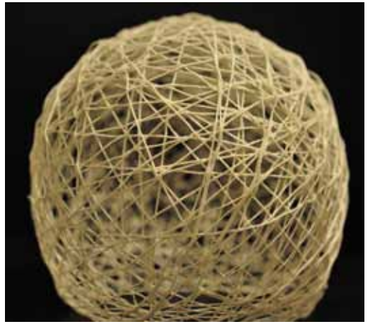
The physical object—handmade lampshade—and its tactile quality became the core element of this project. Some people think it is a mood lighting device. It's difficult for them to understand the message each color conveys. As a data visualization tool, the "C Lamp" was not successful. It reflected users' different and changing emotional states, but did not clearly show the nuances of the data. It is easy for users to notice dramatic color changes (e.g. from blue to red). If the change is a shift in tone within the same color (e.g. from red to pink), it is difficult to tell the difference. The "C Lamp" did accomplish one of its objectives, successfully communicating interpersonal messages visually by varying the brightness and color of light.

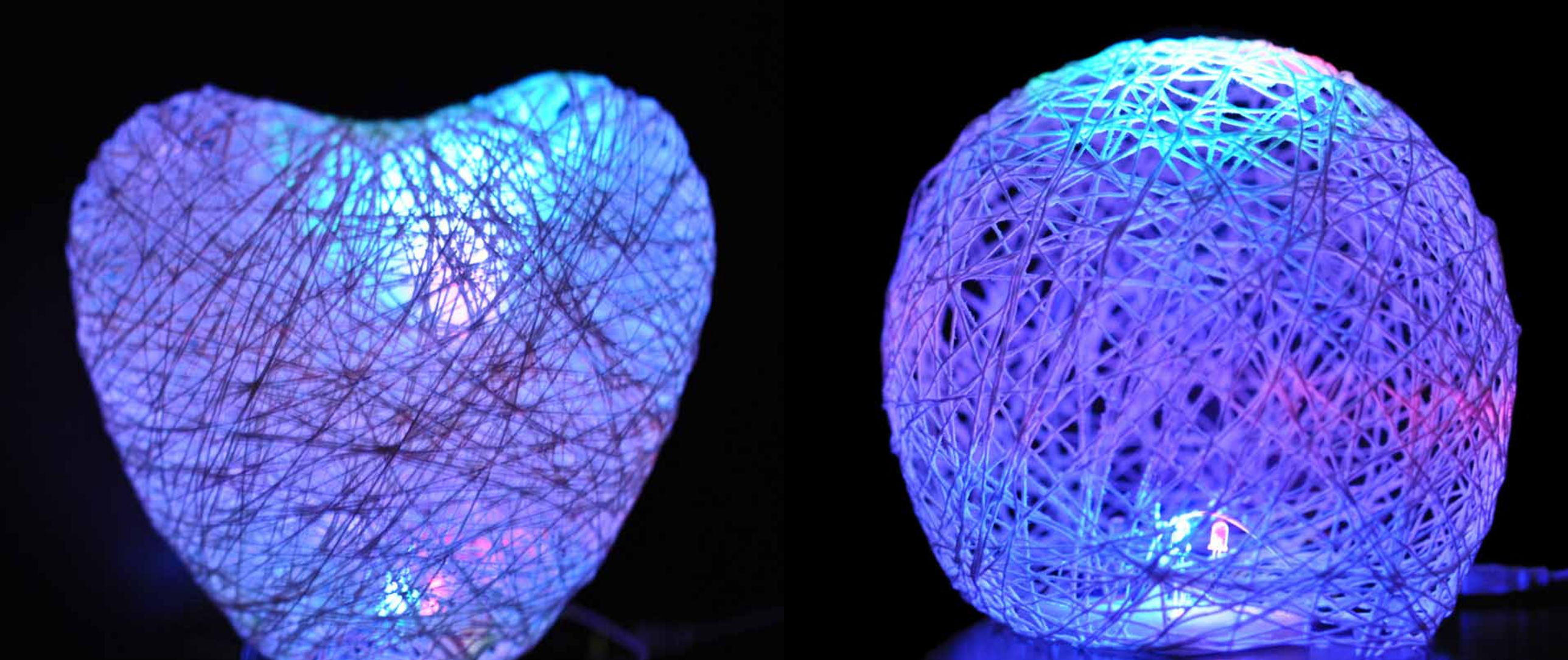
"C Lamp" is a physical data visualization device but its purpose is to not show all of its content. It's more about an experience of seeing a message and feeling a conversation. The color and brightness of light and the lampshade integrate into a poetic experience. Those I showed the prototype said they could feel the emotional message through the color and pulse of light. They focused not only on the color of light, but also the moment the color changed. As its color changed, the lamp conveyed new messages and brought different experiences.

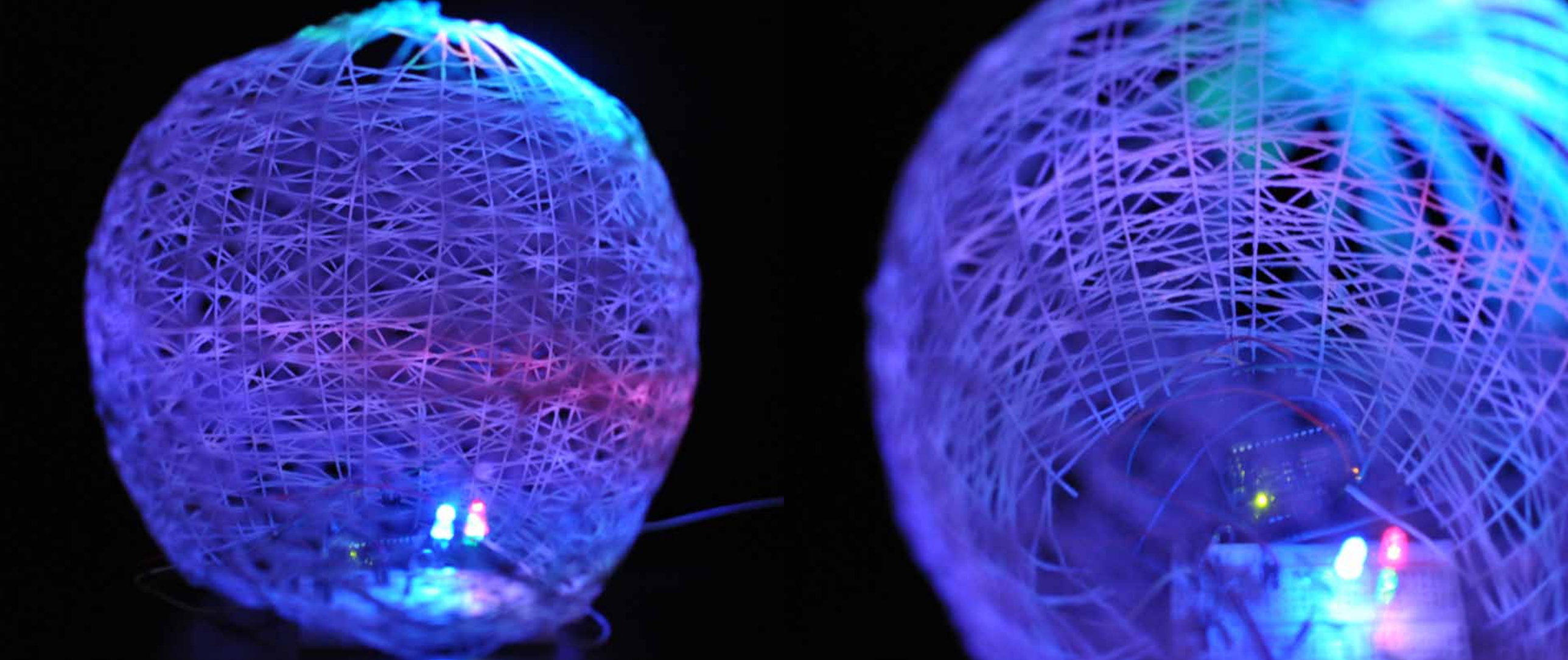
What role could light play in communication over distance? What kind of particular emotional experience could it convey? Is color an important and unique property of light? These questions brought me to the next project, "LightOn."

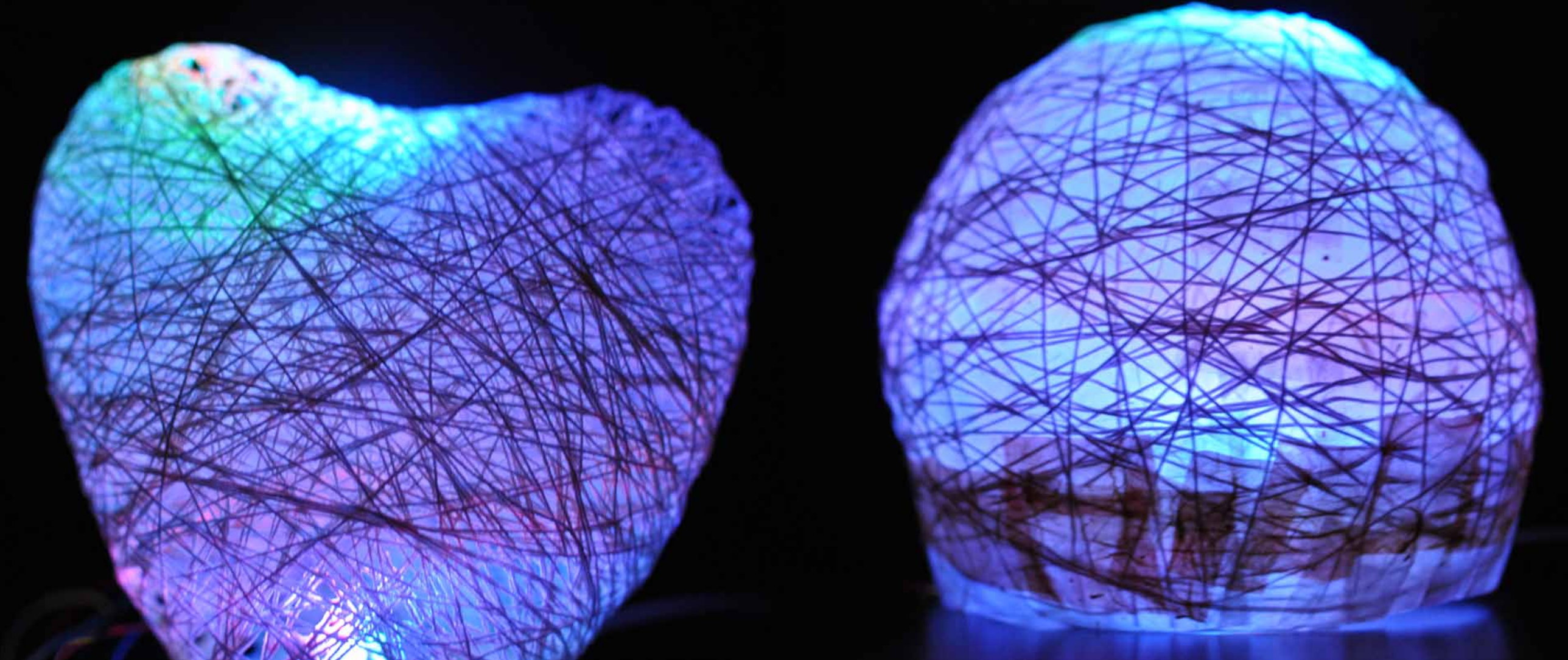


C Lamp lampshades









LightOn

Case Study Two

Project Overview

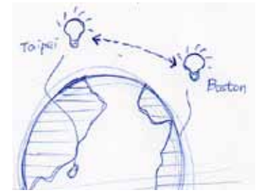
The initial idea for the LightOn project came from a scene in my memory. My family always leaves a light on for family members who come home late to make them feel that someone is waiting for them. Here, light not only illuminates the environment but also carries the warm message that someone is waiting for you. I decided to make a pair of lamps for people living apart, to create a warm experience that would make them feel they are not alone, using new media, objects (lamps), and ambient information (light).

The concept prototype is a pair of network-connected lamps and triggers located in different places. When one person turns their light on, a lamp in another site will also turn on. It provides a subtle and peripheral means of communication for people in different places.

Scenario

My wife travels all over the world for artist residencies. We live separately for several months of the year. We usually keep connected through email, Skype, and phone calls (if her residency is in the United States). It's not always convenient for us to talk over the phone or stay in front of computer and chat at the same time. Email becomes our first choice for communicating with each other. Email is an efficient way to communicate because it can cross time and space, but it lacks the quality of warmth for both of us. The network-connected lamps offered a different and richer experience.

I have one lamp in our house and she has another one with her wherever she stays. Both lamps connect wirelessly over Internet. When the sky goes dark, I turn my lamp on and her lamp turns on simultaneously. When she sees her light come on, she knows that it's not a joke or something scary like a ghost. She knows that it's me turning the light on for her because the sky is dark. The light conveys the messages that I miss her and



Concept sketch

Screen shoots from scenario demo video

I am thinking about her. When she presses the button and turns her light off, I know she knows I am thinking about her. The lamplight connects us.

Objective

My objective for this project was to investigate interpersonal connections. How can I represent interpersonal connection through the quality of light? What kind of emotional experience can we get from light? What is the difference when the light is on and off?

Physical Form

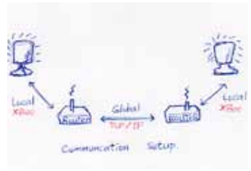
The physical object for this project is a table lamp, named "LAMPAN" that I brought from IKEA. It is a white plastic lamp whose shape is extremely simple. The focus of this project is the quality of light, not the physical lamp itself. A white plastic simple-shape lamp can minimize the influence of physical form on the overall experience.

Process

Since I planed to keep the physical form as simple as possible, the project development process was basically a technology process—programming and building an interface. The main concept for the prototype is the ability to control the pair of lamps simultaneously over the Internet.

The functional prototype was broken into two versions: Action Script and Arduino. The first version was programmed on Action Script 3.0 and used Union Platform as a central web server for transmitting data. The physical interface was built on a Phidgets board, a set of "plug and play" building blocks for low cost USB sensing and control from your computer, including LEDs and buttons. Phidgets connected with the computer that ran the Action Script code through USB and two Phidgets connected to each other through the Union Platform that Action Script code talked to. This prototype functioned very well. The only downside was that it required a computer transmitting and receiving data between two Phidgets boards. This version provided a clear coding logic and built a solid foundation for the programming structure of my next version.

The second version of my prototype was programmed with the Arduino platform. The physical interface was a controller box that contained a custom Arduino circuit board, an XBee chip, a relay, and an ON/OFF control button on top of the box. There are two power slots on the side of the box; one is for Lamps to plug in directly, and another is for the power cord to connect to a wall plug. The interface boxes send and receive data back and forth via the ZigBee, an XBee chip that can send and receive data wirelessly (Wi-Fi or radio). This version is the final functional prototype of the "LightOn" project.



Concept sketch

Prototype detail view

Code

```
/*  Light on project
 *   Alex Wang   11/16/2010
 */
const int btnPin = 12;                  // digital pin 12 for button (btnPin)
const int ledPin2 = 7;                  // digital pin 7 for LED
const int ledPin3 = 8;                  // digital pin 8 for LED
const int ledPin = 13;                  // digital pin 13 for LED (ledPint)

int btnVal= 0;                          // current state of button
int prevbtnVal = 0;                     // previous state of the button
int serialVal;                          // variable to store data coming from serial port
boolean lightOn = false;                // boolean to store the state that LED is on or off

void setup() {
  pinMode(btnPin, INPUT);               // set the btnPin as an INPUT
  digitalWrite(btnPin, HIGH);           // Pull up the built-in resister in button pin (pin 12)
  pinMode(ledPin, OUTPUT);              // ledPin is as an OUTPUT
  pinMode(ledPin2, OUTPUT);             // ledPin is as an OUTPUT
  pinMode(ledPin3, OUTPUT);             // ledPin is as an OUTPUT
  Serial.begin(9600);                   // open the serial port
}

void loop() {
  btnVal = digitalRead(btnPin);         // read state of switch
  delay(2);                             // debounce the switch
                                        // compare the button value to its previous value
  if (btnVal != prevbtnVal) {
                                        // if the state has changed, check the switch
    if (btnVal == LOW) {                // if switch has been pressed
      if (lightOn == false) {           // if LED is off
        lightOn = true;                 // change state variable and
        digitalWrite(ledPin, HIGH);     // turn LED on
        digitalWrite(ledPin2, HIGH);    // turn LED on
        digitalWrite(ledPin3, HIGH);    // turn LED on
        Serial.println(5);              // send serial data (ascii 5) about LED state (turn LED on) to serial port
      }
      else if (lightOn == true) {       // if LED is on
        lightOn = false;                // change LED state variable and
        digitalWrite(ledPin, LOW);      // turn LED off
        digitalWrite(ledPin2, LOW);     // turn LED off
        digitalWrite(ledPin3, LOW);     // turn LED off
        Serial.println(3);              // send serial data (ascii 3) about LED state (turn LED off) to serial port
      }
    }
  }
                                        // read serial port
  if (Serial.available() > 0) {         // if something is in the serial port (serial register)
    serialVal = Serial.read();          // read the incoming data
  }

  if (serialVal == 53) {                // if receive number 53 (ascii 5 is number 53)
    if (lightOn == false) {             // if LED state is off
      lightOn = true;                   // then set the LED state on
      digitalWrite(ledPin, HIGH);       // turn LED on
      digitalWrite(ledPin2, HIGH);      // turn LED on
      digitalWrite(ledPin3, HIGH);      // turn LED on
    }
  }

  if (serialVal == 51) {                // if receive number 51 (ascii 3 is number 51)
    if (lightOn == true) {              // if LED state is on
      lightOn = false;                  // then set the LED state off
      digitalWrite(ledPin, LOW);        // turn LED off
      digitalWrite(ledPin2, LOW);       // turn LED off
      digitalWrite(ledPin3, LOW);       // turn LED off
    }
  }

  // save the current button value as the previous value,
  // for next time through the loop
  prevbtnVal = btnVal;
}
```

Conclusion

Light is a beautiful metaphor for the quality of interpersonal connections. People separated by distance connect with each other when the light is on. Light in our culture makes people feel safe and warm. The connection between people stands for the same thing. When you feel an emotional connection (virtually or physically) with a loved one, you feel safe and warm. You feel her heart. You feel she is close even through you know she is not physically next to you. Using light as a metaphor for interpersonal connection enriches this experience because the light transforms the virtual connection to something physical that you can see and even touch. The light here not only conveys messages (I miss you or I am thinking about you) or care from a loved one, but also stands for a loved one's physical presence. The lamp becomes an interface to represent your loved one and the light becomes the carrier of these messages.
It was amazing to see people fall in love with this project when they tested the prototype. They were impressed to physically see the connection with a loved one across distance. They felt warm when they thought of the light as a message, such as I love you, and lived in the light just like being hugged by their loved one. They said the experience was elegant, warm, and poetic. And the interface is so simple that the only action is pressing a button—the light will take care of the rest.

A future variation for the "LightOn" project is to add color to the light. By adding some colors, light can convey more specific messages. Motion and sound are also possibilities for future projects. I believe they can enrich the quality of interpersonal connection and add another dimension to interpersonal communication.

C Lamp prototypes

Knock

Case Study Three

Project Overview

Knock is a pair of networked woodpeckers designed to call attention to people from various locations in a virtual network. The working prototype is a simply shaped wooden woodpecker, with a built-in circuit board that can communicate with other "Knock" objects. The concept for this project is to substitute something more playful and physical for the normal ways people call for each other's attention on the Internet, e.g. jumping icons, songs or phone rings, pop up windows.

Objective

The purpose of this project was to explore how sound and motion can improve interpersonal communication. The goal of the project was to create an off-screen interface showing the presence of other people in a network and facilitating communication with them. The idea came from a simple action, knocking on the door or table, that people usually do when they want someone's attention. When people work and live apart, they often choose instant messaging to talk to one another. Jumping icons or the ringing of instant messages appears on their computer desktops, calling their attention anytime everyday. It is very efficient for communicating but somehow a little bit boring. Everything happens on the screen. If users are somewhere without a screen, nothing will happen. Therefore, I designed this physical attention-getting device that I hope will create more playful and enjoyable communication.

Physical Form

The physical form of this project is a woodpecker. When a woodpecker pecks a tree, the sound and action are similar to the sound and action of people knocking on doors or tables. The shape of a woodpecker evokes a knock action. Thus, I used the woodpecker as the physical form for this project. Using sketching, illustration, form sculpting, and wood modeling I played with different abstract woodpecker shapes to arrive at a form that is communicative.

Ideation sketches

Concept model testing

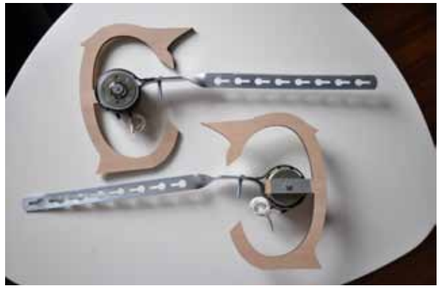
Technology

The concept prototype was programmed on the Arduino platform. The mechanical part was made with a rotary solenoid, a switch, an XBee chip, and a custom built Arduino circuit board. There is a spring inside the rotatory solenoid to bring the woodpecker back to its position or knock on the wall automatically when a user presses the woodpecker's tail. When the woodpecker's tail is pressed, it triggers the switch and sends a signal to another woodpecker through the network. When the other woodpecker receives the signal, it will knock on the wall in the same way that the first one knocks. In other words, when you manually make one woodpecker peck the wall, its connected partner, wherever it is located, will knock on the wall simultaneously.

Conclusion

Knock serves as a physical interface to substitute for instant messaging, a normal way people get each other's attention over distance. Knock not only achieved this goal but also opened up an opportunity for interaction. This exchange of knocks is not the linear interaction of seeing a jumping icon on the computer, clicking the application, opening up a pop up window, typing a response, then sending it back. Instead, it's open enough to allow users to create and discover their patterns of behavior over time (their custom Morse code). This simple and playful action and reaction allows people to develop and devise their own ways of communicating.

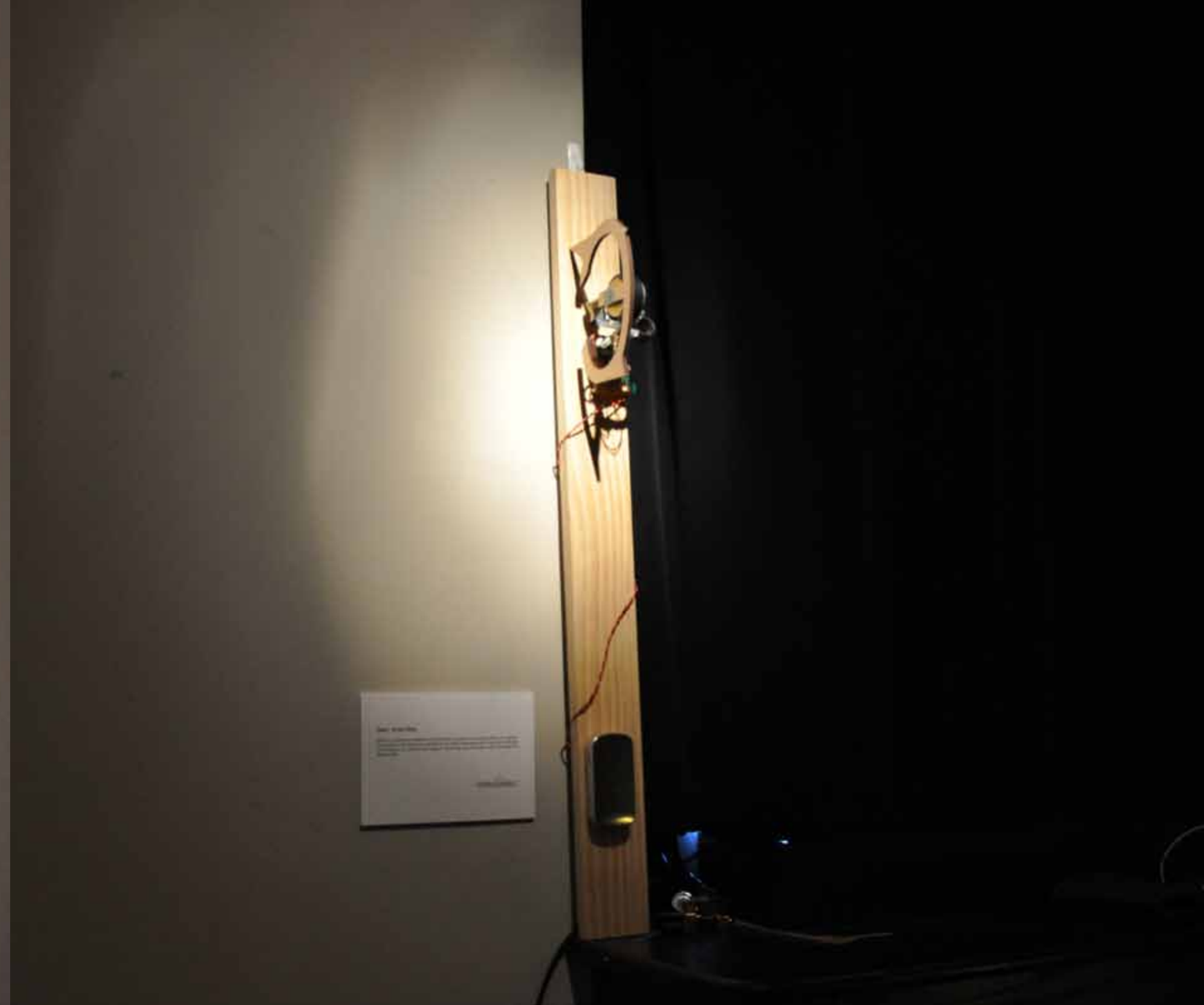
"Knock" was exhibited in the MediaLucious show in March 2011. Two "Knock" objects were set up next to two windows. Most of the audience pushed the woodpeckers' tails, saw the reaction, and laughed. They said "it's interesting" and "it's like a toy." There were a few audience members who played with "Knock" crazily. They quickly pushed the tail and tried to see whether the other "Knock" object would react in the same frequency or not. And then there were two groups of people who stood in front of two "Knock" objects and really talked to each other by knocking their woodpecker seeing it trigger the other side. It was an invaluable moment to me to see how they communicated through "Knock," and that they created their own pattern of communication.

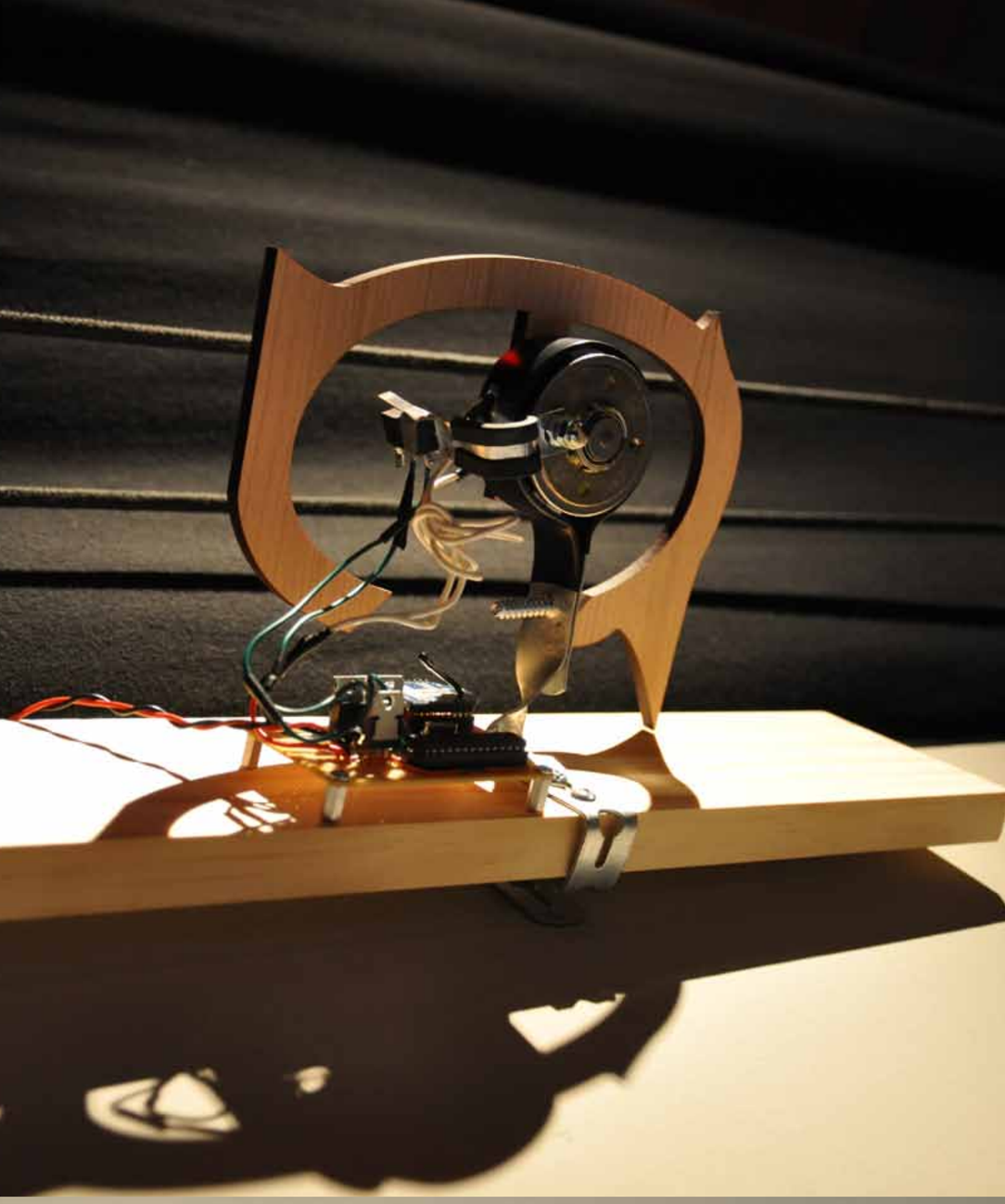


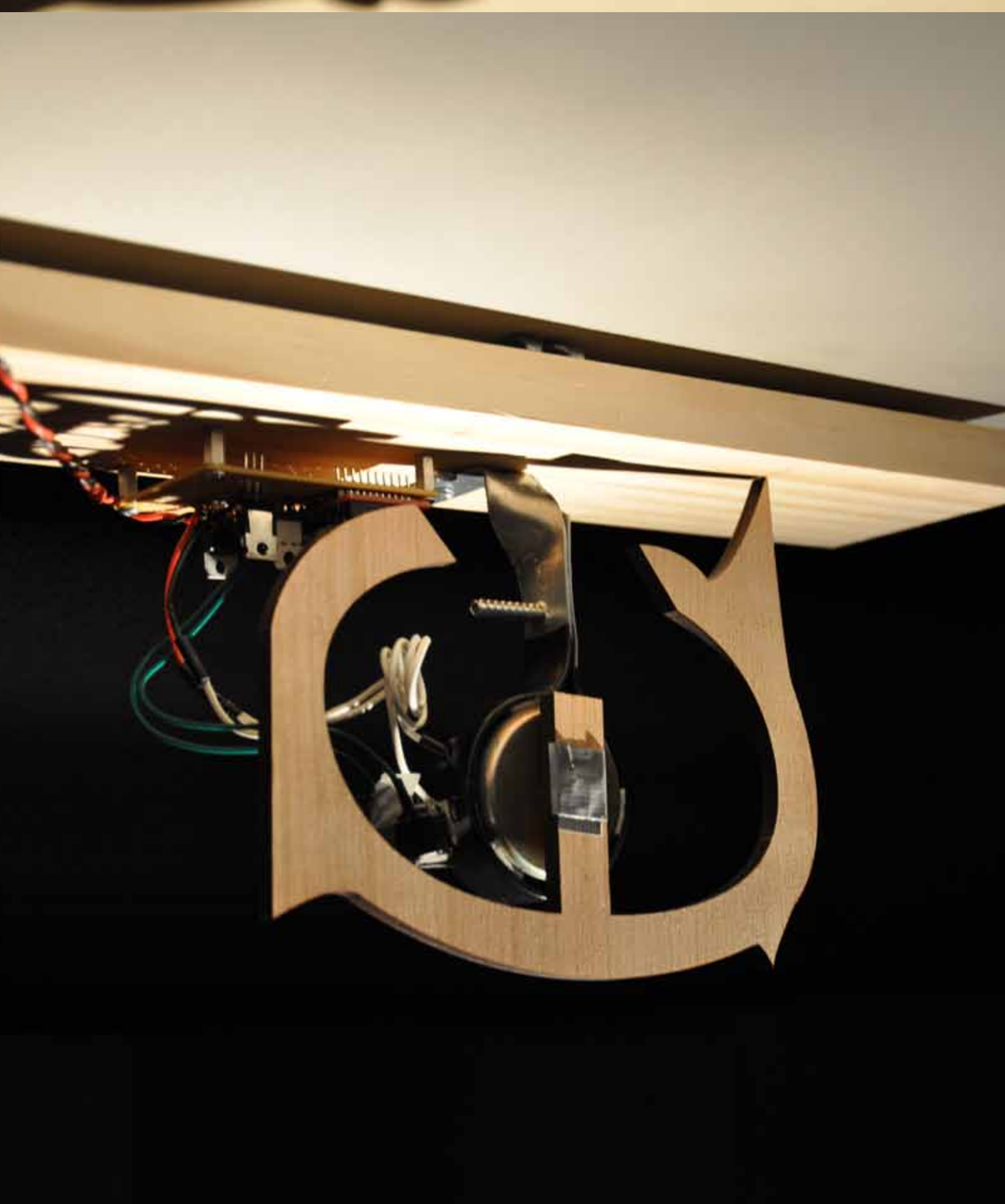
Final prototype

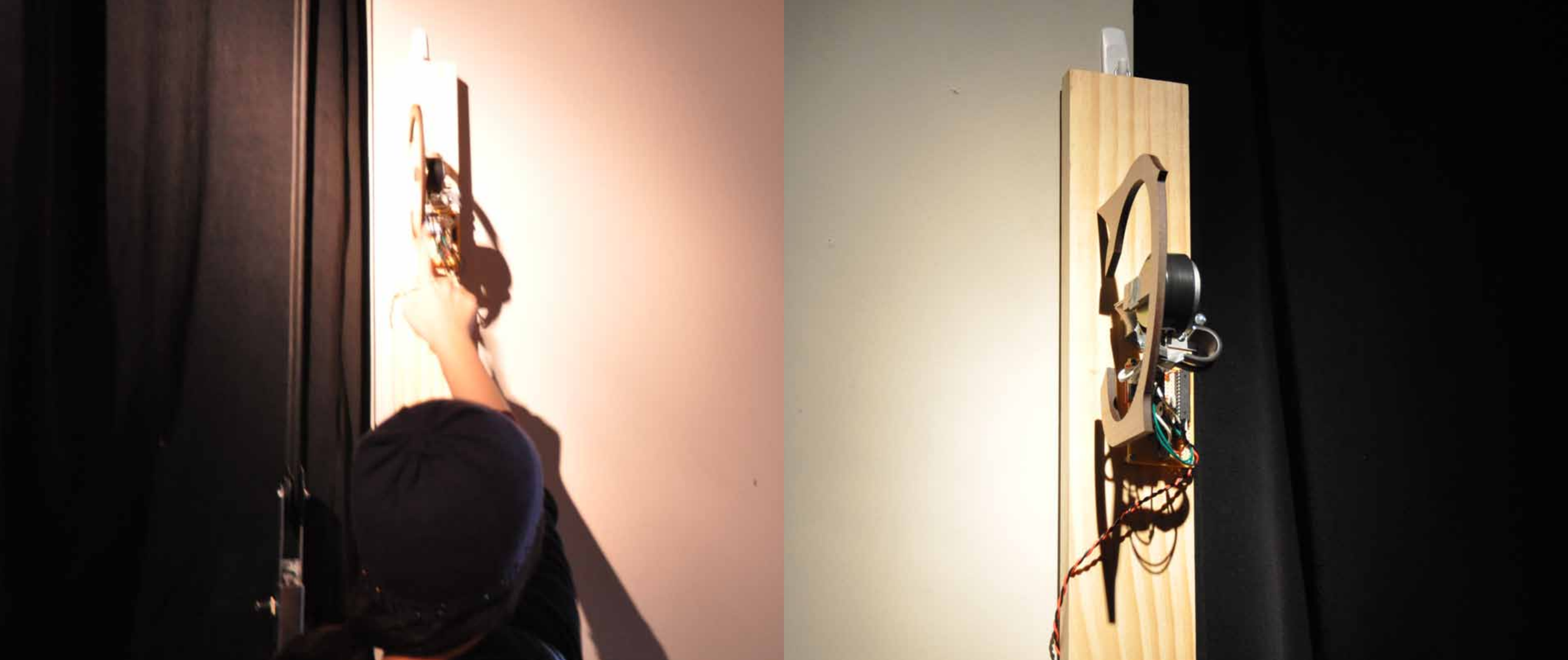
Code

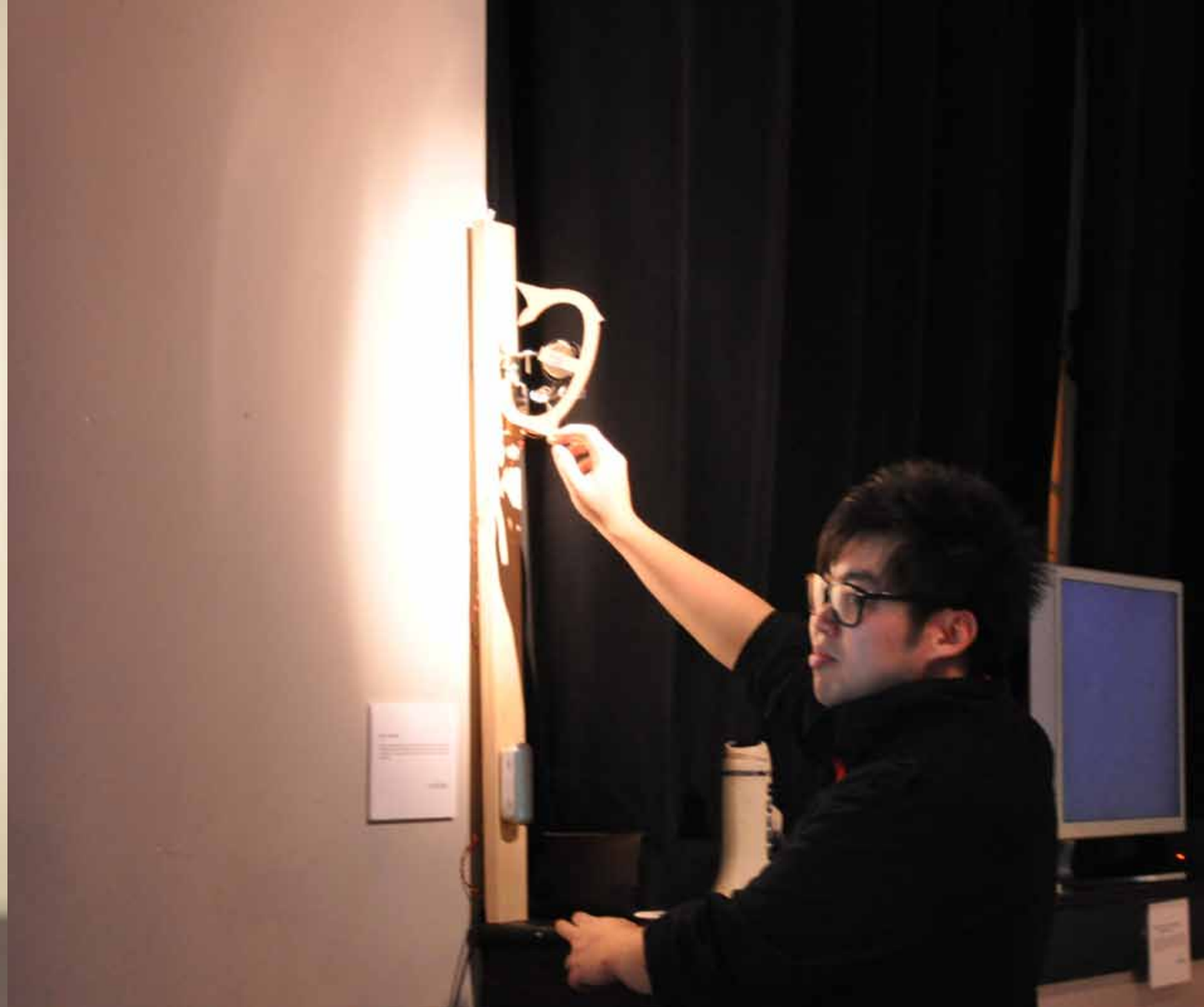
```
/* Knock
*  Alex Wang 12/14/2010
*/

const int birdPin =  8;         // the number of the solenoid pin
const int buttonPin = 7;      // the number of the pushbutton pin
int buttonState = 0;           // current state of the button
int lastButtonState = 0;     // previous state of the button
int serialVal;

void setup() {
 // set the digital pin as output:
 pinMode(birdPin, OUTPUT);
 // initialize the pushbutton pin as an input:
 pinMode(buttonPin, INPUT);
 // turn on pullup resistor
 digitalWrite(buttonPin, HIGH);
 Serial.begin(9600);
}

void loop()
{
 digitalWrite(birdPin, LOW);
 delay(10);
 // read the pushbutton input pin:
 buttonState = digitalRead(buttonPin);
 delay(2);  // debounce the switch

 if (Serial.available() > 0) {      // to check if there is any data coming from serial port
   serialVal = Serial.read();      // read the incoming date
 }

 if (serialVal == 53) {
  birdNock();
  Serial.println(3);
  delay(100);
 }

 // compare the buttonState to its previous state
 if (serialVal != 53) {
   if (buttonState != lastButtonState) {
     if (buttonState == LOW) {
       Serial.println(5);
     }
   }
 }

 // save the current state as the last state,
 //for next time through the loop
 lastButtonState = buttonState;
}

void birdNock() {
 digitalWrite(birdPin, HIGH);
 delay(150);
 digitalWrite(birdPin, LOW);
}
```

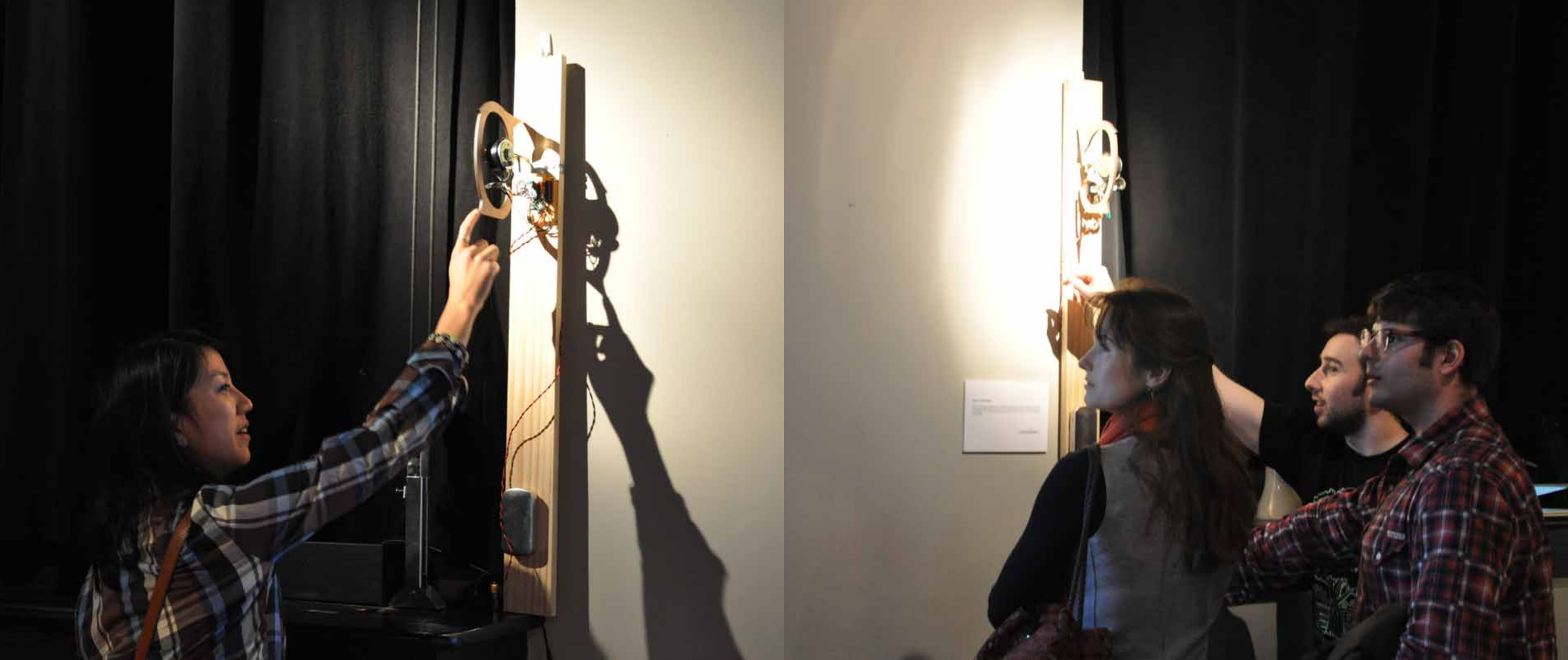












LightMate

Case Study Four

Project Overview

LightMate is a pair of interconnected lamps capable of conveying a number of emotions through action and movement. It was born in pairs for interpersonal communicating, connecting family members or friends who live apart.

Objective

We check emails and Facebook, keep each other company over Skype, and show that we have an enormous need for social contact while staying at home. But there is no way for us to physically feel the connection and touch communication. LightMate is built to provide a fun and interesting way of communicating, and to serve as an interactive toy for people who spend most of their time on-screen in the virtual world, allowing them to relax and have fun with a physical object in the real world.

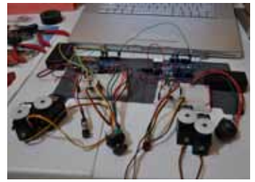
Technology

The working prototype was programmed on the Arduino platform and used ZigBee technology for communicating between two "LightMates." Inside, one servo connects to the lamp's head and another connects to the body. The two servos join together in a way that lets the head move in three dimensions.

There is a built-in button for turning the light on and off, and a built-in joystick for controlling the head's movement. Ultimately, the lamp's head can play the role of a joystick as well, letting users directly manipulate and change the angle of the head and create motion.

Scenario (System)

Two "LightMate" lamps are set up in different rooms. John and Mary sit in front of a "LightMate" while working separately. The two lamps are both turned on. John turns the light off and on to get Mary's attention, showing that he is nearby and wants to interact. Next John turns the lamp's head left, and Mary's LightMate's head turns left as well. At this point, there are two reactions Mary could



Setup servos and buttons for LightMate project.

LightMate prototype

perform. She could turn the lamp's head back to its original position or even move it right, left, and right to convey the message "don't bother me John." Alternatively, she doesn't move the lamp's head, but moves herself to the lamp and keeps working on her project.

The system is open enough for users to choose whether they want to interact with the other side or not. Both kinds of response convey messages and form communication between the two lamps (no response is also a response). They are free to communicate their thoughts (messages) by manipulating the movements of the lamp head. For instance, up-down movement conveys the message "yes" or "I agree."

Process

The development process was broken into three phases: programming, physical form design, and building. I first worked on the code to make the two servos listen to the commands from the joystick. Then I took the light-control code from the "LightOn" project and combined it with the code I was working on. Finally I worked on the function that made the servos connected to two Arduino chips control each other remotely via the XBee chip.

I sketched and prototyped different shapes of lamps that tested the extremes between the overly functional and the overly cute. Finally I settled on the lamps' current form—cute but not losing the feeling that it's a lamp. Then I worked on putting electronic components—servos, a joystick, and a custom Arduino board —inside the cardboard prototype and adjusted the position and the setting of those components.

Code

```
/* LightMate
 * Alex Wang  2/27/2011
 */

#include <Servo.h>

// create servo objects to control servos
// a maximum of eight servo objects can be created
Servo myservo1;
Servo myservo2;

// variable to hold value of analog in 1 and move servo
int servo1Pulse;
int servo2Pulse;
const int btnPin = 12;          // digital pin 12 for button (btnPin)
const int ledPin = 13;          // digital pin 13 for LED (ledPint)

int btnVal= 0;                  // current state of button
int prevbtnVal = 0;             // previous state of the button
int serialVal;                  // variable to store data coming from serial port
boolean lightOn = false;        // boolean to store the state that LED is on or off

void setup()
{
 pinMode(btnPin, INPUT);        // set the btnPin as an INPUT
 digitalWrite(btnPin, HIGH);    // Pull up the built-in resister in button pin (pin 12)
 pinMode(ledPin, OUTPUT);       // ledPin is as an OUTPUT
 Serial.begin(9600);            // open the serial port
 myservo1.attach(9);            // attaches the servo on pin 9 to the servo object
 myservo2.attach(10);           // attaches the servo on pin 10 to the servo object
}
```

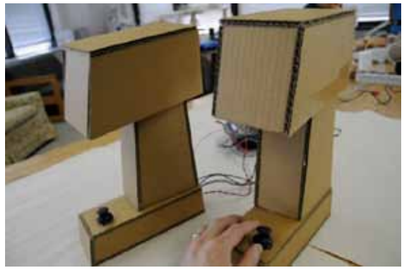
```
void loop()
{
 // ----- Light code Start -----
 btnVal = digitalRead(btnPin);       // read state of switch
 delay(2);                           // debounce the switch

 // compare the button value to its previous value
 if (btnVal != prevbtnVal) {
 // if the state has changed, check the switch
  if (btnVal == LOW) {               // if switch has been pressed
   if (lightOn == false) {           // if LED is off
    lightOn = true;                  // change state variable and
    digitalWrite(ledPin, HIGH);      // turn LED on
    Serial.println(5);               // send serial data (ascii 5) about LED state (turn LED on) to serial port
   }
   else if (lightOn == true) {       // if LED is on
    lightOn = false;                 // change LED state variable and
    digitalWrite(ledPin, LOW);       // turn LED off
    Serial.println(3);               // send serial data (ascii 3) about LED state (turn LED off) to serial port
   }
  }
 }
 // read serial port
 if (Serial.available() > 0) {       // if something is in the serial port (serial register)
  serialVal = Serial.read();         // read the incoming data
 }
 if (serialVal == 53) {              // if receive number 53 (ascii 5 is number 53)
  if (lightOn == false) {            // if LED state is off
   lightOn = true;                   // then set the LED state on
   digitalWrite(ledPin, HIGH);       // turn LED on
  }
 }
 if (serialVal == 51) {              // if receive number 51 (ascii 3 is number 51)
  if (lightOn == true) {             // if LED state is on
   lightOn = false;                  // then set the LED state off
   digitalWrite(ledPin, LOW);        // turn LED off
  }
 }

 // save the current button value as the previous value,
 // for next time through the loop
 prevbtnVal = btnVal;

 // ----- Servo Code Start -----
 servo1Pulse = map(analogRead(A0), 0, 1023, 0, 180);
 servo2Pulse = map(analogRead(A5), 0, 1023, 0, 180);

 myservo1.write(servo1Pulse);    // tell servo to go to position
 myservo2.write(servo2Pulse);    // tell servo to go to position
 delay(15);                      // wait 15ms for the servo to reach the position
}
```

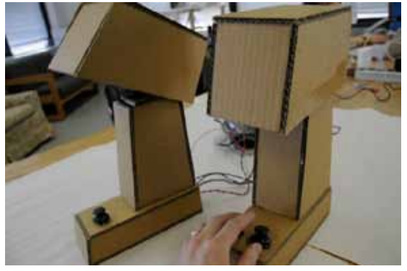
Conclusion

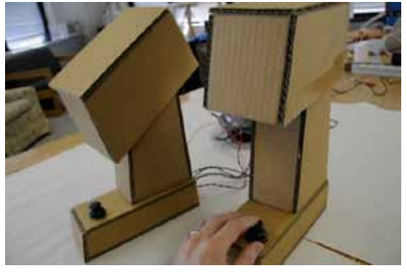
"LightMate" conveys more than just light. It serves as the last case study because it combines all the aspects of ambient information explored in the previous projects: light, sound, motion, physical objects, and lamps. Through light intensity the lamp provides soft feedback that someone is thinking of you, and represents someone's presence as well. Slapping or repeatedly toying with the lamp's head triggers movements in another paired lamp, forcing your partner to react, adjust his lamp, maybe slap it back, or other actions. The noise from the servo also conveys messages, for example, I am here or let's play. "LightMate" is more than a lamp. It accomplishes my goal of creating an object that can stand in for a person in other location. It is a substitute for that person. The object becomes live and active. While the shape of "LightMate" is not that of a person, its actions and reactions make you feel that the lamp is alive. The highlight of this project is the success with which personal emotion can be performed through the motion of the lamp's head.

People using the system felt that it was actually someone interacting with them because of the robotic feeling of the "LightMate" and the movements of lamp's head. They were fascinated by the emotion conveyed by the head's movements. You feel sad when you see LightMate's head down. When you see the head nodding you know it's saying "yes." The motion enriches the experience of communication.

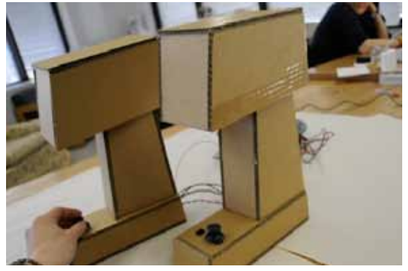
My next step for this project is to explore more emotional expression and actions. In addition, I hope to refine the prototype by replacing the current servo with an advanced servo that will remember its current position and send feedback to circuit board. This will simplify the interaction, allowing users to directly manipulate the lamp head to turn it to the angle they want, without requiring a joystick controller.

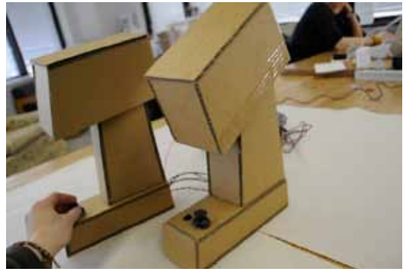


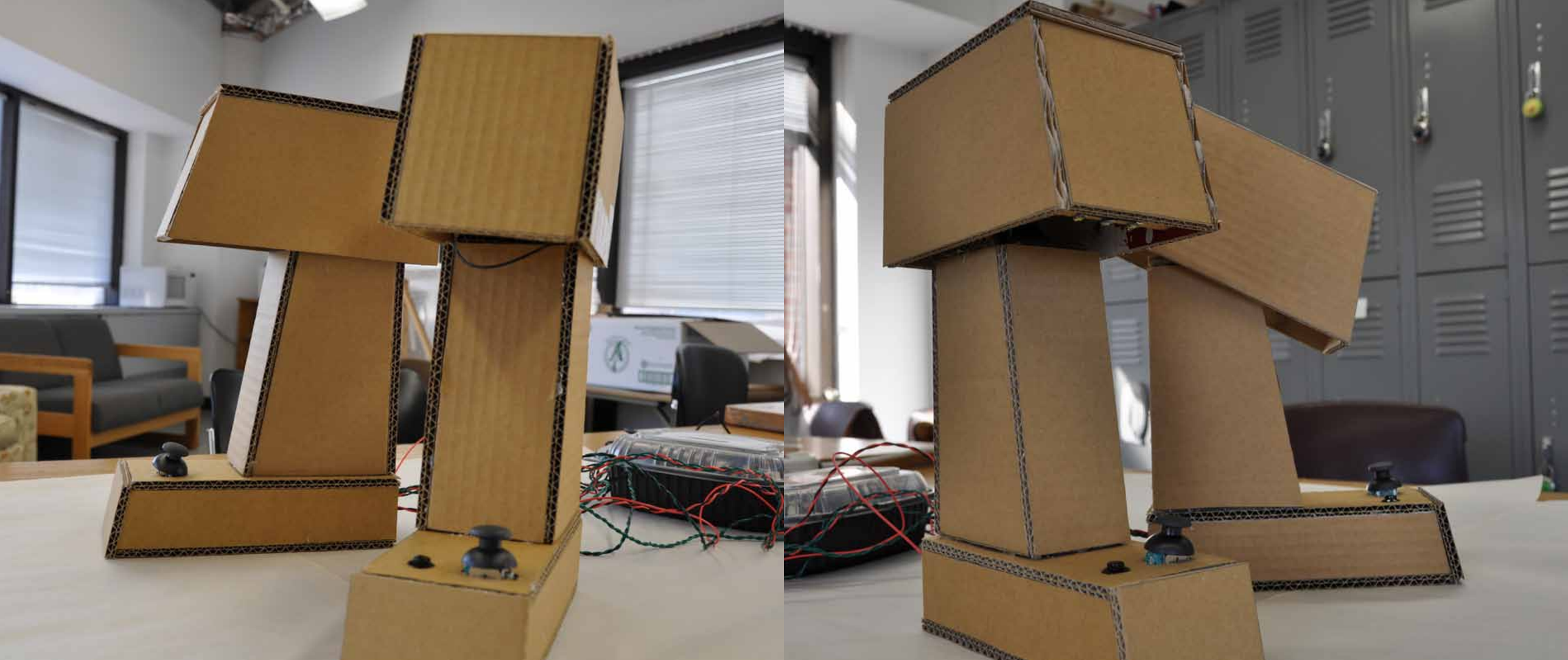


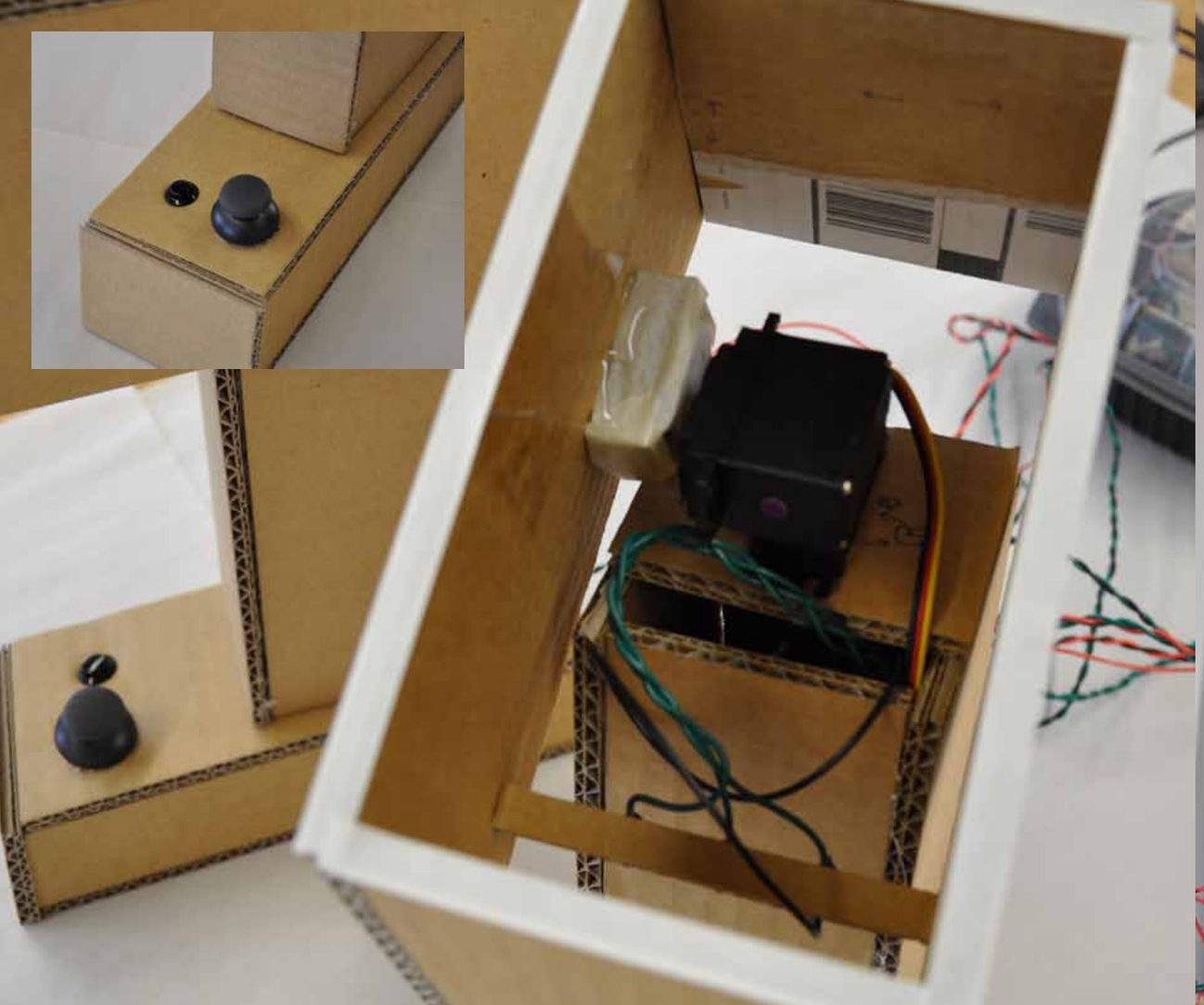


Testing the prototype and getting the "say yes" feeling from the up-down movement of LightMate's head.









Reflection

My case studies introduce interactive communication opportunities for emotional interaction (C Lamp and LightOn) and social activities (Knock and LightMate) according to which ambient information is applied to the communication experience. My projects imply that communication in daily life should not be limited by audio or video media forms, but can also be extended to more sensual, tactile or other subtle actions.

Looking at where I have arrived in my investigations, I am excited by the future. My DMI experience has given me not only the knowledge and skills of Interaction Design, but also a spirit of experimentation and a can-do attitude.

Over the past two years, I learned how to start a project with an abstract concept then refine my idea to a practical and executable plan. I gained skill in rapid prototyping, and can now choose to program a project in one of three different languages (Action Script, Processing, or Arduino). At DMI I learned to apply these coding languages to screen-based or object-based platforms. I learned a never-give-up attitude when I had to spend 90% of project time debugging code. Most importantly, I learned to trust myself and believe I can make it.

Physical interface is definitely a current trend (e.g. Wii and Xbox Kinect). Still, most contemporary physical interfaces are applied to screen-based media (e.g. TV games or screen-based applications). The challenge I see for further development is to make interaction invisible, surrounding us like air.

The advice I would give to young designers is to define new interface systems based on the natural rules of ambient information. Don't overwrite the rules. Simplicity is always a better choice when you deal with ambient information and physical interface. And never give up. Working on a physical interface, you have to write hundreds of lines of code and build custom physical objects. It's impossible to get everything right the first time, so you have to try and try and try. Debugging your code and rebuilding your objects will be the daily tasks in your life. If you are patient and enjoy the process, then you will get double (or triple) satisfaction when the prototype works.

In the future, I will continue to work on similar projects that shape and improve the experience of interpersonal communication by applying ambient information to everyday physical artifacts. I will try to combine screen-based media with physical interface to develop richer experiences.

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