Sparklry: Designing "sparkle" of interactive jewelry

Maho Oki
Future University Hakodate
116-2 Kamedanakano-cho,
Hakodate, Hokkaido, Japan
okimaho@acm.org

Koji Tsukada
Future University Hakodate
116-2 Kamedanakano-cho,
Hakodate, Hokkaido, Japan
tsuka@acm.org

TEI '17, March 20-23, 2017, Yokohama, Japan
ACM 978-1-4503-4676-4/17/03.
http://dx.doi.org/10.1145/3024969.3025053

Abstract
At present, many projects embed smart LEDs –multiple LEDs dynamically controlled by computers – into clothes or accessories to support novel expressions or daily activities. However, most of them do not consider the "sparkle" of traditional jewelry. We propose a presentation technique for interactive jewelry called "Sparklry", which can present "sparkles" on a jewel stone using internal LEDs. These sparkles are designed by integrating (1) a traditional jewel, (2) a light shielding sheet with small slits, and (3) an LED array. We developed a prototype and several examples of jewelry to explore appropriate designs of slits and LED patterns. Moreover, we developed two prototypes.

Author Keywords
Interactive Jewelry; sparkle; LED; augmented Jewelry.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; See

Introduction
Many projects these days embed smart LEDs –multiple LEDs dynamically controlled by computers – into clothes or accessories to support novel expressions or daily activities. For example, Fujimoto[3] developed an LED body suit that can enhance dance performances by

Figure 1: Examples of a same jewelry (crystal Swarovski) with/without our system.

Figure 3: First prototype of the Sparklry. 1: a LED matrix, 2: slit sheets, 3: Swarovski stones.

combining body expression and lighting effects. Ringly [9] is a commercial interactive jewelry capable of representing the status of a smartphone using an LED, a vibrator, and Bluetooth communication. There are also some toolkits that support the creation of wearable systems, like LilyPad [1] or Sparkle [6]. Thus, there are many wearable accessories and support technologies; however, most of them did not care about the "sparkle" of traditional jewelry. There are various cutting / polishing techniques that add attractive "sparkles" to traditional jewels (e.g., diamond). In this paper, we focus on a new technique to add "sparkle" to jewelry, "Sparklry", by integrating conventional jewelry and computer technologies.

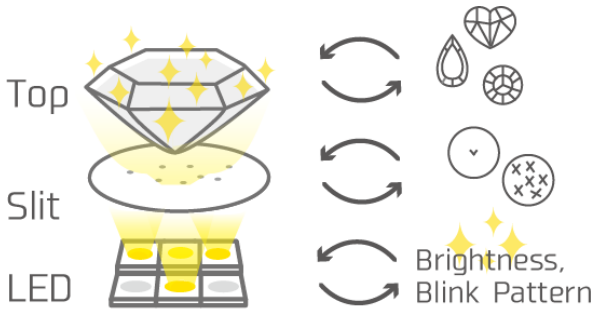

Figure 1: Basic concept.

Sparklry

The key idea of our system is to design the "sparkle" of jewelry by combining (1) a traditional jewel, (2) a light all directions. We set one of the stones on the system using a stone setting. The slit sheets are created from silver Origami papers. We prepared many slit designs and cut the papers using a CNC paper cutter (Roland iDecora). The LEDs are designed as a 3 × 3 LED matrix.

We soldered 9 white chip LEDs (UW1143B, 400 mcd, 2.7 × 3.5 mm) on our original board. The LEDs are controlled by Arduino. We developed software to generate various light patterns. Figure 2 shows the two blinking examples of the same jewelry with/without our system. Without our system, the jewel projects flat light and looks like a cheap toy. On the other hand, many small sparkles appear on a jewel using our system, which makes it look like traditional jewelry under great lighting. Figure 4 shows additional examples using our system.

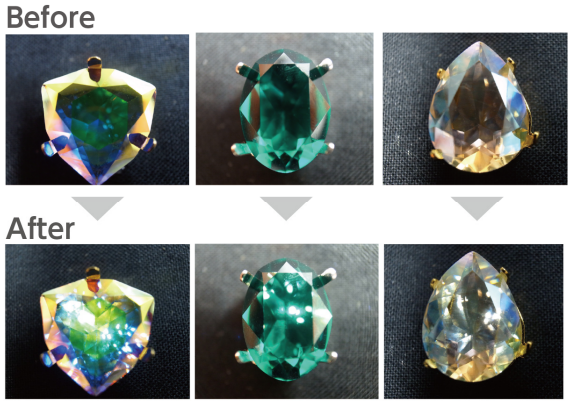

Figure 4: Examples of jewelry augmented by our system.

First Prototype

The first prototype is designed to explore appropriate designs of a slit sheet and LED patterns (Figure 3). We prepared Swarovski stones that are beautifully cut from all directions. We set one of the stones on the system using a stone setting. The slit sheets are created from silver Origami papers. We prepared many slit designs and cut the papers using a CNC paper cutter (Roland

iDecora). The LEDs are designed as a 3 × 3 LED matrix. We soldered 9 white chip LEDs (UW1143B, 400 mcd, 2.7 × 3.5 mm) on our original board. The LEDs are controlled by Arduino. We developed software to generate various light patterns. Figure 2 shows the two blinking examples of the same jewelry with/without our system. Without our system, the jewel projects flat light and looks like a cheap toy. On the other hand, many small sparkles appear on a jewel using our system, which makes it look like traditional jewelry under great lighting. Figure 4 shows additional examples using our system.

Applications

Next, we developed two prototype applications: an earring-type and a showcase-type.

Earring-type prototype

The earring type prototype is designed to be as small as possible to make it easier to wear. The device structure is shown in Figure 5. The controller part is separated from the earring (LED) part and connected by thin wires. It is hidden behind the ear when the earring is worn (Figure 6 bottom). The controller part has a micro-controller (ATMega328P-AU, Atmel), an acceleration sensor (KXR94-2050), and a small battery (SparkFun). These are housed in the case printed by a 3D printer, which is attached to the ear hook.

The earring part consists of the main Swarovski stone, three LEDs, a slit sheet, and eight small Swarovski stones for decoration. The LEDs (NFSW036CT, 9.2 cd, 3.5 × 3.5 mm) and slit sheet are arranged to fit under the main Swarovski stone (crystal color, 12 × 12 mm). We attached eight small Swarovski stones (8 × 4 mm) for decoration around the main Swarovski (Figure 5 and 6) to hide the LEDs completely. We bonded the metal clip to the back of the LED board. We made slits (size: 0.2 mm, number: about 20) on the slit sheet in the same way as in the first prototype. The prototype detects the wearer's movement using the acceleration sensor and blinks at random for a certain period of time.

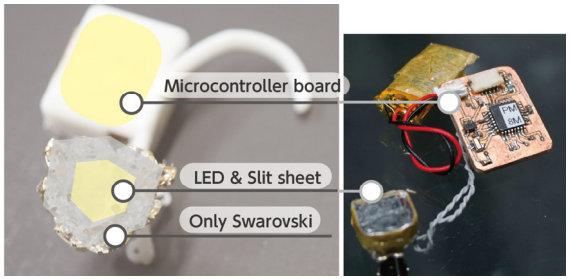

Figure 5: Earring-type prototype.

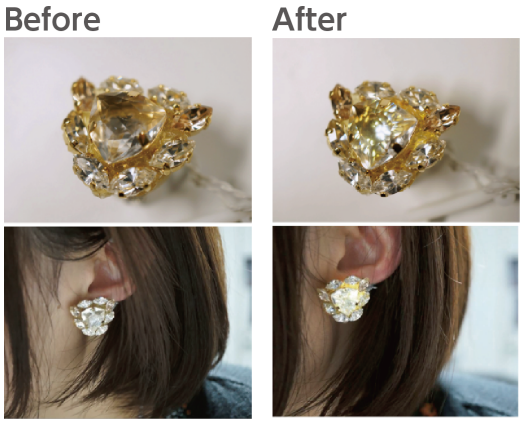

Figure 6: Examples of the earring type prototype. Left: turn off LEDs, right: turn on LEDs.

Showcase type prototype

The showcase type prototype is designed such that people can see sparkles with various Swarovski stones using our system. It is a small box on top of which the Swarovski stone is set (Figure 7). People can change the kind of Swarovski and the slit sheet. The user can watch the effect of the sparkles using our system in his/her hand from various angles. The device consists of a micro-controller (Arduino Pro mini), an acceleration sensor (KXR94-2050), a small battery, and an LED board. We thought that more LEDs could increase the expression of the sparkle of the Swarovski. Therefore, we selected small but low-brightness LED (OSWT1608, 74 mcd), and arranged nine LEDs on the LED board. These are housed in a case (about 7 cm × 7 cm ×5 cm), and the LED board is attached to the cover of the box. We designed the cover such that it has a hole to set the slit sheet and Swarovski unit just above the LEDs and printed it using the 3D printer. We bonded velour fabric on top of the cover to adjust the appearance of the jewelry case. The LEDs basically alternate between on and off for a certain period. Moreover, people can change the lighting pattern by tilting the device.

Discussion

Slit design

We found that the number of slits was also important while experimenting using the first prototype. Fewer slits (e.g., 1 slit per LED) produced less and weak sparkles on the Swarovski. Many slits (e.g., 30 slits per LED) made it too bright and lit the whole Swarovski stone. It is expected that the amount of the light incident on the Swarovski depends on the slit's size/ shape/number. The position of the slit also influences the reflection of light on the Swarovski stone. Therefore, we will explore suitable parameters of the slit's size/shape/number and derive the relationship between the surface of the Swarovski and slits to make sparkles effectively.

Figure 7: Showcase-type prototype.

Related works

Many research projects embed smart LEDs into clothing or accessories for both aesthetic and performance purposes. For example, there are LED body suits that enhance dance performance[3], wearable lighting devices that explore lighting effects around a person's face [8], and a wearable display device that uses the afterimage effect created by a user's movements[5]. The "Beauty Technology"[4] uses the body's surface as an interactive platform by way of LEDs or sensors attached to the skin or fingernails.

Other art projects[10,11] that have been developed include beautiful fashion accessories that light up by using LEDs and the original case. Some commercial, interactive accessories are capable of representing the status of a smartphone using LEDs[2,7,9].

Although there are many wearable devices that use LED lighting, most of them do not augment traditional accessories, and they are especially lacking in "sparkle." Various cutting and polishing techniques exist to add attractive "sparkles" to traditional jewels (e.g., diamond). We think that integrating these techniques with computer technology can make jewelry more impressive and more expressive while maintaining a natural appearance; therefore, we proposed and prototyped a new technique for adding "sparkle" to jewelry by integrating conventional jewelry and multiple LEDs that are dynamically controlled by computers.

Acknowledgements

This project is supported by JSPS 25700019.

Video URL

https://youtu.be/VyQlLyRWm_M

References

[1] Buechley, L., Eisenberg, M., Catchen, J., and Crockett, A. The LilyPad Arduino: Using Computational Textiles to Investigate Engagement, Aesthetics, and Diversity in Computer Science Education. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM (2008), 423–432.

[2] CuteCircuit. Mirror Handbag. http://shop.cutecircuit.com/products/mirror-handbag.

[3] Fujimoto, M., Naotaka, F., Terada, T., and Tsukamoto, M. Lighting Choreographer: An LED Control System for Dance Performances. *Proceedings of the 13th International Conference on Ubiquitous Computing*, ACM (2011), 613–614.

[4] Katia Vega and Fuks, H. *Beauty Technology*. Springer International Publishing, Cham, 2016.

[5] LIU, X., Vega, K., Qian, J., Paradiso, J., and Maes, P. Fluxa: Body Movements As a Social Display. *Proceedings of the 29th Annual Symposium on User Interface Software and Technology*, ACM (2016), 155–157.

[6] SparkFun Electronics. Sparkle Kit - Diamond. https://www.sparkfun.com/products/retired/12729.

[7] Swarovski. Swarovski Activity Tracking Jewelry. http://www.swarovski.com/Web_US/en/91215/promotion/Swarovski_Activity_Tracking_Jewelry.html.

[8] Zhao, N. and Paradiso, J.A. HALO: Wearable Lighting. *Adjunct Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2015 ACM International Symposium on Wearable Computers*, ACM (2015), 601–606.

[9] RINGLY: Smart Jewelry and Accessories. https://ringly.com/.

[10] KYEOK KIM. http://www.kyeokkim.com/.

[11] Dian Luo. http://showtime.arts.ac.uk/dianluo.