Rayz

Janice Ng
Simon Fraser University
250-13450 102nd Ave.
Surrey, BC Canada
janicen@sfu.ca

Brendan DeBrincat
Simon Fraser University
250-13450 102nd Ave.
Surrey, BC Canada
bdebrinc@sfu.ca

Janet Lau
Simon Fraser University
250-13450 102nd Ave.
Surrey, BC Canada
lauhiul@sfu.ca

Abstract
The interactive wearable *Rayz* was a research piece that focused on engaging users to reflect on health risks by wearing it and interacting with technologies in the environment.

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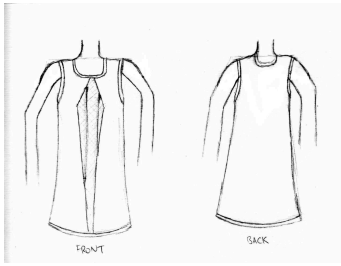
Interactive Wearable; Electromagnetic Field; Radiation

ACM Classification Keywords
Applied computing: Arts and humanities: Media arts

Introduction
Rayz was an interactive dress that increased awareness of electromagnetic field radiation absorbed by the body. Today, the existence of technology is found to be ubiquitous which seamlessly integrates into our daily lifestyles where usage is on a constant basis without resistance. According to the Canadian Wireless Telecommunications Association, 74% of Canadians are using the cell phone network on a daily basis. Hence, technologies are seen as a piece of object rather than a device emitting harmful radiant energy, such that when objects heat our skin, we are not aware of the effects of living tissues burning. As a result, the observations lead to a concept of raising potential health concerns of

electromagnetic field radiation emitted by technologies when the user wore the dress and interacted with its surrounding technological environment.

In order to drive the form, various precedent studies were considered in relation to our project. For instance, there was Ying Gao's Living Pod collection of clothing, interactive art exhibitions of Sachiko Kodama who used ferrofluids that reacted to electromagnetic fields, as well as Luke Stergeon's exploration project in physically visualising electromagnetic field in order to make the invisible visible.



Concept

Extensive use of technology in our daily lives allowed us to notice that devices are not merely a piece of object, but are living creatures in a way which emits radiation, similar to the human body emitting heat and gases. Therefore, the team raised a question of "What if we can create an interactive wearable that helped people visualize health risks of interacting with electromagnetic radiation?" This derived to the concept of encouraging users to reflect on health concerns of electromagnetic radiation emitted by daily technologies upon the reaction of a dress while using a piece of device.

During our research, we studied numerous electromagnetic radiation topics in order to achieve a compelling design for our art piece. For instance, we learned that the earth's ozone layer is a protection against the sun's UV rays and that there was a hole formed due to CFC gases produced by old thrown out appliances, resulting UV rays to penetrate much more easily and caused the hole to become larger. We then applied the dress as the layer of external skin, which alluded to the body skin and as the dress detected the presence of technology, it would open up as a sense of thinning the skin by allowing radiation to force its way into the internal body structure. Additionally, we were on the verge of altering our concept since we read that daily technologies emit only non-ionizing radiation which to current study indicates that no harm will be caused because they do not have enough energy to do so. Soon after, we found that brain cancer is potentially caused by wireless cellular devices since frequent use next to the ear would generate heat against tissues which can become mutated. This portion was translated to our dress through the use of LEDs and how they pulsed in the relaxed state, but glowed vividly after detecting the presence of a device (indicating that organs are being damaged and the user should become alert). Lastly, the overall shape referred to an X-ray shield. Hence, the wearable raised health issues to allow users to become more aware of their surroundings.

Interaction and User Experience

The intended user interaction of the wearable was to reveal the outcome of electromagnetic radiation upon using technology. When the user was not wearing the dress, they would not be aware of impacts caused by technological devices. After putting it on and interacting

with an input such as a cellphone that was brought up close to the proximity sensor, an interruption was caused which triggered the dress to open and LEDs to illuminate brightly as the output (as seen in Figure 1). Also, the proximity sensor was placed near the chest since for instance, text messaging on the phone or using appliances, it involved a natural position of raising it up to the chest area or devices come in contact in the chest area. While the dress became responsive through its subtle actions, the wearer would become more aware as he or she saw the situation.

Figure 1. Human interaction with *Rayz.*

Technical Implementation

Our system was comprised of two Arduino UNO boards, an ultrasonic sensor, two servo motors, one white LED strip, and a 12 volt battery pack. The first Arduino board acted as a microcontroller and to power the 5 volt ultrasonic sensor, while the second powered the two servo motors. The ultrasonic sensor was used to detect the proximity of electronics to the user's body. The servo motors served as an output for the system. One rotated fully to 180 degrees to the right and the other 180 degrees to the left (opening up the dress) based on the proximity detected. The LED strip was the second output, and also reacted according to the detected proximity. It first pulsated slowly when nothing was detected, and glowed brighter and more steadily when an object neared. The light strip was powered by a 12 volt battery pack hidden in the dress.

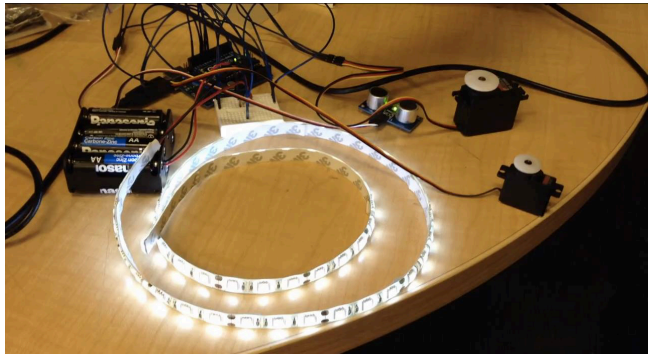


Figure 2. Electronics for *Rayz.*

The flow of data through *Rayz* started when the wearer moved an electronic object closer to their chest. The return rate (speed) of the pulses sent and received by the sensor was sent along to an Arduino UNO, where a calculation determined how far away the object was. Inside the microprocessor the distance change is smoothed. From these control signals were sent to both the LED light strip and to the servo motors outputs.

Findings

Over the course of researching and creating this project, many insights were discovered from the beginning stages to the final iterations.

At the fabrication phase, the team noticed that an electromagnetic field can be found anywhere under the form of heat energy while we were making our own EMF sensor since it was difficult to find one in the market. For instance, when body heat touched the piece of wire, our LED started to react. We also found that different devices emit different intensity of electromagnetic field such that an electric socket was higher than an iPhone. However, the antenna gave us imprecise readings where we had to use an ultrasonic sensor instead to detect the proximity of devices. Additionally, because two servo motors, a 5 volt ultrasonic sensor and a 12 volt LED strip required a lot of power, we solved it by using another Arduino board since it was smaller and created pouches inside the dress to carry all the electronics.

For user experience, we discovered that subtle and minimalistic design was a better approach rather than using colourful fabric and LEDs. The earlier prototypes showed it looked chaotic and had an energetic mood. When it was altered to a simple white while glowing white light, the representation was more calm which allowed users to reflect on their actions and environment upon the use of technology. At first, we had problems in creating an embodied experience since our initial ideas were too literal and that the interactions were too simple, such that when the user raises their arm as a natural movement of trying to get phone signal, the wearable will glow red. In the end, with deeper research in the domain, we were able to overcome the issue.

Conclusion

By prototyping a concept that demonstrated harmful issues of electromagnetic field signaled by daily technology upon wearing the dress and interacting with space, multiple learnings and findings opportunities were revealed. For example, we discovered that electromagnetic field came in many forms and different aesthetic choices offered a variation of experiential emotions towards users.

For improvements in the future, further research is necessary to create a more compelling project. The garment could be altered as well to suit a wider range of audience. With the electronics, more research and investment would be required to embed wearable friendly electronics that truly detected electromagnetic fields and to allow mobility. Since the majority of daily technologies generate only non ionizing radiation which has low non harmful energy, it would be necessary to strengthen the concept and design to extend its abilities to convey the message of potential danger.

Along with the interaction and experience implemented, the project generated a reflective piece that enhanced an exploration of the idea in raising concerns of electromagnetic field radiation amongst daily technology.

Inspiration

The project has been inspired by: Ying Gao's "Living Pod" [1], Sachiko Kodama's "Breathing Chaos" [2] and Luke Sturgeon's "Visualizing Electromagnetic Fields" [3].

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