SensArt Demo: A Multisensory Prototype for Engaging with Visual Art

Daniella Briotto Faustino
Carleton University
1125 Colonel By Drive
Ottawa, ON K1S 5B6, Canada
daniella.briottofaustino@carleton.ca

Sandra Gabriele
Carleton University
1125 Colonel By Drive
Ottawa, ON K1S 5B6, Canada
sandra.gabriele3@carleton.ca

Rami Ibrahim
Carleton University
1125 Colonel By Drive
Ottawa, ON K1S 5B6, Canada
ramif.ibrahim@carleton.ca

Anna-Lena Theus
Carleton University
1125 Colonel By Drive
Ottawa, ON K1S 5B6, Canada
anna.theus@carleton.ca

Audrey Girouard
Carleton University
1125 Colonel By Drive
Ottawa, ON K1S 5B6, Canada
audrey.girouard@carleton.ca

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Abstract
Typically, visits to modern art galleries or museums are characterized as visual experiences supported by text-based information describing the works of art. Our goal was to investigate the potential of providing a fuller and richer experience while viewing visual art by appealing to the senses beyond sight. We designed *SensArt*, a multisensory experience whereby someone viewing a painting received a translation of the art through a headset with music and a belt programmed with vibration patterns and changes in temperature.

Author Keywords
Human-computer interaction; design; multisensory; haptic; music; vibration; temperature; visual arts; museum studies; wearables

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H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; J.5. Computer applications: Arts and humanities: Fine art.; B.6.3. Hardware: Logic design: Design Aids

Introduction
Typically, information provided to gallery and museum visitors use words to describe visual works of art either as printed text or audio recordings [8]. While these

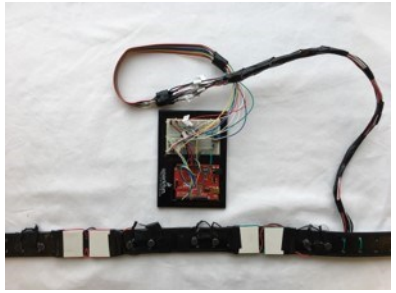

Figure 1: *SensArt* electronic components, including mini disk vibration motors and Peltier thermoelectric cooling modules are connected to an Arduino board

Figure 2: *SensArt* cover contains the belt and all electronic components

descriptions are helpful for providing context, translating ambiguous concepts inherent in visual art with words is not a simple or easy task [3]. Providing additional stimuli might make complex concepts of visual art more understandable and enhance visitors' experiences while engaging with the art. However, it is essential to understand human perceptual limitations when designing for multisensory experiences that stimulate more than one sense simultaneously [6].

Our goal was to evaluate whether the stimulation of the senses beyond sight would provide a fuller and richer experience for those viewing works of art. We designed a multisensory experience whereby someone viewing a painting received a translation of works of art through a headset with music and a belt programmed with vibration patterns and changes in temperature. Through a user study, we sought to understand how sensory prompts might provide people with rich information when experiencing art.

Related Work

Previous work looking at ways to enhance the art gallery and museum experience for visitors indicates that providing alternative sensory aids is beneficial for both disabled and able-bodied visitors. However, researchers recommend exercising caution when reinterpreting visual experiences for other senses as not every aspect of a work is translatable [3].

A six-week multisensory art exhibition at the Tate Britain art gallery in London used light, soundscapes, mid-air haptic feedback, scents and taste to support artworks [6]. The researchers found that participants responded positively to the multisensory enhancement of the art. We conceptualized our study based on the premise that appealing to senses other than sight can enhance a viewer's experience.

Design Considerations

We were deliberate in our selection of the sensory stimuli for the prototype to ensure that each user's experience would not interfere with that of other visitors. We focused on the design of a wearable device that uses sound, temperature and vibration.

Sound

Previous studies show that instrumental classical music paired with visual content can markedly enhance the emotional experience of the viewer [1]. However, frequency-modulated sounds can negatively affect the experience and are not ideal for evoking emotions [2]. We considered these findings and used music, rather than abstract tones for the design of a prototype.

Temperature

Research shows a warm stimulus changes the level of arousal (alertness) and dominance (intensity) of emotions experienced by participants [9]. Different temperatures were associated with different feelings, such as warmth to communicate pleasant feelings and cold to boost fear [10]. Based on this research, we set temperatures on the prototype to correspond with the emotions exhibited by the paintings.

Vibration (haptics)

Researchers have found haptic feedback can be used to express emotions and that signal length and intensity are important for haptic perception [4]. Depending on the body part, sensation points need to be positioned more or less apart from one another in order to be perceived separately [5]. We considered previous

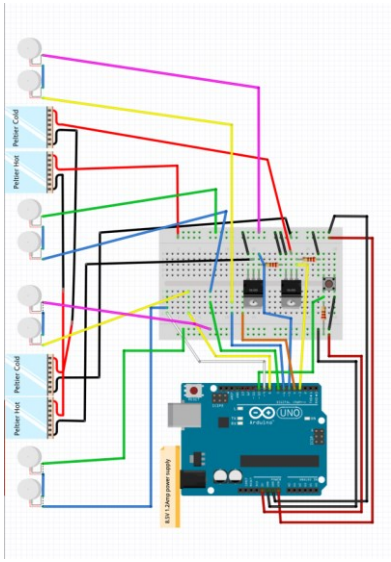

Figure 3: Electronic connections

Figure 4: The assembled *SensArt* belt prototype

findings related to intensity, frequency and distance between vibration actuators to build our prototype.

Prototype

We designed and built *SensArt*, a multisensory belt worn slightly above the waistline, to ensure close contact with the user's body. We chose to make the prototype in the form of a belt because of its portability and the ability to adjust it according to the size of the wearer. Additionally, we did not want to overwhelm wearers, who would be presented with information for more than one sense simultaneously. Because the lower back has relatively low sensitivity [7], a non-obtrusive belt seemed appropriate.

The prototype consisted of eight 2 mm mini vibrating disk motors (3V each) and four Peltier thermoelectric cooling modules (15V each), two for heating and two for cooling. Each pair of vibration motors were wired in parallel (the negative wire from one vibration motor was connected to the positive wire of another vibration motor). Similarly, we wired each pair of Peltier modules in a parallel arrangement.

All actuators were attached on the inside of a 4 cm high leather belt, covering 48 cm of the back portion. We limited the area where the actuators would be placed to avoid stimulation on the user's stomach, which is more sensitive and could cause discomfort. We positioned a pair of vibration motors on each of the extremes of the defined area, followed by a pair of Peltier thermoelectric cooling modules, and another pair of vibration motors. We left 5.5 cm of space in the middle where actuators would not make contact with the wearer because of the concave area on the body created by the spine (Figure 1).

We constructed a belt cover made of synthetic drapery fabric and binding tape with Velcro fasteners to house the belt and the electrical components (Figure 2). We connected the components to an Arduino UNO electronics board, powered by an 8.5V 1.2A AC/DC adapter (Figure 3). A manual pushbutton switch activates the stimuli scripts (Figure 4). Users listen to music, transmitted through AKG Monitor headphones.

The preparation of a multisensory experience with *SensArt* includes:

- choosing paintings and finding information explaining the emotional and descriptive characteristics of each painting;
- identifying music that represents the mood and content expressed by the paintings; and
- mapping and programming the intensity of the vibration stimuli to the arousal levels of the music and the heating/cooling modules to match the mood evoked by the paintings.

We conducted a preliminary evaluation with 12 participants (Figure 5), in which they viewed one painting as a visual-only experience and another painting as a multisensory experience, wearing the *SensArt* prototype. We collected data about participants' understanding of the descriptive and emotive qualities of the artworks. Our results showed no significant difference between the visual-only experience and the multisensory experience. We attribute these preliminary findings both to a potential mismatch of intensity of the stimuli and the difficulty in translating abstract visual concepts into words. However, we found that the majority of participants

Figure 5: Use of *SensArt* prototype in a Lab setting

preferred the multisensory approach. Additionally, participants who do not usually go to art galleries or museums indicated they would be more likely to visit if multisensory experiences were provided.

Conclusion

SensArt is a prototype that uses music, vibration patterns and temperature changes to translate the emotive and descriptive qualities of works of art. Given its potential for attracting more visitors to art galleries and museums, we believe that our approach is a step in the right direction towards providing a richer multisensory experience for viewing visual art.

We hope to experiment with other intensities and pattern combinations to better translate and transmit emotive and descriptive information about artworks to enhance the experience of engaging with visual art. Future work might also include expanding the scope of this work to include other types of sensory stimulations such as scent and touch.

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