Practice Report

Adapting Artworks for People Who Are Blind or Visually Impaired Using Raised Printing

Tjaša Krivec, Tadeja Muck, Rolanda Fugger Germadnik, Igor Majnaric, and Gorazd Golob

Everyone has the right to freely participate in the cultural life of the community (United Nations, 2012). In Europe and around the globe, many efforts have been made in order to include people with visual impairments and blindness into the cultural life (Braille Authority, 2012; Brvar, 2010; European Blind Union, 2011; Kennedy, 2003; Kurze, 1996; Salzhauer Axel & Sobol Levent, 2003; Wright, 2009). The objects and artifacts exhibited in museums for people with visual impairments are available either by direct touch of the original or its 3-D reproduction. Paintings, on the other hand, require a different approach—usually a tactile adaptation is created.

This paper describes the process used to create a tactile adaptation of the painting Portrait of Empress Elisabeth of Habsburg, which hangs in the Celje Regional Museum in Slovenia as a part of the Cultural and Art Historical Collection. It was painted between 1873 and 1875 by the Austrian artist Georg Martin Ignaz Raab. The Empress Elisabeth, also known as Sissi (1837–1898), was famous especially in the Habsburg monarchy for her extreme beauty and unconventional style of life. Her life inspired many movies that ensured her legacy for generations to come.

Thanks are due to the Celje Regional Museum for permitting the use of their painting and for the opportunity to exhibit our final adaptation. We also thank the company GREC d.o.o., which printed all the adjustments and provided us with some professional guidance.

There are many techniques used in tactile adaptation. Two are used very often, namely the microcapsule technique (Braille Authority, 2012) and the thermovacuum technique (Rener, 1992). To create a tactile adaptation in this study, a new technique with an inkjet printer, the Roland UV LEC-330, was tested (Roland, 2012). The printer uses a special varnish that can be cured by ultraviolet (UV) light to generate raised relief surfaces printed layer by layer. This cannot be used for numerous copies, though, as the printing procedure is very time consuming. The printer adjustment and mistake correction are simple because the technique is digital. Apart from these technical aspects, we also explored ways of conveying the content of the actual image as best we could (Salzhauer Axel & Sobol Levent, 2003). The painting was carefully transformed into a tactile adaptation with the help of a museum expert; thus, during the adaptation, all historically important data were preserved.

The process unfolded in three stages that are described below. In each stage, in addition to the technical use of the printer, subjects who are blind or visually impaired were interviewed to tell us whether the information at that point in the adaptation was easily perceived tactilely or not. Their comments were taken into consideration in the following stage. The final, third adaptation now hangs alongside the painting in the museum, where it is available for museumgoers who are blind or visually impaired.

METHODS

Subjects

The subjects who participated in this study were found with the help of the Slovenian Association of People with Visual Impairments and Blindness and the Institute for Youth with Visual Impairments and Blindness of Slovenia. Our aim was to exhibit the tactile adaptation in a museum. Our main criterion was, therefore, that subjects be...
interested in art and the exploration of art. The average age was 35 years. All subjects agreed that tactile adaptation is useful and a likeable medium that helps improve their understanding of the visual world. Not all subjects were involved in all three stages of the adaptation. In Table 1, their involvement and some demographical data are presented.

**Three stages of adaptation**

The painting’s dimensions are 79 x 63.3 centimeters (roughly 31 x 25 inches) (see Figure 1). The tactile adaptations, due to size restrictions connected to the sense of touch, were smaller—only 36 x 29 centimeters (approximately 14 x 11 inches) in size (Brvar, 2010). The three tactile adaptations were printed in a similar way, with only minor differences. Table 2 shows printer settings and printing conditions.

The appropriate museum expert was consulted throughout the procedure; however, the historically relevant features were determined beforehand. These were the stubborn and strong character of Elisabeth as portrayed, depicted in the shape of her mouth and chin; her soft skin and voluminous hair, representing her youth and beauty; the ornaments in her hair and at her neck; the flowers on her dress; and the sumptuously detailed frame that surrounds the original.

**Stage 1: First adaptation and group interview.**

The framework of the first tactile adaptation was created with two simple lines (see Figure 2). It was a guide and an orientation tool for the tactile adaptation. The eyes were created with a circle plus another curved line representing the eyelid. The nose was created with a curve, which indicated the direction of Elisabeth’s gaze in the portrait. The mouth was set directly under the nose, the lines clinging to original contours. The ornaments on her head, at her neck, and on her dress were filled with a gloss varnish. Small details had to be eliminated after the museum expert prioritized the importance of the motifs, the most significant of which was her necklace. Also, some ornaments on her dress were not included in the tactile version. Overall, we chose fewer details, to create a more comprehensible perception. The hair was indicated with only a few curved and low raised lines. In this adaptation, no additional textures were used; the relief was created with 1–7 layers. The height of the measured lines was from 0.05 mm to 0.09 mm.
After the first tactile adaptation, a group interview with four subjects was held. All subjects agreed that the adaptation’s low raised lines were inadequate to the sense of touch. All subjects needed a great deal of time to navigate independently through the adaptation. Subject one, for instance, did not immediately understand the curved nose line: in her opinion, a straight line would be more specific. The contours used for the frame, mouth, and eyes, though, were well recognized by all subjects.

Table 2
Printing conditions and printer settings for all three stages.

<table>
<thead>
<tr>
<th>Settings and conditions</th>
<th>First tactile adjustment</th>
<th>Second and third tactile adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>RIP (Raster Image Processor) settings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Print quality</td>
<td>Standard quality</td>
<td>High quality</td>
</tr>
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<td>Printing mode</td>
<td>Gloss (layers 1–7)</td>
<td>Matte (layers 1–10) and embossing (layers 11 and 12)</td>
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<tr>
<td>Printing direction</td>
<td>Uni-direction</td>
<td>Bi-direction</td>
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<tr>
<td>Printing conditions</td>
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<td></td>
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<tr>
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<td>Ljubljana</td>
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<td>Paper</td>
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<td>285 g/m² Stardream Diamond</td>
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<td>Printer</td>
<td>UV Roland VersaLEC 300</td>
<td>UV Roland VersaLEC 300</td>
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<tr>
<td>Ink</td>
<td>ECO UV (gloss) and ECO UV (black)</td>
<td>ECO UV (gloss) and ECO UV (black)</td>
</tr>
<tr>
<td>Temperature</td>
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<td>21°C (70°F)</td>
</tr>
<tr>
<td>Humidity</td>
<td>25%</td>
<td>25%</td>
</tr>
</tbody>
</table>
Stage 2: Second adaptation and individual interviews. In reaction to these perceptions, we decided to create textures within the rendered shapes for the second adaptation (see Figure 3). The selection of textures was based on an intuitive process following on the series of interviews and comparisons of different textures. Founded on the direct feedback from the subjects, the textures with larger elements seemed to improve the quality of the tactile image. In addition, the line width was important. Although the line was of appropriate height, it could not be recognized if it was too thin. The second adaptation included lines with more appropriate heights.

For the frame, a crossed-strap motif was used as a texture. For the painting itself, a background texture was added in order to give the individual the feeling of canvas; we wanted to show the medium of the original. For the skin, a plain matte texture was chosen. For the ornaments and jewelry, the texture was created out of very high small dots lined with a smooth borderline. For the hair texture, thin curves that followed the original hair flow were lined closely together. The texture of the dress used in the second adaptation was created with a flow of low and wide dots. Inside the folds of the dress, the dots were closer together, and where the dress was stretched they were farther apart. In this adaptation, the relief was created with 4–14 layers. The height of the measured lines was from 0.05 mm to 0.47 mm.

Eleven subjects were questioned in individual interviews. Figure 4 shows in what way certain graphic features were presented, following the subjects’ stated preferences. The ornaments in the hair and dress, as well as the
Figure 3. Digital version of the second tactile adaptation.

strap around the neck, were recognized with possible mistakes by 64% of the subjects. The jewelry around the neck was not recognized by 9% of the subjects and was recognized with possible mistakes by 45% of subjects. The main reason for the mistakes, the subjects stated, was the sharp and strong feeling of the texture and the blurriness of the borderline,

Figure 4. Reflection of input garnered for the second adaption of the painting.
which was not sharp enough to determine the form of the ornaments and jewelry. Sixty-four percent of the subjects recognized the hair texture; however, 45% did not separate it sufficiently from the background texture. Nine percent could not distinguish the hair at all. The main reason was the similarity of the hair texture to the background, especially when the fingers moved cross the hair and not parallel with the curves. The dress texture was recognized by 54% of subjects, with 36% of subjects recognizing it with possible mistakes. The subjects described the dress texture as pleasant and agreeable.

The best-presented motifs in the second adaptation were the frame, the facial features, and the dress. To achieve a better presentation, more attention needed to be given to the ornaments and hair.

Stage 3: Third adaptation and individual interviews. In the third tactile adaptation, some small corrections in response to the interviews in the second stage were made (see Figure 5). The texture used for the ornaments in this adaptation was compounded from a line created by sharp dots as a borderline and an inner texture that was gloss varnish (see Figure 6). This solution contributed to an enormously improved version. Because the ornaments were small and were surrounded with other textures, we isolated the most important motifs and placed them under the legend of textures (see Figure 7). The hair texture in this iteration included the right amount of appropriately proportioned curves, which were recognizable and made for a considerable contrast with the background. Figure 8 represents the final tactile
adaptation as it is exhibited in the Celje Regional Museum.

To confirm the success of the third adaptation, two more interviews were conducted. Both subjects confirmed a great improvement in the adaptation. For a more precise understanding of the process and for details of how to determine different textures, contact Tjaša Krivec for more information, images, and charts.

**Measuring and Capturing of Prints**

The prints were captured with a digital microscope, Dino Lite AM 413T, and JEOL SEM6060.
LV. The captured images were studied on a computer screen, where the width and height of different lines and textures were digitally measured with ImageJ software.

CONCLUSIONS
In this study, three adaptations of the Empress Elisabeth’s portrait were made, using an inkjet printer, Roland UV LEC-330. The technique enables the rendering of extremely delicate and fine lines, and numerous different textures. Along with the museum expertise and the expertise of subjects who are blind or visually impaired, using this technique for creating a tactile adaptation of fine arts for people with visual impairments enables their participation in their cultural heritage. The tactile users were very satisfied with the final adaptation of the artistic work, as has been reported by the museum after the end of the study.

REFERENCES
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