Digital Decal

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1. Introduction

Decal, short for 'decalcomania', is a technique of transferring graphic images from specially prepared paper to another surface upon contact. It was popularized as a decorative technique for ceramics during the 1870s. The technique was also frequently used by the Surrealists. Presently, decals are widely used for instant lettering, tattoos, and pictograms. With the simple action of rubbing, graphic images can be quickly transferred to a variety of surfaces. This motivated us to ask the following question: "Can we apply the direct and playful image transfer method of decals to pen-based computing?" Our response to this is the concept of 'digital decal'. With digital decal, ordinary paper replaces special decal films. The user can simply place a sheet of printed paper on the tablet screen, and then rub on it with a pen. The rubbed image is transferred directly to the screen in the same manner as with a traditional decal (Figure 1). Furthermore, any thin material such as colorful fabrics or leaves also can be used in place of paper.
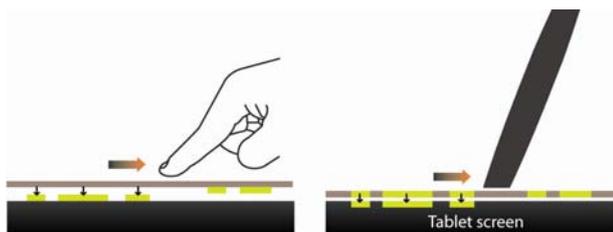

Figure 1: Traditional decal (left) and digital decal (right)

2. Implementation

In order to implement the concept of digital decal, we built a DecalPen prototype. The prototype consists of two main parts: a color sensing part and a position sensing part. It uses an optical fiber bundle to transfer an image under the tip of the DecalPen to a color sensor. The sensor determines the average RGB values of the image and sends them to the computer. For position sensing, it has an LC resonator at the tip tuned to the tablet hardware of the computer. The location of the pen is determined at the frequency of 100Hz. The computer then paints pixels in the detected color where the DecalPen is pointing. The real-time cycles of such scanning and painting create the experience of decal, spanning the physical real world and the digital computing world.

When DecalPen was first built, we found that the sparseness of printed pixels was much higher than we expected. Even though the scanning and printing cycle is repeated about 100 times a second, each printed pixel is separated by approximately 3mm in normal operations. To solve this problem, we have the system print a certain number of dots around the current point with a Gaussian probability profile. This spray effect produces a more natural-looking picture. Moreover, it is effective in color mixing when strokes overlap.

Severe discordance between the original image and the copy was also a problem. The main cause seemed to be the system delay between the detection of the stylus position and the color sensing. A basic dead-reckoning technique was used in order to overcome the system delay problem. Because rubbing is a regular and periodic movement, it is possible to predict the position of DecalPen for a short amount of time. After system delay compensation, the quality of copied image was significantly improved.

For the DecalPen demo application, we designed two transfer modes: scanner mode and stencil mode. With the former, the user can simply copy an image onto a screen (Figure 2- left). With the latter, on the other hand, only a particular region of the screen predefined by the user is painted with scanned patterns (Figure 2-right).

Figure 2: Scanner mode (left) and stencil mode (right)

3. Conclusion

DecalPen can be used as a medium of artistic expression for children as well as adults. The users can copy interesting graphic images to a screen intuitively by simple rubbing, and edit it to express their feeling or ideas. In this respect, DecalPen is similar to I/O Brush [Ryokai et al, 2004] in a sense. However, DecalPen provides a considerably different artistic experience from I/O Brush, thanks to its directness and spatial congruence in interaction. DecalPen is an extension of our previous work TransPen & MimeoPad [Lee et al, 2007], which enables 'digital rubbing'. If we employ both devices together, the directness of image transfer via DecalPen and TransPen will make the process of drawing and editing more effective and pleasurable.

References

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