Graffiti Fur: Turning Your Carpet into a Computer Display

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Figure 1: *A user draws pattern on a tablet and the device draws the pattern on the carpet (left). The device can draw large images (right).*

Introduction

Computer displays play an important role in connecting the information world and the real world. In the era of ubiquitous computing, it is essential to be able to access information in a fluid way and non-obstructive integration of displays into our living environment is a basic requirement to achieve it. Here, we propose a display technology that utilizes the phenomenon whereby the shading properties of fur change as the fibers are raised or flattened. One can erase drawings by first flattening the fibers by sweeping the surface by hand in the fiber's growth direction and then draw lines by raising the fibers by moving a finger in the opposite direction. These material properties can be found in various items such as carpets and plush toy in our living environment. Our technology can turn these ordinary objects into displays without requiring or creating any non-reversible modifications to the objects. It can be used to make a large-scale display and the drawings it creates have no running costs.

Implementation

We have developed two different devices to draw patterns on a "fur display" utilizing this phenomenon: a roller device and a pen device. The roller device consists of 16 fur-raising components (each consisting of a rod and a servomotor that lowers and lifts the rod) attached to the bottom of the roller. When the rod is lowered, it raises the fiber as the user moves the roller. In addition, a rotary encoder is mounted on the wheel shaft to measure the horizontal movement of the roller. The rotary encoder and servomotors are controlled by an microcontroller. The system lowers and raises the rods according to the measurements of the rotary encoder to leave patterns on the fur. Drawing with the device proceeds as follows. First, user will freely draw or edit their favorite pattern in our application program using either of these four method: (1) draw freely using finger or pen, (2) convert a monochrome bitmap of an illustration into a dot pattern, (3) capture a picture in real time by using the tablet PC's camera or (4) type text into the textbox. Then, these data will be transmitted to the device and user can start drawing on the fur surface by rolling the device over its surface in the direction opposite to the fur growth direction (Figure 2).
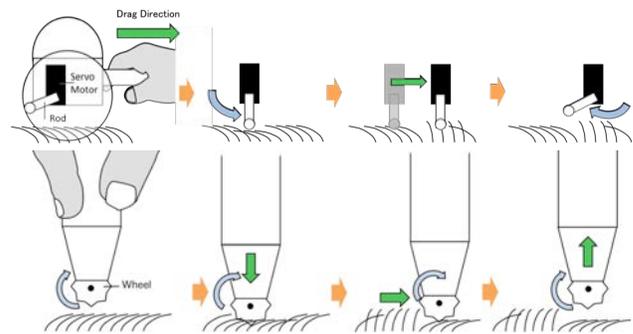
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Figure 2: *Principle of roller device (top), pen device (bottom)*

The pen device consists of a grip, control buttons, a wheel, servo motor, and gyro. The gyro measures the global orientation of the pen grip, and the servomotor twists the pen tip according to the measurement from the gyro. The user first calibrates the system by pressing the calibration button while holding the pen in the canonical posture facing toward the fur growth direction. The other button is used for starting and stopping. Afterwards, in whatever orientation the user holds the pen grip, the system always keeps the wheel orientation parallel to the fur growth and adjusts the direction of the wheel rotation so that the wheel continuously raises the fibers (Figure 2).

Examples

Our display can be used in a number of daily living contexts, in particular, on large spaces such as floors or walls and on objects such as toys, clothes, and curtains. For example, users can draw special pictures for their loved ones on their birthday or write messages for visitors. Children can also play storytelling games with others using the drawings they have drawn while including items from their surroundings. With this, children can easily modify their drawings according to the story or game they are playing. Besides that, users can change the drawings on their carpets according to their mood. In addition, a hotel can use our devices to draw welcome signs on their mat or to show direction of the entrance. It is also possible to implicitly tell that a carpet is cleaned by leaving a message. On a soft, foldable object curtain, users can draw on a curtain and fold the curtain to show a different illustration, or draw patterns on their soft toys or clothing without the need to modify the objects.

Acknowledgment