enchanted scissors:
A Scissor Interface for Support in Cutting and Interactive Fabrication

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Figure 1: *enchanted scissors*

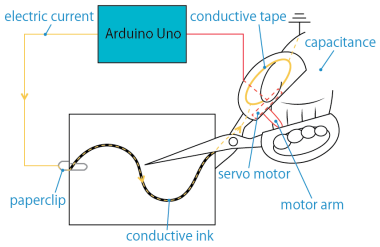

Figure 2: *System Design*

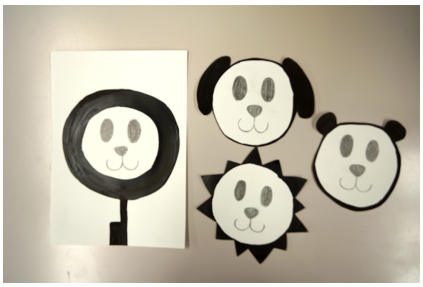

Figure 3: *Cutouts from the same template*

1 Introduction

We present an approach to support basic and complex cutting processes through an interactive fabrication experience [Willis et al. 2011]. Our system, enchanted scissors, is a digitally controlled pair of scissors (Figure 1). It restricts areas that can be cut while requiring the user's exertion of force and decision to execute each cut. Therefore, unlike a completely digitalized cutting device, the user can freely apply improvisations within the permitted areas in real-time. A pair of scissors is a common tool seen and used in everyday life; the user can instantly recognize its operation method. It has varieties of usage from opening a letter to creating a complicated paper craft. While using scissors, it is common to cut unintended parts or difficult to control the blades for cutting intricate details. enchanted scissors prevents these errors in advance by using two switchable programs to restrict the areas that can be cut. Both programs provide real-time feedback to the user during the cutting process as regular scissors would. This allows a comfortable connection of the user's physical input and the output implemented by the device.

2 enchanted scissors

enchanted scissors was created using mostly the same parts as those of a regular pair of scissors. We focused on the conductivity of the scissors metal blades and use conductive ink to mark the areas the user can cut or avoid to cut. Since the device reacts only when the blades come in contact with the line drawn in conductive ink, the user is able to predominantly control the line's design and the execution of each cut.

A capacitive sensor can be created when a conductive line or a shape is attached to the paperclip connected to a micro-controller (ATmega328P). This allows low electric current to flow into the line, thus forming a circuit. enchanted scissors has a wire connecting one of the blades with the inside of its handle where conductive tape is attached. This way, when the blades touch the circuit, electric current extends from the surface of the paper to the interior of the handle where the user would hold. In other words, the user can indirectly touch the conductive line through the device (Figure 2). When the blades touch the circuit, the micro-controller reads a certain degree of capacitance and the servo motor contained in the device reacts according to that value.

The device operates on two modes. The first program forbids the drawn line to be cut, thus the user can cut adjacent and/or nonadjacent to the line. When the user attempts to place the blades on the line, the angular position of the servo motor's arm changes, forcing the two handles apart from each other. The second program allows the user to cut only on the line drawn in conductive ink. The servo motor's arm recedes when the blades touch the line, enabling the user to cut freely with the device.

Our objective is to have different types of users incorporate enchanted scissors in multiple situations to improve their cutting performances. Children can practice coordinating scissors as the device dynamically provides tactile restrictions if the blades go off track. By accomplishing to cut accurately with the device, they are able to learn the skills of using scissors and possibly continue to improve. Changing the thickness of the conductive line allows the user more or less space to experiment with improvisation. The thinner the line, the more likely the chance of fabricating detailed crafts. On the other hand, with thicker lines, the restriction would be lower and the user can enhance creativity. As seen in Figure 3, the three cutouts originate from identical template (3cm-thick circles drawn in black conductive ink), despite resulting in the shape of different animals. It was based on the user's decision to add original arrangements within the painted area. With further practice, enchanted scissors can be used with eyes closed. Even if the user cuts carelessly without visual information, the device will protect the designated areas. This prevents undesirable accidents to happen such as cutting the contents inside envelopes. Moreover, enchanted scissors can be a supportive cutting tool for the visually impaired.

In the future, we intend to modify the device to output gradual haptic feedbacks depending on the distance between the blades and the conductive line.

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References

WILLIS, K. D., XU, C., WU, K.-J., LEVIN, G., AND GROSS, M. D. 2011. Interactive fabrication: New interfaces for digital fabrication. In *Proceedings of TEI 11*, ACM, 69–72.

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