Design Method of Digitally Fabricated Spring Glass Pen

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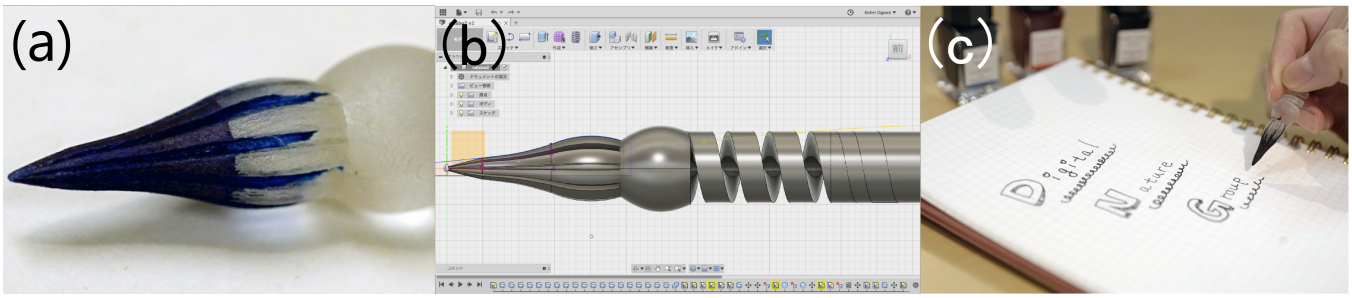

Figure 1: (a) Structure of the pen tip where the capillary phenomenon occurs. (b) This is modeled using 3DCAD software. (c) This figure shows that it is actually written with a pen printed with a 3D printer.

CCS CONCEPTS

• **Human-centered computing** → *Haptic devices*;

KEYWORDS

interaction, digital fabrication, pen, structure, haptic

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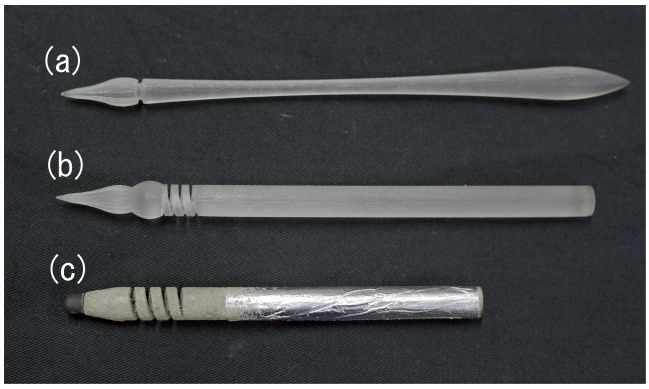

Figure 2: Development of three types of pens using 3D printers. (a) Glass dip pen. (b) Our proposed pen. (c) Spring pen.

1 INTRODUCTION

In this study, We propose a method to develop a spring glass dip pen by using a 3D printer and reproduce different types of writing feeling. There have been several studies on different types of pens to change the feel of writing. For example, EV-Pen [Wang et al. 2016] and haptics pens [Lee et al. 2004] changes the feel of pen writing with using vibration. However, their proposed method does not reproduce tactile sensation of softness by using vibrations.

A pen is a part of our everyday life. Considering that there are so many types of pens available, there is a need to produce a pen suitable for individuals. A glass dip pen requires technology for its development. Glass dip pens, which were first developed in Japan, use the capillary phenomenon and require glass artisan skills for their development. Therefore, we developed our spring glass dip pen by imitating a glass dip pen using a 3D printer (Fig. 2(a)). Moreover, we reproduced a new feel of writing and softness by applying the structure of a spring pen in our design method [Tanaka et al. 2017], which could not be reproduced using a general glass dip pen (Fig. 2(b)).

Recently, stylus pens, which are used as digital terminals, have become popular. Generally, a commercially available stylus pen can only produce the feel of a hard touch when it touches the tablet screen. Therefore, we developed a soft touch pen, similar to a brush, with a spring pen's structure using a 3D printer (Fig. 2(c)). The pen has many writing tastes, and there are various preferences depending on people.

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Therefore, in this study, we propose a method of freely adjusting the softness of a pen and developing a user-desired pen.

2 IMPLEMENTATION

Our pen is developed using a 3D printer. The pen's 3D data is designed using the Fusion 360 software (Fig. 1(b)). The skills of craftsmen are necessary to develop a glass dip pen. However, it can be easily developed by digital fabrication. The capillary phenomenon is produced by creating fine gaps at the pen tip. Further, ink can be transmitted from the gap of a fine pen tip, which holds a certain amount of ink, for writing on paper (Fig. 1(a)). Spring-Pen [Tanaka et al. 2017] based on the structure of the spring, between the pen tip and the handle part of the glass dip pen, cannot be reproduced with ordinary glass. Thus, we developed a soft glass dip pen to produce a new writing feel.

Figure 3: Stylus pen developed by us.

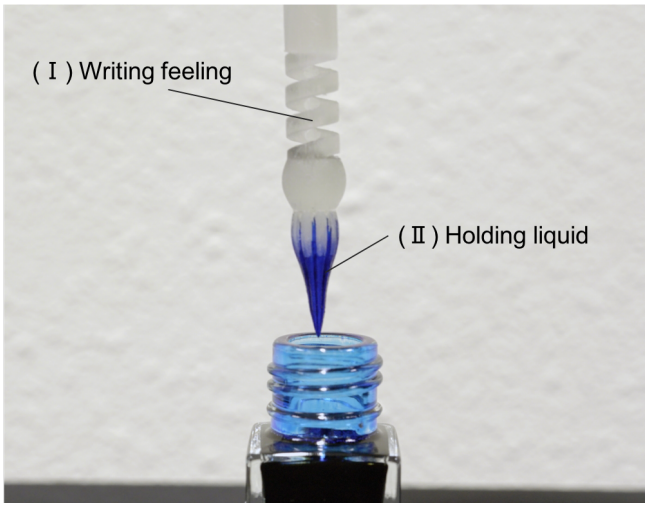

Figure 4: Spring Glass Pen - our proposed structure.

In addition, the stylus pen shown in Fig. 1(a) was created based on the structure of Spring-Pen as well. By using a stereolithographic 3D printer with superior lamination accuracy than a thermoforming 3D printer, we realized a pen size as small as that of a commercially available stylus pen with a thinner pen diameter (Fig. 3). Further, by applying conductive powder UBS-0010LAg, we made it applicable to tablets.

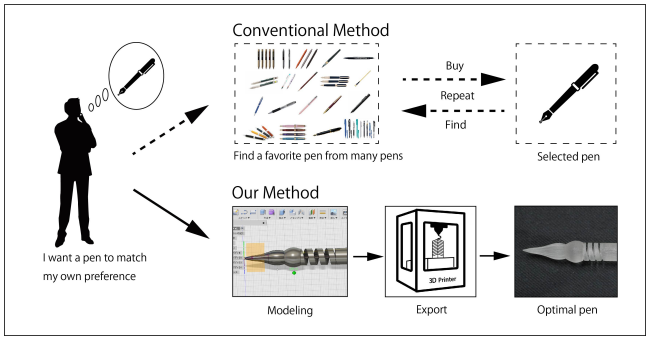

Figure 5: Our system workflow.

We can adjust the softness of our pen by changing its parameters, such as coil cross section and number of turns of the spring (Fig. 4(I)). In addition, we can adjust the ink holding capacity by changing the width of the groove of the pen tip (Fig. 4(II)). In this way, our pen can be developed by combining simple structures. Therefore, anyone can easily produce a pen that suits their preferences by using the digital fabrication method (Fig. 5).

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