

FlexStroke: A Jamming Brush Tip Simulating Multiple Painting Tools on Digital Platform

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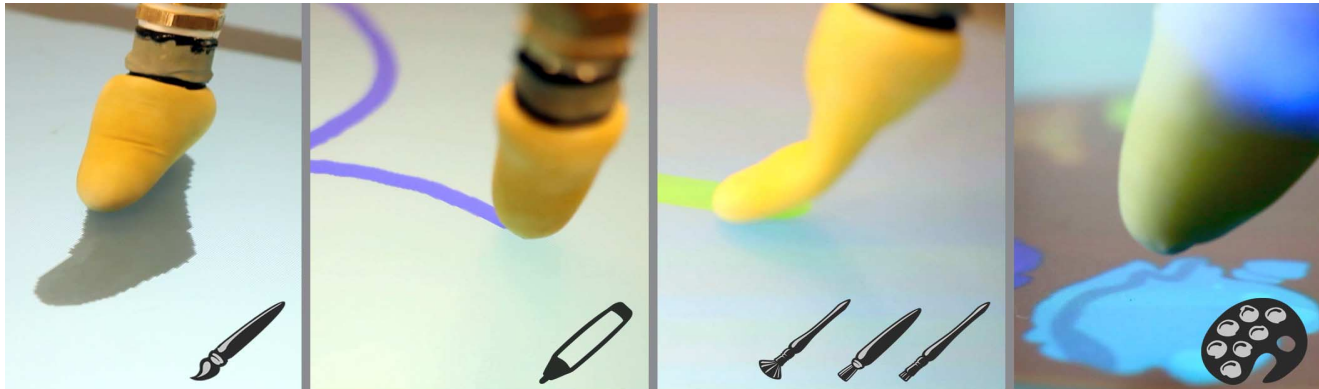


Figure 1: FlexStroke multi-pattern strokes: Chinese Brush, crayon, oil brush and the color picker (left to right)

ABSTRACT

We propose a new system to enable the real painting experience on digital platform and extend it to multi-strokes for different painting needs. In this paper, we describe how the FlexStroke is used as Chinese brush, oil brush and crayon with changes of its jamming tip. This tip has different levels of stiffness based on its jamming structure. Visual simulations on PixelSense jointly enhance the intuitive painting process with highly realistic display results.

ACM Classification: H5.2 [Information interfaces and presentation]: User Interfaces. - Interaction Styles.

General terms: Design; Human Factors.

Keywords: Painting System; Jamming Structure; Brush Stroke, Input Device.

INTRODUCTION

Modern computer graphics have enabled some truly artistic creations on digital platforms and provided a large gallery of paint functions and features. However, the painting experience contains more than visual results, but also requires physical manipulation in the actual painting process. The viscosity, friction and the bending force provide rich infor-

mation to users, varying with different brushes. MAI and DAB [2][1] both imitated a real paintbrush by giving tactile feedback and constructing a mixed reality system. Some other works connected real brush directly to the digital paint system. IntuPaint [5] used IR platform to sense real brush for intuitive painting with it. SensuBrush [4] relies on special capacitive fur to recognize its tip shape. These painting experiences are quite similar to real ones, but one brush only contains one pattern of stroke.

Apart from providing natural interaction and rendering traditional paint results, we value characteristics of digital paint: many options on stroke patterns and customized strokes. For this, we create FlexStroke, which has a multi-pattern tip. When the tip is soft and deformable, user could easily shape it and create a unique tip pattern. After shaping, vacuum will pump and the shape will be fixed in a solid-like status.

JAMMING STRUCTURE

Jamming is the mechanism by which the material can transfer between deformable and stiff states with very small differences in its volume. Jamming can be experienced in vacuum-packed coffee. When coffee particles are in a loosely packed state, the whole package is soft and deformable; when air is removed, particles are jammed into a rigid state. The whole changes could be simply actuated by a single vacuum pump, which is electrically accessible and relatively cheap [3].

Our jamming system consists of a 12V DC vacuum pump with an 8 L/min maximum flow rate and a maximum vacuum pressure of 46kPa. Particles are 0.1mm crystal balls in a

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silicone ball. The ball would harden in only seconds when the pump starts working.



Figure 2: FlexStroke brush and its Jamming tip

IMPLEMENTATION

In recent prototype, we demonstrate three different patterns of tip: Chinese brush, oil brush, and crayon. They differ from tip stiffness and visual effects; besides, the oil brush and crayon could change its color physically by LEDs.

CHINESE BRUSH

For brushing stroke, we keep the tip in the deformable status and the particles can easily move inside. The jamming tip is like a water ball. When holding the pen and drawing on the screen, its tactile feedback simulates real Chinese brush very well. We offer "airbrushes" on PixelSense, which display a spray of ink by painting pixels in a circular region around the brush.

OIL BRUSH

Most painting applications have plenty of choices on strokes but their angle always keep static and wouldn't change due to the drawing movement. In our system, movement angle would directly affect the contact area. More, the tip shape is deformable and customized at soft status. Different movement angles and tip structures are shown in Figure 3, black parts of tip indicate its contact areas.

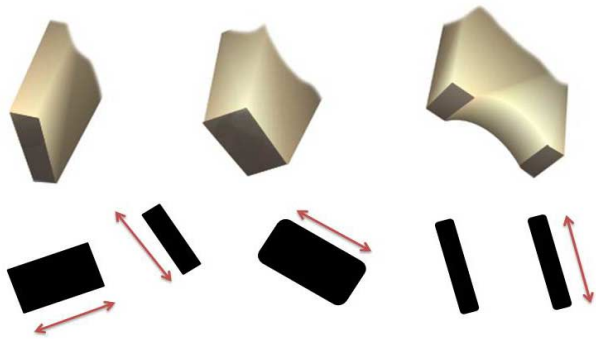


Figure 3: Brush pattern and its different strokes

CRAYON

Crayon is another brush type in our prototype, which maintains fixed size of stroke. Its visual display is consisting of static circle, regardless of the real tip shape and how people draw with it.

COLOR PICKER

The tip color indicates painting color in physical world, so we add color-picking function to our tip. We use three led lights to get the 3-primary colors (RGB). They are placed in a plastic ball for scattering and connected to an Arduino board. The voltages are digitally controlled, mapping 0-3.3V



Figure 4: FLEXSTROKE User Interface

to RGB value (0-255). Their voltages are determined when users pick color on the digital palette.

SOFTWARE SYSTEM

The software system is based on Microsoft PixelSense. Its IR sensing system provides access to raw image data of the tip contact area on the screen. Figure 4 shows our UI design of FlexStroke application.

CONCLUSION and FUTURE WORK

In this paper, we proposed a novel interface for a digital paint system: FlexStroke. The system integrated traditional painting experiences with digital painting environment. Jamming structure of the tip realized changeable stiffness and separately showed the characteristics of three different strokes. Besides, the customizing function of oil brush leaves freedom to shape unique stroke patterns. In our system, physical elements of painting tools could be digital controlled, opening up new ways for painting system.

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