Mid-Air Drawing Brush

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Introduction

The system I designed allows users to perform natural movements of painting with a flat brush to draw on a digital canvas. Additionally, different directions of movements will trigger corresponding sounds in real-time. The movements, the digital lines, and the sounds all over make the mid-air drawing experience like a natural and beautiful art performing.

Related Work

The tradition painting methods in the physical world rely on different brushes, paints, and canvas. We picked up the pigments and apply them on the canvas to visualize what we saw and think and how we view the world. With the development of the computer, digital painting become popular among artists and designers. From drawing via mouse on the remote screen to drawing via stylus pen on the touch screen, However, such digital drawing stills make people who used to brush on the canvas feel unnatural to use. The feeling of metal across the glass screen usually makes painters disappointed.

The emerge of VR and AR technology blurs the line between the digital and physical world. Such technologies also bring artist opportunities to paint in the 3D world. VR painting experience, for example, Tilt brush [1], is immersive but the device of VR is too heavy to long-time painting.

AR Drawing applications like Paint Space AR [2] allows users to draw in the air with all sorts of digital brushes and colors, as shown in Figure 1. But the usability problems of these applications are two things: one is the size of view range is limited; the user can only view the art within the phone screen. Another is the drawing process is unnatural for users because they have to hold the phone upright to achieve the shape they want.
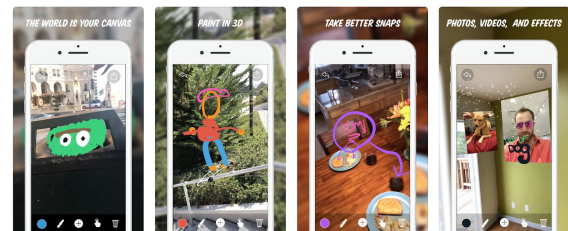

Figure 1. Paint Space AR interfaces.

Expect for the VR and AR, there is another project called I/O Brush [1], as displayed in Figure 2 that picks up the physical world's texture and color and allows children to draw on a touch screen using these colors via a big brush.

Figure 2. Children are using the I/O Brush to pick up color from the environment.

Design Philosophy

The system I designed still preserve the natural movement of drawing with flat brushes. I utilized the IMU system on the mobile phone to capture the movement of the human. The phone is attached with a flat brush, which provides a good affordance with users so that they can effortlessly know how to use this tool to paint on a digital canvas. What's more, unlike the I/O Brush I mentioned before, the system I developed doesn't rely on a touch screen. Instead, users are allowed to draw in the mid-air with the most natural body movement without the limitation of a small screen. The system will simultaneously map the movements of the human hand on the digital canvas.

One of the problems of mid-air drawing compared to other drawing tools is the lack of haptic feedback. Thus, to compensate for the loss of haptic feedback from the real canvas, I used sound feedback to indicate different directions of movements. The positive direction of movement causes higher pitch while the negative direction of movement activates lower pitch.

Implementation

The system has two components: the brush and the drawing application. The brush is a mobile phone with general IMU systems. I attached a real flat brush on the phone to provide the affordance for users. The drawing application will track the movement of the phone, which is developed via Unity 3D. Unity is a powerful real-time game engine, which supports fancy graphics rendering, user interfaces and capability to get input from different devices. The interface is shown in the following figure 3, 4.
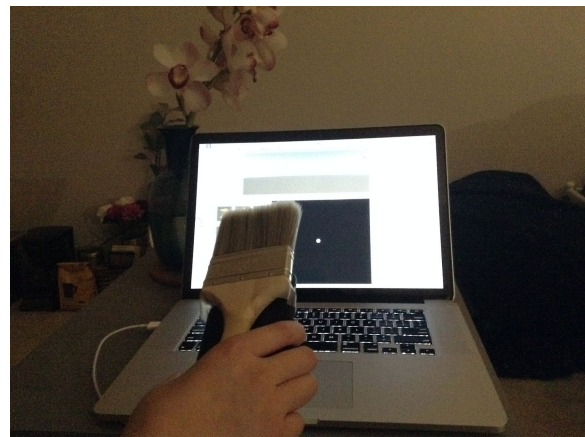

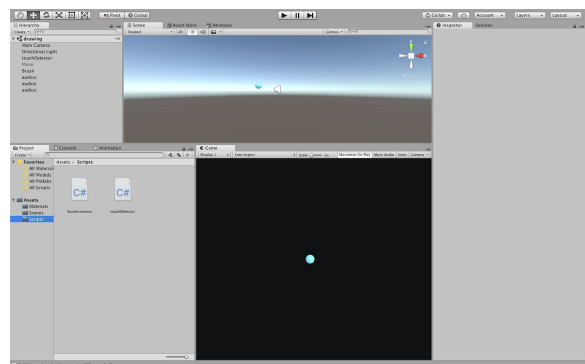Figure 3. The brush and the mid-air drawing application.

Figure 4 Unity development Interfaces.

The simple logic behind the game is as you can see from the following figure. To communicate the IMU information between the phone and Unity, I downloaded a software named Unity Remote, which could send the data of the IMU of the phone to Unity. Unity will sync the acceleration of the phone with the acceleration of the game object, which is a virtual ball. TouchDetector script will listen to the touch events; whether the touch began, moved or ended. When the touch began, the moving virtual brush starts to render its trails so that it's like the user is drawing on a digital canvas.

To use this system, firstly, users need to connect the phone with a USB cable to their computer. After opening the game file on the computer, the user will see a blue ball on the screen. To trigger the brushes, users first need to touch on the screen of the phone to activate the tail rendering. During that time, the user can move the phone and movement trail will display on the digital canvas simultaneously. The process is shown in the Figure 5.
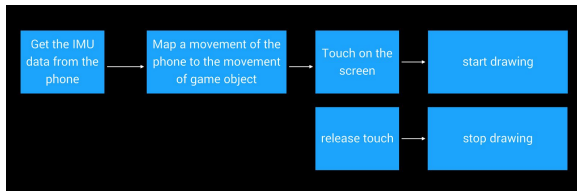

Figure 5 the use flow diagram.

Because of the brushes attached on the phone, users can draw as they are using a real painting brush. The system only detects four degrees of freedom so that the behavior of drawing on a flat canvas is more realistic; the movement of brush can't go through the canvas. Also, the direction of movement will cause different sound feedback. Four directions (left to right, right to left, up to bottom, and bottom to up) match different pitches.

Discussion and Reflection

This Mid-air drawing application unleashes the power of the natural movement of painting with flat brushes. It also incorporates non-visual sound feedback, which leads to the idea of combining drawing and dancing, and music performing. Another interesting application could be gesture detection. The information detected by the inertial sensors is rich and accurate to increase the current optical-tracking gesture system.

Currently, the system needs the USB cable to get the data from the phone. In the future, I will use Bluetooth communication to get rid of the cable; users are able to move more freely. Plus, this system only uses the IMU system of the mobile, yet another interesting solution could be a small inertial sensor attached to different sizes of brushes. What's more, this system could provide a physical canvas and palettes to create a more realistic painting experience.

Reference

[1] Tilt Brush by Google at
https://www.tiltbrush.com/

[2] Paint Space AR on the App Store at
https://itunes.apple.com/us/app/paint-space-
ar/id1260267722?mt=8

[3] Kimiko Ryokai, Stefan Marti, and Hiroshi
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