# Fluid Sketching: Bringing Ebru Art into VR

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**Abstract**

In this interactive demo, we present Fluid Sketching as an innovative virtual reality application, which is highly inspired by traditional marbling art. By using a particle-based simulation combined with natural, spatial, and multi-modal interaction techniques, we create and extend the original artwork to build a comprehensive interactive experience. With the interactive demo of Fluid Sketching during Mensch und Computer 2018, we aim at increasing the awareness of paper marbling as a traditional type of art and demonstrating the potential of virtual reality as an innovative digital and artistic medium.

## 1 Introduction

Paper marbling is a traditional art that is based on the decoration of paper by the creation of an abstract design on a water-based surface. It is called *Suminagashi* in Japan and the first example of this art appears in the 12th century. Afterwards, in the 15th century, *Ebru* that is the Turkish art of paper marbling emerged in Central Asia before spreading to Europe. Paper marbling has a long history in Europe and the Western world, yet few people are familiar with this beautiful unique creation of art (Wolfe, 1990).

Our motivation is to bring this cultural art into immersive virtual environments to increase the awareness of paper marbling and to engage people by enabling them to experience the 3D creation of such artwork in Virtual Reality (VR). For this reason, we created our Fluid Sketching application (Eroglu, 2018). Fluid Sketching is an immersive drawing tool that is heavily inspired by paper marbling. It enables to sketch digital structures that look and behave like fluids, similar to the oil-based paint used in marbling. We adapted painting to the third spatial dimension as possible in VR. The user creates 3D structures, which can be additionally manipulated in a natural and interactive way in space. To create natural interaction techniques that resemble paper marbling, we first analyzed the toolset used for creating marbled paper art.

Based on this analysis, we developed interaction methods for an immersive virtual environment that are strongly inspired by paper marbling art.

With this demo, we enable the conference's participants to experience this type of interactive sketching and additionally give them a chance to try out and experience the traditional marbling in this modern interpretation in VR. We would also like to learn how the broad variety of attendees experiences our Fluid Sketching demo and identify aspects for future improvement.

The Fluid Sketching application was initially developed for a CAVE environment. For this demo, we ported the application to consumer-level hardware. It will be presented on an HTC Vive head-mounted display. In the next section, we present how the traditional toolset was mapped to spatial interaction techniques, which is followed by a discussion. The paper is concluded with a short summary.

# 2 Paper Marbling

The basic process of paper marbling consists of placing water in a tray and sprinkling or dropping oil-based inks onto the water surface. Afterwards, artists shape these spread-out drops by using metal wires, styluses, or combs. Thereby, a pattern is created on the water surface that can then be transferred to a paper by placing it on top (Fairchild, 1999).

In the creation of marbled paper art, artists shape the oil-based inks on the water surface. However, after dropping the inks on the surface, it is not possible to stop the diffusion of the ink or undo this action. If mapped to a digital environment, we can not only create similar effects through physical simulation but also have the possibility to control this process, e.g. provide an undo or pause feature or change the behavior of the diffusion.

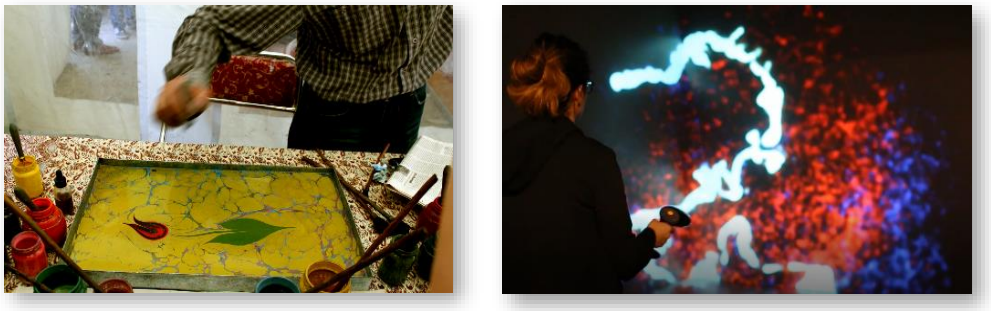

*Figure 1: Left: An artist sprinkles oil-based inks onto a water surface (© User:Urmen19, Wikimedia Commons, CC-BY-SA-4.0). Right: A user creates a fluid sketch in the virtual environment.*

In our application, we realized the act of dropping inks on a water surface as emitting particles from the tip of the controller, as seen in Figure 1. We use the dominant hand as the primary 3D drawing tool of the application, similar to the brush used for dropping the ink into the

water. Emitted particles then diffuse into the virtual environment, interacting with other particles that were drawn earlier. The details of the fluid simulation and particle interaction are described in (Eroglu, 2018).

Spreading out drops on the water surface with a metal wire is implemented by enabling the user to manipulate the drawn 3D fluid-like sketch by using the tracked non-dominant hand, as seen in Figure 2 on the right.

In addition to that, we enable users to manipulate the sketch by blowing into it. The blowing metaphor is a multi-modal interaction method for the manipulation of fluid sketches. It is inspired by blowing, which is used in watercolor painting to smear the ink on the surface. We implement the blowing technique with a microphone.

*Figure 2: Left: An artist uses a stylus to shape oil-based inks on a water surface (© User:Urmen19, Wikimedia Commons, CC-BY-SA-4.0). Right: A user shapes the drawn sketch by using her non-dominant hand in the Fluid Sketching system.*

Furthermore, users are able to change the type of the brush. They can vary the viscosity, density and turbulence of fluids, and select the desired color, size and initial speed for the brush stroke. This augments the traditional type of marbling by extended creative freedom. Additionally, users are able to stop the diffusion process whenever they have an appealing view. The system also offers an eraser to remove parts of the sketch, which is not possible with the traditional toolset. The last step in paper marbling is to transfer the created pattern from the water surface onto a paper. Our system provides a feature to save the virtual fluid artwork, so users can take their artwork outside of the virtual environment.

# 3 Discussion

Fluid Sketching is inspired by the creation of the paper marbling. The main difference between paper marbling and Fluid Sketching is the introduction of the third spatial dimension to create 3D fluid sketches. The advantage of having the third dimension is that artists are able to sketch, observe and move around themselves in an intuitive way, which is not possible with traditional paper marbling.

By mapping droplet inks as particles in 3D space, users have more control over the animated fluid diffusion. In the original process of paper marbling, after dropping inks on a water surface, artists are not able to stop or adapt the behavior of the diffusion. Our application enables this so that users can create brush strokes e.g. with varying turbulent diffusion behavior. One improvement could be to provide an undo feature, which was requested by some participants in the user study presented by Eroglu et al. Undoing the effect of recently drawn particles on other particles in the scene is a non-trivial problem, as the diffusion and interaction between particles have already taken place. A reasonable way to address this subject will be investigated in the future iteration.

The manipulation of particles by the non-dominant hand, which is inspired by the shaping of ink drops on the water surface, gives users a natural, direct and intuitive way of interacting with the emitted particles. Fluid Sketching enables users to configure the size of the interaction range between their hand and the drawn sketch. Therefore, users have more control over the affected regions of the sketch, compared to the traditional art. What the current system is lacking is a comb-like tool, which is occasionally used in paper marbling to shape the sketch. This type of manipulation will be addressed in future iterations by adding comb-like virtual geometry for the interaction. Furthermore, we introduced a blowing metaphor for manipulating the sketch to match the multi-modal nature of the paper marbling process. One problem we observed is that manipulating the sketch by blowing can cause destructive outcomes. This can be improved by adding a toggle feature that is easily accessible via hand controllers, such that users can enable or disable the blowing interaction while sketching.

Transferring the pattern on the water surface to a paper is the last step of the paper marbling process. By saving the drawn sketch in a 3D file format, users can not only take their creation out of the virtual environment but can also import it into an animation tool. This allows users to do further elaboration such as coloring or adding rendering effects.

# 4 Summary

Fluid Sketching is a novel artistic medium to create 3D fluid-like sketches in immersive virtual environments. It is highly inspired by the traditional art of paper marbling. We analyzed the process of marbled paper art creation and mapped the tools and methods into virtual environments. Furthermore, Fluid Sketching provides a spatial user interface for complex parametrization of the brush as well as natural techniques to interact with the fluid sketch.

To increase the awareness of paper marbling and for further improvement on the Fluid Sketching system, we present our application at Mensch und Computer 2018 conference. We want to give visitors the opportunity to experience VR as an innovative, highly interactive and creative digital medium and present the traditional art of paper marbling to the audience.

# References

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