Digital Painting Classroom: Learning Oil Painting Using a Tablet

Tuur Stuyck *
KU Leuven

Sunil Hadap†
Adobe Research

Philip Dutré ‡
KU Leuven

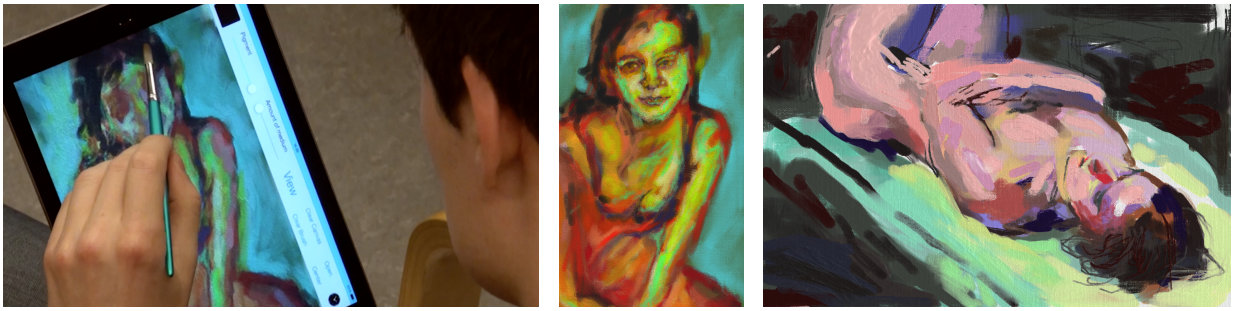

Figure 1: *Left: Example use of our digital oil paint tool with brush. Middle and Right: Digital oil paint examples made with our tool.*

Abstract

We investigate how the use of a real-time physically plausible oil paint simulator implemented on mobile hardware can be used to teach novice painters the fundamentals of the art and how more experienced painters can use it as a cheap and fast experimental tool. The paint system believably recreates 3D oil painting with a number of new user-interactions. The paint reacts to the gravity vector set by the tablet and the paint is rendered using the ambient light captured by the front facing camera. The user experience ranges from thin, diluted watercolor paint to thick impasto oil paint allowing to recreate a variety of traditional painting styles digitally.

Keywords: Oil Paint Simulation, Learning, Tablets

Concepts: •**Human-centered computing** → *Tablet computers;* •**Computing methodologies** → *Physical simulation;*

1 Overview

We show how a realistic mobile paint tool can be used to as a support tool to teach the fundamentals of oil painting and color theory to its users. This significantly reduces the barrier to take up oil painting as there are no material cost involved and learning can take place anywhere and anytime.

The simulator accurately recreates color mixing because the pigments are stored in a multi-layered structure to model the peculiar nature of pigment mixing in oil paint and they are rendered using the Kubelka-Munk pigment model. The user experience ranges from thick shape-retaining strokes to runny diluted paint that reacts naturally to the gravity set by tablet orientation. Finally, the paint is rendered in real-time using a combination of carefully chosen efficient rendering techniques. The virtual lighting adapts to the tablet orientation, or alternatively, the front-facing camera captures the lighting environment, which leads to a truly immersive user experience. In our experience, our system enables artists to quickly try out ideas and compositions anywhere when inspiration strikes, in a truly ubiquitous way. They don't need to carry expensive and messy oil paint supplies. Please see Figure 1 for some example paintings made with the system.

Apart from realistic physical behavior, a digital implementation offers additional inherent advantages such as load and save functionality, instant paint drying, no material expenses. People interested in oil painting can use a digital tool to gauge their interest before committing to art classes and material or it can be used to train, revise and experiment with aspects of oil painting that were taught in a physical art class. However, to fully understand the art of oil paint, the user should ultimately paint with real materials to get a sense of the beauty and complexity of real paintings. Our proposed system is meant to make this transition smoother.

2 Simulated Oil Paint Behavior

We developed a painting system that is able to truthfully recreate the following paint styles:

Impasto is a painting style where thick layers of paint are applied to the canvas.

Scumbling is a technique where one brushes thin layers of paint over each other so that some of the paint beneath shows through.

Glazing refers to mixing thin glazes tinted with pigments to create small color adjustments.

Watercolor effects are obtained by mixing and laying watered down pigments and allowing it to blend.

Wet on Wet refers to working over the surface while the paint beneath is still wet.

Wet on Dry refers to working over the surface while the paint beneath has dried.

Dry Brush refers to paint being dragged across the canvas so that specks of color are collected by the high spots on the

*tuur.stuyck@cs.kuleuven.be
†hadap@adobe.com
‡philip.dutre@cs.kuleuven.be

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canvas as well as moving and mixing wet paint on the canvas.

3 Learning to Paint

After interviewing numerous art teachers we concluded that a digital tool can be helpful to teach the following concepts to novice painters:

Understanding contrast Warm and cool colors or light and dark colors.

Color Mixing and Using a Limited Color Palette Understanding how colors combine to create many varieties from a limited basic color palette. Understanding how black and white pigments tend to dull colors and showing alternatives to lighten or darken colors.

Understanding Compositions Routing; guiding the eye of the observer through the painting, foreground and background.

Oil Paint and Pigment Behavior Understanding the difference between very diluted and runny paint versus thick shape-retaining paint strokes.

We give a short overview of our proposed exercises to address the previously listed aspects of painting:

Color Wheel Mix colors to recreate the color wheel from a limited set of pigments.

Color Gradient A user is shown a grayscale discrete gradient and is asked to recreate the scene with a single color and black and white. This encourages experimenting with lightening and darkening a color as well as the concepts of color tone.

Imitating the Masters to teach about color selection and composition.

The user can use self-evaluation by comparing to a reference solution or rely on peer evaluation, such as feedback from their art teacher, to get information on their progress.

4 Results

Artists strongly agreed that paint studies are useful and that our proposed system can satisfy this need, see Table 1 (top) for score data of a selection of the questions asked. Both in open-ended questions and in the questionnaire, artists indicated that they found the virtual oil paint believable despite the simplified viscoelastic model. They very much showed their interest in using this application as a tool to perform preliminary paint studies or to paint on the go. Question six shows the high variability between different types of users, not everyone would use our system to finish complete paintings. This is however not unexpected since we propose our system as a tool to try out ideas. The high variability is due to the difference between digital and traditional artist preferences. The ease of use to perform paint studies as well as the portability of the system proved to be one of the main advantages. The biggest downside artists noted is the lack of simulated brush behavior which can be addressed in future work as our model poses no restrictions on the brush model used.

The scores for the different contributions and user-interactions are listed in Table 1 (bottom). The features are ordered in decreasing order of importance according to experienced oil paint artists. From our user study we can conclude that all our proposed features contribute to the digital painting experience. The varying lighting and environment interaction is perceived as a positive contribution to the painting experience but it is somewhat less important then the paint dynamics itself. The use of multiple layers for storing pigments is valued most by artists, even with only two layers as tested in the study. This contribution is closely followed by simulated paint dynamics and varying gravity. Even though we use an approximate viscoelastic model results are convincing as indicated by the responses to question five in Table 1.

Our system obtained a System Usability Score of $85.4/100$ with a standard deviation of $\sigma = 7.4$. This score is significantly above the industry average value, indicating the high perceived usability of our contributions integrated into painting software.

	Score	**Median**
1. I found the experience enjoyable	4.6±0.5	5
2. Testing ideas is helpful	4.1±0.6	4
3. I would use this system for testing ideas	4.2±1.0	4
4. This system would allow me to paint more efficiently	3.8±0.6	4
5. I found the digital oil painting experience believable	4.2±0.5	4
6. I would use this to make complete virtual paintings	3.2 ±1.5	3
Multi-Layer Pigments	4.5±0.5	5
Dynamic Simulation	4.5±0.5	4
Varying Gravity	4.2±1.0	5
Environment Interaction	3.7±0.8	4
Varying Lights	3.6±0.8	3

Table 1: ***Top:*** *General application evaluation average scores with standard deviation and median score. Scores can range between 1 and 5, higher is better.* ***Bottom:*** *Feature scores in descending order of perceived importance. Individual artist scores can be found in the supplemental material.*

5 Conclusion

The system proves to be very useful to teach users the fundamentals of oil painting but it seems unlikely to be able to teach more advanced skills such as how to manipulate the brush in different ways. Creativity is somewhat limited due to the limited ways of interacting with paint. In real life artists often use sponges, cloth and a palette knife to manipulate the paint. The ease of this natural workflow is very difficult to recreate digitally. Nonetheless, the tool eases the learning process and users can make progress at home.

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