Graphite: Interactive Photo-to-Drawing Stylization on Mobile Devices

Amir Semmo
Digital Masterpieces GmbH, Germany
Hasso Plattner Institute for Digital Engineering, University of Potsdam, Germany

Sebastian Pasewaldt
Digital Masterpieces GmbH, Germany

Pencil Drawing | Pastel | Pen-and-Ink

Figure 1: Results produced with *Graphite*. The mobile app implements a generalized example-based rendering pipeline using classical and modern neural-based filtering, that can be interactively parameterized to create unique image stylizations.

ABSTRACT

We present *Graphite*, an iOS mobile app that enables users to transform photos into drawings and illustrations with ease. *Graphite* implements a novel flow-aligned rendering approach that is based on the analysis of local image-feature directions. A stroke-based image stylization pipeline is parameterized to compute realistic directional hatching and contouring effects in real-time. Its art-direction enables users to selectively and locally fine-tune visual variables—such as the level of detail, stroke granularity, and sketchiness—using the Apple Pencil or touch gestures. In this respect, the looks of manifold artistic media can be simulated, including pencil, pen-and-ink, pastel, and blueprint illustrations. *Graphite* is based on Apple's CoreML and Metal APIs for optimized on-device processing. Thus, interactive editing can be performed in real-time by utilizing the dedicated Neural Engine and GPU.

CCS CONCEPTS

• **Computing methodologies** → **Non-photorealistic rendering**; **Image processing**.

KEYWORDS

image stylization, image filtering, artistic rendering, mobile devices

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1 MOTIVATION

Image filtering provides an essential tool in mobile photography to increase the viewers' engagement with the edited results [Bakhshi et al. 2015]. With the advent of neural processing engines, in particular, artificial intelligence increasingly found its applications to automate image filtering for laborious tasks, such as content-aware editing. A popular application is to transform photos into stylized renditions with the help of convolutional neural networks. Most stylization apps, however, do not provide the tools required for art-direction [Isenberg 2016], in particular to "benefit modes of expression, and new styles of expression" [Hertzmann 2018]. Instead, we believe that mechanisms of artwork production—such as modeled via pictorial semiotics [Rudner 1951]—need to be explicitly designed as part of image stylization pipelines to provide the necessary interactive control for artistic expression.

In this work, we present *Graphite*, a mobile app that enables to interactively parameterize a generalized photo-to-drawing stylization

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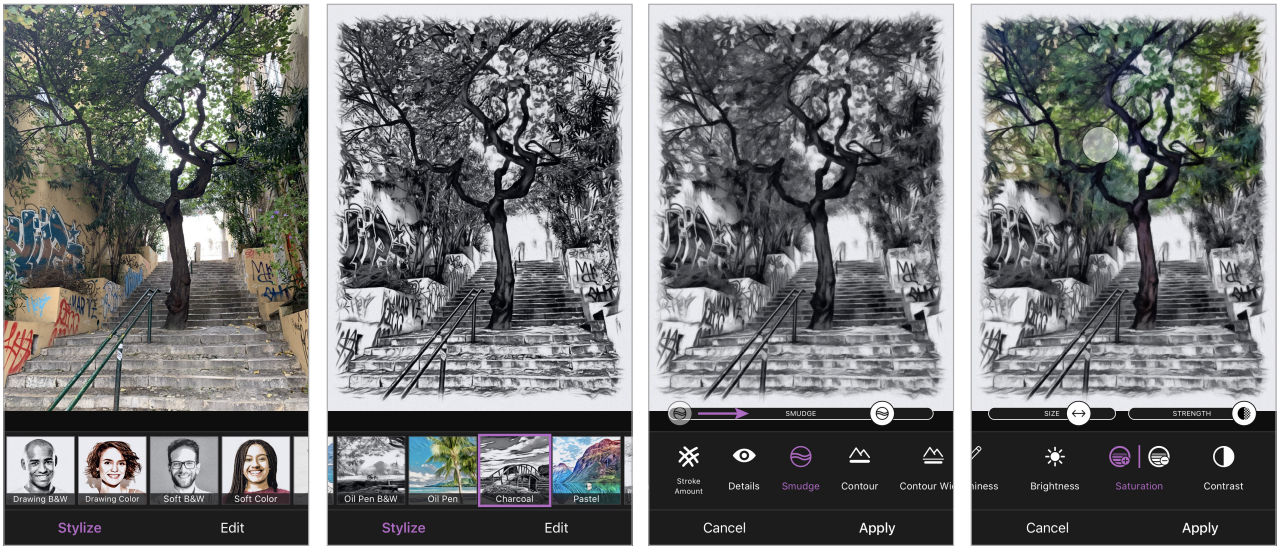

Input Preset Selection Global Adjustments Local Adjustments

Figure 2: *Graphite* supports editing at multiple levels of control: preset selection, global adjustments and local adjustments.

pipeline to compute realistic pencil drawing, hatching and contouring effects. At this, *Graphite* explicitly models design mechanisms and visual variables required to model manifold artistic media (Figure 1) and support art-direction—such as to locally fine-tune the level of detail, stroke granularity, degree of smudging, sketchiness, and image contrast.

2 APP DESIGN

To enable a wide gamut of expression, we designed *Graphite* with a semiotic structure in mind [Semmo et al. 2017] that helps to parameterize its image processing pipeline with respect to multiple visual variables (compare to *crispness* and *color* in Figure 2):

- *Location-based Filtering & User Interaction.* All design aspects can be configured on preset level to obtain quick results, which can be further fine-tuned by global and local adjustments—operating in spatial space [Semmo et al. 2016]—to ease the usability [Klingbeil et al. 2017] (Figure 2).
- *Point/Line/Area.* Tonal art maps (TAMs) are blended according to color luminance [Lu et al. 2012] and combined with a contour-lining approach [Winnemöller et al. 2012].
- *Color/Brightness.* Standard filters for color adjustment give the user control over brightness, contrast and saturation.
- *Form/Shape/Texture.* A feed-forward neural style transfer is used for geometric abstraction and texture transfer.
- *Transparency.* Explicit layering is not supported, but colors can be erased for localized blending with a virtual canvas.
- *Orientation.* Flow-based Gaussian filtering and feature-aligned TAMs are used to obtain realistic directional hatching effects.
- *Shading/Shadows.* Filters for shadows, highlights and blackpoint are used for adjustments of luminance distributions.
- *Crispness/Resolution.* A smudging tool is implemented that operates within the Gaussian filter kernels to create control over unsharpness and the level of abstraction.

Graphite has been optimized for iOS 13. Its neural-based processing is performed with Apple's CoreML API, while real-time editing is enabled with Apple's Metal and PhotoKit APIs. Each filtering stage is implemented in a resolution-independent way, so that performance-optimized rendering can be implemented according to the hardware specifications. Providing an in-app printing service, *Graphite* also serves as a tool for creating personalized prints.

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