QuickToon: A Real-Time Video Stylization and Sharing System on General Processors

Hongsheng Yang, Huanliang Sun, Jiangbo Lu
Advanced Digital Sciences Center, Singapore
{hs.yang, huanliang, jiangbo.lu}@adsc.com.sg

ABSTRACT
We present a video stylization and sharing system named QuickToon, which supports generating a variety of useful and pleasing visual effects and allows easy use in video chat or sharing via social networking services (SNS). Based on our highly efficient edge-preserving smoothing filter, non-photo-realistic video rendering effects can be generated on the fly such as skin beautification, cartoon-like rendition, object outline, pencil sketch, and color stroke. Without requiring any GPUs that would otherwise seriously limits portability, the QuickToon system runs comfortably in real time (over 30 FPS) on general processors such as CPUs or embedded CPUs. The system can take in video frames either from a live webcam feed or any photos/videos from the local store, while the transformed imagery can be used in a live Skype video call, or saved locally, or uploaded and shared to SNS with one click. We demonstrate with concrete examples the functionality of this system, and underline its utility in video communication and photo/video sharing.

Categories and Subject Descriptors
H.5.1 [Multimedia Information Systems]: Video; I.4.9 [Image Proc. and Computer Vision]: Applications

General Terms
Design, Experimentation, Performance

Keywords
Video stylization, video communication, photo sharing

1. INTRODUCTION
Recent years have witnessed the ever-increasing popularity of video chat and conferencing, as well as photo editing and sharing, thanks to easy access to the Internet and portable computers (e.g., laptops, tablets, and smart phones) equipped with quality webcams. Not content with being just a passive user, people often find it useful and fun if they could personalize their imagery in certain ways for live video chat or photo/video sharing via social networking services (SNS). From a research perspective, this concerns non-photorrealistic rendering (NPR), whose goal is to generate different aesthetically pleasing, stylized image/video effects.

We briefly review a few relevant prior work here. Winnemölle et al. [3] presented a real-time image abstraction framework that creates visually compelling cartoon-like and painterly-like effects on GPUs. Their user study shows that the abstracted images with perceptually important structures stressed are helpful for visual communication, subject recognition, and memory tasks. However, even after choosing a simplified image abstraction engine, their approach can only achieve 9 – 15 frames per second (FPS) for the GPU version and 0.3 – 0.5 FPS on the CPU to process a VGA-sized image. Yang et al. [4] showed that their NPR technique can remove unwanted details like wrinkles exposed in HD portrait videos typical for high-end video conference systems. Again, their solution needs a powerful GPU for real-time video processing, which is not available in most laptops or mobile devices. Nimmagadda et al. [2] have quantitatively measured an average bandwidth reduction of 32%, if only salient information in the given image is transmitted, whereas fine details are eliminated. This study shows the strength of NPR for bandwidth/energy-efficient visual communication, but their NPR effect is still very rudimentary.

This paper presents a real-time, CPU-based video stylization and sharing system called QuickToon. Our system has a few major advantages and features differentiating itself substantially from the existing NPR techniques or systems [3, 2, 4], which include 1) real-time, high-quality NPR effects achieved for VGA-sized videos on CPUs, 2) a holistic and flexible video stylization system with all the modules carefully designed and optimized, and 3) a user-friendly video processing and sharing software that facilitates easy use in live video chat or photo/video sharing through SNS. With one click, one can share stylized videos in a live Skype video call.
Figure 2: Left panel: Some stylized visual effects generated in real time on CPUs by the QuickToon system. Right panel: The software UI. The skin beautification effect is also shown in comparison with the original image.

chat session or upload selected images to Flickr (Fig. 1). Providing users with an array of controllable visual effects effortlessly (see Fig. 2), QuickToon is interesting and useful.

2. TECHNOLOGY AND PERFORMANCE

This section gives an overview presentation of the QuickToon system architecture, important functional modules, and also the runtime performance. As shown in Fig. 1, QuickToon supports processing images or video frames from a live webcam capture or offline photos or video clips. At this stage, our QuickToon mainly generates various visual effects based on a common edge-preserving smoothing (abstraction) engine, which has a desired property of suppressing contrast/details in low-contrast regions while preserving or even accentuating visually salient features. Unlike [3, 4] using the bilateral filter for this purpose, our abstraction engine is based on the cross filter [5, 1]. We have made important changes over [5] and achieve significant acceleration on the CPUs. Once a given image is analyzed to separate the details from the main structures, diverse image/video stylization effects can be produced by applying e.g. soft color quantization and/or (salient) edge detection and superimposition schemes. Currently the QuickToon system features five kinds of visual effects, i.e., skin beautification, cartoon-like rendition, object outline, pencil sketch, and color stroke. For each effect, QuickToon also allows more fine-granular parameter control over e.g. the color quantization level, edge styles and density, and etc. For the rendering results, QuickToon supports a few options such as feeding them to a live Skype video chat session or uploading them to Flickr, or being saved out as photos or video clips for later use.

We have measured the runtime speed of the fundamental abstraction engine on a laptop with an Intel i5 four-core CPU, each running at 2.5GHz. Table 1 reports the speed measured when processing a VGA-sized video stream.

Table 1: Runtime speed of the abstraction engine

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<tr>
<th>Frame Rate</th>
<th>Single-core version</th>
<th>Multi-core version</th>
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<tr>
<td>26 FPS</td>
<td>56 FPS</td>
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3. SOFTWARE DESIGN AND FEATURES

The QuickToon demo software uses Qt4 to develop the user interface (UI) and the SNS sharing functionality. Our design concept is clear and clean. Users can select different sources of input photos and videos through the Video Sources pull-down menu. They can choose among different effects and adjust each effect using sliders in an advanced control panel (see Fig. 2). Users’ favorite settings will be automatically saved. On the tool bar, one can choose to save out the processed image or video clip, or click the Flickr icon to share them to one’s Flickr space. By clicking the Skype icon, one is prompted with a frameless window, which allows her to share the processed video stream in a seamless way with the remote video chat participant(s) through Skype. As far as we know, there is few third party software that supports quickly sharing photos to SNS websites on (laptop) PCs, while many others are mobile OS based. Therefore, this functionality is a convenient UI design for end users.

4. CONCLUSION AND FUTURE WORK

We have presented a lightweight video stylization and sharing system achieving visually pleasing effects in real time on CPUs. This work is motivated by noticing users desire for personalized video editing and easy sharing in video chat or through SNS. We have also mapped the QuickToon prototype on a Samsung Galaxy S2 Android phone. We plan to add more visual effects and support more SNS sharing, and also release its first version for free public download.

5. ACKNOWLEDGMENTS

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6. REFERENCES

[6] Flickr allows Yahoo, Facebook and Google accounts to sign in.

http://qt.nokia.com/