UGly-Net: Playful Exploration of U-Net for Glitch Effects

Seri Lee
Pulse9 Inc.
Seoul, South Korea
emma@pulse9studio.com

Eun Jee Sung
ModuLABS
Seoul, South Korea
eunjee.lynn.sung@gmail.com

Jieun Park
Pulse9 Inc.
Seoul, South Korea
jp@pulse9studio.com

Juhee Lee
ModuLABS
Seoul, South Korea
juhee1108@gmail.com

Abstract

Recent work has made significant progress in various fields through deep learning. However, the implementation of neural networks has become more complex and difficult understand without sufficient field knowledge. In this work, we propose UGly-Net, a tool for generating neural network glitch video effects by modifying the layers and feature maps. While manipulating each part of the layer to create unique glitch effects, the user can easily learn the structure of underlying U-Nets. The results include archetypal glitch art effects from electronic media and novel effects resulting from complex feature maps of the neural network. Our video demo can be found at https://uglynet.github.io.

1 Introduction

Glitch art or effect is a relatively recent form of art that manipulates digital images by altering their digital encoding in unconventional ways. Since the series of works by Reed Ghazala in the 1960s, glitch artists have created works using electronic hardware and their noises. In the late 1990s and early 2000s, digital artists began working with software-based visuals (e.g., Ant Scott and Iman Moradi)[1]. Video glitch effects are now widely adopted in visual effects.

Originally created for medical image segmentation, U-Net[5] is a variation of the encoder-decoder model with skip connections from the encoder to decoder to better preserve the features of the original data. The decoder decodes vector feature maps from the bottleneck together with the output of encoder layers. For frame interpolation, recent works using U-Nets have reported good performance in synthesizing frames for slow-motion videos.

Using U-Net as the video synthesis model, we attempted to explore the creative potential of neural networks for glitch video art and effects. It was designed as a playful interactive tool that lets non-experts in deep learning to play with neural networks and create diverse glitch videos.

2 UGly-Net

Our model in UGly-Net is based on that of Super SloMo[2], which uses two U-Nets for frame interpolation. The first U-Net estimates the optical flow. The second U-Net refines the approximated flow and predicts soft visibility maps. Each U-Net has feature maps from 23 convolution layers and five skip connections.

33rd Conference on Neural Information Processing Systems (NeurIPS 2019), Vancouver, Canada.

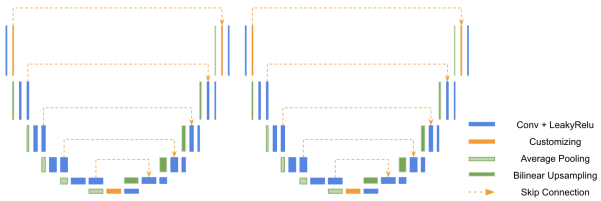

Figure 1: Illustration of the architecture of UGly-Net: After experimenting with different combinations to modify the feature maps, we found that we could reproduce considerable glitch-effect results by changing the feature maps from three layers and five skip connections (colored in orange).

2.1 Model Structure

Among the layers in the U-Net model, we allowed users to modify the feature maps in three layers (the first encoder layer, the bottleneck layer, and the last decoder layer) and five skip connections in each U-Net. UGly-Net lets users apply various operations, including addition, subtraction, multiplication, and skip connection removal.

2.2 Interface

Users can start from a well-trained and stable U-Net for slow-motion video synthesis, and then transform the network by freely making modifications to each part of the network. For each flow estimation and flow interpolation U-Net, users can decide how to manipulate the feature map output of each interactive layer. They can also manipulate the input video's RGB channels. Operations can be defined by clicking on corresponding parts of the visualization. UGly-Net changes the network feature maps according to user-generated variations to synthesize the video with glitchy effects. As the color of each part changes according to selected operations, the final result of a user's selection visually represents the user's unique set of artistic expression and experience. The videos are then collected and displayed in the gallery along with their corresponding U-Nets. The appendix contains a list of supported operations for each part and sample visualization results.

Changing the feature maps using UGly-Net produced a wide variety of video effects. Some resembled classical glitch effects on cathode-ray tube televisions or 8-bit computers, such as misalignment and distortion[3]. Others produced genuine and inspiring patterns that have rarely been observed in previous sets of commercial glitch effects or artworks. For selected examples, please refer to the appendix.

3 Conclusion

UGly-Net is a new experimental tool that invites users to experiment with U-Nets, making neural networks playful, accessible, and inspiring. To the best of our knowledge, this is one of the earliest projects to adopt neural networks in the field of glitch video effects.

Experiments have been conducted on various versions of the back-end U-Net. Using Attention U-Net Architecture[4], we created a light-version Super SloMo model with 30% model size reduction. A 'uniform effect' model with 1×1 convolution bottleneck layer also allows single operation to modify the bottleneck layer immediately, and has smaller model size. Although not used in the current version of UGly-Net, we plan to conduct further experiments with U-Net models in the near future.

Acknowledgments

We used Super SloMo U-Net designed by NVidia[2] and developed by Avinash Paliwal[6]. The web-based visualization was created with p5.js[7]. This work was supported by ModuLABS and Yangjae Innovation Hub via Deep Learning College program with Pulse9.

References

[1] Den Heijer, E. (2013, April). Evolving Glitch Art. *In International Conference on Evolutionary and Biologically Inspired Music and Art*, pp. 109–120. Springer–Heidelberg.

[2] Jiang, H. Sun, D. Jampani, V. Yang, M. H. Learned-Miller, E. & Kautz, J. (2018) Super SloMo: High Quality Estimation of Multiple Intermediate Frames for Video Interpolation. *In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, pp. 9000–9008.

[3] Betancourt, M. (2016). *Glitch Art in Theory and Practice: Critical Failures and Post-Digital Aesthetics*. Focal Press.

[4] Oktay, O. Schlemper, J. Folgoc, L. L. Lee, M. Heinrich, M. Misawa, K. & Glocker, B. (2018). Attention U-Net: Learning Where to Look for the Pancreas. *arXiv preprint arXiv:1804.03999*

[5] Ronneberger, O. Fischer, P. & Brox, T. (2015, October). U-net: Convolutional Networks for Biomedical Image Segmentation. *In International Conference on Medical image computing and computer-assisted intervention* pp. 234–241.

[6] https://github.com/avinashpaliwal/Super-SloMo

[7] https://p5js.org/

Appendix: Implementation Details

Interface

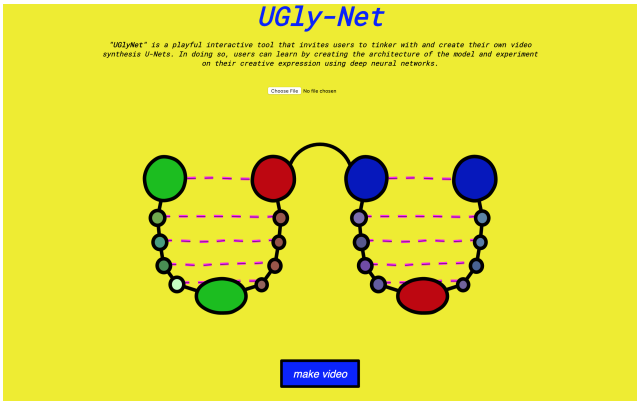

Figure 2: Main page

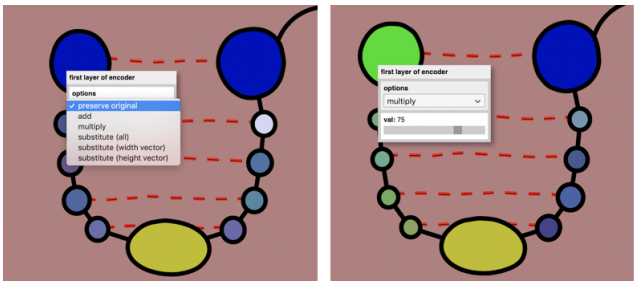

Figure 3: Interaction for manipulating feature maps

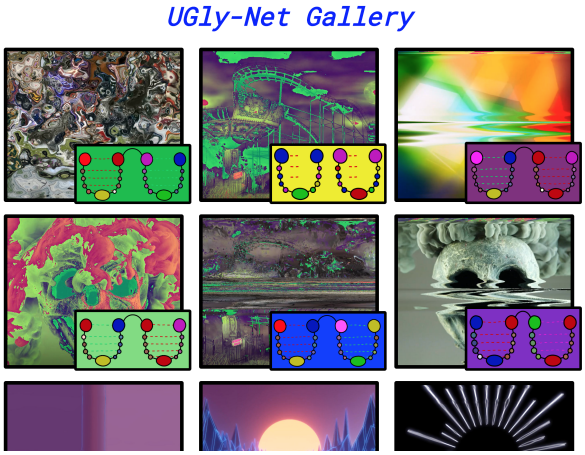

Figure 4: Gallery page

Sample Results

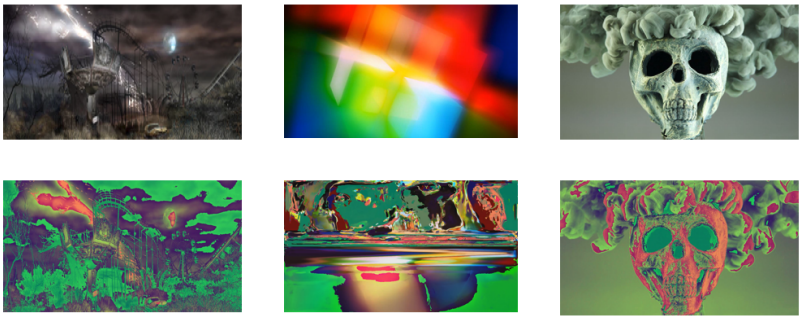

Figure 5: Original video(top) and sample results for UGly-Net(bottom).

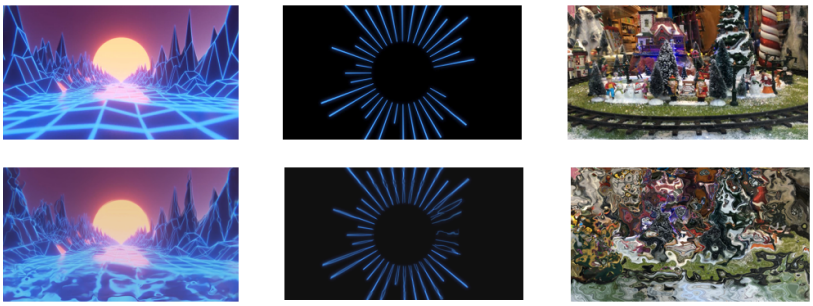

Figure 6: Original video(top) and sample results for UGly-Net(bottom).