Style Transfer: Rendered Effect On Product Design Raw Sketch Image

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0 Context

When it comes to product design, the design process(apart from research) always begins with a bunch of raw sketches where lines fly around. Then in teamwork, we usually skip the following step of raw sketch–rendering–adding shade or applying simple colours and textures on those sketches. By skipping the rendering step, the collaborative iteration process speeds up, while misunderstandings of ideas also rise through sketch-based communication.

1 Aims of project

Transfer raw sketches of product design into greyscale rendered style (white model).

2 Methods

2.1 Data Collection:

This dataset has two parts. The first part includes raw sketches of objects(described as concept sketch in the original dataset), which are downloaded from the website of this paper[1]. The other part includes 3D model images in the perspective that corresponds with the raw sketch(described as registered 3D model in original dataset), which are not provided directly as a package but images presented on the webpage. A web scraper is used to collect these images.

Another scaled version of this dataset is made by flipping and zooming in the images, resulting in four times the number of images in the collected dataset.

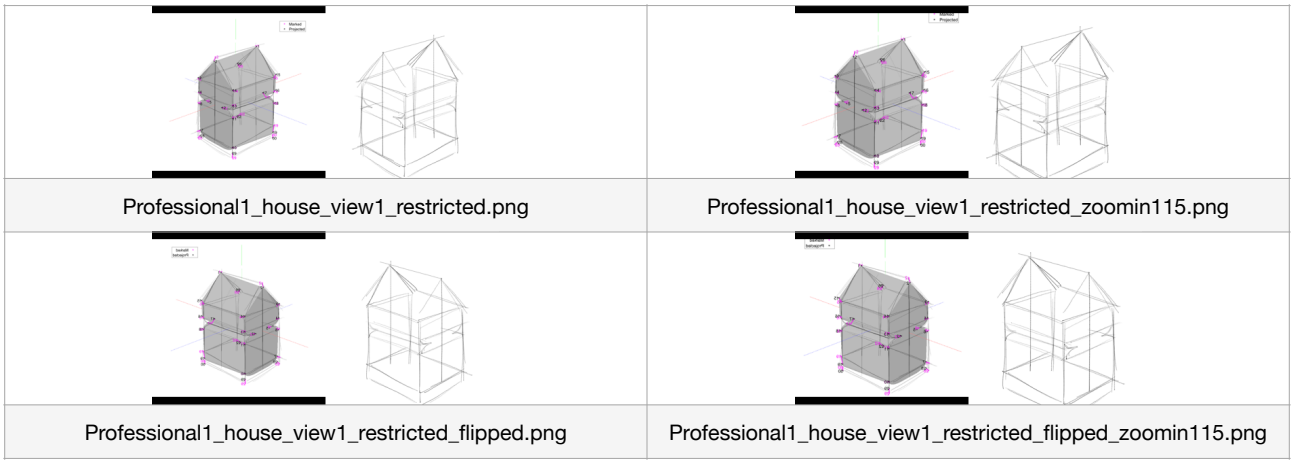


FIG1. EXAMPLE VARIATIONS OF DATASET

[1] Gryaditskaya, Y., Sypesteyn, M., Hoftijzer, J.W., Pont, S., Durand, F. and Bousseau, A. (2019). OpenSketch. ACM Transactions on Graphics, 38(6), pp.1—16.
link: https://repo-sam.inria.fr/d3/OpenSketch/index.html

2.2 Training and Test:

A Pix2Pix model is deployed by adapting the notebook from Week 6 of this course("*w06_pix2pix_keras_full_code.ipynb*"). Details of several training attempts are listed below(FIG.2). Testing process is done along with the training process, using validation image as input of the generative model.

Attempt One	Attempt Two	Attempt Three
Dataset: Original Dataset (210 combined images, including 168 training images and 42 validation images)	Dataset: Original Dataset (210 combined images, including 168 training images and 42 validation images)	Dataset: Scaled Dataset (840 combined images, including 672 training images and 168 validation images)
Epochs: 500	Epochs: 500	Epochs: 200
Batch Size: 128	Batch Size: 128	Batch Size: 64
Feature Number: 64 (both generator and discriminator)	Feature Number: 128 (both generator and discriminator)	Feature Number: 64 (both generator and discriminator)
Training duration: 46min	Training duration: 1h 13min	Training duration: 2h 43min

FIG2. TRAINING PARAMETER DETAILS OF THREE ATTEMPTS

3 Brief Evaluation and discussion of results

3.1 Evaluate

According to FIG.3, all three trained models shows the ability to render the raw sketch with in-shape color, and overall light and shadow distribution. It turns out sketches of simple and less surfaces objects tends to have better-generated result, while more complex one would be messed up. Model trained in attempt three has the most accurate generated result from validation dataset. But this can be a result of repetitive propagation of the original dataset, as part of training images are similar to some in validation images.

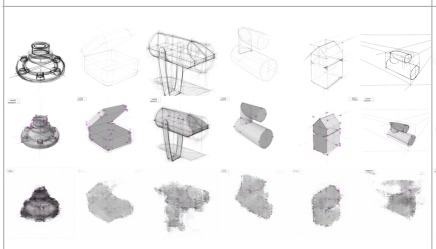
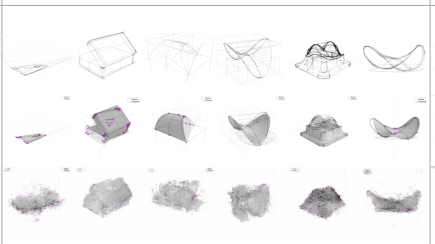
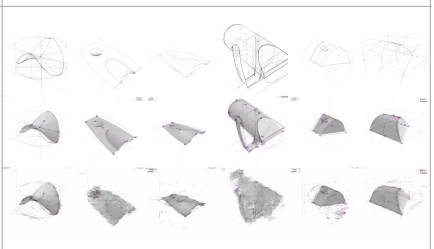
Attempt One	Attempt Two	Attempt Three
		
attempt_one_500eps_val.png	attempt_two_eps500_val.png	attempt_three_200eps_val.png

FIG3. FINAL RESULTS GENERATED FROM VALIDATION DATASET

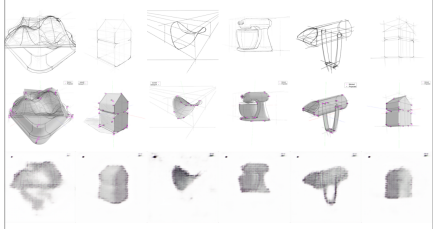
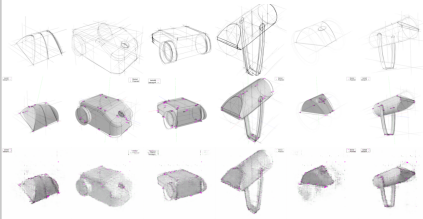
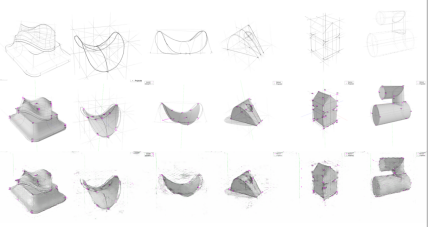
Attempt One: 200 epochs	Attempt Two: 200 epochs	Attempt Three: 200 epochs
		
attempt_one_200eps_train.png	attempt_two_eps200_train.png	attempt_three_200eps_train.png

FIG4. RESULTS GENERATED FROM TRAINING DATASET AFTER 200 EPOCHS

Compared to attempt one, the training process in attempt two shows a faster learning process with the expansion of feature numbers. Moreover, the model in attempt three performed even better with the scaled dataset, as the results have a more precise and similar look to the 3D model images. But this can be a concern of overfitting. (FIG.4)

3.2 Discussion

In this project, three training process that differs from epoch number, feature number and dataset scale are conducted. Expansion of feature number and repetitively scaled dataset shows a distinctive improvement on results generated from validation images. Increasing feature numbers may create more potential and variation a model can achieve. The dataset can be further scaled by adjusting the contrast of image, or slightly rotating the image(but still maintaining upwards). However, it still needs further attempt and investigation to say whether flipped or zoomed images have positive effect on the model. More data to train is good, but manually propagating dataset with similar information may result in repeats of original information in both training and validation data, causing confusion to evaluation.

All three trained models have partly achieved the goal to transfer the style of raw sketches into rendered versions.

4 References

[1] Gryaditskaya, Y., Sypesteyn, M., Hoftijzer, J.W., Pont, S., Durand, F. and Bousseau, A. (2019). OpenSketch. ACM Transactions on Graphics, 38(6), pp.1–16.