# Crowd Sourcing Clothes Design Directed by Adversarial Neural Networks

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## Abstract

Deep neural networks (DNNs) applications are now increasingly pervasive and powerful. However, fashion designers are lagging behind in leveraging this increasingly common technology. DNNs are not yet a standard part of fashion design practice, in either clothes patterns or prototyping tools. In this paper, we present DeepWear, a method using deep convolutional generative adversarial networks (DCGANs) for clothes design. The DNNs learn the feature of specific brand clothes and generate images, then patterns instructed from the images are made, and an author creates clothes based on that. We evaluated this system by evaluating the credibility of the actual sold clothes on market with our clothes. As the result, we found it is possible to make clothes look like actual products from the generated images. Our findings have implications for collaborative design between machine and human intelligence.
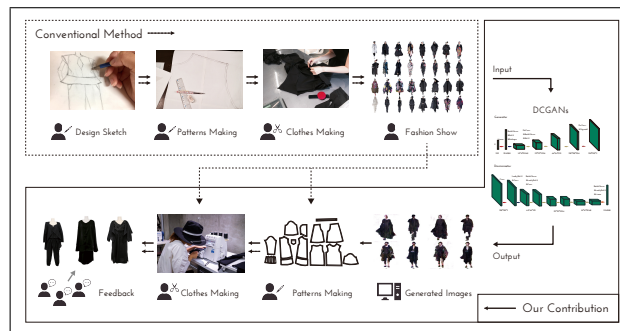
Figure 1: Our system workflow.

## 1 Introduction

Recent advances in computational fabrication have afforded the opportunity to use automated tools and machines to support fashion design. However, finding inspiration is still a difficult task. In this work, we present DeepWear, a practical system that uses DCGANs [1] to generate images for designers to make clothes by receiving instructions from those images. State-of-the-art learning techniques such as DCGANs are first applied to the workflow of designing clothes. The system takes specific brand [2] clothes images as the input, learns the feature of the input, generates images that

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looks close to the clothes, then patterns are instructed from the images are made, and an author creates clothes based on that. In the evaluation, we conduct a content analysis of our system in practicality by comparing the actual sold clothes with our clothes and other brand clothes by questioning which are the specific brand clothes actual sold. The results show that our system is possible to make clothes that look like actual products from the generated images. This paper shows the implications for collaborative design between machine and human intelligence.

## 2   Method

We collected clothes images of a specific brand announced between 2014 and 2017. We used web scraping Python code to create the training dataset. As the result, over 1.1K images were collected. Several steps were performed to be learned the feature of the images. We paint the background white so that only people and clothes are cut out, and processed it into RGB image of 128 px x 128 px. We use these images to generate new image by DCGANs. We followed implementation and training procedure recent work by Radford et al. [1]. Training was done with a batch size of 7, using Adam with hyperparameters ($\alpha = 0.0002$, $\beta_1 = 0.5$, $\beta_2 = 0.999$, $\epsilon = 10^{-8}$), and run on an NVIDIA Titan X GPU for 1000 epochs. We stopped running around 43000 iteration (about 270 epoch), because the loss become quite small and generated images look good. At the 43000 iteration, Generator loss is $16.1374$, discriminator loss is $1.39158$. Generated images are shown in Fig. 2.

Seven partcipants(6 females and 1 male) aged between 21 and 23 partcipated. They are experienced fashion design patterners and had clothing experience of 1 year and a half to 5 years (Patterners are people who draw patterns of clothes based on instructions from designers). We ask them to draw patterns based on the generated images. These works were done under the presence of an author or by online calls. We set the time limit 70 minutes for all subjects. The pattern created for the first was the image in Fig. 3 A, the second pattern was asked to draw the pattern based on the image selected by each subject (shown in Fig 3 B). Based on the pattern that the patterner handwritten, using two kinds of black cloth, an author made three kinds of clothes. The working time was about 50 hours.

## 3   Evaluation

Table 1: The result of the questionnaire that to distinguish the source brand clothes.

|  |  |  |  | Ave |
|---|---|---|---|---|
| Other | 80 (1) | 78 (5) | 97 (7) | 85 |
| DeepWear | 121 (3) | 87 (6) | 107 (8) | 105(+23.5%) |
| Source brand | 131 (2) | 120 (4) | 115 (9) | 122(+43.5%) |

We conducted an experiment to evaluate whether the image generated from DCGANs can be instruction sources for creating a new clothes. The experiment is comparing and evaluating the quality of the actually sold clothes on market with our clothes and the other brand clothes. We prepared images of the source brand and output of our method and images of other brands[2]. To the subjects, six clothes of the source brand were first exemplified. After that, we asked clothing images one by one in random order and evaluated whether or not the displayed image (shown in Fig 4) can be seen closer to the product of the source brand in 7 stages of 1 (looks different) to 7 (looks source brand). An weighted averages of these results are shown in the Table. 1. We have shown that our output is close enough to the learning source brand, as the output costumes are significantly closer to the learning source brand than other brand costumes. Looking at the answers of the subjects, the clothes that were judged to be most similar to the clothes of the original brand were the output of our system (3) and the clothes of the actual learning source brand.

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[2]https://page.auctions.yahoo.co.jp/jp/auction/v499221070, https://page.auctions.yahoo.co.jp/jp/auction/260446858, https://page.auctions.yahoo.co.jp/jp/auction/m218550387

# References

[1] Alec R. & Luke M. & Soumith C. (2015) Unsupervised representation learning with deep convolutional generative adversarial networks., *arXiv preprint arXiv:1511.06434*

[2] FASHION PRESS. (2017) Retrieved September 15, 2017 from www.fashionpress.net/collections/brand/42

# A   Supplementary materials



Figure 2: Generated images. The above image is clothes images (128 px). The below image is certain brand shoe images that we additionally genrated (256 px).
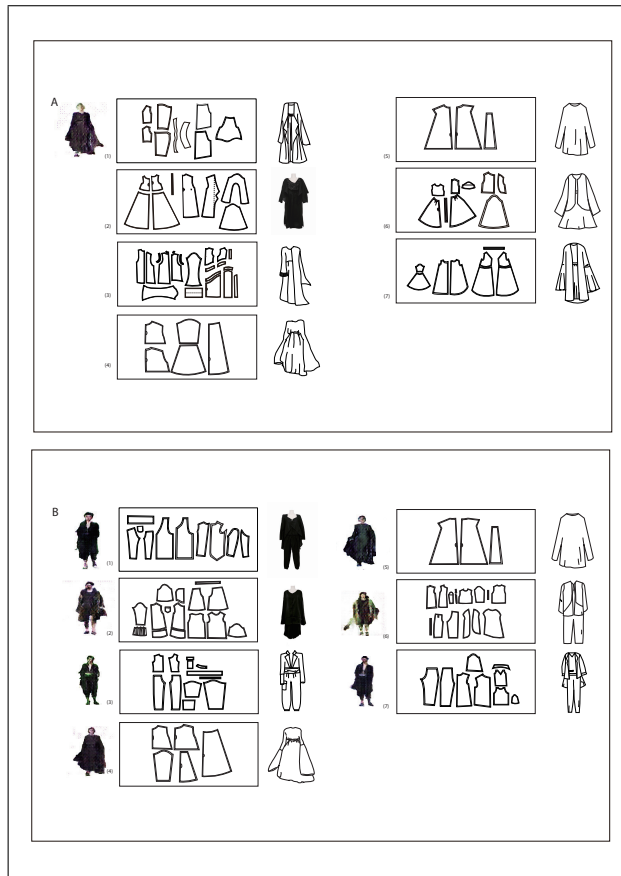
Figure 3: Drawn patterns.



Figure 4: We showed these clothes to subjects to survey can they distinguish brands.