Text-Adaptive Generative Adversarial Networks: Manipulating Images with Natural Language

Seonghyeon Nam, Yunji Kim, Seon Joo Kim
Dept. of Computer Science, Yonsei University
Seoul, South Korea
Manipulating Images with Natural Language

Icons made by Freepik from www.flaticon.com
Manipulating Images with Natural Language

This small bird has a blue crown and white belly.
Manipulating Images with Natural Language

This small bird has a blue crown and white belly.

Processing... Here it is.
Related Work

- Existing methods rely heavily on sentence embedding vectors
- They fail to preserve text-irrelevant contents (e.g. background)
- Coarse multi-modal modeling is not enough for the disentanglement

This particular bird with a red head and breast and features grey wings.

This small bird has a blue crown and white belly.
Contribution

- Our key idea is word-level local discriminators for fine-grained training
- Our method effectively changes visual attributes while preserving text-irrelevant contents

This particular bird with a **red head and breast** and features **grey wings**.

This small bird has a **blue crown** and **white belly**.
Overview of TAGAN

This flower has petals that are yellow and are very stringy.
Generator

This flower has petals that are yellow and are very stringy.

To preserve original contents, we add a reconstruction loss: $L_{rec} = \|x - G(x, t)\|$
Discriminator

The discriminator consists of

1. Unconditional discriminator → Make image realistic
2. Text-adaptive discriminator → Make image match the text

This flower has petals that are *yellow* and are *very stringy*. 
1. Compute local discriminator scores

\[ f_{w_i}(v) = \sigma(W(w_i) \cdot v + b(w_i)) \]

- text
- image
- text
Text-Adaptive Discriminator

1. Compute local discriminator scores
   \[ f_{w_i}(v) = \sigma(W(w_i) \cdot v + b(w_i)) \]

2. Compute text/image attentions
   \[ \alpha_i : \text{softmax weight for word } i \]
   \[ \beta_{ij} : \text{softmax weight for word } i, \text{ and image feature level } j \]
Text-Adaptive Discriminator

1. Compute local discriminator scores
   \[ f_{w_i}(v) = \sigma(W(w_i) \cdot v + b(w_i)) \]

2. Compute text/image attentions
   \[ \alpha_i : \text{softmax weight for word } i \]
   \[ \beta_{ij} : \text{softmax weight for word } i, \text{ and image feature level } j \]

3. Aggregate the scores with attentions
   \[ D(x, t) = \prod_{i=1}^{T} [\sum_{j} \beta_{ij} f_{w_i,j}(v_j)]^{\alpha_i} \]
Manipulation Results on CUB-200

Original

This particular bird with a **red head and breast** and features **grey wings**.

This bird has **wings that are blue** and has a **white belly**.

A small bird with **white base** and **black stripes** throughout its belly, head, and feathers.
Manipulation Results on Oxford-102

Original

The petals are white and the stamens are light yellow.

The petals of the flower have yellow and red stripes.

This flower has petals of pink and white color with yellow stamens.
Qualitative Comparison

This is a **black bird** with **gray and white wings** and a **bright yellow belly and chest**.

This flower has **petals that are white** and has **patches of yellow**.

Original

[Dong et al., 2017]

[Xu et al., 2018]

Ours
Conclusion

- We propose a Text-Adaptive Generative Adversarial Network (TAGAN)
- Our method disentangles and manipulates fine-grained visual attributes
- Our method outperforms existing methods on CUB-200 and Oxford-102

Please visit our poster (#126) for more information

https://github.com/woozzu/tagan