

# Computer generated car design

A literature review by Lennert Bontinck

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# Remember the interesting work?

## Real life applications

- Hackrod (Pette, 2015)
- Czinger (Girish, 2020)



## Image generation

- StyleGAN (Karras et al, 2018)
- Predicting cybertruck design (Trevedi, 2019)
- Automating Car Design Studio with GAN (Radhakrishnan et al, 2020)



## GAN control

- Understanding hidden units in deep NN (Bau et al, 2020)
- GANSpace (Härkönen et al, 2020)



Pette, B. (2016). *The world's first ai-generated car*. Retrieved February 17, 2021, from <https://blogs.nvidia.com/blog/2016/07/26/hack-rod-car-ai/>

Girish. (2020). *A revolutionary hypercar built for the 21st century*. Retrieved February 17, 2021, from <https://www.czinger.com/about-21-c>

Karras, T., Laine, S., & Aila, T. (2018). A style-based generator architecture for GAN. *CoRR*, *abs/1812.04948*. <http://arxiv.org/abs/1812.04948>

Trivedi, C. (2019). *Fun with stylegan: Let's predict the tesla cybertruck design!* Retrieved February 17, 2021, from <https://bit.ly/2QNL9wL>

Radhakrishnan, S., Bharadwaj, V., Manjunath, V., & Srinath, R. (2018). Creative intelligence-automating car design studio with generative adversarial networks (gan). In A. Holzinger, P. Kieseberg, A. M. Tjoa, & E. Weippl (Eds.), *Machine learning and knowledge extraction* (pp. 160–175). Springer International Publishing.

Bau, D., Zhu, J.-Y., Strobelt, H., Lapedriza, A., Zhou, B., & Torralba, A. (2020). Understanding the role of individual units in a deep neural network. *Proceedings of the National Academy of Sciences*, 117(48), 30071–30078. <https://doi.org/10.1073/pnas.1907375117>

Harkonen, E., Hertzmann, A., Lehtinen, J., & Paris, S. (2020). Ganspace: Discovering inter-pretatable gan controls.



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# Technical details

- Machine Learning and Knowledge Extraction book by Springer International Publishing
- Paid paper available on springer
- Professionally peer reviewed
- Radhakrishnan S., Bharadwaj V. Manjunath V. and Srinath R. (2018)

SBN: 978-3-319-99740-7 P. 160-175

```
@inproceedings{creativecargan,  
  title = {Creative Intelligence - Automating Car Design Studio with Generative Adversarial Networks (GAN)},  
  author = {Radhakrishnan, Sreedhar and Bharadwaj, Varun and Manjunath, Varun and Srinath, Ramamoorthy},  
  year = 2018,  
  booktitle = {Machine Learning and Knowledge Extraction},  
  publisher = {Springer International Publishing},  
  address = {Cham},  
  pages = {160--175},  
  isbn = {978-3-319-99740-7},  
  editor = {Holzinger, Andreas and Kieseberg, Peter and Tjoa, A Min and Weippl, Edgar}
```



International Cross-Domain Conference for Machine Learning and Knowledge Extraction  
... CD-MAKE 2018: Machine Learning and Knowledge Extraction pp 160-175 | [Cite as](#)

## Creative Intelligence – Automating Car Design Studio with Generative Adversarial Networks (GAN)

Authors

Authors and affiliations

Sreedhar Radhakrishnan , Varun Bharadwaj , Varun Manjunath , Ramamoorthy Srinath

Conference paper

First Online: 24 August 2018

2

1

2.2k

Citations Mentions Downloads

Part of the [Lecture Notes in Computer Science](#) book series (LNCS, volume 11015)

### Abstract

In this paper, we propose and implement a system based on Generative Adversarial Networks (GANs), to create novel car designs from a minimal design studio sketch. A key component of our architecture is a novel convolutional filter layer, that produces sketches similar to those drawn by designers during rapid prototyping. The sketches produced are more aesthetic than the ones from standard edge detection filters or gradient operations. In addition, we show that our system is able to generate hitherto unseen perspectives of a car, given a sketch of the car at just a single viewing angle. For extensive training, testing and validation of our system, we have developed a comprehensive, paired dataset of around 100,000 car images (with transparent backgrounds) and their respective sketches. Our work augments human intelligence and creativity using machine learning and deep neural networks. Our system has the significant benefit of reducing the cycle time in the sketch-to-image process which has largely been considered a creative domain. This is achieved by learning to interpret a preliminary sketch drawn by a designer, to generate novel visual designs in a matter of seconds, which may otherwise require considerable time and effort. While the system enhances the productivity of the designer, the machine learning enhanced design visualizations can cut costs during the product prototyping stage. Our system exhibits good impactful potential for the automobile industry and can be easily adapted to industries which require creative intelligence.

### Keywords

Computational creativity Generative Adversarial Networks Automobile design

Deep learning Computer vision Sketching filter

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Cite paper

# Purpose of the paper

- Give a better insight on existing GAN and sketch filter technology
- Create a better sketch filter: BiSECT
- Have a publicly available paired DB of sketches and cars
- Creative system to convert (car) sketches to multiple prototypes

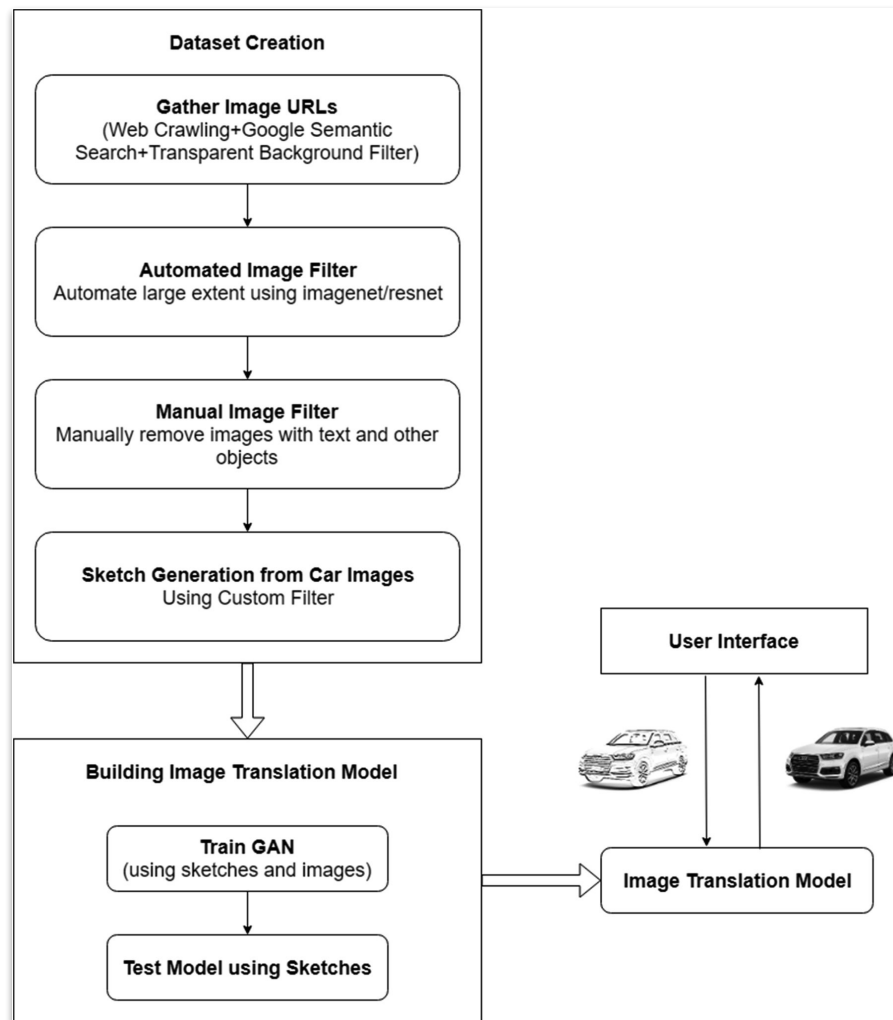


Figure 1 from paper

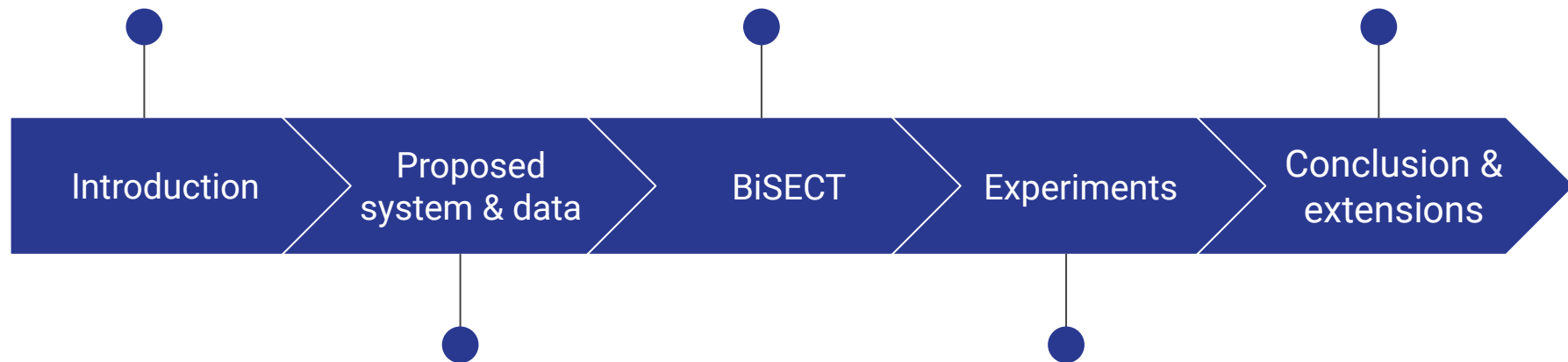


# Contents of the paper

CNNs, GANs, CC and  
the need for the  
proposed system

The BiSECT Sketching  
filter for making a  
paired DB

Discussing their 3  
contributions and  
possible extensions



The three components  
of the system and the  
100k images

Multiple experiments,  
both creative and  
more formal



# Contents of the paper

Introduction

Proposed  
system & data

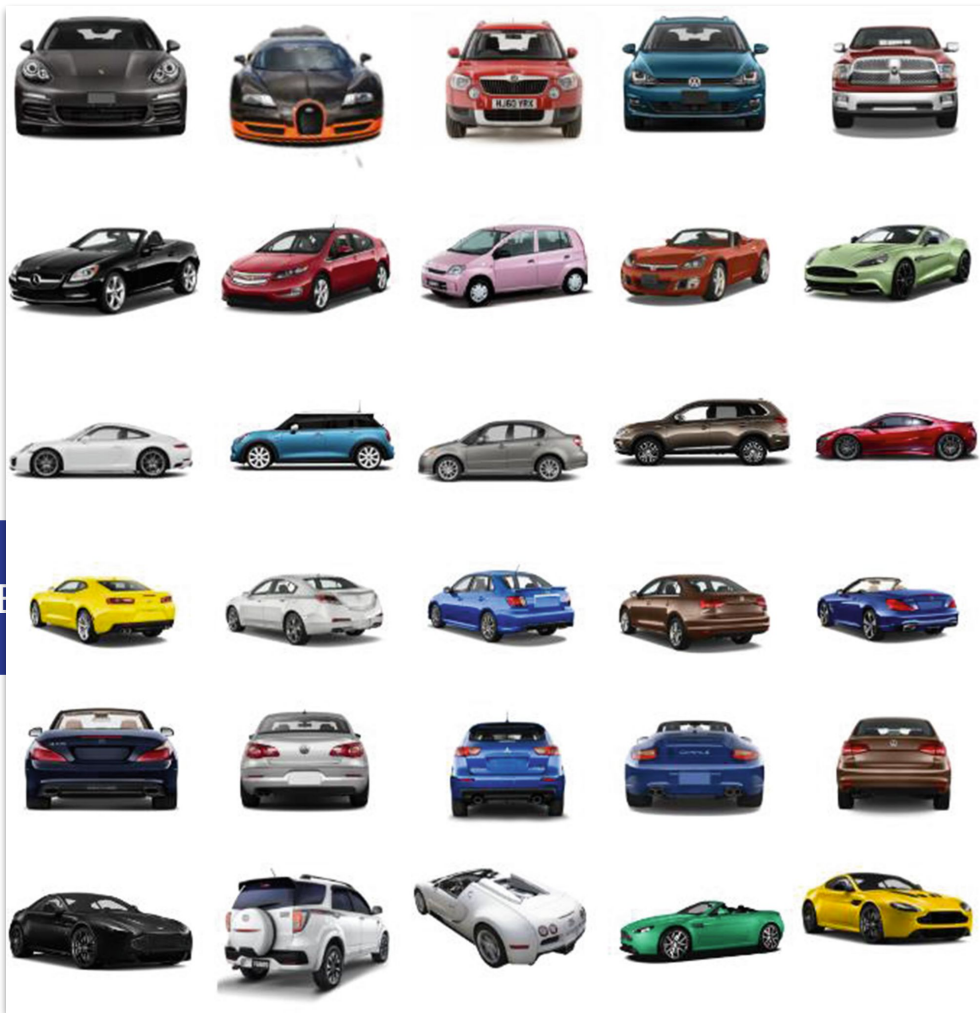


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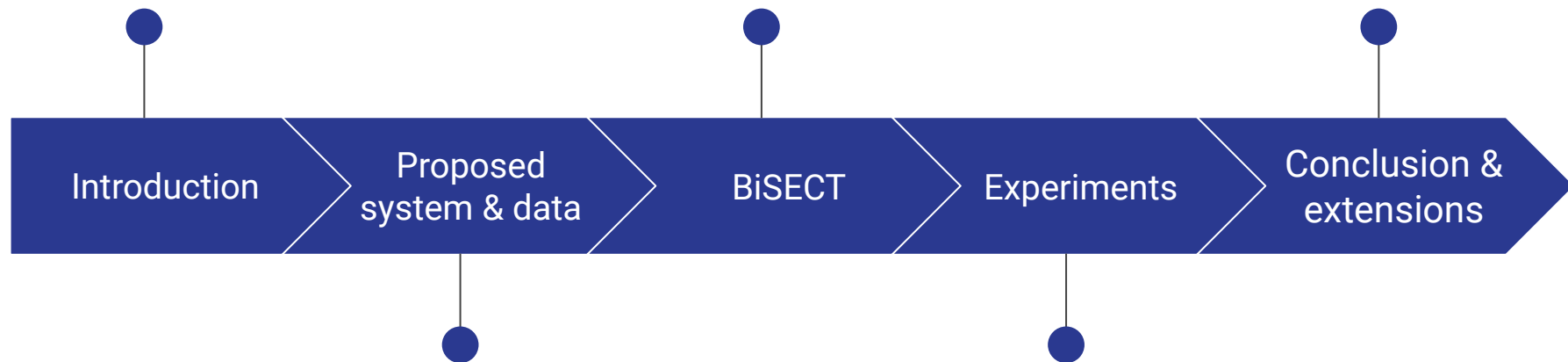


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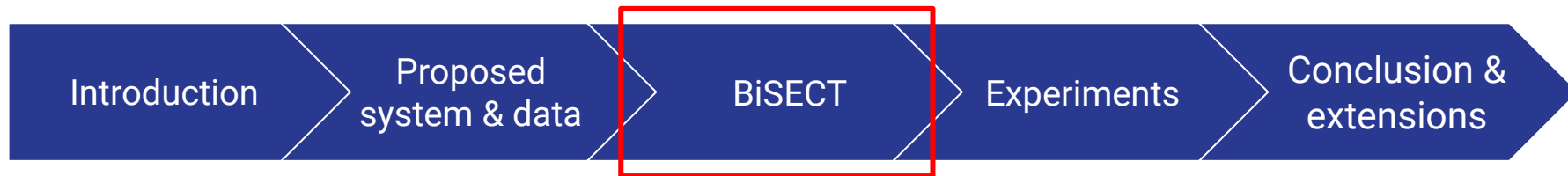
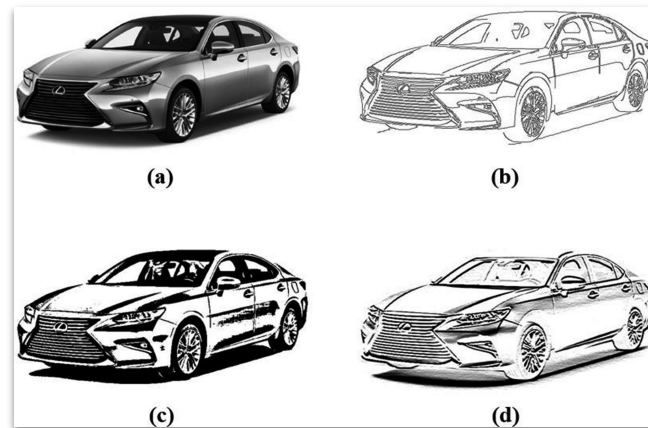
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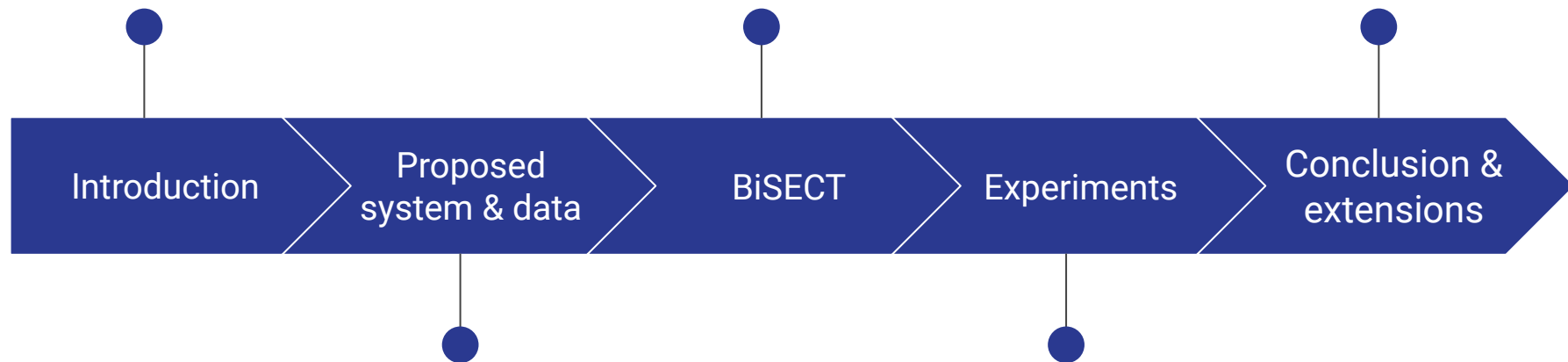


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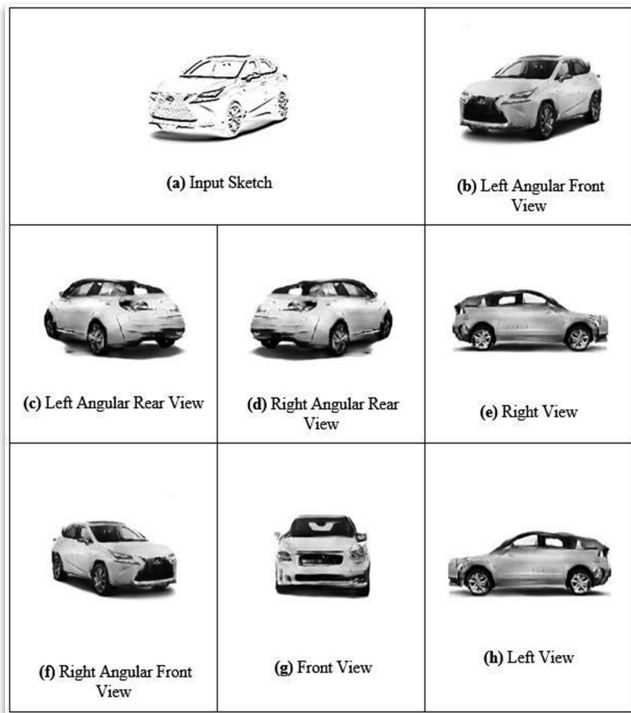


Figure 12 from paper

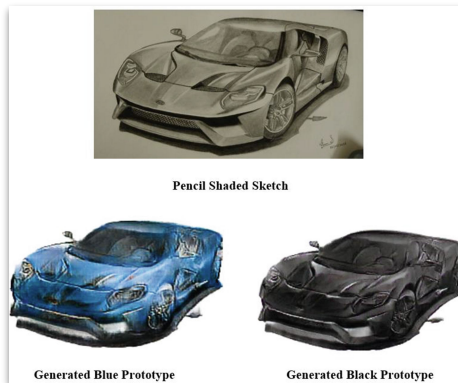


Figure 11 from paper

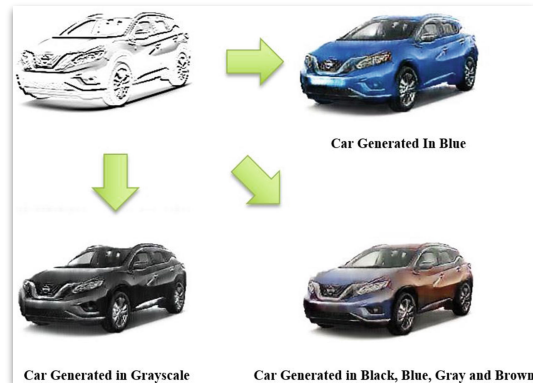


Figure 10 from paper

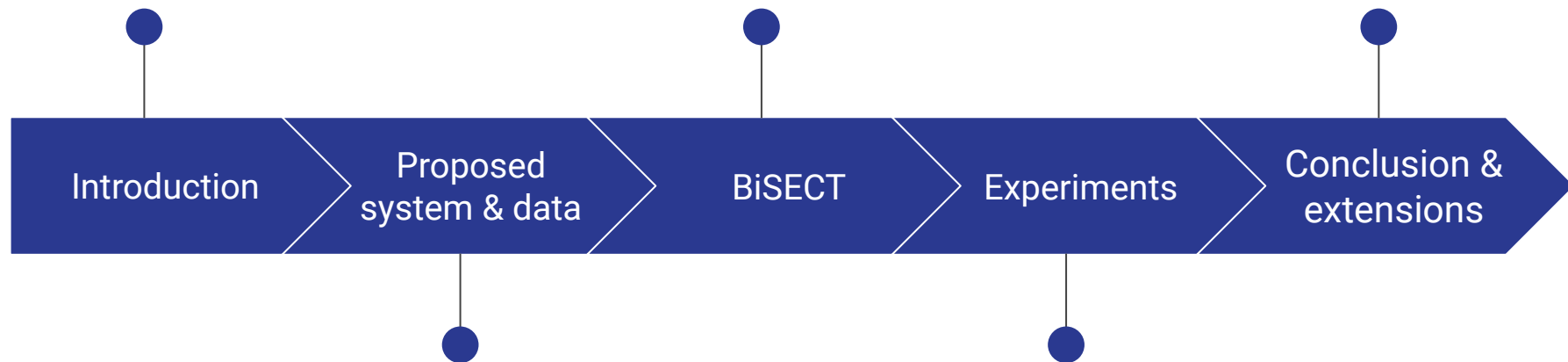


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# What I found interesting

- Their literature review
- The working of the created BiSECT sketching filter
- Using fewer data and iterations to boost creativity
- The (lack of) defense for deeming the system creative
- Using computational creativity to visualize human creativity
- Using computer generated data as training data for another AI
- Ability to generate hitherto unseen perspectives

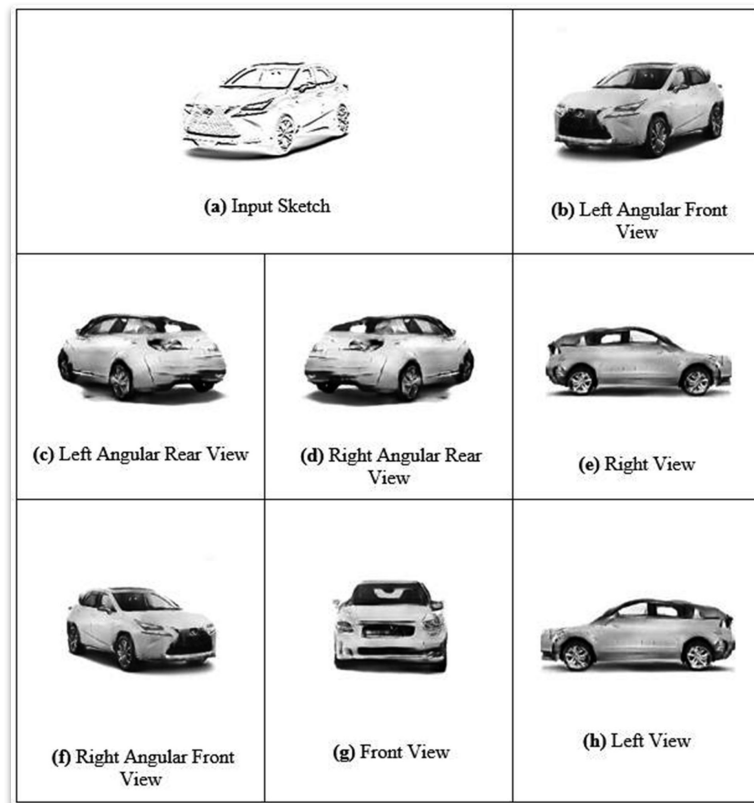


Figure 12 from paper



# What is learned

- DB & GAN development and how it is discussed in a professional paper
- Use of creative systems in real life
- Relevant literature
- Sketch filter techniques
- An economically interesting application of computational creativity

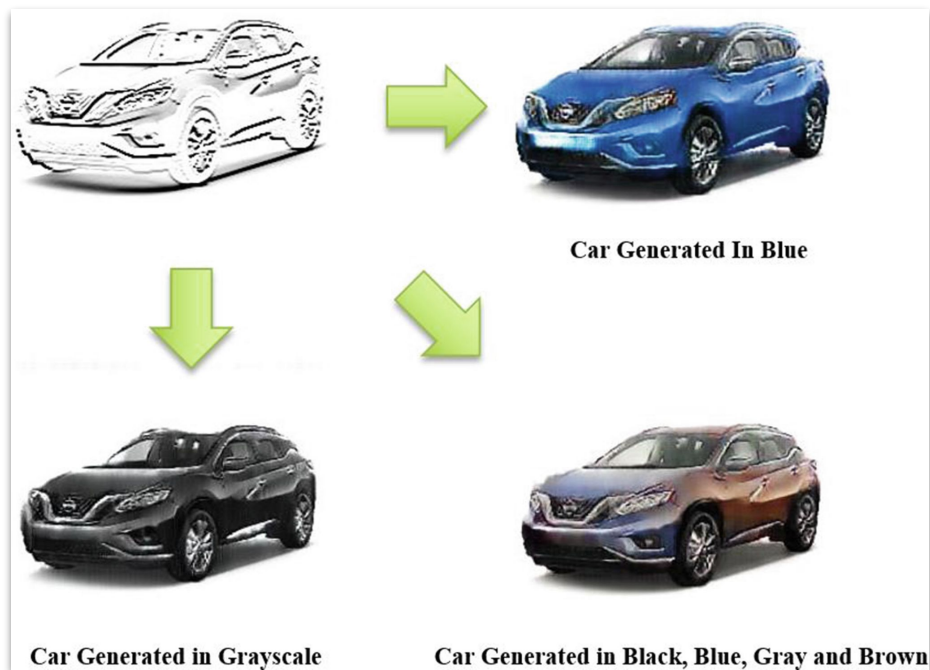
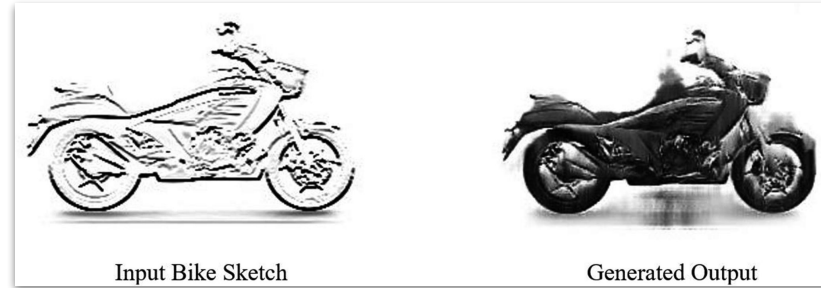


Figure 10 from paper



# Key conclusions

- Creativity is often used as catch phrase, even in respected papers
- Creative systems can aid creative professions instead of replacing them
- There exists many different GANs, some of which take input
- Recent developments in generative AI will make computational creativity more interesting



Figures 13 & 14 from paper



# Questions?

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