

# Development of Aesthetic Algorithms for Acquired and Generated Digital Image

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# Outline

- **Motivation**
- Objective
- Research Problems
- Previous work
- Research gap
- Current work

# 1. Motivation

- 3D computer graphics and animation, games, and films, need the scene be more beautiful and expressive.

One Screenshot of **games** “Word of Warcraft”



3D graphics model



One frame from **movie** “Star Wars” 1997

Reference: Chi-Wing Fu, Jiazhi Xia, Ying He. LayerPaint: A Multi-Layer Interactive 3D Painting Interface, ACM Conference on Human Factors in Computing Systems, 2010

# 1. Motivation

- Painters can arrange light, form, texture and color in a considered and beautiful way.
- Even the best photograph is essentially an optical artifact not easily subject to such consideration.



Thomas Moran (1837-1926),  
"Green River of Wyoming" 1878.



William Holman-Hunt (English, 1827 – 1910),  
"The Lady of Shalott", painted 1889-1902



Francisco De Goya y Lucientes (Spanish,  
1746-1828), "Lavendimia Goya lou"

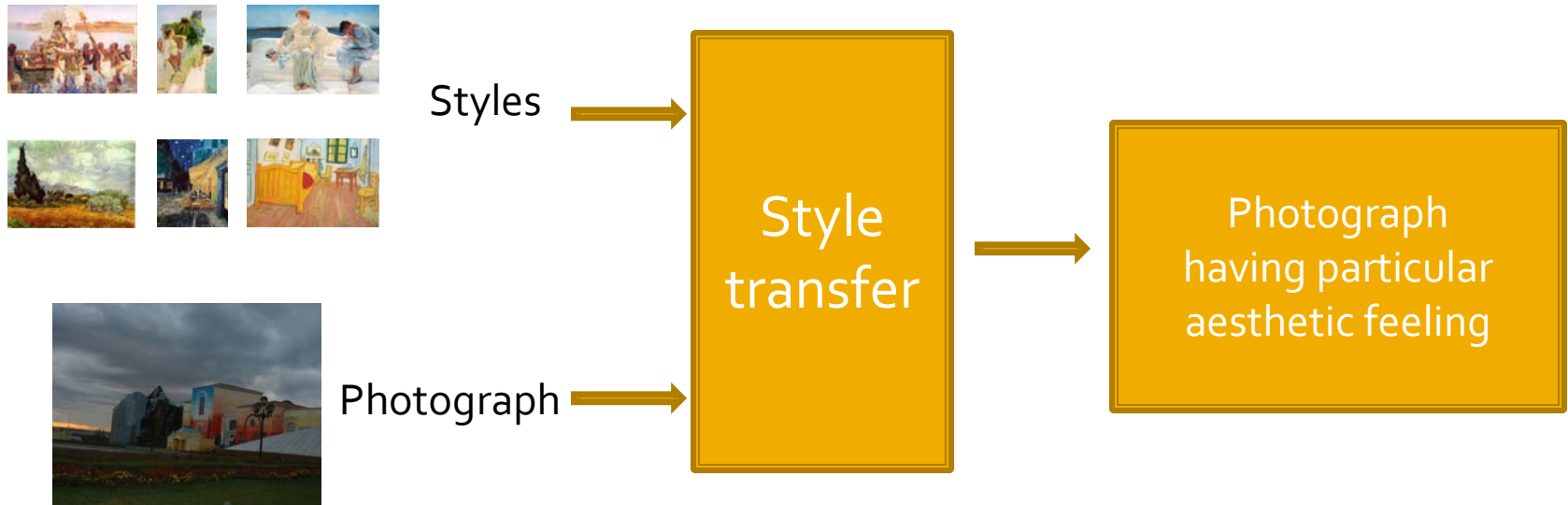
- Can we learn from paintings on captured digital photographs?

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# 2.Objective

- Study of pre-existent art works and attempt to identify what constitutes a style.
- Apply styles to acquired and generated digital images.

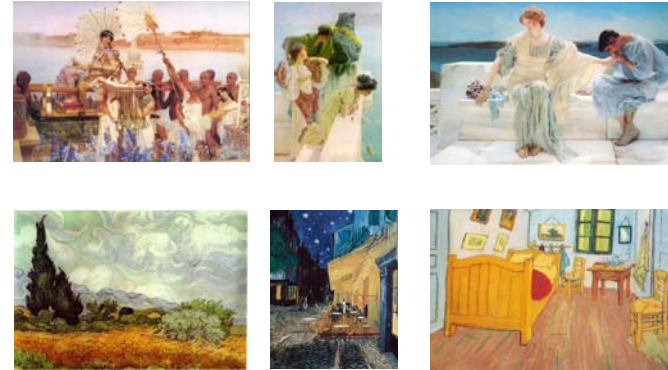


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# 3. Research Problems

- What constitutes a style?



- In the visual arts, style refers to the aspects of the visual appearance of a work of art.
- Factors affecting a style: formal principles such things as the content, paint thickness, choice of medium, size of canvas and brushstrokes.



# 3. Research Problems

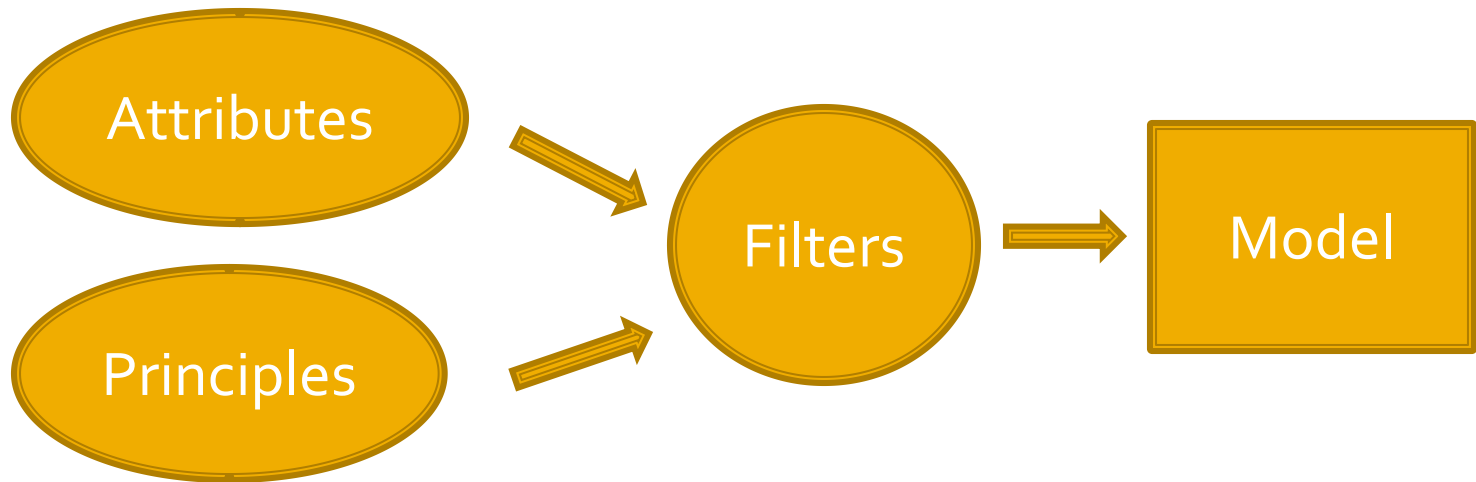
- In paintings these aspects have been deliberately arranged according to formal, instinctive, cultural and personal preferences.
- Even the painter finds it difficult to clearly identify them.
- This presents a real problem to computerized analysis.

Qualitative → Quantitative

- We concentrate on color saturation, color value, tone (lightness), focus, line, corner, edge that are retrievable.

# 3. Research Problems

- How to express the style mathematically and apply it to acquired and generated digital images?



- We need a general model for all of the attributes and principles.

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# 4. Previous work

- Painterly rendering
  - An area of computer graphics mostly to emulate the brush strokes effects seen in traditional paintings.



top row:  
"watercolor",  
"Van Gogh",  
"Impressionism",

bottom row:  
"Abstract",  
"Pointillism",  
"Flower" and  
"Abstract" styles

Reference: James Hays, Irfan Essa. Image and Video Based Painterly Animation. Proceedings of the 3rd international symposium on Non-photorealistic animation and rendering, 2004, citation 84(Google scholar). (School of Computer Science, Carnegie Mellon University)

# 4. Previous work

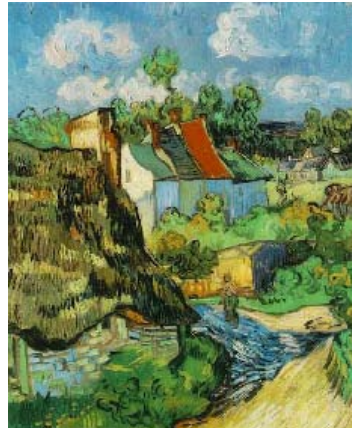
- Related Papers about Painterly rendering :
  - J. Lu, Pedro V. Sander, Adam Finkelstein, “Interactive Painterly Stylization of Images, Videos and 3D Animations”. Proceedings of the ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games, 2010. (The Hong Kong University of Science and Technology, Princeton University)
  - Martin Schwarz, Tobias Isenberg, Katherine Mason et al. “Modeling with Rendering Primitives: An Interactive Non-Photorealistic Canvas”. Proceedings of the 5rd international symposium on Non-photorealistic animation and rendering, 2007. (Department of Computer Science, University of Calgary)
  - Romer Rosales, Kannan Achan, and Brendan Frey, “Unsupervised Image Translation”, International Conference on Computer Vision, 2003. (Probabilistic and Statistical Inference Laboratory, University of Toronto)

# 4. Previous work

- Re-Colour: **shifts** the **colour** of the photograph to match the colours of the reference image.



Source



Reference



Result

Reference: CHANG Y. SAITO S., NAKAJIMA M.: Example-Based Colour Transformation of Image and Video Using Basic Colour Categories. IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 16, NO. 2 (2007).  
(Department of Computer Science, Tokyo Institute of Technology)

- It only considers the colours of the source image but not their distribution and styles. In other words: the above example would achieve unnatural results if the target painting was not green.

# 4. Previous work

- Related Papers about re-coloring:
  - TAI Y. W., JIA J. Y., TANG C. K., “Local colour transfer via Probabilistic Segmentation by Expectation-Maximization”. In Proceedings of 2005 IEEE Computer Society Conference on Computer Vision and Pattern Recognition”, San Diego, USA, Part vol. 1 (2005), 747-754. (The Hong Kong University of Science and Technology, The Chinese University of Hong Kong)
  - NEUMANN L., NEUMANN A., “Colour Style Transfer Techniques using Hue, Lightness and Saturation Histogram Matching”. Computational Aesthetics in Graphics, Visualization and Imaging (2005), 111-122. (Grup de Gràfics de Girona, Universitat de Girona, and Institució Catalana de Recerca i Estudis Avançats, ICREA, Barcelona, Spain)
  - GREENFIELD G. R., HOUSE D. H.: A Palette-Driven Approach to Image Colour Transfer. Computational Aesthetics in Graphics, Visualization and Imaging (2005), 91-98. (Mathematics & Computer Science, University of Richmond)
  - REINHARD E., ASHIKHMIN M., GOOCH B., SHIRLEY P.: Colour Transfer between Images. IEEE Computer Graphics and applications, special issue on Applied Perception (2001), 34-41. (University of Utah)

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# 5. Gap: What' new in our research

- The reviewed work only consider one element (e.g brush stroke, color) separately.
- Differently, we consider color saturation, color value, tone (lightness), focus, line, corner, edge that are retrievable as a layered operations.
- Each operation would be passed through the image in a way that is selective and is in a dynamic relationship to all the other operations.

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# 6. Current work

- Currently, we define the global style of painting in the use of colour as the hue spread in artist's colour space, and saturation/lightness distributions guided by the contrast.
- Two artists used:
  - Sir Lawrence Alma-Tadema (English 1836-1912), one of the most renowned painters of the late nineteenth-century.
  - Vincent Van Gogh (Dutch 1853-1890) whose paintings had a far-reaching influence on 20th century art for their vivid colours and emotional impact.

# Conclusion

- Currently, our work considers painting style as being defined as the global contrast of the three attributes Hue, Saturation and Lightness.
- Our current results are encouraging and future work will explore other constituent aspects of a painter's style.

# Questions

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Thank you!

Q&A