Aesthetic Agents: Swarm-based Non-photorealistic Rendering using Multiple Images

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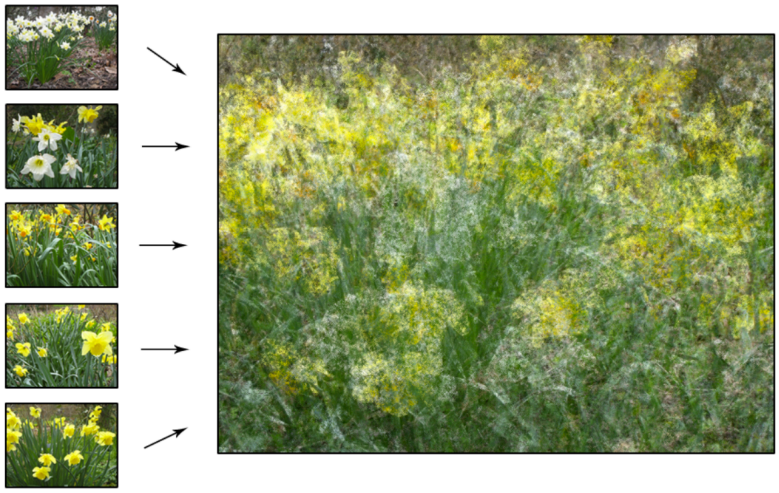

The authors of this paper explored the creation of expressive images through the use of multiple digital images as references. They introduced a swarm-based multi-agent system that is able to create expressive imagery. Each agent in the system is assigned a digital image as its aesthetic ideal (or reference). In the initial stage, the system creates *n* agents and assigns *n* images, one image for each agent. Each agent occupies a single pixel within a digital canvas. During each iteration of the system, agents can move 1 pixel according to their movement mode. In the random mode, the agent can move to any of its eight surrounding pixels. In the greedy mode, the agent moves to the pixel that is the most different from its aesthetic ideal. Then, agents modify the color value of the pixels they currently occupy to be closer to the color value of the same pixel in the aesthetic ideal image according to a preset interpolation value. Each time an agent expresses its aesthetic ideal, its fertility level increases by one. When the fertility level is greater than or equal to the agent's proliferation value, the agent starts to reproduce where a new agent is spawned at the same location and with the same aesthetic ideal as its parent. Production of new agents continues until a preset maximum population is reached.

The creation of expressive images is one of the major goals in non-photorealistic rendering. The swarm-based multi-agent system has been previously explored to create artistic works. However, the majority of previous works were based on color-based swarm painting approach. This paper is one of the very few works that utilizes digital images as a source for creating artistic works.

The authors first presented some background information about swarm intelligence systems to clarify the idea that this work is based on. To emphasize the contribution of this work, the difference between color-based and image-based painting approaches is also presented. The authors explained the process of creating expressive images by their swarm-based system in three steps:

1- **Sense Color & Move**: where each agent can sense the color value of the pixel it currently occupies (random mode) or the pixel it currently occupies and those immediately neighboring it (greedy mode).
2- **Express Aesthetic Ideal**: where agents modify the color value of the pixels they currently occupy.
3- **Reproduce**: which is the asexual reproduction of new agents according to the fertility level of each agent and to the maximum population size.

Different numbers of modern art movements are investigated using the current swarm-based system. The system is used to create simulated images from the following art movements and it produced pleasant results:

- **Montage.**
- **Impressionism.**
- **Cubism.**
- **Futurism.**
- **Abstract Expressionism.**

I found that the inspiration from nature that was evidenced in this paper is very interesting. Swarm-based algorithms have been used in many studies to solve certain types of problems. Swarm-based painting could be a robust technique due

to the properties of swarm intelligence systems. However, it would be better if evaluation of performance as well as potential were combined together.

Reference

Love, Justin, et al. "Aesthetic agents: swarm-based non-photorealistic rendering using multiple images." *Proceedings of the International Symposium on Computational Aesthetics in Graphics, Visualization, and Imaging*. ACM, 2011.