EXPLORING SWARM BEHAVIOR FOR ARTISTIC RENDERING: FROM ABSTRACT ART TO TARGETED IMAGE RENDITION

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Inspired by Dr. Palmer's human swarm experiment, the researcher developed a unique image renderer using swarm intelligence (SI). Agents within the system leave colorful trails, generating abstract art or modified renderings of target images. The study demonstrates that the swarm-based approach offers increased rendering speed and produces distinctive visual effects compared to traditional techniques.

01 HUMAN SWARM EXPERIMENT

1. There are 100 people (agents) wear one of 10 different color T- shirts.
2. Twenty of those agents are given caps from the same color palette. No agent wears a cap matching their own T-shirt.
3. In this environment, the agents initially move random . After some time has elapsed, they are given a set of rules. In this scenario, the agents are told to look at their shirt color and follow the nearest person who is wearing a cap of that color

Figure 1: *Human Swarm Experiment*

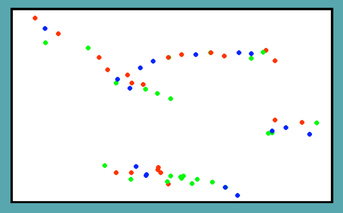

Figure 2: *Agents (people) in the virtual environment*

02 STRATEGIES

Inspired by the Human Swarm experiment and image rendering works of Dr. Bob Bosch and Daniel Shiffman, We used three different strategies to generate Images:

1. Abstract Swarm Art Using Human Swarm Behavior (Figure 3)
2. Randomly Rendering a Target Image.
   a. Figure 4 shows the initial piece where the width of the trace reflects the darkness of the pixels.
   b. Figure 5 shows the final image one can generate in this strategy
3. Rendering a Target Image using Swarm Behaviour (Figure 6, Figure 7 and Figure 8)
   a. Figure 6 is the initial phase of making the agents attract to dark areas

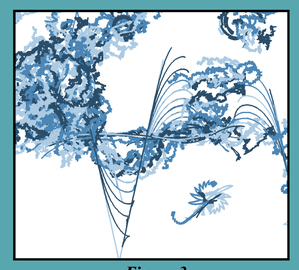

Figure 3

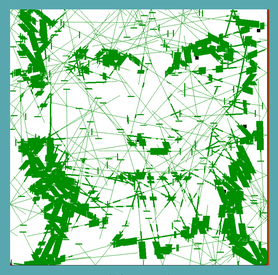

Figure 4

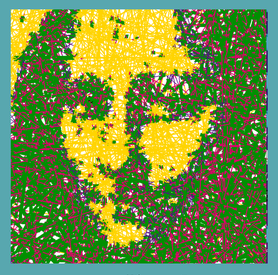

Figure 5

Figure 6

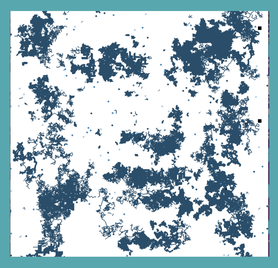

Figure 7

Figure 8

03 RENDERING A TARGET IMAGE USING HUMAN SWARM BEHAVIOR

Once we had the target images on the screen we let agents move around the screen. Their behavior is as listed below:

1. If the agent is alone, it is moving randomly without leaving any traces.
2. If the other agents near them match the criteria of being followed or following the current agent, they would form a chain. Now the agents can leave a trace.
3. The head agent of the chain is attracted to darker areas of the image or repelled by brighter areas.
4. Longer the chain, thicker line of trace they will leave.
5. Longer the chain, the darker the areas they will be attracted to.

Figure 9: *Target Image*

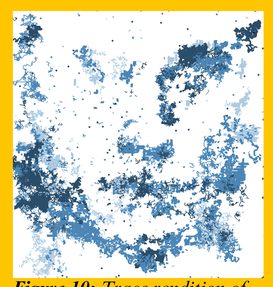

Figure 10: *Trace rendition of target image*

04 IMPLEMENTATION & RESULTS

Different variables can be changed when rendering a target image using swarm behavior. The two variables that significantly impacted the image generation were:

1. Follow Radius: The radius each agent looked around searching for other agents
2. Follow Distance: The distance each agent maintained with other agent when moving in a chain.

Figure 10: *The process of rendering a traget image.*

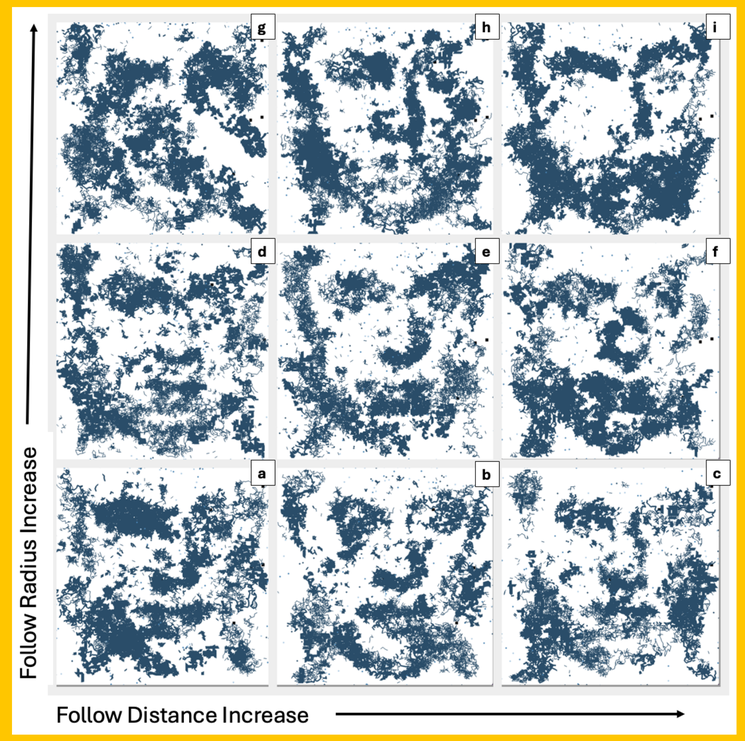

Figure : *Target image of Dracula with different levels of Follow Distance and Width*

05 REFERENCES

1. D. Palmer, M. Kirschenbaum, et. al. "Using a Collection of Humans as an Execution Testbed for Swarm Algorithms" Proceedings of the 2003 IEEE Swarm Intelligence Symposium. SIS '03 Indianapolis, IN, USA , 2003, pp58-64, doi:10.1109/SIS.2003.1202248
2. R. Bosch, *Opt Art: From Mathematical Optimization to Visual Design*. Princeton University Press, 2019.
3. G. Greenfield and Penousal Machado, "*Swarm Art*", *Leonardo*, Volume 47 , Issue 1, 2014, doi.10.1162/LEON_a_00695