Exploration of Drip Painting Through Swarm Robotics

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Abstract

This study introduces a generic framework for the utilization of the multi-robots in experimental artworks. The proposed framework consists of low-fidelity mobile robot agents, predefined trigonometric equations as an initial path for robots, ultrasonic sensors for distance detection between robots and obstacles, and simple rules depending on the measured distance value. The framework was tested in a case study in which drip painting has been chosen as a part of the experiment setup. Findings and outcomes obtained from the case study are presented.

Taking its origins from self-organized and complex systems in nature, the term swarm has been influential in various fields including architecture, design, and computation. In swarm-based models, simple interactions among parts of the system are commonly considered to lead to a collective intelligence that leads to more complex information than the arithmetic sum of the parts. Investigation of swarm-based models in real-world scenarios is one of the main motivations of this study. With this motivation in mind, we focused on experimenting with artworks through the use of multi-robot systems. In the scope of this paper, drip painting [4] is chosen as a specific technique, trigonometric equations [2] are used as predefined movement paths for mobile robots, and distance detection is used as an input for changing the velocity and direction of the mobile robots.

In the case study, 4 differential-drive wheeled robots are used and each robot is equipped with one of the cyan, magenta, yellow and umber colors and is programmed to follow the trigonometric equation given below. The selected equation creates an open and continuous curve with multiple oscillations and enriches the possibilities of interactions. Interaction related obstacle avoidance behavior is illustrated as follows (Figure 1).
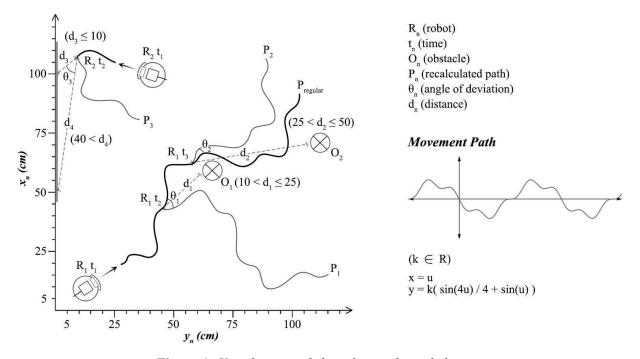

Figure 1: *Visualization of obstacle avoidance behavior.*

Figure 2: *Selected snapshots from the experiment*

Experimenting with the drip painting technique has provided a degree of heterogeneity and allowed us to observe not only the trajectories of the robots but also the velocity changes that take place in agent to agent interactions. With rhythmic drips, the robots painted their routes on the canvas as dashed curves that became denser as they slowed down and became thinner as they accelerated. Different from the robotic swarm studies that focus on the action of painting with multi-robots [3] and the generation of robots' motion paths via mathematical equations [5], we use ink to paint directly in a physical environment. In addition, the integration of path generation algorithms derived from predefined trigonometric formulas can be considered another contribution. In this sense different from the study of Zhou [5], several qualities (thickness, transparency, color, generating new colors upon overlapping) can be listed as new explorations. Moreover, unlike the 3D form making explorations of Andreen et al. [1], robots have been used as acting agents that construct the 2D outcomes. The proposed framework demonstrates the potential to be applied to a variety of form-making explorations such as tracing, carving, drawing, and engraving.

References

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