Animations Rendered by Braitenberg Vehicles

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ABSTRACT

We describe an approach to generating animated sequences of images drawn using stroke-based rendering. Individual strokes are generated as a history of movements of a class of purely reactive computational agents known as Braitenberg Vehicles embedded on a digital canvas. The entire animation represents an aggregate of all the movements of the agents across an entire run. We provide end users with a software tool to produce such animations and allow users to set the sensory capabilities of agents on a low level basis. The agents perform feature detection based on such capabilities. The end users thus interact with the agents with a variety of input images to discover a range of renderable outcomes. Artists inform us that the animations that result from our output provide an engaging visual experience.

Categories and Subject Descriptors

I.3.6 [**Computer Graphics**]: Methodology and Techniques; I.2.2 [**Artificial Intelligence**]: Automatic programming

General Terms

Experimentation

Keywords

Non-Photorealistic Rendering, Computational Agents

1. INTRODUCTION

One of the goals of non-photorealistic rendering[1, 8, 10] has been to create abstract pictorial styles. Our motivation is to provide artists with opportunities to generate visual art in a manner that is engaging, yet beyond the scope of their traditional drawing tools. We wish to mediate artistic creativity through an interface between a human and a population of decentralised computational agents in a process somewhat akin to swarm art[2, 3].

Here we demonstrate a non-photorealistic approach to creating images based on the sensory capabilities of computational agents reacting to pixels on a source image and depositing strokes on an output image. Images are generated as aggregations of simple line strokes[1, 7, 9]. End users can pause the system at any time and adjust agent characteristics, thus providing users an interactive process with the system.

We call the agents in our system 'vehicles', in reference to the particular types of agents we employ: Braitenberg Vehicles, named after Valentino Braitenberg, who first proposed them. Braitenberg Vehicles are a class of simple, reactive agents[4, 5, 6]. While the main use of Braitenberg Vehicles has been in the control mechanisms of robotic systems, we speculate whether the abstract architecture described in [4] can be adapted to produce artistic styles of rendering, based on reactions to image data.

2. TYPES OF VEHICLES

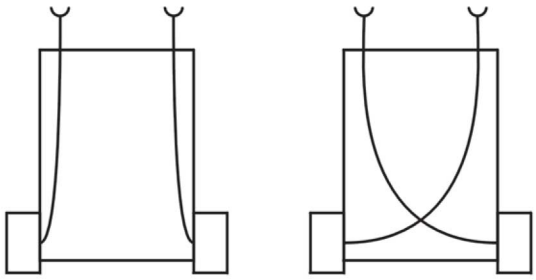

Figure 1: Schematic drawings of two basic types of vehicles. Vehicles possess two sensors and two actuators (wheels). The coupling of sensors, combined with an ability to change the speed at which wheels rotate, allows the configuration of four personality types.

See figure 1. The figure depicts two types of vehicles. Each vehicle possesses two sensors and two actuators (wheels). On the left side of the figure the sensors are directly coupled to the actuators on the same side of the vehicle as the sensor, while in the figure on the right, the sensor-actuator couplings are reversed. A level of sensation is calculated based on proximity to sensory input. The activation function can either increase or decrease the speed at which the wheels rotate. So a vehicle will turn towards or away from sensory input data and speed up or slow down.

This simple behavioural mechanism results in four personality types that Braitenberg described: The Coward (turns away from sensory data, increases speed); The Bully (turns toward sensory data, increases speed); The Explorer (turns away from sensory data, decreases speed); The Lover (turns toward sensory data, decreases speed).

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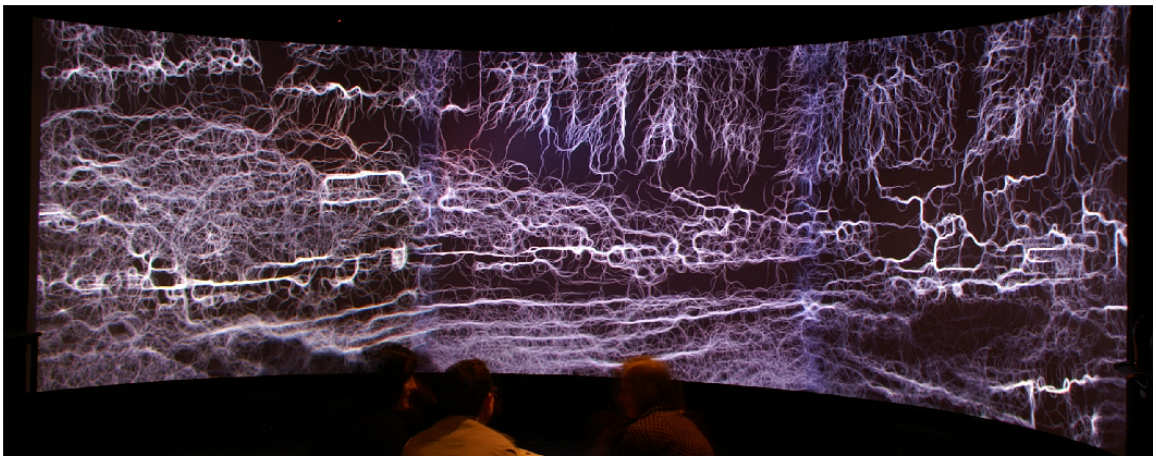

Figure 2: A sample of image generated by the software. This image was taken from a video file that the software generated.

3. RESEARCH QUESTIONS & FINDINGS

Research Question 1: How can we utilise Braitenberg Vehicles to create engaging art? We adopted Braitenberg Vehicles as computational agents that operate on images. Sensors detect local data in the form of grayscale pixels. Vehicles react to concentrations of pixels according to predefined personality types (see section 2).

Research Question 2: What types of rendering styles will emerge from our runs? One style of rendering we discovered was the tracing of edges. Lover personalities tend to promote crowding around pixel brightnesses that they are tuned to seek out. The image depicted in figure 2 is typical of a system setting in which the Lover aspect of a vehicle's personality will combine with the Coward aspect to seek areas of white pixels, whilst avoiding black pixels. The Explorer aspect will cause the vehicle to meander in areas of lighter level grays, while aggressively attacking areas of mid-level grays.

Research Question 3: What user-specifiable parameters are possible for the user to influence the run? For this paper we limited the manipulation of global settings to just the personality types in our runs. We could have used not just the four personality types, but the all the other settings detailed – number of vehicles, eye stalk length, eye stalk angle, base vehicle speed, final image background and foreground colours. Our runs focussed mainly on the sensing of visual extrema in our source images (whites and blacks). The manipulation of personality types that we performed suggested means of exploring areas of changing contrast in images. The most stark example we found of the user being able to influence the visual output of a run was in enabling or disabling worshipper and coward personality settings. While a form of fuzzy edge detection is performed in either case, the type of behaviour exhibited at edges is markedly different.

4. REFERENCES

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