CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

S0911

Project Title

The Behavior of a Swarm of Simple Robots Expressing Collective Intelligence

Abstract

Objectives/Goals

The objective of this study was to design a swarm of tiny robots modeled off of ants that were able to accomplish complex tasks, despite each individual being limited in its abilities. I tested out the existence of the four main characteristics of swarm robotics in these robots: collaboration, scalability, robustness, and most of all, low cost. At the end I made the robots do a final task, which was a simulation of an ant colony searching for food in order to see whether my robots actually qualified as swarm robots with collective intelligence.

Methods/Materials

Attiyn85, LED, Phototransistor, DC motors, MOSFET, Li-ion Coin Battery. I created a palm-sized robot that was equipped with only a phototransistor, an LED, and two DC motors. I designed several different kinds of simulations such as dispersement and synchronization experiments. I tested whether the tiny robots showed signs of collective intelligence depending on whether they could complete the given task.

Results

Even though I did not directly implement any kind of work distribution program, the robots were able to evenly distribute the work of scouting for an area among themselves. The graph of task efficiency showed a linear slope, indicating these tiny robots showed decent efficiency for its simplicity. The test for robustness also showed robots being able to pass on information even if several robots malfunctioned in between. Each robot costed around $15 to make, and took about a whole day to build, achieving low cost.

Conclusions/Discussion

The tiny robots, having only two input sensors that perceived its surroundings, were capable of having communications with one another, completing the final simulation. The robots were capable of showing all four characteristics of swarm robotics, proving that my project was successful. Although these experiments were done under ideal conditions, it proves the validity of this concept of using simple robots to have them accomplish a larger task as a whole, eventually leading to future applications such as rescue robots during natural disasters.

Summary Statement

I designed a functional swarm of tiny robots using only the bare minimum parts, proving the possibilities of this type of swarm robotic system.

Help Received

From the prototyping and the actual production, the tiny robots were made completely by myself, along as conducting the experiments. I received help from my father in software development of these robots, who taught me how to program.