Swarm Robotics Research Team

A Robotic Application of the Ant Colony Optimization Algorithm

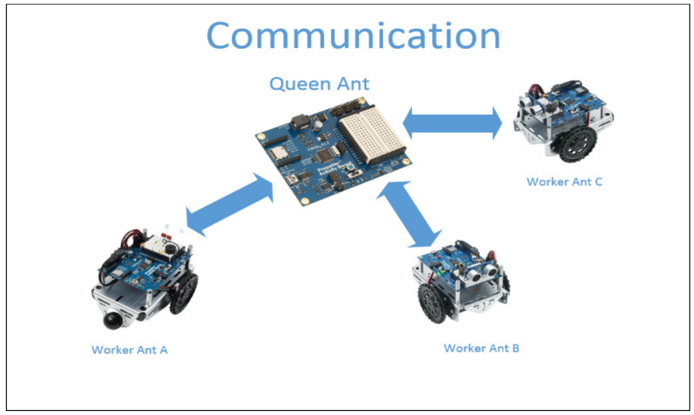
The Ant Colony Optimization (ACO) algorithm is generally used to find the optimal path between a starting point and a target point within certain predetermined constraints. The algorithm is inspired by the collective behavior of ants. Ants start searching for food sources by going in all random directions secreting pheromones on each traveled path. which are used as a communication tool. As ants search for food, those that are successful return to their home more frequently than others, and leave behind more traces of these pheromones. Other ants see these tracers, and are more likely to follow this shorter path. The algorithm uses this pattern to find the shortest path to a goal using probability based on the frequency of paths taken. The goal of our team's research is to create a small-scale application of this algorithm using Propeller Activity Bots. Using these small micro-controlled robots, as well as additional hardware and sensors, we aim to investigate the practical application of this algorithm, as well as investigate the feasibility of use in larger scale scenarios, such as in mapping paths in disrupted for natural disaster relief first responders. By limiting ourselves to a small-scale terrains example, we hope to identify the bare-bone necessities for such an implementation of the Ant Algorithm, which have not previously been evident in computational simulations. Through our research we hope to engineer a basic model of practical implementation for the use of those wishing to make use of these concepts in the future.

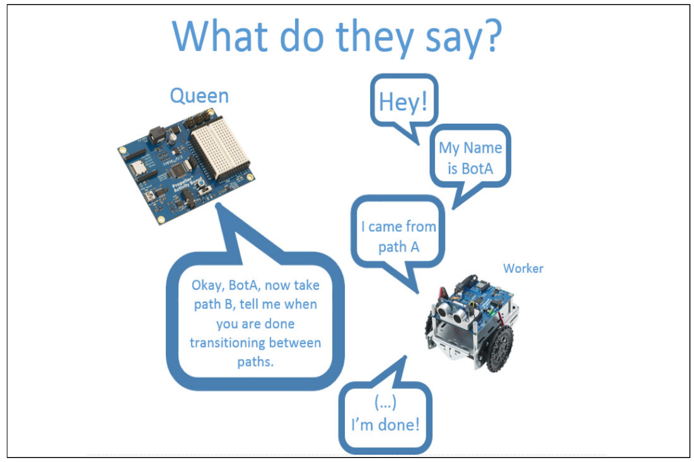
Background Information:

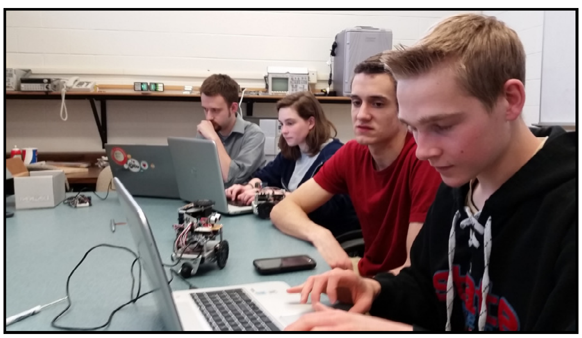
The Ant Algorithm was devised to solve the traveling salesman problem. The traveling salesman problem asks for the shortest path given a series of given points that should each only be passed once. The Ant Algorithm is a simplified version of the problem in which probability is used to determine the shortest path based on the frequency at which ants return from their respective paths.

This ant algorithm has been developed and tested through computer-aided simulations, but has seldom been used in physical or practical applications. With our research, we aim to investigate the practicality of this algorithm for engineering solutions. We hope that our example application of this algorithm will shed light on aspects of the problem that may require further consideration, leading to a more sophisticated solution for future applications.

Purpose: To research and test the practicality of the Ant Algorithm for finding the shortest path to a specified target.

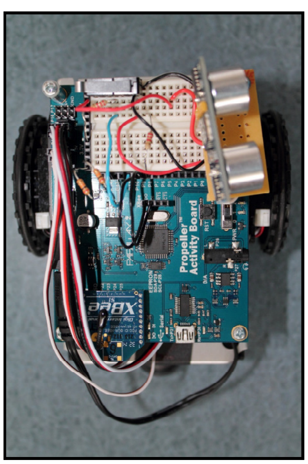


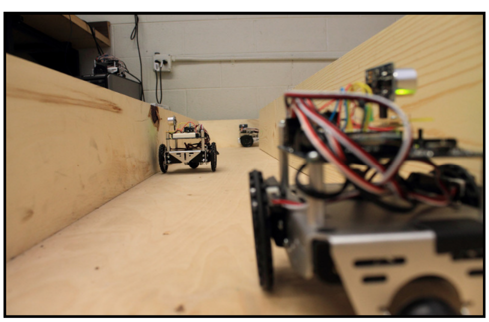




Procedure
- Simulate using MATLAB
- Devise a plan to simulate with robots
- Develop software and troubleshoot
- Run multiple tests and collect data
- Formulate a conclusion

Materials
- Activity Bot from Parallax-The robot used to test the algorithm
- SimpleIDE from Parallax –The software used to program the robots
- Xbee from Parallax-Used to communicate between the robots
- Ultrasonic Sensors-used to determine spacing so that robots do not collide
- Maze-houses three paths that are used to test the algorithm





Future Directions?

We hope that our example application of this algorithm will shed light on aspects of the problem that may require further consideration, leading to a more sophisticated solution for future applications. In order to continue to bridge this gap between theory and practical use in the future, we aim to increase the complexity of our model, through the use of a bigger maze and longer paths. Future research should also be devoted to the development of an A.I. system that can deal with the possibility of paths that have not been predetermined.

The Swarm Robotics Research Team would like to thank Professor Sami Khorbotly for giving us the opportunity to work on this project and test it for ourselves.

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