Abstract

This internship aims to explore the field of Artificial Intelligence in the context of Swarm Robotics. Therefore, one of my goals is to provide experimental set-up with robots for further research and to search into different options for AI to implement on the robots and choose the most suitable for the adaption in complex tasks and complex environments.

I work with the Thymio Robot, which is quite easy to take in hand. For this project, robots are linked with a Raspberry Pi to remotely control, update and deploy the robot controllers through SSH. Therefore, after robots the robots were ready for some experiments, I have to specify the environment and also which was the fitness function. Fitness Function evaluates how close a given solution is to the optimum solution of the desired problem. For this project, the task consists to avoid static and dynamic obstacles (walls, other robots) on a table. Indeed, obstacle avoidance is an essential component to achieve successful navigation.

In this context, I used the fuzzy logic which is certainly one of the most adopted approaches in this report for a beginner as me. The advantage of using fuzzy logic for navigation is that it allows the easy combination of various behaviors outputs through a command fusion process. The goal is to determine the speed of right and left wheels based on the distance of the obstacles around the robot measured by the sensors of the robots. We first proceeded to determine the value of the sensors in order to calculate the distance on possible obstacle and then, elaborate the inference rules to determine the robot's behavior according to its intrinsic parameters...

To conclude, a collective intelligence emerged from the local interactions between the robots. Therefore, some aspects of the Swarm Intelligence are an interesting alternative to classical approaches to robotics because of some properties of problem solving by social insects: flexible, robust, decentralized and self-organized. Indeed, some tasks may be too complex for a single robot to perform but can be performed with the help of other robots. We are reaching a stage in technology where it is no longer possible to use traditional, centralized, hierarchical command and control techniques to deal with systems that have thousands or even millions of dynamical changes. The type of solution swarm robotics offers, and swarm intelligence in general, is the only way of moving forward.

Furthermore, another goal of mine is to create a bridge between art and science and convey concepts of AI and swarm robotics to the general public through an art exposition at the end of the semester in collaboration with students in the Art Department.

The exposition is inspired by the pheromone-based form of communication found in various species of social insects such as bees and ants, Thymio robots are placed on a heat sensitive surface that changes color based on their movements. The robots interact both among themselves and with the environment, and thus produce a continuously evolving pattern that emerges solely based on their movement, or lack thereof.

The exposition was a total success. Indeed, conveying concepts of AI and swarm robotics to the general public through an art exposition is very hard. However, the audience was very interested in our demo and lot of people came to know more about the project. Some parts of the project could be improved, and some perspective can be envisaged in the future.