MicroBots

Overview

Our project’s main goal is to research and find out the best way both hardware-wise and software-wise to improve significantly the microbots present today. Today’s microbots have mainly a few flaws. The first flaw is that current microbots are very primitive and most of them use pre-existing hardware to achieve their goals. For example, quadcopters are one of the most common microbots seen today. This proves that the microbot research efforts today are quite software oriented and not as much hardware. However, the hardware aspects of the microbots is very critical and should be given equal importance as compared to the software. This is because specialised hardware with the ability for the microbots to work together will provide for a more functional microbot as compared to the plain quadcopter. The second flaw is that microbot researchers have not explored swarm research in microbots which allows these microbots to behave as one swarm. More information about this is below.

Hardware

Now, I will briefly explain the hardware which I will be using for this project. As we all know, our microbots need to be adaptive and modular. Modular robots can combine many smaller robots into a much larger one allowing us to complete various tasks. Our microbots have to be able to do various tasks such as carry objects of various mass, navigate rooms and mazes autonomously, map out the internal structure of a building without aid and identify people and objects. For this, a modular morphology is required and I will go into details later. The base design of this microbot is based on the quadcopter. Each microbot requires 4 motors, 4 motor Drivers, a microprocessor, a camera and a communication method. This quadcopter is estimated to be about 5-7cm motor to motor and that is relatively small. This quadcopter is placed in a carbon fibre buckyball frame to protect it from obstacles in all directions. The carbon frame is lined in steel as well allowing it to be magnetised and demagnetised using electricity. The microprocessor will be the Intel Edison which is a SD card sized computer running full Linux with a dual core 500Mhz Intel Atom processor. A custom PCB will be designed to interface to this Edison and control the motors. The Intel Edison has integrated Wi-Fi capabilities which can be used as a communication method. The camera will be a light 2g compact camera. This microbot system allows for the elimination of a base station and the range of the microbots is virtually unlimited. Since each bot is a highly powerful computer, a swarm together can be considered a supercomputer which can do parallel processing and allows for high-speed decisions by the swarm.

Software

Finally, I will elaborate on the swarm component. The swarm algorithm is designed to explore places as fast as possible while trying to stay as close together. The reason behind the swarms having to stay together is due to the constraints of the range of WiFi, this is also further supported by the fact that the latency of communication between microbots would increase as distance increases. Due to the latency of communication between the microbots being the limiting factor in parallel processing, the microbots would try to reduce distance between themselves by forming a spherical shape. However, the microbots must also try to spread out as much as possible to increase the area in which they explore. Taking maze solving as an example, when the swarm of microbots are going through a maze, at every juncture, the microbots would split into 2 separate swarms. The 2 separate swarms would still be under a larger “superswarm” group which would still allow communication between the swarms, however, there would be no parallel processing between the swarms under the same “superswarm” group. The 2 individual swarms; however, would still operate like a swarm between the microbots in the same swarm group and try to have a spherical shape as much as possible and still doing parallel processing between the microbots in the same swarm group. So back to the maze example, if a particular swarm were to meet a dead end, it would request the other swarm in the “superswarm” group about its path since diverging and re-join the other swarm. To clarify, there can be “superswarm” groups in “superswarm” groups so the swarms can split till the point where they are individual microbots. If any of the swarm groups can too far from the WiFi range, they can break from the uppermost “superswarm” group and act like it were its own swarm. What this means is that the swarm would not re-join the other swarm even when it gets close enough and specific commands would be needed for it the region the group. This would describe how it essentially operates.