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Project Title: Improving 'Collective Intelligence' in Swarm Robotics utilising Computer Vision and Environmental Interventions

Supervisors: Dr Kevin Meehan, Mr Thomas Dowling, Dr Jennifer Hyndman

Keywords: Computer Vision, Swarm Robotics, Machine Learning, Artificial intelligence

Project Summary:

In successful swarm robotic systems, the bots are decentralised with limited capabilities. This is what allows the bots to simulate natural swarm behaviour that can be observed in birds, ants and other insects in nature. This is possible due to the utilization of multiple algorithms to help the bots self-organise, cooperate and coordinate. These bots can communicate with other robots and can also react to environmental conditions. This research proposes the use of Computer Vision to intervene using adaptive environmental conditions when bots malfunction to correct autonomous behaviour in decentralised swarms. This algorithm will increase the overall performance of the collective as the corrective behaviour will have an impact on neighbouring bots. This research will use a small swarm of bots called 'Kilobots' to evaluate the effectiveness of the collective intelligence algorithm. These bots are small cylinder-shaped robots with a diameter of 33 mm and a height of 34 mm. The Kilobots use two vibration motors to allow for clockwise rotation, counter-clockwise rotation, or forward motion through vibration of the legs. These will be used with a camera system to capture the natural behaviour of the bots in the swarm and also with emulated behaviour to demonstrate common malfunctions. This study will investigate an appropriate object detection and object tracking system to be used with deep learning techniques to more effectively monitor bot behaviour and classify malfunctions. Finally, the success of the automated intervention will be evaluated and compared to other non-vision based techniques.

Candidate Qualifications/Requirements

The candidate should have achieved at least a 2:1 degree in a Computing related subject area. Ideally, the candidate will have programming experience using Python.