Cooperative “Queue leu leu” Robots

AU516 SAA - Projet de cursus

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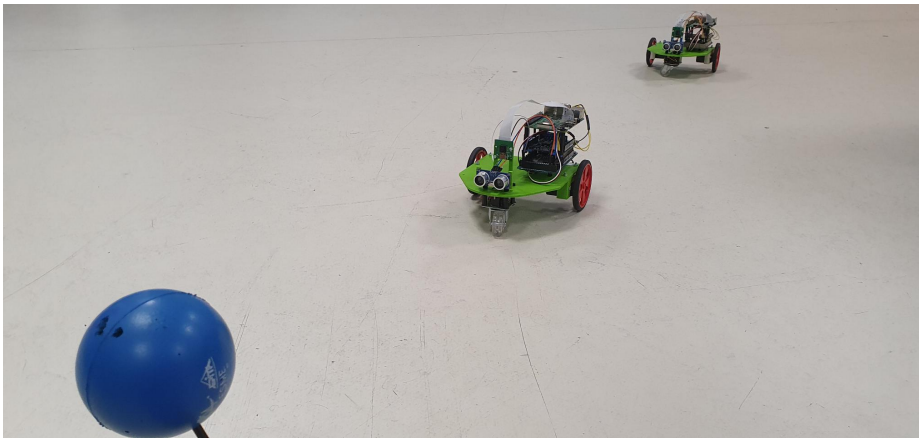

Figure 1: Queue leu leu robots

In this document, we detail the content of the project AU516 titled Cooperative "Queue leu leu".

Context

In this project, we are interested in making robots follow a blue ball. The first robot that detects the ball will be the leader, namely the first in the queue. The other robots will have to align with each other to complete the queue, as shown in Figure 1.
Each robot has a camera, an Arduino board and a Raspberry Pi to control the robot's displacement. The camera will be used to detect the blue ball and estimate the required commands to reach the ball. For each Raspberry Pi, there is a WIFI component. This component will be used to inform all the robots around who the leader is. Be careful, you need to be on the same network to be able to communicate with each other !

Project statements

You need to form **groups of four students**. Then, each group needs to validate with the professors the following tasks:

1. **(Connection verification)**: Verify that you are able to connect remotely to your robot.
2. **(Ball detection)**: Show to the professors your reasoning in order to make your robot detect the ball (a flowchart is expected). Validate with the professor.
3. **(Ball detection implementation)**: After, the validation of the approach by the professors, you can start to implement it using Python. To interact with the robot's camera, you will use the library picamera as follow:

```
from picamera import PiCamera
from picamera.array import PiRGBArray
```

you will need to capture the camera stream using the PiCamera method `capture_continous`. For more information, visit the picamera official documentation.

4. **(Ball following)**: Think and explain your reasoning to make your robot follow the ball. Show the flowchart, then, validate with the professors.

5. **(Ball following implementation)**: Implement a code that allows the motors, connected to the Arduino board, to execute commands coming from the Raspberry Pi. Both cards communicate with each other using a `TTL-232R-5V-PCB` [1]. This PCB is connected from one side to your Raspberry Pi USB port and from the other side to the Arduino's **Serial port 1 (RX1/TX1)**. After this task, you have done 40% of the project.

6. **(Network architecture)**: Define a common network to exchange information between robots and determine what kind of information has to be exchanged.

   (a) Draw your flowchart and check with the professors!

   (b) Define the information that needs to be exchanged between the robots.

   (c) Implement a simple network with a simple information exchange. Show it to your professors !

   (d) Implement the network architecture with the selected exchanged information.

   When you finish this task, you have done 60% of the project.

7. **(Robot identification and leader selection)**: Propose a distributed algorithm that identifies the robot and then the leader.

8. **(Leader and follower selection)**: Propose a distributed algorithm that selects the leader and the follower.

9. **(Queue leu leu)**: Now, propose a solution where the leader is following the ball and the follower is following the leader. When you finish this task, you have done 100% of the project, then you just need to present your work.

Remark: Each group will have one robot that can only be used during the time allocated to the project (24h in total).

Evaluation

At the end of the project, each group has to submit on **Moodle IPSA** the following elements (before **January 5th, at 8 p.m.**):

1. Overleaf document that contains the following points in English:

[1] https://docs.rs-online.com/4a3e/0900766b813827fc.pdf

- Introduction;
- Related work on this topic;
- The proposed work with the algorithmic of the developed approach;
- The obtained results;
- Conclusion.

2. A video proving the successful work or the latest achievement.
3. The implemented programs (on the Arduino board and on the Raspberry Pi).
4. A presentation and a demonstration on **January, 9th between 1.30PM**- **5.30PM** in english.