Intelligent Robotic Systems
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Second Lab Activity

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Objective

The task for the robot(s) in the second lab activity is to find a light source and move towards it, while avoiding collisions with walls, boxes, and other robots. The robot should reach the target as fast as possible and, once reached it, it should stay close to it (either standing or moving).

Constraints

- The wheel velocity must not exceed 15 (i.e., 15^{-2} m/s) due to physical constraints.
- The robot (a footbot) is equipped with only light and proximity sensors.

Additional constraints

- Values equal to 1 recorded by the footbot proximity sensors are considered collisions.

Solution implemented

Task definition

The solution implemented contains 4 different behaviours: *light_found*, *collision_avoidance*, *random_walk* and *phototaxis*. Before combining the final behavior from the four listed above, each one was individually tested.

- the *light_found* behaviour stops the robot from wandering when it gets close to the light source, it was tested in order to find an appropriate light intensity threshold that allowed the robot to stop when close enough to the light source.
- The *collision_avoidance* behavior enables the robot to steer away from obstacles. When close to an obstacle, the robot rotates on its axis until the obstacle is behind it, allowing the robot to proceed normally.
- the *random_walk* behaviour makes the robot wander randomly, "exploring" the arena.
- the *phototaxis* behaviour moves the robot towards the light source by rotating it on it's axis until it faces the light and then going straight.

Task composition

The implemented task composition somewhat resembles a finite state automaton that can be represented by a fully connected graph. Only a single behaviour can be active at a time and the active one gets decided at each tick by the *define_task* function, the selected behaviour will then be executed.

Problems faced

Some problems emerged during the execution of the composite behaviors that did not appear during the testing of the individual ones. One problem has been solved, while another remains unresolved.

Solved problems

A problem that occurred regarded the *obstacle_avoidance* behaviour in combination with the *phototaxis* one. When avoiding an obstacle if the light was positioned behind the edge of the obstacle the robot was trying to avoid, the robot would often get stuck, as it was switching between the 2 behaviours described above. The problem was mitigated by introducing some randomness in the *phototaxis* behavior by extracting the speed values assigned to both wheels from a uniform distribution.

Unsolved problems

The biggest and still unsolved problem faced regards a specific configuration of the arena. When the robot encounters a funnel-like structure, if it gets trapped inside, it is unable to escape. The funnel structure is composed by 2 obstacles positioned in a "V" shape, creating the funnel mouth, while the funnel spout is the light source. In this particular case the robot will get stuck between the *obstacle_avoidance* and *phototaxis* behaviours and never be able to exit or circumnavigate the funnel.