Fakulti Teknologi Maklumat dan Komunikasi

Universiti Teknikal Malaysia Melaka

BITI 3523

ARTIFICIAL INTELLIGENCE IN ROBOTICS AND AUTOMATION

Group Assignment: Cockroach Hide Behavior

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Course: BITI S1G2

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Understanding and Analysis

Cockroach is a very dirty and disgusting insect. The way it crawls is the dirtier part in cockroach. A lot of bacteria may accumulate when it crawls. Cockroaches give nightmares for many people especially when it flies. Cockroaches can bite people and the bites may cause swelling or irritation or inflict minor wound infections. Cockroaches like to stay and hide in the dark and moist. They like to hide behind and under furniture and in cupboards. Since cockroaches like the dark, they are mostly active during the night.

Cockroach hide behavior is one of the most suitable examples or situations for innate releasing mechanisms of animal's behavior. There are four cockroaches hide behavior. Firstly, when the light goes on, the cockroach will turn and runs away or flees since the cockroach does not like light bright place and will find a dark place to hide. Thus, cockroaches will try to stay away from the light or bright place. The second behavior is when the cockroach found a wall or gets to a wall, the cockroach will follow the wall. Cockroaches can climb and walk on walls since it has sticky foot pads. Cockroach can also walk on glass or metal surfaces easily. The third behavior is when the cockroach finds a place for hiding, it will go in and hide. The place that cockroach really like to hide is in the narrow place since cockroach is a thigmotactic insect. The last behavior is when the cockroach hides, it will wait until it does not feel scared anymore then it will come out even though the lights are turned back off earlier. The behavior will break into three type only which are run away/flee, wall following and hide. The third and last behavior are combined in the hide behavior while the first behavior will be in the run away/flee and the second behavior will be in the wall following part.

In our project, we want to figure out whether the cockroach hide behavior can be applied in innate releasing mechanisms using Eyesim. If possible, what problem might occur? We will use these three types of behavior. Moreover, since our robot in the Eyesim simulator cannot detect any light source, we will substitute it with motion. Thus, when the cockroach detects the any motion near itself, it will run away.

Objective

The objectives for this project are:

1. To analyze the requirements and behaviors of the robot.
2. To create a suitable simulated environment to test the robot.
3. To implement the required behaviors to achieve the Cockroach Hide Behavior in the simulation.

Design

Innate Releasing Mechanism (IRM)

Innate Releasing Mechanism (IRM) is a term belongs to the concept of ethology, which believed that animals have a built-in neural structure (network of neurons) that will cause the release of an automatic behavioral response (fixed action pattern) when exposed to specific stimuli (releasers). For example, when a predator sees a prey, it tends to has an instinctive response to hunt the prey, given that the predator is hungry at that time. When the predator is not hungry, the IRM will not activated, thus it is the hungry state of the predator which cause the IRM to be activated. Thus, the predator hunting for prey is consider as an example of fixed action pattern which is activated by the IRM.

In this assignment, we have designed three IRM which represent three types of the cockroach behavior to be implemented in our virtual robot. Below are the illustrations of the three IRM designed by our group:

1. Left Wall-following Behavior

The sensor of the robot will scan the left side of the robot to detect whether there is a wall nearby, if a wall is detected at the left side and the robot is not staying too close to the left wall, it will slightly turn to the left side and continue driving by follow the detected wall.

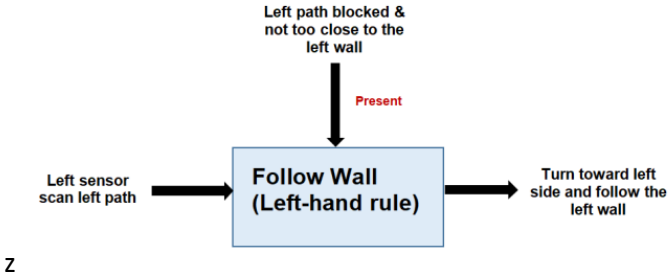

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Figure 1 – IRM of Left Wall-following behavior

2. Hide Behavior

The sensor of the robot will scan the path around the robot (in our case is only left, right and front side), when the robot detected that the left, right and front path of it have been blocked, which means it has reached a corner of the wall, it will hide for a while at that corner. The hide behavior the robot will execute when found a corner is it will turn for 180 degree and wait for 3 seconds before it starts to move again.

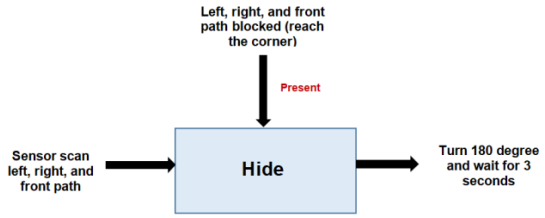

Figure 2 – IRM of Hide behavior

3. Flee Behavior

In this case, the flee behavior is represent the behavior of cockroach run away when it detects the light source. However, since the light source is hard to implement in the Eyesim application, we represent the light source by using another robot. The sensor will scan the surrounding of the robot, when it detects the light source which is represented by another moving robot, it will run away from that robot by turn for 180 degree and then drive straight forward to the front.

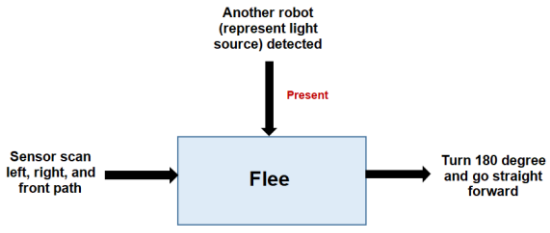

Figure 3 – IRM of Flee behavior

Flowchart

The flow for the robot to carry out the process that represent the cockroach behavior had been illustrated into a flowchart as below:

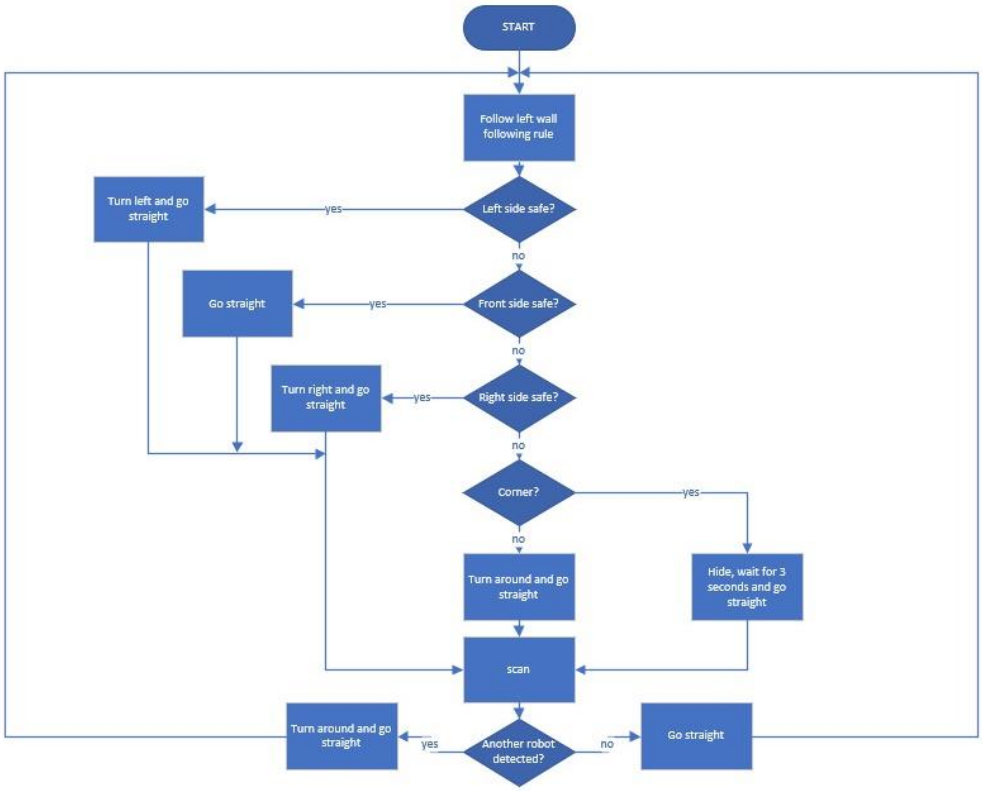

Figure 4 – Flowchart for cockroach behavior

The robot will follow the left wall following rule first, by scanning the left side of it to check whether there is a wall at its left side, if a left wall is detected, the robot will turn left and drive straight along the left wall that had been detected. If there is no wall detected at the left side, the robot will scan the front side and go straight if it is safe and if it is not, it will scan the right side will turn right and drive straight along the right wall that had been detected. Next, if all the left, right, and front path of the robot is detected as blocked, which means the robot has reached a corner of the wall, the robot will execute the hide behavior where it will turn for 180 degree and stay at that corner for 3 seconds before it continues to move. After every action, the robot will scan its surrounding to check the left, right, and front path. If there is another moving robot is detected, the robot will define that moving robot as the light source and execute the flee behavior where it will turn about 180 degree and drive straight to the front to get away from that moving robot. If there is no left wall and moving robot detected, the robot will continue to scan around and check its left, right, and front path. However, if none of the situations above have been detected, the robot will move randomly while continue scanning its surrounding until any of the situations is detected again.

Implementation

There are two robots in the simulation where the first one follows the cockroach behavior and the second one is just a substitute for the light in the flee behavior. The second robot drives around the space randomly while avoiding the walls.

As stated before, we implemented the cockroach behavior into the robot in Eyesim. The robot has three modules based on the cockroach's behavior which are sense, wall following and hide. We have substituted the light sensing with motion detection in the flee behavior. There are 4 functions in the coding which are *image_diff, avg, sense* and *main*. All the functions except for *main* is for the motion detection or the flee behaviour. In the real-world situation, a Raspberry Pi camera would be used. We choose QVGA, as this image resolution still fits completely onto the onboard LCD we are using. When the robot detects movement, it will turn around and run. The *image_diff* function is used to the difference of the images captured by the robot is calculated and the *avg* function is used to calculate the average difference. This mirrors the cockroach's behavior to run when it detects light or in this case, motion. In the *sense* function, the robot reads two images at 100ms apart. It proceeds to call the *image_diff* followed by *avg*. If the average difference, that is displayed on the screen, exceeds threshold, the alarm will go off, the robot will turn around and run.

Meanwhile, in the *main* function, the wall following and hide behavior is compiled together. We used the three PSD sensors of the robot to enable the left wall following rule. If the left side is safe, it will turn left and follow the wall while if the front side is safe, it will continue straight and then go right if the right side is safe. Every time the robot moves, it will call on the sense function, to ensure that it is safe and free from harm. When all three sensors detect that it is in a tight closed space, (< HIDE) it will then turn around and wait. This mirrors the hide behavior in cockroaches where it will wait until it feels safe to go out.

Limitations

Although the cockroach behaviour was successfully implemented into the robot, unfortunately there are still a few limitations or shortcoming that we acknowledged and wish to fix in the future.

1. ***The robot could get confused and identify the second robot as a wall.***
   This particular event may happen when the second robot, the light substitute is too close with the robot when it is too close to the walls or a corner, which then triggers the robot's sensor and then goes into hiding.
2. ***The robot's movement through the space is slow and not smooth.***
   The robot may at times get stucked and move slowly. This also can be seen when it runs into the edge of a wall and cannot move properly. The robot's movements are also slow and stops after every action.
3. ***At times, the robot may go around in circles.***
   This happens especially when it is in a large empty space where it doesn't detect and walls around it.

There are possible ways to overcome the limitations and some of it could be as stated below.

1. Modify the wall following behavior.
2. Increase its sensitivity so it will not identify with the robot as a wall.
3. Removing or limiting the VWWait() function to ensure the robot moves faster after every action to make it look more smooth when navigating.

Conclusion

In conclusion, the cockroach behavior can be applied in innate releasing mechanisms using Eyesim with a suitable environment. The three types of behavior cockroaches have which are the flee, wall following and the hide behavior are successfully implemented into the robot. Although the robot could function well, it still has its limitations such as confusing the second robot as a wall, not being able to move smoothly and fast and at times, going around in circles but these limitations could definitely be overcome.

References

1. Bräunl, T 2020, Robot adventures in python and C. Springer International Publishing, Switzerland. https://doi.org/10.1007/978-3-030-38897-3
2. Hadley, D 2019, 10 Fascinating Facts About Cockroaches: Interesting Behaviors and Traits of Cockroaches, Accessed on 10/01/2021 at https://www.thoughtco.com/fascinating-facts-about-cockroaches-1968524
3. Hadley, D 2019, What Is Thigmotaxis?, Accessed on 10/01/2021 at https://www.thoughtco.com/thigmotaxis-definition-1968579
4. Murphy, R, Murphy, R.R, Arkin, R.C, 2000, Introduction to AI Robotics, MIT Press https://books.google.com.my/books?id=RVlnL_X6FrwC

HONOUR'S PLEDGE FORM

In our honour We, as listed & signed below, as students from the **Fakulti Teknologi Maklumat & Komunikasi (FTMK), Universiti Teknikal Malaysia Melaka (UTeM)** have neither knowingly given nor received any inappropriate assistance in academic work on this assignment, except within our group/team members, for the course **BITI 3523 AI in Robotics & Automation.** We have also not plagiarized or be complicit with those who do.

We pledge that throughout the duration of receiving this remote learning assessment task till submission We have been honest and observed no dishonesty.

Group Assignment (10%): Cockroach Hide Behavior

CLO3: *Organize solution steps in solving robotics using Artificial Intelligence concepts. (A4, PLO6)*

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