1.

For random wander, we use random number generator to generate a number. And we use that to define the direction it goes. For obstacle avoidance, we use a state machine to determine the robot state. The sensor will provide the distance information and check whether the distance is smaller than the threshold. The state machine will determine the state by using the sensor feedback.

2.

We used a time interrupter for the basic layer to check the distance and update current state independently from the main loop. The higher layer is running as according to the current state in the main loop.

3.

We used the IR sensor and Sonar sensor at the front of the robot in the beginning. But the sensor is not working. We only use IR sensor in the end.

4.

For random wander, we use random number generator to generate a number from 0, 1, and 2 every loop. If the number is 0, the robot will go forward for a certain distance. If the number is 1, the robot will go left for a certain distance. If the number is 2, the robot will go right for a certain distance. We also make the robot turn a little bit right when it moves straight, which gives the robot movement a little bit uncertainty.

5.

Most errors come from the sensor itself. We receive some bad readings from time to time.

6.

We can add PID controls into the function to increase the smoothness of the robot behavior.

7.

Any obstacles that around the robot corner cannot be detected.

8.

Overall, the bad readings only occurs when we tested it. It seems like the sensor cannot get accurate data when it faces to some smooth surface.

9.

We used Booleans in the code to provide information for state machine to check whether there is an obstacle too close to the robot. The Booleans can be used for us to check the states.

10.

The robot can be stuck inside a space if the space is not big enough for it to turn around. We let the robot to go back first to create some room and turn after that.

11.

We convert the distance to steps and make the robot move step by step. Then we let the robot record the movements in steps to check whether it achieve the goal.

12.

Diagram

Description automatically generated

13.

The basic function inside the software is the same as what we designed. But due to the response time, the robot may response slower in the real world.