Obstacle Avoidance Testing 4(3 Ultrasonic Sensor & PController)

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Hardware Version: 4.0

Software Version: V4.0

Goal: Verify and confirm the robot’s ability to avoid obstacles in different cases

Contents

[Purpose 1](#_Toc415948880)

[Decision 2](#_Toc415948881)

[Measurements 2](#_Toc415948882)

[Test objective 2](#_Toc415948883)

[Assumptions 2](#_Toc415948884)

[Procedures 2](#_Toc415948885)

[Expectations 3](#_Toc415948886)

[Scenarios 3](#_Toc415948887)

[Test Report 5](#_Toc415948888)

[Analysis 5](#_Toc415948889)

[Normal case 5](#_Toc415948890)

[Extreme Case 1 5](#_Toc415948891)

[Extreme Case 2 5](#_Toc415948892)

[Conclusion 6](#_Toc415948893)

[Action 6](#_Toc415948894)

[Distribution 6](#_Toc415948895)

# Purpose

Test the efficiency of the robot’s ability to avoid incoming obstacles when navigating to a specified waypoint.

# Decision

The obstacle avoidance logic will be implemented into the final project if the robot successfully avoids all created scenarios.

# Measurements

For each scenario, the robot will be tested on its ability to avoid an obstacle. Therefore, a failure occurs when the robot collides or rubs any obstacle and fails to arrive at waypoint.

# Test objective

The objectives are to confirm the robot’s ability to avoid obstacles, to look for any weak-points and specific scenarios where the obstacle avoidance logic would fail.

# Assumptions

The random obstacles will only be placed on the random obstacle field of the play area and none will be present on the shooting area, the starting location and the safe zones.

# Procedures

For each run, the robot will be placed at grid location (0,0) facing north and will navigate to (3,3)

There are a total of three scenarios: normal, extreme case 1 and extreme case 2.

Each scenario will have 5 runs. If the robot fails to avoid an obstacle, a detailed description will be provided for that run.

# Expectations

The robot should be capable of successfully passing all three cases. The robot will detect any incoming obstacles located at 20cm from the robot at a full range of 180 degrees.

## Scenarios

**Figure 1**. Normal Case: Only one obstacle is present and the obstacle is placed at an angle perpendicular to the robot’s orientation when encountering the obstacle.

**Figure 2***.* Extreme Case 1: The corner of an obstacle is placed in the front sensor’s view so that it is hard to perceive the obstacle as ultrasonic waves will be deflected to the left and right. There is a small gap between the two blocks in order to see whether if the US sensor will confuse the gap with the actual path or not.

**Figure 3**. Extreme Case 2: Multiple obstacles, one after the other, placed in such a way that the robot will enter many obstacle avoidance modes. If the robot sees 2 walls consecutively, it will avoid the obstacle the other way to prevent moving to the set path.

# Test Report

**Table 1.** Obstacle avoidance run. The test was performed following the procedure as described above.

|  |  |  |  |
| --- | --- | --- | --- |
| Run | Normal Case (error) | Extreme Case 1 (error) | Extreme Case 2 (error) |
| 1 | Pass 3cm | Pass 3cm | Pass 5cm |
| 2 | Pass 2cm | Pass 4cm | Pass 7cm |
| 3 | Pass 3cm | Pass 3cm | Pass 6cm |
| 4 | Pass 4cm | Pass 3cm | Pass 7cm |
| 5 | Pass 3cm | Pass 4cm | Pass 8cm |

# Analysis

## Normal case

The robot was able to successfully avoid the obstacle and go to the destination. Accuracy tolerable of ~3cm.

## Extreme Case 1

The robot passed the test as it was able to detect the incoming obstacle, and the robot is able to differentiate small gaps from passable path. However, the robot detects the obstacle at a distance closer than expected. Thus, for angled obstacles, the robot detects at a closer distance. Accuracy tolerable of ~3.6cm.

## Extreme Case 2

When the robot goes into the area where there are 3 blocks, the US sensor on the front and on the left are able to detect the obstacle as the robot goes along the path. As a result, the robot successfully avoided the obstacle, and arrived near destination. The error at the end of the obstacle avoidance is ~7cm, which is fairly significant.

# Conclusion

The Obstacle avoidance implemented in Software Version 4.0 is considered “passed” as the robot can avoid obstacles even in extreme cases. However, it is important to realize that the longer the robot stays in avoidance mode, the larger the error is.

# Action

The new obstacle avoidance will be implemented into the software V4.0 and onwards. Further improvement on its obstacle avoidance algorithm and its integration will be implemented before the final competition. Also, the time will be recorded to ensure that the obstacle avoidance is done in the fastest time.

# Distribution

Software Development and Hardware integration