Beta Demo Test

**Test 1**

**Date :** 2021/3/24

**Tester:** Junjian Chen

**Author:** Shichang Zhang

**Hardware version:** 1.5 (in Part 2.5 of [Hardware Document](https://docs.google.com/document/d/11jkA_S_xBqyCbcn2NyMuM-OMDEybDfRy/edit#))

**Software version:** 1.5 (in Part 7.0 of [Software Document](https://docs.google.com/document/d/19JaY5629aUu4Y4rjoQJ-jWyeQLqNSAcr/edit))

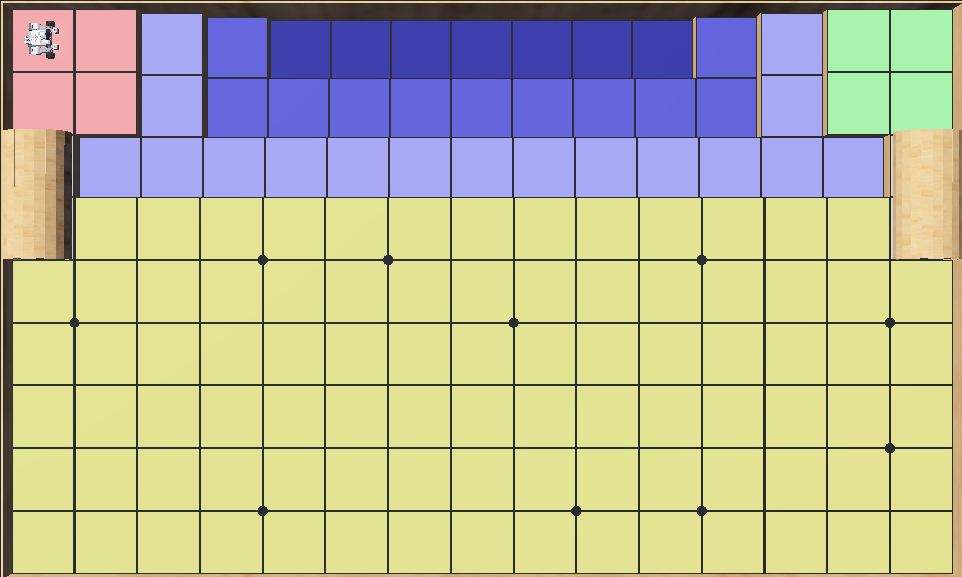
**Test Purpose:**

Determine whether the robot can satisfy the requirements of the beta demo.(red team view)

1. Localize to the start point and issue three beeps
2. Cross the bridge without hitting the bridge
3. navigate to the asserted waypoint
4. issue three beeps at the asserted waypoint
5. return back to the start point

**Test Procedure:**

Test map:



We will place the robot at the input waypoint that is on the 45° line of the upper left corner of the world. We expect the robot to navigate to the waypoint and return to the start point (1,8) with limited error.

1. Bridge is localized at (0,5) to (1,7)
2. The robot is placed at input coordinate.
3. The robot is set to be oriented to the input angle.
4. Set the forward speed of the robot to be 500, rotate speed to be 200.
5. Pass the parameters related to the start region to the robot (i.e. RED\_LL, RED\_UR).
6. Start the program.
7. Record whether the robot localizes to the start point in 30 seconds.
8. Record whether the robot hits the bridge while travelling the bridge.
9. Record whether the robot reaches the waypoint and beeps.
10. Record whether the robot successfully returns to the start point (1,8), (0.3048,2.4384) in meters.
11. Stop the program. Record the final translation value indicated by the webot.

**Test Data:**

|  |  |  |  |
| --- | --- | --- | --- |
| Trial# | Start Point (ft,ft) | Angle (deg) | Waypoint (ft,ft) |
| 1 | (0.5,0.5) | 0 | (1,4) |
| 2 | (0.5,0.5) | 90 | (1,4) |
| 3 | (0.5,0.5) | 145 | (1,4) |
| 4 | (0.5,0.5) | 195 | (2,4) |
| 5 | (0.5,0.5) | 240 | (2,4) |
| 6 | (0.4,0.4) | 0 | (4,1) |
| 7 | (0.4,0.4) | 75 | (4,1) |
| 8 | (0.4,0.4) | 145 | (3,2) |
| 9 | (0.4,0.4) | 225 | (3,2) |
| 10 | (0.4,0.4) | 330 | (7,1) |
| 11 | (0.7,0.7) | 0 | (7,1) |
| 12 | (0.7,0.7) | 45 | (7,1) |
| 13 | (0.7,0.7) | 180 | (6,1) |
| 14 | (0.7,0.7) | 270 | (6,1) |
| 15 | (0.7,0.7) | 315 | (6,1) |

**Expected Result:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Trial# | Localize Successfully | Hit Bridge | Reach the Waypoint | Final Translation (m,m) |
| 1 | Yes | No | Yes | (0.3048,2.4384) |
| 2 | Yes | No | Yes | (0.3048,2.4384) |
| 3 | Yes | No | Yes | (0.3048,2.4384) |
| 4 | Yes | No | Yes | (0.3048,2.4384) |
| 5 | Yes | No | Yes | (0.3048,2.4384) |
| 6 | Yes | No | Yes | (0.3048,2.4384) |
| 7 | Yes | No | Yes | (0.3048,2.4384) |
| 8 | Yes | No | Yes | (0.3048,2.4384) |
| 9 | Yes | No | Yes | (0.3048,2.4384) |
| 10 | Yes | No | Yes | (0.3048,2.4384) |
| 11 | Yes | No | Yes | (0.3048,2.4384) |
| 12 | Yes | No | Yes | (0.3048,2.4384) |
| 13 | Yes | No | Yes | (0.3048,2.4384) |
| 14 | Yes | No | Yes | (0.3048,2.4384) |
| 15 | Yes | No | Yes | (0.3048,2.4384) |

**Test Results:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Trial# | Localize Successfully | Hit Bridge | Stop at Waypoint | Translation (m,m) | Error (m,m) |
| 1 | Yes | No | Yes | (0.3050,2.4345) | (0.0002,-0.0039) |
| 2 | Yes | No | Yes | (0.3092,2.4336) | (0.0044,-0.0048) |
| 3 | Yes | No | Yes | (0.3083,2.4460) | (0.0035,0.0076) |
| 4 | Yes | No | Yes | (0.3017,2.4419) | (-0.0031,0.0035) |
| 5 | Yes | No | Yes | (0.3082,2.4445) | (0.0034,0.0061) |
| 6 | Yes | No | Yes | (0.3051,1.4473) | (0.0003,0.0089) |
| 7 | No | No | No | (1.0394,2.5786) | (0.7346,0.1402) |
| 8 | Yes | No | Yes | (0.3112,2.4451) | (0.0064,0.0067) |
| 9 | Yes | No | Yes | (0.3093,2.4427) | (0.0045,0.0043) |
| 10 | Yes | No | Yes | (0.3024,2.4423) | (-0.0024,0.0039) |
| 11 | No | Yes | No | (0.3231,2.1946) | (0.0183,2.2438) |
| 12 | Yes | Yes | No | (0.1097,1.1765) | (0.1951,1.2619) |
| 13 | Yes | Yes | No | (0.2330,1.9263) | (0.0809,1.5121) |
| 14 | Yes | Yes | No | (0.2239,1.7404) | (-0.0809,1.6980) |
| 15 | Yes | No | Yes | (0.3145,2.4434) | (0.0097,0.0050) |

**Test Report:**

The test is performed 15 times for different input start points, waypoints, and angles. The pass rate is 66.7%. We expect the robot to navigate to the waypoint on the island and then return back to the start point with limited error. From the tested output, we observed that the robot failed to satisfy the beta demo requirements in 5 trials. In two trials, the light sensors failed to detect the grid line and jumped into the sea. But we have confirmed that our light sensor is reliable. And we did not encounter this problem in other trials. So we regarded this as an exception. However, in other failed trials, we observed that the robot hit the bridge when it was returning back. The robot usually got stuck at the start of the tunnel due to the errored angle. We guess this was caused by the factor that the asserted waypoint was far from the bridge (e.x. waypoints (6,1) and (7,1)). There might be some errors produced during the travel to the asserted waypoint. Overall, in most conditions, the robot performed a favorable job but it failed for some cases. We need to integrate the algorithm to let the robot perform perfectly.

**Conclusion:** Fail

**Action:** Need to add some corrections on the robot’s orientation before returning home.

**Distribution:** software development

**Test 2**

**Date :** 2021/3/24

**Tester:** Junjian Chen

**Author:** Shichang Zhang

**Hardware version:** 1.5 (in Part 2.5 of [Hardware Document](https://docs.google.com/document/d/11jkA_S_xBqyCbcn2NyMuM-OMDEybDfRy/edit#))

**Software version:** 1.6 (in Part 7.0 of [Software Document](https://docs.google.com/document/d/19JaY5629aUu4Y4rjoQJ-jWyeQLqNSAcr/edit))

**Test Purpose:**

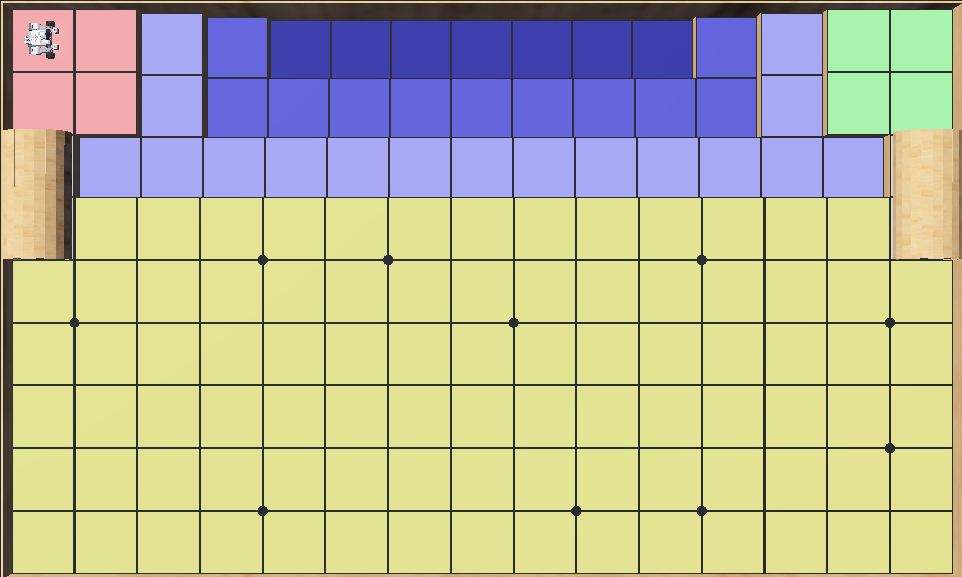
In test 1, the pass rate is 66.7%. So we updated the software and reteste the map.

Determine whether the robot can satisfy the requirements of the beta demo.(red team view)

1. Localize to the start point and issue three beeps
2. Cross the bridge without hitting the bridge
3. navigate to the asserted waypoint
4. issue three beeps at the asserted waypoint
5. return back to the start point

**Test Procedure:**

Test map:



We will place the robot at the input waypoint that is on the 45° line of the upper left corner of the world. We expect the robot to navigate to the waypoint and return to the start point (1,8) with limited error.

1. Bridge is localized at (0,5) to (1,7)
2. The robot is placed at input coordinate.
3. The robot is set to be oriented to the input angle.
4. Set the forward speed of the robot to be 500, rotate speed to be 200.
5. Pass the parameters related to the start region to the robot (i.e. RED\_LL, RED\_UR).
6. Start the program.
7. Record whether the robot localizes to the start point in 30 seconds.
8. Record whether the robot hits the bridge while travelling the bridge.
9. Record whether the robot reaches the waypoint and beeps.
10. Record whether the robot successfully returns to the start point (1,8), (0.3048,2.4384) in meters.
11. Stop the program. Record the final translation value indicated by the webot.

**Test Data:**

|  |  |  |  |
| --- | --- | --- | --- |
| Trial# | Start Point (ft,ft) | Angle (deg) | Waypoint (ft,ft) |
| 1 | (0.5,0.5) | 0 | (1,4) |
| 2 | (0.5,0.5) | 90 | (1,4) |
| 3 | (0.5,0.5) | 145 | (1,4) |
| 4 | (0.5,0.5) | 195 | (2,4) |
| 5 | (0.5,0.5) | 240 | (2,4) |
| 6 | (0.4,0.4) | 0 | (4,1) |
| 7 | (0.4,0.4) | 75 | (4,1) |
| 8 | (0.4,0.4) | 145 | (3,2) |
| 9 | (0.4,0.4) | 225 | (3,2) |
| 10 | (0.4,0.4) | 330 | (7,1) |
| 11 | (0.7,0.7) | 0 | (7,1) |
| 12 | (0.7,0.7) | 45 | (7,1) |
| 13 | (0.7,0.7) | 180 | (6,1) |
| 14 | (0.7,0.7) | 270 | (6,1) |
| 15 | (0.7,0.7) | 315 | (6,1) |

**Expected Result:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Trial# | Localize Successfully | Hit Bridge | Reach the Waypoint | Final Translation (m,m) |
| 1 | Yes | No | Yes | (0.3048,2.4384) |
| 2 | Yes | No | Yes | (0.3048,2.4384) |
| 3 | Yes | No | Yes | (0.3048,2.4384) |
| 4 | Yes | No | Yes | (0.3048,2.4384) |
| 5 | Yes | No | Yes | (0.3048,2.4384) |
| 6 | Yes | No | Yes | (0.3048,2.4384) |
| 7 | Yes | No | Yes | (0.3048,2.4384) |
| 8 | Yes | No | Yes | (0.3048,2.4384) |
| 9 | Yes | No | Yes | (0.3048,2.4384) |
| 10 | Yes | No | Yes | (0.3048,2.4384) |
| 11 | Yes | No | Yes | (0.3048,2.4384) |
| 12 | Yes | No | Yes | (0.3048,2.4384) |
| 13 | Yes | No | Yes | (0.3048,2.4384) |
| 14 | Yes | No | Yes | (0.3048,2.4384) |
| 15 | Yes | No | Yes | (0.3048,2.4384) |

**Test Results:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Trial# | Localize Successfully | Hit Bridge | Stop at Waypoint | Translation (m,m) | Error (m,m) |
| 1 | Yes | No | No | (1.3106,0.1158) | (1.0058,2.3266) |
| 2 | Yes | No | No | (0.6736,1.9599) | (0.3688,0.4785) |
| 3 | Yes | No | No | (1.4630,1.1217) | (1.1582,1.3167) |
| 4 | Yes | No | Yes | (0.3045,2.4348) | (-0.0003,-0.0036) |
| 5 | Yes | No | Yes | (0.3104,2.4386) | (0.0056,0.0002) |
| 6 | Yes | No | Yes | (0.3106,2.4440) | (0.0058,0.0056) |
| 7 | Yes | No | Yes | (0.3071,2.4427) | (0.0023,0.0043) |
| 8 | Yes | Yes | Yes | (0.2994,2.4369) | (-0.0054,-0.0015) |
| 9 | Yes | No | Yes | (0.3112,2.4420) | (0.0064,0.0036) |
| 10 | Yes | No | Yes | (0.3066,2.4420) | (0.0018,0.0036) |
| 11 | Yes | No | Yes | (0.3142,2.4368) | (0.0094,-0.0016) |
| 12 | Yes | No | Yes | (0.3132,2.4328) | (0.0084,-0.0056) |
| 13 | Yes | No | Yes | (0.3099,2.4438) | (0.0051,0.4438) |
| 14 | Yes | No | Yes | (0.3025,2.4463) | (-0.0023,0.0079) |
| 15 | Yes | No | Yes | (0.3059,2.4427) | (0.0011,0.0043) |

**Test Report:**

The test is performed 15 times for different input start points, waypoints, and angles. The pass rate is 73.3%. We expect the robot to navigate to the waypoint on the island and then return back to the start point with limited error. From the tested output, we observed that the robot failed to satisfy the beta demo requirements in 4 trials. In one failed trial the robot hit the bridge slightly but the correction method helps the robot go back to our planned path. Other failed trials all have the waypoint (1,4). We found that after localizing to the nearest point (it is (1,4) in this test) after going through the bridge, if we ask the robot to move to (1,4), it will do some unreasonable behavior. These unplanned behaviors usually let the robot hit the wall and crash. We also observe that the robot currently can better deal with the condition that the waypoint is far from the bridge. When a waypoint far from the bridge (e.x. (7,1)) is asserted, the robot will now use light localization methods before and after going across the bridge so that the errors during travelling long distances can be reduced. Overall, in most conditions, the robot performed a favorable job but it failed for the case that (1,4) is the asserted waypoint. We need to integrate the algorithm to let the robot perform perfectly.

**Conclusion:** Fail

**Action:** Need to deal with the (1,4) special condition.

**Distribution:** software development

**Test 3**

**Date :** 2021/3/25

**Tester:** Junjian Chen

**Author:** Shichang Zhang

**Hardware version:** 1.5 (in Part 2.5 of [Hardware Document](https://docs.google.com/document/d/11jkA_S_xBqyCbcn2NyMuM-OMDEybDfRy/edit#))

**Software version:** 1.7 (in Part 7.0 of [Software Document](https://docs.google.com/document/d/19JaY5629aUu4Y4rjoQJ-jWyeQLqNSAcr/edit))

**Test Purpose:**

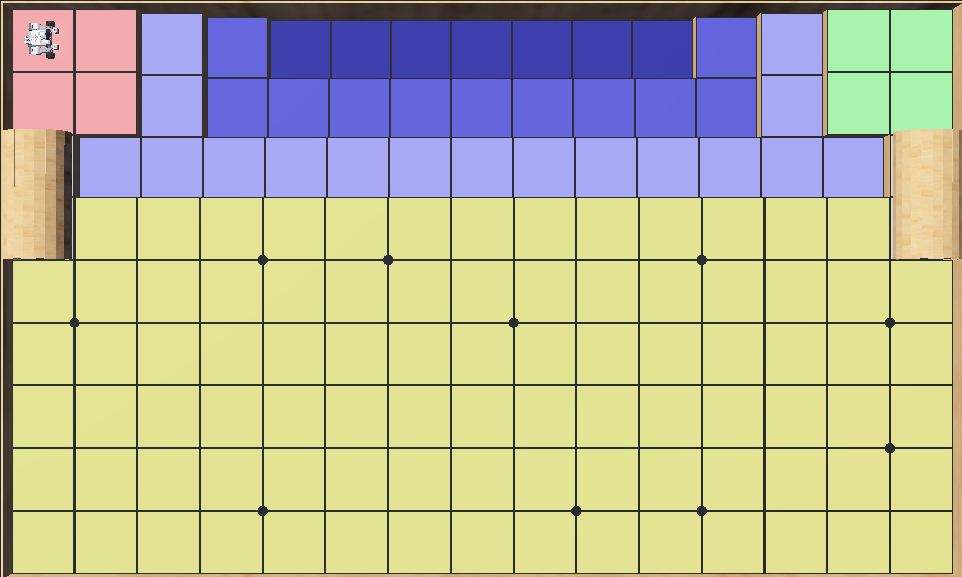
In test 1, the pass rate is 66.7%. So we updated the software and reteste the map.

Determine whether the robot can satisfy the requirements of the beta demo.(red team view)

1. Localize to the start point and issue three beeps
2. Cross the bridge without hitting the bridge
3. navigate to the asserted waypoint
4. issue three beeps at the asserted waypoint
5. return back to the start point

**Test Procedure:**

Test map:



We will place the robot at the input waypoint that is on the 45° line of the upper left corner of the world. We expect the robot to navigate to the waypoint and return to the start point (1,8) with limited error.

1. Bridge is localized at (0,5) to (1,7)
2. The robot is placed at input coordinate.
3. The robot is set to be oriented to the input angle.
4. Set the forward speed of the robot to be 500, rotate speed to be 200.
5. Pass the parameters related to the start region to the robot (i.e. RED\_LL, RED\_UR).
6. Start the program.
7. Record whether the robot localizes to the start point in 30 seconds.
8. Record whether the robot hits the bridge while travelling the bridge.
9. Record whether the robot reaches the waypoint and beeps.
10. Record whether the robot successfully returns to the start point (1,8), (0.3048,2.4384) in meters.
11. Stop the program. Record the final translation value indicated by the webot.

**Test Data:**

|  |  |  |  |
| --- | --- | --- | --- |
| Trial# | Start Point (ft,ft) | Angle (deg) | Waypoint (ft,ft) |
| 1 | (0.5,0.5) | 0 | (1,4) |
| 2 | (0.5,0.5) | 60 | (1,4) |
| 3 | (0.5,0.5) | 105 | (1,4) |
| 4 | (0.5,0.5) | 180 | (1,4) |
| 5 | (0.5,0.5) | 255 | (1,4) |
| 6 | (0.4,0.4) | 0 | (1,4) |
| 7 | (0.4,0.4) | 75 | (4,1) |
| 8 | (0.4,0.4) | 120 | (4,1) |
| 9 | (0.4,0.4) | 225 | (6,2) |
| 10 | (0.4,0.4) | 300 | (6,2) |
| 11 | (0.7,0.7) | 0 | (5,5) |
| 12 | (0.7,0.7) | 30 | (1,1) |
| 13 | (0.7,0.7) | 90 | (1,1) |
| 14 | (0.7,0.7) | 135 | (7,1) |
| 15 | (0.7,0.7) | 315 | (7,1) |

**Expected Result:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Trial# | Localize Successfully | Hit Bridge | Reach the Waypoint | Final Translation (m,m) |
| 1 | Yes | No | Yes | (0.3048,2.4384) |
| 2 | Yes | No | Yes | (0.3048,2.4384) |
| 3 | Yes | No | Yes | (0.3048,2.4384) |
| 4 | Yes | No | Yes | (0.3048,2.4384) |
| 5 | Yes | No | Yes | (0.3048,2.4384) |
| 6 | Yes | No | Yes | (0.3048,2.4384) |
| 7 | Yes | No | Yes | (0.3048,2.4384) |
| 8 | Yes | No | Yes | (0.3048,2.4384) |
| 9 | Yes | No | Yes | (0.3048,2.4384) |
| 10 | Yes | No | Yes | (0.3048,2.4384) |
| 11 | Yes | No | Yes | (0.3048,2.4384) |
| 12 | Yes | No | Yes | (0.3048,2.4384) |
| 13 | Yes | No | Yes | (0.3048,2.4384) |
| 14 | Yes | No | Yes | (0.3048,2.4384) |
| 15 | Yes | No | Yes | (0.3048,2.4384) |

**Test Results:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Trial# | Localize Successfully | Hit Bridge | Stop at Waypoint | Translation (m,m) | Error (m,m) |
| 1 | Yes | No | Yes | (0.3071,2.4341) | (0.0023,-0.0043) |
| 2 | Yes | No | Yes | (0.3082,2.4433) | (0.0034,0.0049) |
| 3 | Yes | No | Yes | (0.3069,2.4477) | (0.0021,0.0093) |
| 4 | Yes | No | Yes | (0.3060,2.4416) | (0.0012,0.0032) |
| 5 | Yes | No | Yes | (0.3044,2.4429) | (-0.0004,0.0045) |
| 6 | Yes | No | Yes | (0.3132,2.4457) | (0.0084,0.0073) |
| 7 | Yes | No | Yes | (0.3109,2.4440) | (0.0061,0.0056) |
| 8 | Yes | No | Yes | (0.3091,2.4323) | (0.0043,-0.0061) |
| 9 | Yes | No | Yes | (0.3127,2.4458) | (0.0079,0.0074) |
| 10 | Yes | No | Yes | (0.3094,2.4441) | (0.0046,0.0057) |
| 11 | Yes | No | Yes | (0.2980,2.4372) | (-0.0068,-0.0012) |
| 12 | Yes | No | Yes | (0.3082,2.4318) | (0.0034,-0.0066) |
| 13 | Yes | No | Yes | (0.3005,2.4479) | (-0.0043,0.0095) |
| 14 | Yes | No | Yes | (0.3121,2.4458) | (0.0073,0.0074) |
| 15 | Yes | No | Yes | (0.3095,2.4448) | (0.0047,0.0064) |

**Test Report:**

The test is performed 15 times for different input start points, waypoints, and angles. The pass rate is 100%. We expect the robot to navigate to the waypoint on the island and then return back to the start point with limited error. From the tested output, we observed that the robot now can successfully localize to the start point, go across the bridge, be navigated to the waypoint on the island and return to the start point. The failed condition in the last test (waypoint is (1,4)) is solved. We also find that even if a waypoint that is far from the bridge is asserted, the final translation errors are still very small, indicating that the robot is accurately returning back. Overall, the robot now should satisfy the beta demo requirements.

**Conclusion:** Pass

**Action:** None

**Distribution:** software development