TESTING DOCUMENT

Project: ECSE 211 Final Design Project – Team 6
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Original Author: Alex Hale

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[19/10/2017] Xu Hai: Recorded the information about Test 1.
[20/10/2017] Xianyi Zhan: Recorded the information about Test 2.
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[28/10/2017] Xu Hai: Recorded the information about Test 7-10.
[29/10/2017] Xianyi Zhan: Created the weekly status summary #2.
[30/10/2017] Alex Hale: grammar touch-ups for weekly submission

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1.0 Requirements

1.1 Project Requirements

See Requirements Document

1.2 Testing Requirements

- Each test should note: date, tester(s), report writer, hardware version, software version, goal, procedure, expected result, test report, conclusion, action and distribution.
- Each test should have at least 10 independent trials and record results in a table. Compute Euclidean distance, mean value and standard deviation if possible.
- Potential weak points should be tested.
- Extreme cases of the specifications should be tested.
- Tester should have a clear, expected outcome for each test.

1.3 General Test Procedures

- Test whether the hardware design keeps the robot stable when moving and turning (extreme cases included, e.g. high speed).
- Test whether the hardware design allows the robot to mount and traverse the zip line successfully (extreme cases included, e.g. high speed).
- Test whether the robot gets stuck when it finishes traversing the zip line.

More details will be added according to ongoing software design and development.

2.0 Tests

Test #1 - Hardware Stability
Date: 19 October 2017
Tester: Xu Hai
Report Writer: Xu Hai
Hardware version: robot version lab 5 1.0
Software version: N/A
Goal: Determine if the hardware design can keep stable when the robot is moving and turning.

Procedure: The robot is placed on the ground and then get instructed to move forward, backward and turn around. Each direction should also be tested with speed of 100, 200 and 300, each case is tested at least 5 times.

Expected Result: The hardware design should keep stable all the time.

Test Report: The test was performed totally 60 times following the protocol described above. During the test, the robot can keep stable at most the time (57/60). However, sometimes left motor can drop off when put the robot on the ground. In summary, the left motor dropped off on 3 of the 60 tests.

Conclusion: The hardware design can keep stable when the robot is moving and turning, but the design of left motor connection is not sufficiently stable, potential problem exists.

Action: This test report is sent to the hardware team to review the hardware design. The Gantt chart should be updated to show the revised tasks.

Distribution: Hardware development, project management.

Test #2 - Hardware Stability II
Date: 20 October 2017
Tester: Xu Hai, Xianyi Zhan
Report Writer: Xianyi Zhan
Hardware version: robot version lab 5 1.1
Software version: N/A
Goal: Determine if the hardware design can keep stable when the robot is moving and turning. Check if the left motor dropping off problem has been solved.

Procedure: The robot is placed on the ground and then get instructed to move forward, backward and turn around. Each direction should also be tested with speed of 100, 200 and 300, each case is tested at least 5 times.

Expected Result: The hardware design should keep stable all the time without any hardware issue.

Test Report: The test was performed totally 60 times following the protocol described above. During the test, the robot can keep stable at most the time (60/60). During the entire testing process, the left motor does not dropping off.

Conclusion: The hardware design can keep stable when the robot is moving and turning, the left motor dropping off problem has been solved.

Action: This test report is sent to the project manager and documentation manager. The Gantt chart should be updated to show the project can move on to the next stage. The test team will start to testing the zipline crossing ability of the robot.

Distribution: Project management, Documentation management, Testing team.

Test #3 - Zipline Crossing
Date: 20 October 2017
Tester: Xu Hai, Xianyi Zhan
Report Writer: Xu Hai
Hardware version: robot version lab 5 1.1
Software version: N/A

Goal: Determine if the hardware design can make the robot mount and traverse the zip line successfully.

Procedure: The robot is placed in front of the zip line and then get instructed to mount and traverse it. The test is performed with speed of 200 and 300. Each case is tested at least 10 times.

Expected Result: The hardware design can make the robot mount and traverse the zip line successfully all the time.

Test Report: The test was performed totally 20 times following the protocol described above. In summary, with the speed of 200, the robot dropped off the zip line on 1 of 10 runs. With the speed of 300, the robot dropped off the zip line on 0 of 10 runs. Notice that the supporting structure of the zip line travelling motor is unstable.

Conclusion: The robot performance did not meet the specified outcomes. The hardware design for the zip line is unreliable.

Action: This test report is sent to the hardware team to review the hardware design. The Gantt chart should be updated to show the revised tasks.

Distribution: Hardware development, project management.

Test #4 - Zip Line Crossing
Date: 20 October 2017
Tester: Xu Hai, Xianyi Zhan
Report Writer: Xu Hai
Hardware version: robot version lab 5 1.2
Software version: N/A
Goal: Determine if the hardware design can make the robot mount and traverse the zip line successfully.

Procedure: The robot is placed in front of the zip line and then get instructed to mount and traverse it. The test is performed with speed of 200 and 300. Each case is tested at least 10 times.

Expected Result: The hardware design can make the robot mount and traverse the zip line successfully all the time.

Test Report: The test was performed totally 20 times following the protocol described above. In summary, the robot mounts and traverses the zip line successfully all the time.

Conclusion: The robot performance met the specified outcomes. The hardware design for the zip line crossing is reliable.

Action: This test report will be sent to the hardware team to see the result. The Gantt chart should be updated to show the revised tasks.

Distribution: Hardware development, project management.

<u>Test #5 - Zip Line Sticking at end of Crossing</u>
Date: 20 October 2017
Tester: Xu Hai, Xianyi Zhan
Report Writer: Xu Hai
Hardware version: robot version lab 5 1.2
Software version: N/A
Goal: Determine if the hardware design can make the robot avoid stuck when it finishes traversing the zip line.

Procedure: The robot is placed in front of the zip line and then get instructed to mount and traverse it. The test is performed at least 10 times

Expected Result: The hardware design should make the robot avoid stuck when it finishes traversing the zip line all the time.

Test Report: The test was performed totally 10 times following the protocol described above. In summary, the robot did not get stuck during the test.

Conclusion: The robot performance met the specified outcomes. The hardware design for the zip line crossing is reliable.

Action: This test report is sent to the hardware team to see the result. The Gantt chart should be updated to show the revised tasks.

Distribution: Hardware development, project management.

<u>Test #6 - Pose orientation and position accuracy</u>
Date: 23 October 2017
Tester: Xu Hai, Xianyi Zhan
Report Writer: Xu Hai
Hardware version: Lab - 5 1.2
Software version: Lab - 5 1.0
Goal: Determine if the robot can reach (X_o, Y_o), which in this test, is (1, 6)

Procedure: The robot is placed in corner 0, as shown in the Lab 5 instructions, at position $(a,\ a),\ 0 < a < 1$. The robot is instructed to localize and navigate to $(X_0,\ Y_0) = (1, 6)$.The test is performed at least 10 times. The data collected during the test is recorded, and the standard deviation and mean value of the Euclidean distance error is computed.

Expected Result: The robot should finish the localization successfully and navigate to (X_o, Y_o) within an error tolerance of ± 2.5 degree and ± 2 cm.

Test Report: The test was performed 10 times following the protocol described above. The results can be found in the Lab 5 report. In summary, the robot cannot reach the destination precisely.

Conclusion: The robot performance does not meet the specified outcomes. Localization and navigation are not reliable.

Action: This test report is sent to the software team to review the localization and navigation process. The Gantt chart should be updated to show the revised tasks.

Distribution: Hardware development, project management.

Test #7 - Hardware Stability for design #2
Date: 27 October 2017
Tester: Xu Hai
Report Writer: Xu Hai
Hardware version: robot version final project 1.0
Software version: N/A
Goal: Determine if the hardware design can keep stable when the robot is moving and turning.

Procedure: The robot is placed on the ground and instructed to move forward, backward and turn around. Each direction is tested with speeds of 100, 200 and 300, and each case is tested at least 5 times.

Expected Result: The hardware design should keep stable all the time.

Test Report: The test was performed 60 times following the protocol described above. During the test, the design can keep the robot stable when it moves backward (15 runs), but it can not keep the robot in balance when it tried to move forward (10 runs) or turns around (30 runs).

Conclusion: The hardware design can keep stable when the robot is moving backward, but the design for the centre of gravity is not reliable. In addition, it seems that the wheels come in touch with the support beam above them, which may impose resistance to the rotation of wheels.

Action: This test report is sent to the hardware team to review the hardware design. The Gantt chart should be updated to show the revised tasks.

Distribution: Hardware development, project management.

<u>Test #8 - Hardware Stability II for design #2</u>
Date: 27 October 2017
Tester: Xu Hai
Report Writer: Xu Hai
Hardware version: robot version final project 1.1
Software version: N/A
Goal: Determine if the hardware design can keep stable when the robot is moving and turning. Check if the centre of gravity problem has been solved.

Procedure: The robot is placed on the ground and instructed to move forward, backward and turn around. Each direction is tested with speed of 100, 200 and 300, and each case is tested at least 5 times.

Expected Result: The hardware design should keep stable all the time without any hardware issues.

Test Report: The test was performed 60 times following the protocol described above. During the test, the robot can keep stable all the time (60/60 successful tests).

Conclusion: The hardware design can keep stable when the robot is moving and turning, and the centre of gravity problem has been solved. In addition, the design near the wheels has been rebuilt: the wheels don’t come in touch with the beam anymore.

Action: This test report is sent to the project manager and documentation manager. The Gantt chart should be updated to show the project can move on to the next stage.

Distribution: Project management, Documentation management.

<u>Test #9 - Zip Line Crossing</u>
Date: 27 October 2017
Tester: Xu Hai, Xianyi Zhan
Report Writer: Xu Hai
Hardware version: robot version final project 1.1
Software version: N/A

Goal: Determine if the hardware design can make the robot mount and traverse the zip line successfully.

Procedure: The robot is placed in front of the zip line and instructed to mount and traverse it. The test is performed with speeds of 200 and 300. Each case is tested at least 10 times.

Expected Result: The hardware design can make the robot mount and traverse the zip line successfully all the time.

Test Report: The test was only performed 3 times. During the test, we found that the height of the zip line arm was not high enough to mount the zip line.

Conclusion: The zip line arm was not high enough to mount the zip line. The hardware design for the zip line arm is not reliable.

Action: This test report will be sent to the hardware team to review the hardware design. The Gantt chart should be updated to show the revised tasks.

Distribution: Hardware development, project management.

<u>Test #10 - Zip Line Crossing</u>
Date: 27 October 2017
Tester: Xu Hai, Xianyi Zhan
Report Writer: Xu Hai
Hardware version: robot version final project 1.2
Software version: N/A
Goal: Determine if the hardware design can make the robot mount and traverse the zip line successfully.

Procedure: The robot is placed in front of the zip line and instructed to mount and traverse it. The test is performed with speeds of 200 and 300. Each case is tested at least 10 times.

Expected Result: The hardware design can make the robot mount and traverse the zip line successfully all the time.

Test Report: The test was performed 20 times following the protocol described above. In summary, the robot mounts and traverses the zip line successfully all the time.

Conclusion: The robot performance met the specified outcomes. The hardware design for the zip line crossing is reliable.

Action: This test report will be sent to the hardware team to see the result. The Gantt chart should be updated to show the revised tasks.

Distribution: Hardware development, project management.

3.0 Weekly Status Summary

Weekly Status Summary #1

After analyzing the requirements of Lab 5, we decided that the robot for the final project will be heavily based off of the robot from Lab 5. To ensure that our final project robot is reliable, we needed to built a reliable Lab 5 robot, and to accomplish that goal, we conducted a wide variety of testing. By the end of the week, the hardware and software components of the Lab 5 robot were completely tested. The hardware design is adequately reliable, but the robot did not perform as well in the software tests. It seems that there are errors in the odometry and navigation systems. Next week, we should consider fixing our software issues and confirming that our software is performing correctly with more testing.

Weekly Status Summary #2

According to the results from Lab 5, our localization was not accurate enough. To resolve this, we decided to change our method of localization - therefore, the hardware design needed to be rebuilt. By the end of this week, tests for the entirety of the basic hardware design were finished. Next, we will test motors and sensors, rank them by performance, and select the optimal components for the final robot. Since the WiFi code was provided this week, tests of WiFi connection and transfer capabilities will be conducted next week. In addition, the values used in software (e.g. wheel base and wheel radius constants) should be determined next week.

4.0 Glossary of terms