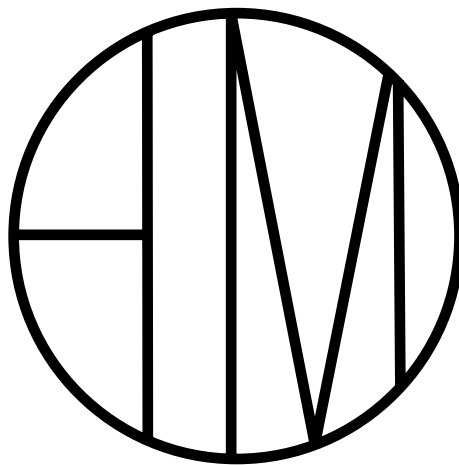


Test Plan LiU Racetrack 2018

LiU Racetrack 2018
Author: Sara Nilsson
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TRUKKMANIA

Status

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2018 HT, LiU Racetrack 2018

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Document history

Version	Date	Changes	Performed by	Reviewed by
0.1	2018-10-15	First draft	Project Group	OK
1.0	2018-10-23	Approved by orderer.	Project Group	SN
1.1	2018-11-23	Reviewed after change in requirement specification.	Project Group	SN
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1 Introduction

This document presents how each requirement in the requirement specification for LiU Racetrack 2018 will be tested and validated. The test plan follows the same structure as the requirement specification where the requirement and its associated test are grouped together.

1.1 Definitions

- **Original system** - Refers to the system developed prior to the start of this year's project.
- **Semi-trailer truck** - Refers to the truck from previous years.
- **LEGO truck** - Refers to the new LEGO truck implemented in the system this year.
- **ROS** - Robot Operating System.
- **roscore** - Is the main-program for the ROS setup. This program runs on the *master-node*.
- **Visionen** - Visionen is an area located at Linköping University, often used to present various types of projects. This report will mention *Stora Visionen* and *Lilla Visionen*, which are two different areas that are located in Visionen.
- **Frenet frame** - A moving coordinate system that follows a reference trajectory.

2 System overview

Below are the tests for the requirements concerning the system overview.

ID	Version	Description	Priority
1	Original	Requirements the project group find unable to fulfill before the delivery must be renegotiated with the orderer well before the deadline.	1
Test Description: This requirement will be seen as fulfilled as long as all renegotiation is discussed and approved before 2018-11-30.			

2	Original	The different parts of the original system will be evaluated and considered for improvements.	1
Test Description: Testing will be done as the original system is evaluated and migrated to ROS. The finished migrated system should have higher performance and thus be an improvement over the original system.			
3	Original	The currently used positioning system must function similarly to the positioning system used in Stora Visionen.	1
Test Description: Verify that the conversion nodes have the same output.			
4	Original	The IR-diodes for the positioning system will be synchronized with the camera shutter to increase its performance.	3
Test Description: Measure the standard deviation of the position of a car standing still both with and without synchronization. If the standard deviation is smaller the demand is fulfilled.			

3 Simulator

Below are the tests for the requirements concerning the simulator.

ID	Version	Description	Priority
5	Reneg. 2018-11-13	A simulator environment will be implemented using Gazebo and Rviz.	2
Test Description: This requirement will be considered fulfilled if there is a functioning simulator that has been developed in Gazebo and Rviz.			
6	Reneg. 2018-11-13	The simulator will contain models of the car, LEGO truck and the truck with both semi-trailer and dolly-steered trailer.	2
Test Description: Testing will be done by opening the simulator and running the program and making sure there are functioning 3D models of the car, LEGO truck and the truck with both semi-trailer and dolly-steered trailer.			
7	Reneg. 2018-11-13	The new simulator will be able to simulate different scenarios and visualize them.	2
Test Description: Verify that the demands are met.			
8	Reneg. 2018-11-13	The simulator will be designed and implemented together with the "Visionen Drone Project".	2
Test Description: Testing will be done throughout the project by documenting the collaboration with "The Visionen Drone Project".			
9	Reneg. 2018-11-13	There should be implemented more than one map.	3
Test Description: Start the simulator and make sure there is more than one functioning map implemented in the simulator. All priority 1 requirements should be fulfilled regardless of which map is running is used in the simulator.			
10	Reneg. 2018-11-13	The user should be able to easily choose between different maps through a user-friendly interface in the simulator.	3
Test Description: Verify that it is possible to choose between different pre-made maps in the simulator. It should be easy to see even for inexperienced users how to choose a map. All priority 1 requirements should be fulfilled regardless of which map has been chosen.			
11	Reneg. 2018-11-13	The user should be able to build their own maps through the graphical interface in the simulator.	3
Test Description: Verify that there is an interface where it is possible to build your own maps. Build a map and start the simulator. All priority 1 requirements should be fulfilled regardless of which map has been generated.			

4 Migration to ROS

Below are the tests for the requirements concerning the migration to ROS.

ID	Version	Description	Priority
12	Reneg. 2018-12-02	As big part as possible from the current system will be migrated to ROS.	1
Test Description: Compare the system implemented in ROS with the original system and make sure there is no functionality missing.			
13	Original	The original system will be modularized into ROS-nodes for ease of use and further development.	1
Test Description: Verify that the demands are met.			
14	Original	Every interface between ROS-nodes will be thoroughly chosen and documented.	1
Test Description: Check that every interface is documented.			

5 Migration to Visionen

Below are the tests for the requirements concerning the migration to Visionen.

ID	Version	Description	Priority
15	Reneg. 2018-11-26	The original system will be migrated to its new location in Visionen without any functionality loss.	2
Test Description: The functionality of the original system is thoroughly documented. When the system has been moved the functionality will be tested and compared to the existing documentation to make sure there has been no performance loss.			

6 LEGO truck

Below are the tests for the requirements concerning the LEGO truck and the EV3-unit connected to it.

ID	Version	Description	Priority
16	Original	The LEGO truck shall consist of a ROS-node which communicates with the workstation..	1
Test Description: This requirement is considered fulfilled when there is working communication between the EV3-unit and the workstation through the ROS-node.			
17	Reneg. 2018-11-26	A state observer for the LEGO truck will be developed.	2
Test Description: This requirement is considered fulfilled when an approved state observer has been developed.			
18	Original	A motion planner will be developed for the LEGO truck.	1
Test Description: This requirement is considered fulfilled when an approved motion planner has been developed.			
19	Original	The motion planner should at maximum take 2 seconds to create a reference trajectory.	1
Test Description: Run the motion planner, with a built in timer, 10 times and check that the elapsed time is not greater than 2 seconds.			
20	Original	A controller for trajectory following will be developed for the LEGO truck.	1
Test Description: This requirement is considered fulfilled when a approved controller for trajectory following has been developed.			
21	Original	While the LEGO-truck is following a reference trajectory of the figure eight, either by driving forward or backwards, the lateral deviation should stay within 5 cm of the reference trajectory 95% of the time.	1
Test Description: Let the LEGO truck drive follow the reference trajectory and log the truck's observed lateral deviation. Calculate the percentage that the deviation is larger than 5 cm.			

22	Original	While driving around the figure eight, both forward and backwards, the heading deviation of the LEGO-truck should stay within 3 degrees for 95% of the time.	1
Test Description: Let the LEGO truck follow the reference trajectory and log the truck's observed heading deviation. Calculate the percentage that the deviation is larger than 3 degrees.			
23	Original	The LEGO truck must be able to reverse through the whole course.	2
Test Description: Set the truck in reverse mode and make sure it can reverse through the whole course without any crashes or unwanted stops. The truck should be able to do this five times in a row to pass the requirement.			

7 Parking feature

Below are the tests for the requirements concerning the parking feature.

ID	Version	Description	Priority
24	Reneg. 2018-11-13	A functioning parking system will be developed for the car.	2
Test Description: Block the road and make sure the car's parking function activates and is functioning as expected.			
25	Reneg. 2018-11-13	If the reference trajectory is blocked and no overtake is possible the car will look for an appropriate space to park.	2
Test Description: Using the implemented <i>park somewhere</i> "button, the car will look for an appropriate place to park. This requirement is fulfilled when either requirement 27 and/or 32 is fulfilled.			
26	Reneg. 2018-11-13	The car must be able to park on a straight part of the racetrack.	2
Test Description: Block the road so that the parking function activates when the car is on straight part of the course. Make sure that the car parks automatically.			
27	Reneg. 2018-11-13	The parked car will at most be parked 3 cm from the racetrack edge.	2
Test Description: This requirement is considered fulfilled if the car parks within 3 cm of the racetrack at least five times in a row.			
28	Reneg. 2018-11-13	When the reference trajectory is clear the car must start moving along the trajectory again.	2
Test Description: At first block the path to activate the parking function. Once the car is parked, remove the obstacle and make sure the car continues along the reference trajectory again.			
29	Original	The LEGO truck must be able to place itself by a loading bay located to its rear.	1
Test Description: Verify that the planner calculates a reference track that places the LEGO truck besides the loading bay.			
30	Original	The LEGO truck shall be able to parallel park into a parking spot.	1
Test Description: Verify that the planner calculates a reference track that places the LEGO truck in the parking spot.			

31	Reneg. 2018-11-13	The car must be able to park to the side of the road while in a curved section of the course.	2
Test Description: Block the road so that the parking function activates while in a curved section of the course.			
32	Reneg. 2018-11-13	A functioning parking system will be developed for the truck with the semi-trailer with the same functionality as the system developed for the car.	3
Test Description: Do the same tests as previously done for the car and make sure the parking function for the truck with semi-trailer fulfills requirement 26 to 29 and preferably requirement 32.			

8 Code quality

Below are the tests for the requirements concerning the code quality.

ID	Version	Description	Priority
33	Original	All code written by the group will comply with the Google Style Guide (https://google.github.io/styleguide/cppguide.html)	1
Test Description: All new files will be read and checked against the Google Style Guide.			
34	Original	Each file will be commented with a description describing its content.	1
Test Description: Each file will be individually reviewed to make sure that it has satisfactory commentary.			
35	Reneg. 2018-11-26	Unused code files will not be included in the final Visual Studio solution.	±
Test Description: All files will be reviewed based on its usage before creation of the final Visual Studio solution. The requirement is considered fulfilled once all files have been reviewed and unused files deleted from the solution.			

9 Finance

For the finance no specific tests will be needed. These requirements will either be tested at the end of the project through the time plan or controlled by the orderer.

10 Delivery

For the delivery no specific tests will be needed. Since each delivery is connected to a toll gate it will be enough to verify that they are delivered by the set date.

11 Time Plan for Tests

Below is the time plan for when and how long the tests for the requirements will take place. Tests with no specific test week and/or no expected test time are labeled with a '-'.

ID	Expected time [min]	Test week
1	30	48
2	30	42
3	30	45
4	30	49
5	30	45
6	30	46
7	60	46
8	-	-
9	20	49
10	20	49
11	20	49
12	45	42
13	45	42
14	-	-
15	60	48
16	30	48
17	20	43
18	20	42

ID	Expected time [min]	Test week
19	20	45
20	40	46
21	40	46
22	30	47
23	30	47
24	30	49
25	30	49
26	30	47
27	30	47
28	30	48
29	30	47
30	30	49
31	30	49
32	30	48
33	90	49
34	-	-
35	-	-
36	90	49