Test Plan

Autonomous Truck with Trailer

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Version 0.3

ADAPT™

Status

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DOCUMENT HISTORY

Version	Date	Changes made	Sign	Reviewer
0.1	2022-10-05	First draft.	J.Barreng, M.Axelsson, T.Johansson	A.Sundstedt
0.2	2022-10-12	Second draft.	J.Barreng, M.Axelsson, T.Johansson	A.Sundstedt
0.3	2022-10-12	Revised test 14	E.Wiman	A.Sundstedt

1 INTRODUCTION

This document presents how the test plan will be executed throughout the project. In order to ensure that all requirements defined in the *requirement specification* [1] are fulfilled, each requirement will be verified with a specific test connected to a requirement. The different subsystems as well as the entire system will be tested methodically during the project.

1.1 Test structure

The tests will be conducted from a set structure borrowed from last years test plan [2], which can be seen in Table 1. Each test will receive a number called *Test number*. Each test number will test different requirements, seen in *Requirements tested*. If a test does not test a specific requirement it will be marked with "-" in Req. tested. Included in the test structure are also *Resources* which specifies the resources needed to conduct the test. *Execution* mentions if the test is done continuously throughout the project or if it will be tested only once on a specific date. Last is a brief *Test description* describing what is tested in that specific test.

Table 1: General test structure.

Test Number	Requirements tested	Resources	Execution	Test description
1	Req. tested	Computer, EV3, etc.	Date of execution	General test description.
2	...	...	...	...

1.2 Test status

After a specific test has been executed, it will be documented in a *Test Protocol* showing the result. Based on the aim for each test they will be given a certain grade, denoted as *pass* or *fail*. If a test is passed, but there are still improvements to be made the test will be given the grade *Passed with complementary work*. A more detailed explanation of the complementary work will be documented in the test protocol. A failed test implies that the test has to be redone after the test session.

2 TESTS

This section presents tests for all requirements with priority 1. If there is more time left towards the end of the project, requirements with lower priorities will be added to the test plan.

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Table 2: Tests for general requirements.

Test Number	Requirements tested	Resources	Execution	Test description
1	1	-	Continuously	Each individual needs to alert the group in case of not knowing how to complete the task.
2	2	Computer, arbitrary obstacle, Visionen, LEGO truck	2022-xx-xx	Place an arbitrary object and make sure that the motion planner plans a path that avoids the object.
3	4	Student within suitable field	2022-xx-xx	See if the person understands the implemented code.

2.1 Test of LEGO truck

In this section the tests of the LEGO truck are described.

2.1.1 *Test of physical requirements*

Here are tests of physical requirements of the LEGO truck presented in Table 3.

Table 3: Tests for physical requirements of the LEGO truck.

Test Number	Requirements tested	Resources	Execution	Test description
4	5	-	2022-xx-xx	Apply a small force in the direction the reflector is mounted and see how large the displacement is.

2.2 Control system tests

In this section tests regarding the control system are presented.

2.2.1 *Test of design requirements*

Here are tests of design requirements for the control system presented in Table 4.

Table 4: Tests for design requirements of the control system.

Test Number	Requirements tested	Resources	Execution	Test description
5	7	Computer, LEGO truck, Visionen	2022-xx-xx	Verify that the dynamical obstacle moves around in the world as well as the truck avoiding the dynamical obstacle.
6	8, 9	Computer, RPi	2022-xx-xx	Verify that the control system operates on the RPi.
7	10	Computer, RPi	2022-xx-xx	Verify that the motion planner operates on the RPi.
8	11	Computer, Gitlab	Continuously	System architect verifies that all merged code utilizes the ROS framework
9	12	Computer, LEGO truck Visionen	2022-xx-xx	Verify that changed parameters are communicated to the ongoing mission.
10	13	Computer, Gitlab	2022-xx-xx	Verify that the code regarding the motion planner is utilizing a POMDP and that the motion planner handles uncertainty in a satisfactory way.

2.2.2 *Test of functional requirements*

Here are tests of functional requirements for the control system presented in Table 5.

Table 5: Tests for functional requirements of the control system.

Test Number	Requirements tested	Resources	Execution	Test description
11	14, 17	Computer, Visionen	2022-xx-xx	Plan a trajectory and monitor if the suggested plan collides with static obstacles or deviates from the simulated world.
12	15	Computer, LEGO truck, Visionen	2022-xx-xx	When the truck starts to move, ensure that the trajectory of the truck is similar to the planed path.
13	18	Computer, LEGO truck, Visionen	2022-xx-xx	Test the predictor by running the truck along the trajectory, introduce a dynamic obstacle and ensure the dynamic obstacle is avoided if it crosses the trajectory of the truck within the stated constraints.
14	21, 22	Computer, LEGO truck, Visionen	2022-xx-xx	Test the motion planner by running the truck along the trajectory and monitor if the motion planner updates the trajectory and uses longitudinal movement to avoid the dynamic obstacle.
15	24	Computer, LEGO truck, Visionen	2022-xx-xx	Test the system by running a mission from start to finish and monitor the performance.

2.2.3 *Interface tests*

Here are tests of interface requirements for the control system presented in Table 6.

Table 6: Tests for interface requirements of the control system.

Test Number	Requirements tested	Resources	Execution	Test description
16	25	-	2022-xx-xx	Ensure that ROS communication works between all subsystems
17	26	Computer	2022-xx-xx	Ensure that the ROS-command publish works for the motion planner.
18	27	Computer	2022-xx-xx	Ensure that the subcription to QualiSys works in the predictor.
19	28	Computer	2022-xx-xx	Ensure that the motion planner is able to avoid dynamical obstacles.

2.3 Performance requirements tests

In this section tests of the performance requirements for the entire system are presented. The tests can be seen in Table 7.

Table 7: Tests for performance requirements.

Test Number	Requirements tested	Resources	Execution	Test description
20	29	Computer, LEGO truck, visionen	2022-xx-xx	Monitor the truck from start to goal making sure that the goal state is reached within a feasible time, unless a dynamic obstacle happens to stop on the path.
21	31	LEGO truck, visionen, Static obstacle	2022-xx-xx	Monitor the movement of the truck, ensuring that the distance from the arbitrarily placed static obstacles are kept to at least 10 cm at all times.
22	32	LEGO truck, visionen, arbitrary dynamic obstacle	2022-xx-xx	Monitor the movement of the truck when a dynamic obstacle approaches the truck, ensuring the distance to the dynamic obstacle is at least 10 cm at all times, unless truck is stationary.

2.4 Visualization tests

In this section tests of the visualization requirements are presented. The tests can be seen in Table 8.

Table 8: Tests for visualization requirements.

Test Number	Requirements tested	Resources	Execution	Test description
23	33	Computer, RPi	2022-xx-xx	Try to use SSH and see if it connects as intended.
24	34, 35, 36, 37,	Computer, Visionen	2022-xx-xx	Project the world and path on the floor using the computer in Visonen.
25	38, 39	Computer, Visonen	2022-xx-xx	Run the intended mission and ensure that the dynamic obstacle appears and that the path updates according to the dynamic obstacle.

2.5   Software quality tests

In this section tests of software quality is presented. The tests can be seen in Table 9.

Table 9: Tests for software quality requirements.

Test Number	Requirements tested	Resources	Execution	Test description
26	49	Computer, Gitlab	Continuously	Verify that all the written code follows Googles style guide by reviewing merge requests.
27	50,51	Computer, Gitlab	2022-xx-xx	Ensure that all code is correctly documented and merged to Gitlab.
28	52,53	Computer, Gitlab	2022-xx-xx	The software architect makes sure that a separate branch is created for this project and that all new code is merged to that branch by approving the merge requests.

3   TEST PROTOCOL

A separate test protocol documenting the test result for each performed test will be set up as soon as the test process is initiated. The tests will be performed according to the test description in Section 2. The template that will be used to document the tests are shown in Table 10. The tests will each receive a status that will either be *pass*, *pass with complementary work* or *fail*. If a test is graded with the status *pass with complementary work* or *fail* a description of what needs to be reviewed in order for the test to pass will be available.

3.1   Test Protocol Template

The general description of the test protocol layout is presented in Table 10 and are borrowed from last years test protocol [2].

Table 10: Template showing the structure of the test protocol.

Test Number	Requirements tested	Execution	Test responsible	Trials	Status
1	Requirement number tested	Date of execution	Responsible project member(s)	Number of trials	Test grade
2	...	...	...	...	...
3	...	...	...	...	...

REFERENCES

[1]   M. Axelsson et al. *Requirement Specification, Autonomous Truck with Trailer*. 2022. URL: http://www.isy.liu.se/edu/projekt/tsrt10/2022/rev_truck/ (visited on 10/04/2022).

[2]   D. Larsson et al. *Test Plan, Autonomous Truck with a Trailer*. 2021. URL: http://www.isy.liu.se/edu/projekt/tsrt10/2021/rev_truck/ (visited on 10/04/2022).