System Requirements Specification

for

Overtake and Collision Avoidance with Thymio

Version 0.1

Prepared by Lorenzo Bartolini, Marco Agatensi

University of Florence

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(a modified version of IEEE Software Requirements Specification Template, K.E. Wiegers, 1999)

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Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Date** | **Reason For Changes** | **Version** |
|  |  |  |  |
|  |  |  |  |

# Introduction

## Purpose

The purpose is to design an overtake and collision avoidance system composed of two Thymios in a well specified environment.

## Document Conventions

<Optional section>

## Intended Audience and Reading Suggestions

Intendend audience is developers, project managers, testers and documentation writers.

## Product Scope

The product scope is to design two Thymios that are able to reach their destination without colliding and applying a well specified collision avoidance algorithm.

## References

None

# Overall Description

## Product Perspective

The project in object is part of a University project.

## Product Functions

* Guide two Thymios to destination
* Perform overtakes
* Avoid collisions

## User Classes and Characteristics

None

## Operating Environment

The environment will be a narrow and long road with two Thymios.

## Design and Implementation Constraints

<Describe items or issues that will limit the options available to the developers. These might include: corporate or regulatory policies; hardware limitations (timing requirements, memory requirements); interfaces to other applications; specific technologies, tools, and databases to be used; parallel operations; language requirements; communications protocols; security considerations; design conventions and standards.>

## Assumptions of Use

<List any assumed factors (as opposed to known facts) that could affect the requirements stated in the SRS. These could include legacy or third-party components that you plan to use, issues around the development or operating environment, or constraints. The project could be affected if these assumptions are incorrect, are not shared, or change. Also identify any dependencies the project has on external factors, such as components that you intend to reuse from another project, unless they are already documented elsewhere (for example, in the vision and scope document or the project plan).>

# System Use Cases

# 

## Reach the end of the road

1. **Objective** – The two Thymios should be able to reach the end of the road, Thymio A needs to overtake Thymio B without crashing.
2. **Priority** – High
3. **Actors** – Two Thymios (A and B)
4. **Flow of Events** 
   1. **Basic Flow**
      1. Thymio A and B move forward
      2. Thymio A reaches B
      3. Thymio A performs the overtake returning on the road
      4. Thymio A and B move forward
   2. **Alternative Flow(s)**
      1. Thymio A and B move forward
      2. Thymio A reaches B
      3. Thymio A while performing the overtake is not able to return on the road in front of B
      4. Thymio A retries to perform the overtake
   3. **Exception Flow(s)**
      1. Thymio A and B move forward
      2. Thymio A reaches B
      3. Thymio A crashes on B while performing the overtake
5. **Includes** - none
6. **Preconditions** – Thymio A is behind Thymio B, Thymio A is faster than Thymio B
7. **Post conditions** – Thymio A reach the end of the road, Thymio B still needs to reach the end of the road
8. **Notes/Issues** - none

## Arrive at destination

1. **Objective** – The two Thymios should be able to arrive at destination without crashing when doing it
2. **Priority** – High
3. **Actors** – Two Thymios (A and B)
4. **Flow of Events** 
   1. **Basic Flow**
      1. Thymio A turns around while B moves forward to reach the end of the road
      2. Thymio A and B face eachother going in opposite directions
      3. They avoid the collision
      4. Thymio A and B continue on the road
      5. Thymio B reaches the end
      6. Thymio A and B arrive at destination
   2. **Alternative Flow(s)**
      1. TODO
   3. **Exception Flow(s)**
      1. TODO
5. **Includes** - none
6. **Preconditions** – Thymio A is at the end of the road, Thymio B still needs to reach the end of the road
7. **Post conditions** – Thymio A and B has arrived at destination
8. **Notes/Issues** – The destination of A is the starting position, the destination of B is the end of the road

# System requirements definition

<Organize the requirements for the product by system features.

Following the structure of the course, we recommend to organize this section using viewpoints. For example, providing subsections containing requirements of the:

* Architecture viewpoint
* Interface and Communication viewpoints
* Time and time synchronization viewpoint
* …

## Architectural Viewpoint

**USER REQUIREMENTS**

USR1-M: Thymio A and B must be able to move forward;

USR2-M: Thymio A must be able to do an overtake;

USR3-M: Thymio A must be able to turn around;

USR4-M: Thymio A and B must be able to indentify the end of the road;

USR5-M: Thymios must be able to avoid collision with each other;

USR6-M: Thymios must be able to identify the other Thymio on the way;

USR7-M: Thymios must be able to follow the road;

USR8-M: Thymio A must be able to go faster than B;

USR9-M: At SoS start Thymios must be in the initial configuration;

**SYSTEM REQ**

**Environment Requirements**

SYS1-R: The Thymio should operate on a space of 1m x 3m;

SYS2-M: The surface must be flat and smooth;

SYS3-R: The Thymio should not operate in a too bright area;

SYS4-M: There must not be obstacles in the entire area;

SYS5-M: The area must contain a single road;

SYS6-R: The end of the road should be delimited;

**SoS structure and rules Requirements**

SYS7-M: The SoS must be composed of 2 Thymios;

SYS8-M: The SoS target must be that each Thymio reaches its final destination without crashing;

SYS9-M: At Sos starts, the Thymios must be positioned on the road facing the same direction;

SYS10-M: At Sos starts, the Thymio B must be in front of A;

SYS11-M: The execution must complete when Thymio A reaches the start of the road and B reaches the end of the road;

SYS12-M: The Thymios must know that the only other entity is the other Thymio;

SYS13-M: Thymio A must perform an overtake when it reaches the Thymio B;

SYS14-M: Thymio A after completing the overtake must turn around after 10 seconds;

SYS15-M: Thymio A must stop when it reaches the start of the road;

SYS16-M: Thymio B must stop when it reaches the end of the road;

SYS17-M: Thymios must follow the road;

**IMPLEMENTATION REQUIREMENTS**

IMP1-R: At the start the Thymio B should be positioned 0.5 m in front of Thymio A;

IMP2-R: The Thymio B should stop for 5 seconds when encounters the Thymio A, either from the front or the back;

IMP3-M: The Thymio A must overtake from the right the Thymio B.

## Communication Viewpoint/RUI

SYS18-M: The Thymios follow the road using the bottom infrared sensor;

SYS19-M: The Thymios identify each other using the front infrared sensors;

IMP3-M: The Thymios identify the street when the bottom infrared sensors reads a value x <= 400;

IMP4-M: The Thymios identify the other Thymios when the front sensors when the front sensor reads a value y >= 300;

# Traceability matrix

<If an upper layer of documentation is available, it is necessary to include traceability of requirements. >

|  |  |
| --- | --- |
| **Requirements from upper layer document (identify precisely the document and its version)** | **This SRS** |
| Assume a road, with 2 undivided lanes. Assume vehicles A and B on the same lane. A is in front, B is behind A starting from a certain initial distance. | USR9-M |
| B is proceeding at a higher speed than A. | USR8-M, USR1-M, USR7-M |
| When B is sufficiently close to A, it performs an overtake |  |
| 10 seconds after the overtake is complete, B (newly in front) make a 180° turn, and start moving forward (i.e., it goes towards A in a possibly colliding trajectory) |  |
| A and B avoid bumping into each other. They apply a resolution, after which both A and B can proceed on their path (move forward) |  |

# Test Cases/Test Plan

<Define test cases for testing your features and requirements.>

<Most often, this is in a separate document. Tests should be defined at this stage to facilitate validation of requirements.>

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Case ID** | **Test Scenario** | **Test Steps** | **Test Data** | **Expected Results** |
| TC01 | Overtake | - Thymio A behind at a higehr speed  - Thymio B in front  - Thymio A moves to the left  - Thymio A aligns to be parallel wrt B  - Thymio A go straight for 10 seconds  - Thymio A moves to the right until it reaches the road | Speed Thymio A = 300  Speed Thymio B = 200 | B in front of A |
| TC02 |  |  |  |  |
| TC03 |  |  |  |  |
| … |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

## Test Cases/Test Plan Traceability Matrix

<Test cases must be traced to requirements, to prove that all requirements have been considered for testing, and tests have been developed whenever appropriate.>

<Note that requirements should be testable, so there must be good reasons to not have tests matched to a requirement.>

|  |  |
| --- | --- |
| **SRS Requirements** | **Test Cases** |
| USR2-M, USR6-M | TC01 |
| … | … |
|  |  |
|  |  |
|  |  |