Project plan

Multiple Autonomous Vehicles in Complex Scenarios

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Project Identity

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1 SUMMARY DESCRIPTION OF THE PROJECT

This section presents a brief description of what output can be expected from the project.

1.1 Purpose and goal

The purpose of the project is to develop a system for multiple autonomous vehicles that will be able to operate in complex scenarios. These multiple vehicles and their algorithms must be able to drive in real time. As this area is broad and complex, the project has been limited to focusing on specific scenarios. Therefore, the goal is to design a system where the autonomous multiple vehicles will be able to independently:

- drive on country roads
- drive in roundabouts with two lanes or drive in four-way intersections

1.2 Deliveries

Smaller deliveries will be made as bi-weekly sprint demos, summarizing the work made during the sprint. At the halfway point a larger delivery and examination will be made. Final delivery will be made at the conclusion of the project.

2 ORGANIZATIONAL PLAN FOR THE ENTIRE PROJECT

Each member in the group has some specific responsibility. This means that the member in question is responsible for making sure that the task gets done. Every member is also divided into one of three main areas when it comes to the actual development, more on this in section 2.2.

2.1 Conditions for cooperation within the project group

Everyone is responsible for putting in the required 240h. Regular meetings are held through employment of the SCRUM framework. This makes sure that everyone knows what needs to be done and who needs help with certain tasks.

2.2 Definition of work content and responsibilities

The workload will be divided into three parts. These are perception, planning and control, and visualisation. No group member is required to devote all their time into a single part. Instead, the group will work in an agile way, prioritising what's most important at the moment. An explanation of what each part entails is as follows:

Perception
This includes processing signals from sensors, localisation and mapping using these signals and state estimation.

Planning and control
Provided there is a map and location of where the vehicle is and where it should be, planning and control will realize the actual motion of the car. This includes planning the optimal trajectory and making the car follow it.

Visualisation
Graphic visualisation of what the vehicle sees and what decisions are made for humans to see. This includes visualising where the car thinks it is and where it's headed, where it thinks obstacles are located and when or if to overtake another car.

3 DOCUMENT PLAN

A document plan can be found in Table 1.

Table 1: Specification for the involved documents.

Document	Accountable / Approved by	Purpose	Distribution	Due date
Requirements specification	Johan Forsman / Orderer	Defining the requirements of the system.	Orderer	2021-09-22
Project plan	Johan Forsman / Orderer	Planning the project.	Orderer	2021-09-22
User manual	Johan Forsman / Orderer	Guidelines for how to operate the system.	Orderer	2021-11-30
Post-study	Johan Forsman / Orderer	A reflection upon the work and achievements.	Orderer	2021-12-06 13:15
Poster	Erik Wahledow / Course Responsible	Overview presentation of the project.	Course Responsible	2021-12-07 12:00
Technical report	Johan Forsman / Orderer	A thorough description of the system and implementation.	Orderer	2021-12-13

4 MEETINGS PLAN

Meetings are held when a new sprint ends and a new one begins. During this meeting the group will review how the previous sprint went and what can be improved. A new sprint is then planned and initiated. Additional shorter meetings will be held two or three times a week to catch up on progress and potential issues.

5 RESOURCES PLAN

The project is financed by ISY at LiU, who provides the material required for the group the develop and test the system. The limitation of the project is 240h work for each project member.

6 MILESTONES AND DECISION POINTS

The milestones, bigger achievements during the project, and the decision points are listed here.

6.1 Milestones

The milestones are listed in Table 2 and provides specific dates when certain progress should be achieved. Some milestones are divided into roundabout or intersection, but only one of these settings will be pursued in the project. A decision will be made on the alternatives by the first release.

Table 2: List of milestones.

Nr.	Description	Date
1	Following a common road. *Given a static map of a road (two lanes), the car can drive along the road in the right lane. The car can also maneuver around static obstacles in the right lane by using the left lane.*	2021-10-01
2	Overtaking on a common road. *The car can safely overtake one car on a common road by using the left lane with oncoming traffic present.*	2021-10-15
3	First release / Halfway Examination. *The project's progress is demonstrated to the orderer.*	2021-10-15

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Nr.	Description	Date
4	Following a roundabout or intersection. *Roundabout: The car can loop around the roundabout.* *Intersection: The car can drive through and take turns in the intersection from every direction.*	2021-10-29
5	Maneuver while following traffic rules. *Roundabout: The car can maneuver a roundabout with two lanes and choose the correct lane and change lanes depending on the exit according to traffic rules.* *Intersecton: The car can maneuver intersections with other cars present and predetermined traffic rules regarding duty to give way.*	2021-11-12
6	Optimisation and edge cases. *Roundabout: When entering the roundabout, the car can adapt its speed in advance to avoid having to stop by the entrance when other cars in the roundabout is present.* *Intersection: The car can deal with situation when other cars are not following the traffic rules* *Common road: The car can perform overtakes with multiple cars in the same lane and oncoming traffic present.*	2021-11-26
7	Project is delivered to the orderer.	2021-12-03
8	Post-study is delivered.	2021-12-06
9	Technical report and film is delivered.	2021-12-13

6.2 Decision points

The decision point, on which a decision is made whether to continue or terminate the project, are seen in Table 3.

Table 3: List of decision points.

Descision point	Description	Date
2	Requirements specification, Project plan.	2021-09-22
5	All functionality, Test protocols, User manual, Demonstration of met requirements.	2021-11-30
6	Technical report, Video presenting the project.	2021-12-13

7 TIME PLAN

Because the project is organised using SCRUM, the most natural is to divide the time budget according to each sprint. As there are eight members of the group, each of whom will have 240 hours to spend, the total hours for the project should add up to 1920 hours. Thus, the time plan is presented in Table 4.

Table 4: Sprint planning.

Week	Sprint	Description	Hours
35-36	Sprint 0	Intro	92
37	Sprint 1	Project start-up	154
38-39	Sprint 2	Following a common road	300
40-41	Sprint 3	Overtaking on a common road	300
42-43	Sprint 4	Following a roundabout/intersection	60
44-45	Sprint 5	Maneuver while following traffic rules	356
46-47	Sprint 6	Optimisation and edge cases	356
48-49	Sprint 7	Finishing up	302
Total	-	-	1920

Because the majority of the group has a more forgiving schedule in the latter half of the project, the expected time commitment is larger then. The fourth sprint has severely reduced hours due to these two weeks coinciding with the exam period.

8 RISK ANALYSIS

Since the pandemic continues there is always a risk of getting sick if there are physical meetings. The vaccine decreases the risk but does not eliminate it. Therefor meetings with external parties are preferred digital. Meetings within the group are mostly held physical (to help productivity), and some objectives in the project requires physical presence. Anyhow one should stay at home if they feel sick or have any symptoms. If anyone in the group gets sick, some delays might occur. In this case there might be a reduction of requirements to satisfy. Hopefully this won't be the case. Implementing the scenarios in the physical cars is the goal of the project. In the unlikely event that the cars won't be at our disposal, due to damages of the car or other factors, the project will proceed with the simulation environment.

8.1 Risks involving hardware

The car's performance is limited (speed and steering) for it to last, but also for safer environment. The batteries for the car should also be handled with care, when charging or operating with them.