1st Home Assignment – Requirement Analysis

Passenger Transportation with Autonomous Vehicles

Introduction

Our company has decided to enter the market of self-driving vehicles. Based on a preliminary study, our best chance is to manufacture special-purpose autonomous vehicles that operate in private properties, because this context has less uncertainty and involves less social responsibility. Our first potential client wants to install driverless autonomous vehicles in their closed office park to offer transportation service to the people working there.

Your team is tasked with the preparation of the project, including the identification of stakeholders and the context of the future system, and also the definition of the main requirements and use cases. To support your work, the appendices of this document contain excerpts from the report of the preliminary study and the products of the first few meetings with the customer.

Tasks

The supplied project file contains the skeleton of the system design project with a partially compiled glossary. Using the predefined packages, complete the following tasks:

a. Study the documents in the appendices. Extend the glossary as you complete the other tasks.
b. Create the list of stakeholders in the predefined Use Case Diagram.
c. Model the system context in the predefined Internal Block Diagram including the information flows between the system and its environment.
d. Model the high-level requirements based on the provided documents in the appendices and refine them to clearly identify the goal of the project.
e. Define use cases based on the requirements and the available resources.
f. *(for extra IMSc credits) Derive more refined requirements for the autonomous vehicle to be shipped (use the diagrams in the "Autonomous vehicle" subpackages). Using the available information, describe the functions that are necessary to build an autonomous vehicle in the described setting. Extend the set of use cases to illustrate their roles in different situations.*

Make sure to maintain a medium-high abstraction level – the goal is *not to design* the system but to identify the high-level requirements and the necessary functions. Your focus should be on collecting critical aspects to guide the development team in the upcoming detailed specification and design phase.

If you find ambiguous or contradicting requirements in the customer specification, document them and explain the problem so that we can contact the customer with well-defined questions. If something is not specified precisely, suggest a design decision and document it so we can get validation from the customer.

Appendices

Customer Specification

We expect the delivery of driverless buses that are capable of transporting passengers around our office park. The buses should get around autonomously inside the site, selecting their route automatically based on the current demand. To this end, we expect the installation of dedicated terminals in front of every major office building through which passengers can publish their transportation requests. We also want to make this feature available as a mobile application, which will let registered users publish their requests in advance (even for larger groups).

The buses must not have any permanent personnel on board, but it is acceptable to have a group of 2-3 people stationed on site who can intervene (either remotely or manually) in case of a technical problem.

Currently, traffic in the office park is limited to authorized vehicles, cyclists and pedestrians. Common traffic law is effective. We are ready to regulate authorized vehicles further (e.g., with additional signals or traffic lights), but the buses must avoid causing accidents. The autonomous vehicles must be able to react to the behavior of cyclists and pedestrians.

The buses must be able to operate under any weather conditions, but the time of operation is limited to between the hours of 7 AM and 10 PM. We will build a dedicated station in the park for storage and maintenance. In case of a non-critical failure, the buses should be able to notify the maintenance team and return to the station autonomously. We expect the buses to be able to complete at least 100 km on average between two interventions.

Before acceptance, we plan to have a 30-day test run during which the system will be evaluated based on the number of transported persons and the number of external interventions.

Remarkable Quotes

The following quotes have been noted during the preliminary meetings and may contain relevant information about implicit customer requirements.

- "Whatever the Health&Safety Department accepts."
- "Obviously, we have to comply with health&safety regulations."
- "Who would want to stand in the pouring rain for hours. . . "
- "We don't want clumsy login screens, make it simple and efficient."
- "Be prepared that the Health&Safety Department will always want more data about the system."
- "Last year we had a bad privacy leakage incident, so we want to make sure it doesn't happen again."
- "Our colleague John has already joked with hijacking your buses and organizing drag races."
- "Of course they should not crash, but if they do, it would be nice to have some sort of black box."
- "The Health&Safety Department is almost as afraid of the authorities as we are afraid of them."
- "During lunch time, we expect around 1000 people to use the service. It would be nice if they could have their meal in the lunch break."
- "How will you make sure the buses are not overcrowded?"
- "We have not decided if this will be a free service or not."
- "I'm quite interested in how these vehicles will handle real-life traffic situations. I used to be very skeptic about this."

Recommended Reading

Some highlights from the preliminary study concerning technical challenges and the state of the art.[1]

- Self-driving car basics [Wikipedia]: `https://en.wikipedia.org/wiki/Self-driving_car`
- Common car-safety features to help brainstorming (also summarized in Table 1): `https://mycardoeswhat.org/safety-features/`

[1] Required primarily for the IMSc task.

Function	Description
Adaptive Cruise Control	Not only maintains your set speed, but your following distance as well; provides some limited braking.
Adaptive Headlights	Adapts to changing roadway conditions – such as curves – to better help illuminate the roadway along your path.
Anti-Lock Braking System	Anti-lock braking systems (ABS) help you steer in emergencies by restoring traction to your tires.
Automatic Emergency Braking	This feature can sense slow or stopped traffic ahead and urgently apply the brakes if the driver fails to respond.
Automatic Parallel Parking	Helps guide you into a parallel parking spot after searching and finding a viable option. You still are responsible for braking and monitoring your environment.
Back-up Camera	Back-up cameras help you see objects directly behind you while backing.
Back-up Warning	Alerts you of objects behind your car as you back out of spaces like driveways or parking spots.
Bicycle Detection	This is a warning feature that alerts drivers when a bicycle has been detected. Some systems can only detect bicyclists when traveling directly in front of the vehicle and when moving in the same direction.
Blind Spot Monitor	These monitors warn you of cars driving in your blind spots. They may provide an additional warning if you use your turn signal when there is a car next to you in another lane.
Curve Speed Warning	Warns you when you're approaching a curve or exit on the road too quickly. This feature tracks the car's speed and location, via GPS, and warns the driver to slow down when approaching curves and exits. Some versions of this feature can coordinate with a database of high-risk curves and exits to alert drivers to take extra caution.
Electronic Stability Control	Helps prevent loss of control in curves and emergency steering maneuvers by stabilizing your car when it begins to veer off your intended path.
Forward Collision Warning	Forward collision warning can alert you of an impending collision with a slower moving or stationary car in front of you.
Hill Descent Assist	Helps keep you at a steady speed when driving down a hill or other decline.
Hill Start Assist	Helps prevent roll-back when starting up again from a stopped position on an incline.
Lane Departure Warning	Lane departure warning systems alert you if you're drifting out of your lane using visual, vibration or sound warnings.
Lane Keeping Assist	May gently steer you back into your lane if you begin to drift out of it.
Left Turn Crash Avoidance	This feature monitors traffic when the driver turns left across traffic at low speeds (such as at a traffic light). The car will automatically brake if it detects that you're turning in front of a car.
Obstacle Detection	Can sense slow-moving or stationary objects when driving at low speeds. Some may even brake for you to avoid obstacles. This feature activates at slow speeds and will provide warnings of impending collisions. For some versions, it will brake the car automatically.
Parking Sensors	Alerts you to the position of objects around your car as you park.
Pedestrian Detection	Uses advanced sensors to detect human movements; some versions may urgently apply the brakes if the driver fails to respond.
Rear Cross Traffic Alert	Warns you if one or more vehicles are about to enter your backing path.
Sideview Camera	Shows you an expanded view of a lane beside you when you use your turn signal, or when you activate the feature manually.
Temperature Warning	Alerts you when the outside temperature is detected to be at or below freezing, which can impact the conditions of roadways.
Tire Pressure Monitoring System	Tire pressure monitoring systems (TPMS) may warn you if your tires are under- or over-inflated, helping increase your fuel economy and even potentially preventing a tire blowout.
Traction Control	Works in the background to help accelerate and prevent wheel slippage (or "over-spinning") when driving on slippery surfaces.

Table 1: Common driver-assistant and safety features in cars