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Master Course

Distributed Computing Systems

Engineering

Workshop EE5620 :

Project Control and Management

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16th April 2017

Contents

List of Abbreviations

ADAS Advanced Driver Assistance Systems

Chapter 1

Introducing TSMW

Author: Wojciech Lesnianski

1.1 Company

TSMW is a young company, which aims at the auto industry and provides own software solutions together with chosen hardware that is available on the market or provided by the customer, to build a system, supporting the car driver with a specific task. If needed, the company provides an analysis and a preselection of available hardware pieces, in terms of quality, availability and price to the customer, as well as an objective recommendation.

The aims and objectives of the company are:

- Development of support systems which satisfy the customer and the end user
- Creation of objectively fitting hardware selections for the customer
- Long terms binding of the customer to the company, through good price and quality of the required system.

1.2 Staff

The following chapter introduces the TSMW team. The young company consists of 4 members which share the tasks between each other to achieve the most with the given capacity, but also all have their special responsibility / role of their own. Especially for a small company, it is of high importance to coordinate the activities to meet the requirements of the customer.

Markus Just	Timo Acquistapace	Simon Schneider	Wojciech Lesnianski
			
Project Leader	Software Architect	Software Engineer	Designer

To make the coordination of the activities possible, we require a clear definition of roles and their interdependencies:

1.2.1 Project Manager

Project Manager is primary responsible for the communication with the customer and acquisition of requirements, as well their transformation into tasks and user stories. He supervises the development process and monitors the process flow.

1.2.2 Software Engineer

The primary task of the Software Engineer is primary responsible for the development of the system backend, decision making about the form of persistent data and the advisement of the software architect. The Software Engineer creates a selection of eligible hardware parts and together with the Project Manager, presents them to the customer.

1.2.3 Software Architect

The main task of the Software Architect is the creation of the architecture, as well as the consultation with all developers about the current development decisions.

1.2.4 Designer

The Designer is responsible for the creation of a user interface prototypes, as well as the development of the user interface throughout the development process. He is also in charge of the company's corporate design and its logo.

1.3 Product

The requested system should be built into the customer's cars and support the driver by bringing his car out of a parking position. Various sensors around the car should provide safety during the process and the driver should always be able to take control of the car. For the system, it should be of no matter, weather the parking position is parallel or perpendicular. In

further development iterations, the process should also provide an external interface for third party systems to start or stop a parking process. The system should be capable of working with the traffic systems of all countries the customer's cars are sold to and take into account the countries rules including the orientation of the bidirectional traffic. For driver's convenience, the system should provide a graphical interface with an overview over the current state of the parking process, as well as the information received from the sensors.

Chapter 2

Aims, Objectives and expected Outcome

Author: Wojciech Lesnianski

In this chapter we will on the one hand discuss, what the overall aim of the project is, and what the objectives are, which we want to achieve either on the way through the project or in its end. Furthermore we will forecast, what our expected outcome of the project is and what the reasons for this forecast are.

2.1 Aim

The aim of the project is to create a system which helps the user to bring out his car from a parking position in the simplest, yet most convenient and reliable way possible.

2.2 Objectives

The project's objectives are:

- Satisfaction of the customer
  We measure our success rate with the satisfaction level of our customers.

- Satisfaction of the end consumer
  Since this is a system, our customer wants to make to provide support for his customers, his own satisfaction, and thus our success, will highly depend on this factor. We want to make his life easier, without asking too much of technical knowledge or making things so complicated to use, that he decides to do his actions without the help of our system.

- Creation of a satisfying hardware analysis
  Since the system is supposed to use third party hardware for significant parts of the functionality, it is an objective to create a good analysis on the state of art of the needed variety of sensors.

- Create a System that is significant on the market
  We want to create a system which other systems get compared to, when it comes to measuring the quality.

2.3 Expected Outcome

The expected outcome of this project is, due to the lack of time and hardware:

- A representative market analysis of current competition systems with the contrast to our product

- A representative market analysis on the needed hardware pieces for our system

- A solid and justified concept for a solution

- A proof of concept

Chapter 3

Project Plan

Author: Hans
Contributor(s): Wurst

Chapter 4

Project Management

Author: Hans
Contributor(s): Wurst

Chapter 5

Resource Allocation

Author: Wojciech Lesnianski

Available resources were always one of the biggest goods Project Managers had to work with, to keep customers happy. Especially with the growing agile approach popularity, where development iterations become smaller, it is of high importance to use all resources the most efficient way. Efficiency in this case, does not always mean, to put the most fitting developer on a task, but also consider where the other resources are allocated at the time. Putting a developer on a task that is not fitting him perfectly might still be a good idea if another developer would not be able to do anything otherwise.

5.1 Methodology of Resource Allocation

There are various methods which aim at the best possible resource allocation and they all first require the user, possibly the project manager, to break down jobs in tasks and classify the tasks and the resources in a specific way. The better the breakdown and the classification is, the better the project manager can allocate his resources.

For this project we will use the method described in the lectures of Dr. Ali Mousavi (see Mousavi [2017]).

This method focuses on classifying tasks and identifying the best possible human resource to fulfill the task. First the human resources get their Indicators of Capability:

- The Enablers (E) cognitive capabilities, skills and roles
- The Preferences (P) personal traits
- Past Attainments (A) past experience in similar roles

It takes an experienced project manager and good self-assessment of the developer to put together a representative and well-founded list of enabler properties.

In the following, we will calculate the impact and utilization of a specific human resource on a specific job as an example. Since we are a small company we take the job implementation as one big job which we separate into tasks (see figure 5.1.1). After writing down the most important skills needed for the single tasks, we can put them all together in a separate table, considering the highest X (see figure 5.1.2).

Considering the weight of a skill W and the availability of the human resource A we can calculate the values A' and A''. With those values we can calculate the Impact and Utilization of a Human Resource for a job:

Impact:	0.68
Utilisation:	0.81

Table 5.1.1: Impact and Utilization of a Human Resource

Those values would have to be compared to the values of other candidates, which would be too much for this assignment.

Basic Tasks	Capability Indicator	Skill Description	X (How much capacity of resource is required)	
Setup a development environment	C_{111}	.Net Knowledge	X_{111}	0.8
	C_{121}	Vehicle Knowledge	X_{121}	0.7
	C_{131}	Simulation Software Knowledge	X_{131}	0.5
	C_{141}	Database Knowledge	X_{141}	0.7
	C_{211}	Likes working in teams	X_{211}	0.4
	C_{221}	Extroverted	X_{221}	0.3
	C_{231}	Adapting to new situations	X_{231}	0.5
	C_{311}	Experience with car systems	X_{311}	0.8
	C_{321}	Experience with .Net projects	X_{321}	0.6
Implement the frontend	C_{112}	.Net Knowledge	X_{112}	0.8
	C_{122}	Design skills	X_{122}	0.85
	C_{132}	Layouting Knowledge	X_{132}	0.85
	C_{212}	Likes to design	X_{212}	0.85
	C_{222}	Likes working with layouts	X_{222}	0.8
	C_{232}	Understanding in customers needs	X_{232}	0.6
	C_{312}	Experience with GUIs	X_{312}	0.7
	C_{322}	Experience with WPF	X_{322}	0.6
	C_{323}	Experience with CarComp. Layouts	X_{323}	0.7
Implement the backend	C_{113}	.Net Knowledge	X_{113}	0.9
	C_{123}	Database Knowledge	X_{123}	0.7
	C_{133}	Sensor/Microcontroller Knowledge	X_{133}	0.5
	C_{143}	C# Programming Skills	X_{143}	0.8
	C_{213}	Likes working in teams	X_{213}	0.5
	C_{223}	Can work independently	X_{223}	0.4
	C_{233}	Adapting to new situations	X_{233}	0.6
	C_{313}	Experience with C#	X_{313}	0.7
	C_{323}	Experience with car systems	X_{323}	0.6
	C_{333}	Experience with .Net Projects	X_{333}	0.75
	C_{343}	Experience with databases	X_{343}	0.6
Test the system	C_{114}	Vehicle Knowledge	X_{114}	0.6
	C_{124}	Simulation Software Knowledge	X_{124}	0.5
	C_{134}	Writing Skills	X_{134}	0.3
	C_{214}	Understanding in customers needs	X_{214}	0.4
	C_{224}	Can work independently	X_{224}	0.7
	C_{314}	Experience with car systems	X_{314}	0.8

Figure 5.1.1: Task-Resource Matching

C'		X'	W (Weight)		A (Availability)		A' (MIN(X';A)/X')		A'' (MIN(X';A)/A)	
C'_{11}	.Net Knowledge	0,9	W_{11}	0,2	A_{111}	0,7	A'_{111}	0,78	A''_{111}	1,00
C'_{12}	Vehicle Knowledge	0,7	W_{12}	0,1	A_{112}	0,6	A'_{112}	0,86	A''_{112}	1,00
C'_{13}	Simulation Software Knowledge	0,5	W_{13}	0,08	A_{113}	0,3	A'_{113}	0,60	A''_{113}	1,00
C'_{14}	Database Knowledge	0,7	W_{14}	0,09	A_{114}	0,1	A'_{114}	0,14	A''_{114}	1,00
C'_{15}	Design skills	0,85	W_{15}	0,17	A_{115}	0,5	A'_{115}	0,59	A''_{115}	1,00
C'_{16}	Layouting Knowledge	0,85	W_{16}	0,17	A_{116}	0,6	A'_{116}	0,71	A''_{116}	1,00
C'_{17}	Sensor/Microcontroller Knowledge	0,5	W_{17}	0,06	A_{117}	0,4	A'_{117}	0,80	A''_{117}	1,00
C'_{18}	C# Programming Skills	0,8	W_{18}	0,1	A_{118}	0,8	A'_{118}	1,00	A''_{118}	1,00
C'_{19}	Writing Skills	0,3	W_{19}	0,03	A_{119}	0,5	A'_{119}	1,00	A''_{119}	0,60
C'_{21}	Likes working in teams	0,5	W_{21}	0,13	A_{121}	0,8	A'_{121}	1,00	A''_{121}	0,63
C'_{22}	Extroverted	0,3	W_{22}	0,09	A_{122}	0,5	A'_{122}	1,00	A''_{122}	0,60
C'_{23}	Adapting to new situations	0,6	W_{23}	0,15	A_{123}	0,6	A'_{123}	1,00	A''_{123}	1,00
C'_{24}	Likes to design	0,85	W_{24}	0,2	A_{124}	0,4	A'_{124}	0,47	A''_{124}	1,00
C'_{25}	Likes working with layouts	0,8	W_{25}	0,2	A_{125}	0,9	A'_{125}	1,00	A''_{125}	0,89
C'_{26}	Understanding in customers needs	0,6	W_{26}	0,13	A_{126}	0,4	A'_{126}	0,67	A''_{126}	1,00
C'_{27}	Can work independently	0,4	W_{27}	0,1	A_{127}	0,5	A'_{127}	1,00	A''_{127}	0,80
C'_{31}	Experience with car systems	0,8	W_{31}	0,2	A_{131}	0,1	A'_{131}	0,13	A''_{131}	1,00
C'_{32}	Experience with .Net projects	0,75	W_{32}	0,19	A_{132}	0,5	A'_{132}	0,67	A''_{132}	1,00
C'_{33}	Experience with GUIs	0,7	W_{33}	0,15	A_{133}	0,9	A'_{133}	1,00	A''_{133}	0,78
C'_{34}	Experience with WPF	0,6	W_{34}	0,1	A_{134}	0,8	A'_{134}	1,00	A''_{134}	0,75
C'_{35}	Experience with CarComp. Layouts	0,7	W_{35}	0,13	A_{135}	0,5	A'_{135}	0,71	A''_{135}	1,00
C'_{36}	Experience with C#	0,7	W_{36}	0,13	A_{136}	0,7	A'_{136}	1,00	A''_{136}	1,00
C'_{37}	Experience with databases	0,6	W_{37}	0,1	A_{137}	0,6	A'_{137}	1,00	A''_{137}	1,00

Figure 5.1.2: Individual Availability

A'		A''	
A'_{11}	0,70	A''_{11}	0,99
A'_{12}	0,85	A''_{12}	0,87
A'_{13}	0,72	A''_{13}	0,94

Figure 5.1.3: Normalisation

Chapter 6

Risk Analysis

Author: Simon Schneider
Contributor(s):

Risk analysis is a process which enables the analysis of risks, associated within a project. A Risk can be generally defined as the probability of something going wrong, and the negative consequences if it does. However, it is hard to find all the risks, which can occur, in a project. At first it should be recognised that a risks exists as a consequence of uncertainty. For this reason the risk analysis process will help to identify potential problems that may occur. Such a risk analysis can be useful in several situations:

- To help to anticipate and neutralise possible problems when planning projects.
- To decide wether to continue with the project or not.
- To improve safety and manage potential risks in the workplace.

6.1 Identifying the Risks

As one of the first steps in Risk Analysis it is to identify the existing and possible problems occur. Some of these areas and threats, which might have an impact on this project, are listet below:

- Project Members - Illness, injury, or another reason leading to a loss of a project member.
- Operational Delays in deliveries.
- Reputational Loss of customer or employee confidence.
- Project Taking too long on concluding key tasks, or experiencing issues with product or service quality, goal not achieved.
- Financial Budget exhausted, Business failure or non-availability of funding.

6.2 Estimate Risks

After some of the possible threats has been faced, the risk can be calculated with both the likelihood of these threats being realised, and their possible impact. One way of doing this is to make a estimation of the probability that this threat occurrs multiplied by the amount it will cost. This leads to the following equation which quantifies the risk:

$$Risk = Probability\,of\,Occurance \cdot Cost \tag{6.1}$$

Additionally there are two possible kinds of processes:

- The total value of a risk of a series of processes that are executed successively can be calculated as follows:

$$R_{Total} = R_n \cdot R_{n+1} \tag{6.2}$$

- The total value of a risk of parallel processes that are executed concurrent can be calculated as follows:

$$R_{Total} = 1 - (1 - R_n) \cdot (1 - R_{n+1}) \tag{6.3}$$

As an example the risk value of an illness of a project member will be calculated. The estimated propbillity will be set to 0.2. Lets assume that the member is ill for about a week. One day has 8 working hours and the salary for this member would be 50£ per hour.

$$Risk = Probability\,of\,Occurance \cdot Cost = 0.2 \cdot 5 \cdot 8 \cdot 50£ = 400£ \quad (6.4)$$

So the risk value for this threat would be 400£.

In order to determine what risks to focus on, an Impact / Probability Chart can be very useful. An Impact / Probability Chart is a two dimensional diagram whereat on the axis of ordinates the probability of Occurrence will be plotted and on the axis of abscissas the impact on the project. The following figure shows an exemplarily Impact / Probability Chart:

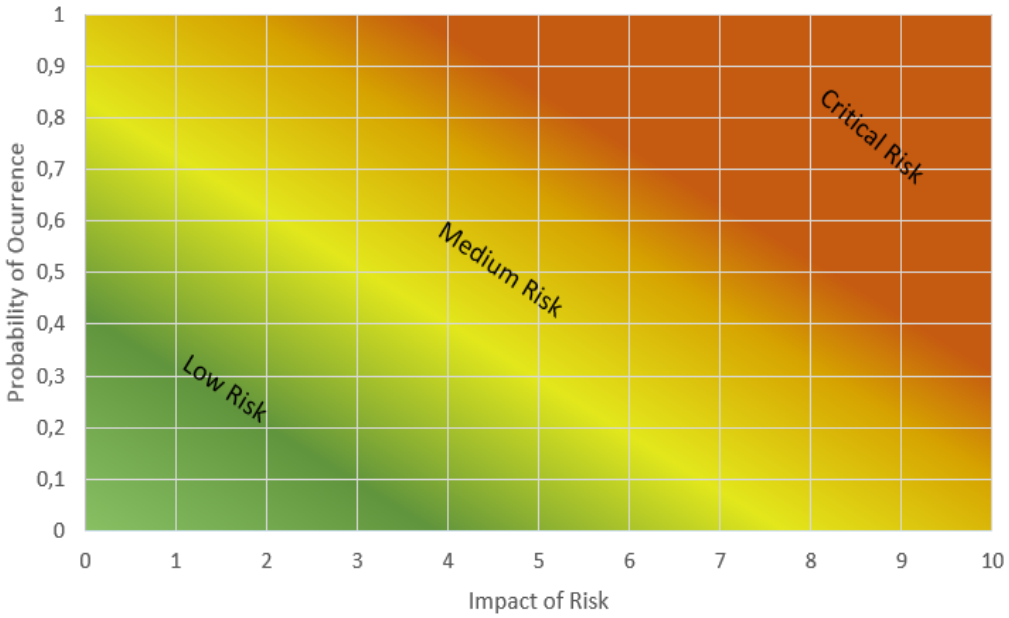


Figure 6.2.1: Impact / Probability Chart

As it can be seen, the chart has several areas. With help of this areas it can be figured out, if the the risk has priority or not. The characteristics of these areas will be explained subsequently:

- Low impact/low probability - risks in this area can often be ignored.

- Low impact/high probability these risks are of moderate importance but they have to be noticed and it should be tried to avoid that they occure
- High impact/low probability - these are of high importance and should not occure because the probablility is very low. If so, a contingency plans should be available.
- High impact/high probability risks in this area are of critical importance and have the highest priority.

To successfully execute a project, the risks has to be identified. Afterwards the focus has to be on the middle and high-priority risks. Otherwise resources on unecessary risks will be a waste. **beispiele fr risk avoiden und zum schluss den tollen satz mit: je weiter das projekt fortgeschritten ist desto geringer wird das risiko**

Chapter 7

Market Analysis

Author: Timo Acquistapace
Contributor(s): Wurst

An important step in the development of a new product is to analyse the market. This analysis not only includes the identification of competitors and their offered technologies, but also the investigation of the demand on the product to develop and its future progression.

The subsequent analysis is done in an indirect way so that the presented information is retrieved by querying the internet and putting altogether the relevant information.

7.1 Current Systems implemented in today's Cars

There are only a few systems available that help the driver in leaving a parking space. These systems exhibit a huge variety of autonomy. The manufacturers Volvo, Audi and Lincoln sheet park assistance systems that take control over the steering wheel when leaving a parking lot (see Volvo Cars Support [2016], Lincoln Motor Company [2014] and Audi Espana). While the steering is done autonomously, the driver has to manually operate the pedals. This kind of systems is mostly restricted to parallel parking.

Mercedes-Benz offers a more autonomous, but also more restricted way of assisted parking. The Mercedes Benz Parking Pilot is able to park and leave

the parking site autonomously. The quitting of the parking site is restricted to those scenarios in which the Parking Pilot was also used to park the car (see Daimler AG [2016]).

Tesla offers the Summon functionality implemented in its Model S and Model X. It allows a driver to leave its car and park as well as retrieve it autonomously. This feature is restricted to perpendicular parking only (see Tesla Inc. [2016]).

7.2 Current Systems available from Suppliers

The development of systems assisting a driver in parking and leaving a parking lot can be illustrated by the evolution of the products originating from Robert Bosch GmbH. While the early systems act as it was described for the manufacturers Volvo, Audi and Bosch (see Robert Bosch GmbH [2013a]), the current systems are now able to drive itself into and back out of a parking site autonomously (see Robert Bosch GmbH [2013b]). Another future application of park assistants is the Bosch Home Zone Park Assist. It enables a driver to train its car for certain parking situations (see Robert Bosch GmbH [2016]). The car records a route that is driven and it is able to reproduce it even if the starting point of the route to drive and the one of the recorded route is slightly different. On its trained way, the car is able to detect impediments and to react to them.

7.3 Scientific Projects

There exist several projects that target on the functionality of autonomously parking to and leaving from a parking lot. While the work of Katsev and Braun (see Braun and Katsev [2004]) that already started in 2004 seems not to have reached the point where leaving a parking lot is implemented since no further resources can be found on that project, Roland Doloczki and Don Kevin Gaubitz produced a working prototype of RC-Car that autonomously leaves a parking space (see Doloczki and Gaubitz [2015]). To achieve their

goal, Doloczki and Gaubitz use ultrasonic and infrared sensors to sense the environment around parked vehicle.

7.4 Development of the market

It is obvious that the demand on systems that perform certain manoeuvres autonomously will increase with the success of autonomous cars. But also in the meantime till these cars make the breakthrough, there might be an increased need for Advanced Driver Assistance Systems (ADAS) like parking assistants. Following McKinsey Inc., there will be three eras in the revolution of self-driving cars (see Bertoncello and Wee [2015]). The first era, starting from now and lasting till the late 2020s, is characterised by the first autonomous vehicles being produced and their impact on established car manufacturers. McKinsey states that the premium makers will take an incremental approach to autonomous vehicles by implementing more sophisticated ADAS. This assumption is supported by Statista, assuming that the shipment of ADAS units will increase by more than 500% in the time from 2012 to 2020 (see Statistica Inc.).

One of the buzz word regarding future driver assistance systems is Valet Parking which means that a car parks itself after the driver has left it and that the car can be retrieved from its parking position without active control of the driver. Therefore, Valet Parking needs the possibility of a car autonomously leaving its parking site. A research project targeting on Valet Parking was announced by Daimler, Bosch and Car2go in the year 2015 (see Daimler AG [2015]).

7.5 Conclusion

It has been worked out that the systems that are implemented in todays cars are less sophisticated than the system that is planned to develop. Additionally, the increasing need for ADAS like park assistants has been exposed. However, there are other scientific projects that aim on the same

kind of system and that have to be overcome by additional functionality or improved safety and reliability. The major competitor in this sector will be the Robert Bosch GmbH that already demonstrated its product with a real vehicle and that is working together with a lot of important car manufacturers like Daimler or Audi.

Chapter 8

Tasks and Work Plan

Author: Hans
Contributor(s): Wurst

Chapter 9

Process Flow, Critical Path Identification and Predictive Models

Author: Hans
Contributor(s): Wurst

Chapter 10

Customer Reports and Analysis

Author: Timo Acquistapace
Contributor(s): Wurst

Giving the customer the possibility to participate in the development of a product by providing him transparency regarding the overall progress and by implementing its feedback is one of the most important success factors. Especially if the final results of the collaboration are not explicitly clear or if the project is some kind of research work, it is of highest importance to gather the customers feedback continuously. The gained feedback serves as an input in adapting the product or even the whole process of development.

Especially in the area of software development, the need for constant interaction between a manufacturer and its customer is widely acknowledged. This fact can be demonstrated by the adoption of agile methods (see figure 10.0.1). These methods, like XP, Scrum and FDD, offer the possibility of high transparency, short feedback-cycles and increased flexibility regarding changes in the requirements or in the market - characteristics that proved themselves good and that are strongly wanted by the manufacturers adopting agile methods (see figure 10.0.2).

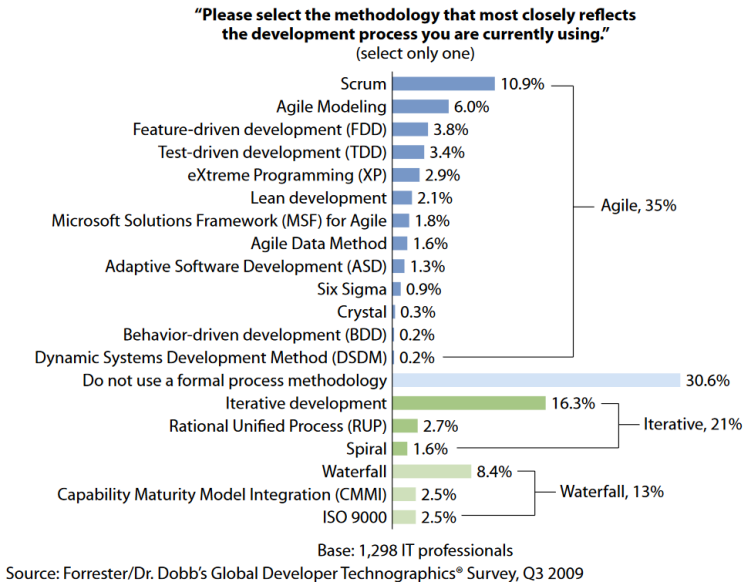


Figure 10.0.1: Adoption of agile Methods in Software Development (West and Grant [2010])

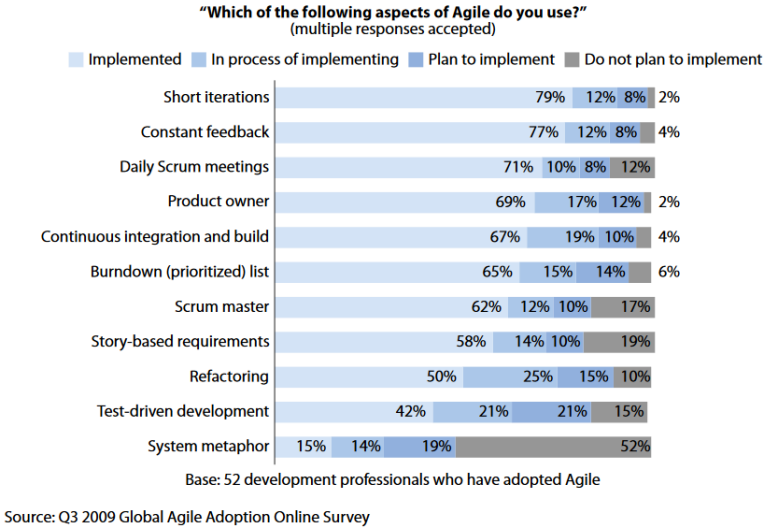


Figure 10.0.2: Adoption of agile Methods in Software Development (West and Grant [2010])

10.1 Determining the Modalities of Collaboration

To embed a process that as well satisfies the customer as it provides the manufacturer the possibility to get as much useful input and feedback as possible, the modalities of collaboration are negotiated as a first step. The salient points in this negotiation are:

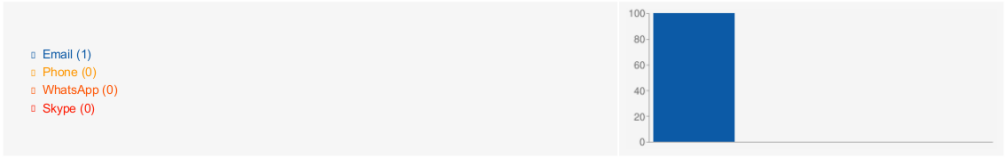
- Who is the customer's specialist contact person and how should the communication with him/her take place?
- Who is the customer's technical contact person and how should the communication with him/her take place?
- In which way will the customer contact our company if necessary?
- What are the customers preferences regarding the reports on the projects progress?

While some of these points like the contact information of a certain person in charge are only of informational kind, other points like the desired way of communication are of high importance. Since there are certain preferences in our company regarding the length of the iterations and the way how the communication should take place, the CORE value of the customers answers in respect of our companys preferences is calculated.

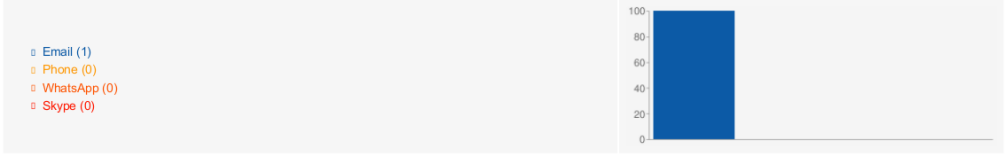
10.1.1 Results

The results of the first questionnaire that serves to determine the modalities of collaboration between our company and our customer are presented in this section. The analysis of the results can be found in section 10.1.2. Answers that contain personal data like contact information are omitted.

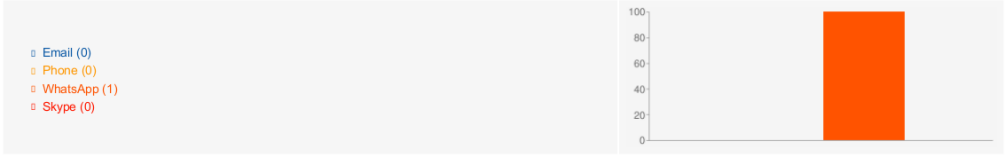
Section	Question title	Question average Satisfaction Value by CORE	Type	Mandatory	CORE	Median	Standard deviation	Mode	CORE verbal range	CORE colour
How we may reach your specialist contact person:	What ways of communication would be acceptable for you?	-	Multiple choice	Yes	No	1	0	1/	-	



How we may reach your specialist contact person:	Please tell us the contact information of your specialist contact person:	-	Textual	Yes	No	-	-	-	-	
Please tell us the contact information of your technical contact person:	What ways of communication would be acceptable for you?	-	Multiple choice	Yes	No	1	0	1/	-	

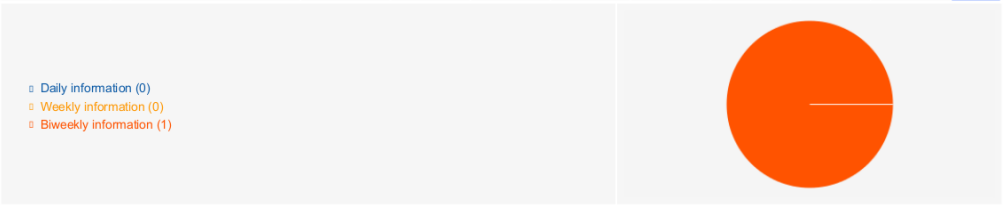


Please tell us the contact information of your technical contact person:	Please tell us the contact information of your technical contact person:	-	Textual	Yes	No	-	-	-	-	
How you want to reach us:	Your preferred way of communication:	-	Multiple choice	Yes	No	3	0	3/	-	



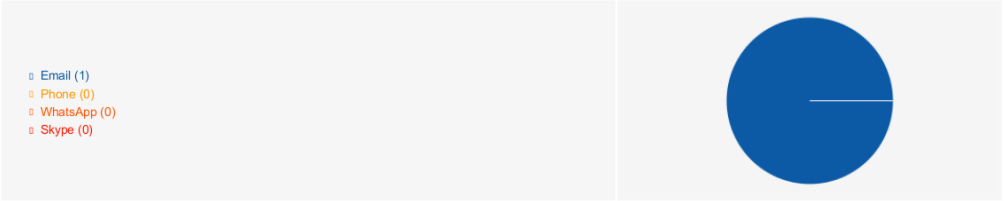
How you want to reach us:	Who do you want to reach in the case of a problem or a change of scope?	100	Exclusive choice	Yes	Yes	100	0	100/	Outstanding	

Exchange of information about the project's progress	How often do you like to be informed about the progress of the project?	100	Exclusive choice	Yes	Yes	100	0	100/	Outstanding

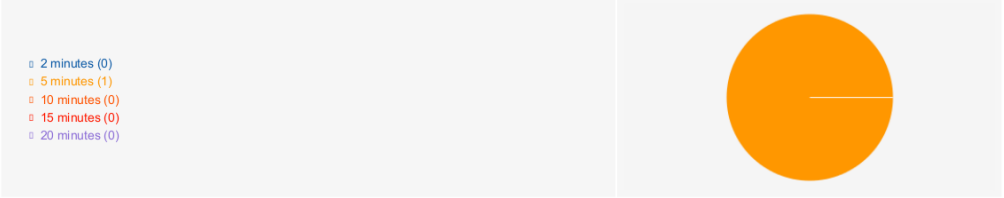


Exchange of information about the project's progress	How much technical detail do you expect from these regular informations?	100	Exclusive choice	Yes	Yes	100	0	100/	Outstanding

Exchange of information about the project's progress	What is your prefer way of communication the project's progress?	100	Exclusive choice	Yes	Yes	100	0	100/	Outstanding



Future use of questionnaires	How much time do you want to spend on answering a future questionnaire at a max?	44	Exclusive choice	Yes	Yes	44	0	44/	Poor



Future use of questionnaires	How long did you spend on answering this questionnaire?	65	Exclusive choice	Yes	Yes	65	0	65/	Satisfactory

Future use of questionnaires	Do you have some other important points regarding our collaboration that this questionnaire didn't cover?	-	Textual	Yes	No	-	-	-	-

10.1.2 Gained Knowledge

The result of the questionnaire is as well important as it is satisfactory to our company since the most answers given by the customer reflect the preferences of our company. This is especially true regarding the questions on the way our company will contact the customer, on the interval that is used for reporting and on the reportings level of detail.

While the fact that our customer wants to contact the project manager and not any other team member complies with our companys preferences, the way of contacting him is suboptimal in our opinion. Nevertheless, our company will attend the customers wished in this point.

To be able to gain honest and serious feedback from following questionnaires and not to overstrain our customers willingness to collaborate, the last section deals with questionnaires in general. It is determined how long it took to answer the current questionnaire and how much time our customer is willing to spent in answering future questionnaires. For the simple reason that it was estimated that answering the current questionnaire would take 10 minutes, the CORE value retrieved from the answers on these questions is not highest achievable value. However, the result shows that the questionnaires length perfectly fit the customers preferences. Future questionnaires will therefore be designed in a way that they nearly have the same length

Form title	Form average Satisfaction Value by CORE	Number of sections	Number of questions	Number of answers	Last answered by	Last answered on	CORE verbal range	CORE colour
CollaborationQuest	85	5	13	1	Taeg5Customer	2017-04-01	Outstanding	

Section title	Form average Satisfaction Value by CORE	Number of questions	CORE verbal range	CORE colour
How we may reach your specialist contact person:	None	2	-	
Please tell us the contact information of your technical contact person:	None	2	-	
How you want to reach us:	100	2	Outstanding	
Exchange of information about the project's progress	100	4	Outstanding	
Future use of questionnaires	55	3	Fair	

Figure 10.1.1: Overview of first Questionnaire's Results

and the CORE values for the options on the question how long it took to answer a questionnaire will be adapted.

10.2 Clarification of the Requirements and Assessment of the first Design

Prototype Gathering and writing down requirements for a product requires high prudence. Young [2004] defines 15 characteristics of good requirements. Even if high effort is expended in the process of requirements engineering, there are mostly requirements that dont exhibit all of these characteristics. In the most cases, these requirements lack clarity and expressiveness.

The unclear requirements as well as a first mockup are the basis of a second questionnaire. Its aims are to inform the customer how the vague requirements were interpreted in the first step, to offer the customer the possibility to give a feedback on this interpretation and to provide him a first sense of the product that will be developed. The mockup that was created for the purpose of this questionnaire is depicted in figure 10.2.1.

10.2.1 Results

The results that help to clarify the requirements and to get a first feedback on the planned design are depicted below and interpreted in the next section

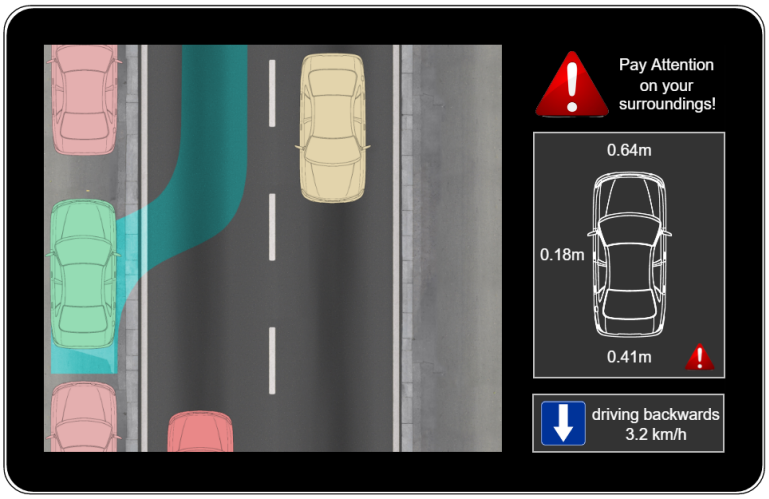


Figure 10.2.1: Initial Mockup of the System

(see section 10.2.2). Since a mistake has been made on the creation of the questionnaire, the assessment how long it took the customer to answer it had to be done in an additional form. The results of the initial survey and the additional form are assembled together.

Questions on the mandatory functional Requirements	Requirement 2.6 states: "The application should provide relevant sensor information to the driver in a graphical overview". We identified the distance to any impediment on any side of the car, approaching cars and the current state of motion (speed, direction) as "relevant information" that could be retrieved from the sensors. Do you identify any other relevant information?	100	Exclusive choice	Yes	Yes	100	0	100/	Outstanding	
Yes (0) No (1)										
Questions on the mandatory functional Requirements	If yes: Which sensor information do you want to be added to the graphical overview?	-	Textual	No	No	-	-	-	-	

Questions on the mandatory functional Requirements	Requirement 2.7 states: "The application should provide information about the current action to the driver in an aerial car view". We identified the current state of motion (speed, direction) and the planned trajectory as important information. Do you identify any other relevant information about the current action?	100	Exclusive choice	Yes	Yes	100	0	100/	Outstanding	

Yes (0)
No (1)

Questions on the mandatory functional Requirements	If yes: Which information on the current action do you want to be added to the graphical overview?	-	Textual	No	No	-	-	-	-	

Questions on the mandatory functional Requirements	Requirement 2.11 states: "The application should consider the traffic rules and should act properly". The traffic rules of which country should be implemented in a first step?	-	Exclusive choice	Yes	No	1	0	1/	-	

Great Britain (1)
Germany (0)
France (0)
USA (0)
other (0)

Questions on the mandatory functional Requirements	If you chose "Other": Which country should we chose?	-	Textual	No	No	-	-	-	-	

Questions on the mandatory functional Requirements	Do you have any further comments on the mandatory requirements?	-	Textual	No	No	-	-	-	-	

Please inform us early if some of these requirements can not be implemented

Questions on the Design Prototype	Requirement 3.2 states: "The application should have a suitable design". Since "suitable" is a very generic term: How much are you satisfied with the general structure of our mockup?	76	Exclusive choice	Yes	Yes	76	0	76/	Excellent	

Questions on the Design Prototype	Are there any improvements regarding the general structure? If yes, please feel free to tell us about it!	-	Textual	No	No	-	-	-	-	

- Currently, the structure is good. But please do not make the area for the sensor information smaller.

Questions on the Design Prototype	Are the sensor information (distances to impediments and speed) presented clearly enough in the mockup?	100	Exclusive choice	Yes	Yes	100	0	100/	Outstanding	

Questions on the Design Prototype	If not: Do you have any suggestions for a better representation?	-	Textual	No	No	-	-	-	-	

Questions on the Design Prototype	Are the information about the current action that is taken presented clearly enough?	35	Exclusive choice	Yes	Yes	35	0	35/	Poor	

Questions on the Design Prototype	If not: Do you have any suggestions for a better representation?	-	Textual	No	No	-	-	-	-	

- Please write only \"Backwards\". To much text distracts the driver

Questions on the Design Prototype	Are the symbols that we used self-explaining enough?	100	Exclusive choice	Yes	Yes	100	0	100/	Outstanding

Questions on the Design Prototype	Do you have any suggestions on how to improve the used symbols?	-	Textual	No	No	-	-	-	-

- Please make sure that you have the rights to use these symbols.

Questions on the Design Prototype	Are you satisfied with the coloring of our mockup which might be the first standard template?	100	Exclusive choice	Yes	Yes	100	0	100/	Outstanding

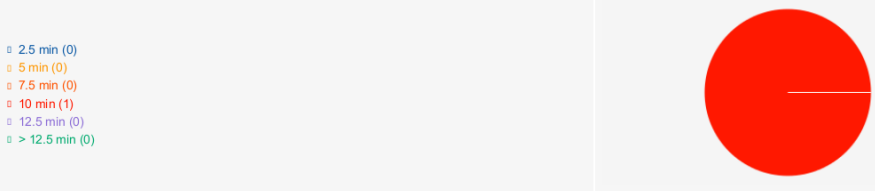
Questions on the Design Prototype	Do you have any suggestions on how to improve the coloring of the standard template?	-	Textual	No	No	-	-	-	-

- You should provide another standard template that is not that dark. May be one template for night-mode (the presented) and one for day-mode (the brighter one)

Questions on the Design Prototype	Do you have any further comments regarding the first draft of our design?	-	Textual	No	No	-	-	-	-

- No.

Assessment of your Effort	How long did it take you to answer the previous Questionnaire?	54	Exclusive choice	Yes	Yes	54	0	54/	Fair



10.2.2 Gained Knowledge and further Steps taken

As it can be seen in 10.2.2, the results are very satisfying and the interpretation of the requirements fits the customers expectations. More detailed feedback could be gathered regarding the design of the system. In the further development, our company will focus its attention to simplify the design e.g. by shortening the presented texts and by trying to scale up the area that presents the sensor information.

Unfortunately, the customer was not able to answer the questionnaire within 5 minutes as preferred, although the open questions on the optional requirements were already omitted. Since this was expected and the clarification of the requirements is a very important point, it is acceptable in the case of the current survey. Nevertheless, there has to be some effort made in the future to keep the questionnaires as short as possible for not deceiving the customer again in this regard.

Form title	Form average Satisfaction Value by CORE	Number of sections	Number of questions	Number of answers	Last answered by	Last answered on	CORE verbal range	CORE colour
Clarification on the Requirements and the Design	91	2	18	1	Taeg5Customer1	2017-04-08	Outstanding	
Clarification on the Requirements and the Design II	54	1	1	1	Taeg5Customer1	2017-04-08	Fair	

Figure 10.2.2: Overview of second Questionnaire's Results

Chapter 11

Product Development and Production Life Cycle Analysis

Author: Simon Schneider, Timo Acquistapace

TODO: There should be some blabla.

11.1 Use Case Diagram

Based on the requirements that were agreed on with the customer, two main use cases of the system can be found:

- Drive out of a perpendicular Parking Lot
- Drive out of a parallel Parking Lot

Both use cases have in common that at the end of the successful process, the user has to regain the control over its vehicle in a defined way. Additionally, the user should always have the possibility to interrupt the process and regain the control over the car, even if the process has not yet finished. Each of the use cases are triggered by the driver as well as they are supported by various sensors and control systems.

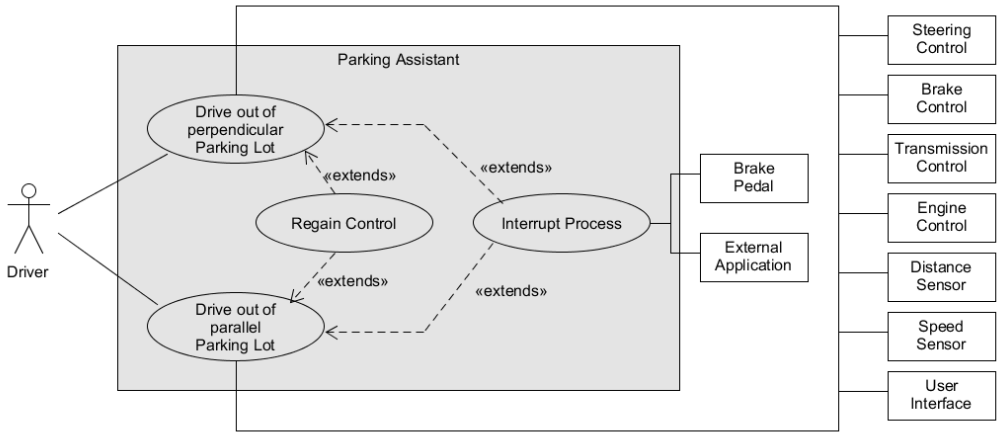


Figure 11.1.1: Overview of the System's Use Cases

11.2 Sensor Overview

To support the presented use cases, the system needs an overview of the cars surrounding. Six sensors, two of them cameras and 4 of them distance sensors, are placed in the car to provide this overview. The placement of the sensors can be retrieved from figure 11.2.1.

The sensors that are placed in the middle of the cars front and rear are cameras. In many cases cameras are already integrated in the car and provide the user a realistic image of its surrounding. The distance sensors at the corners of the bumpers might be radar- or ultrasonic-sensors. Radar sensors have the advantage, that they might be placed within the bumper and that they are therefore not visible.

11.3 Context Diagram

After the use cases and the required sensors have been found, the context of the system to develop can be determined (see figure 11.3.1). Dataflows are depicted with solid arrows while signals that are used to control the systems are sketched with dashed arrows.

Beside the sensor information, the graphical representation of the process

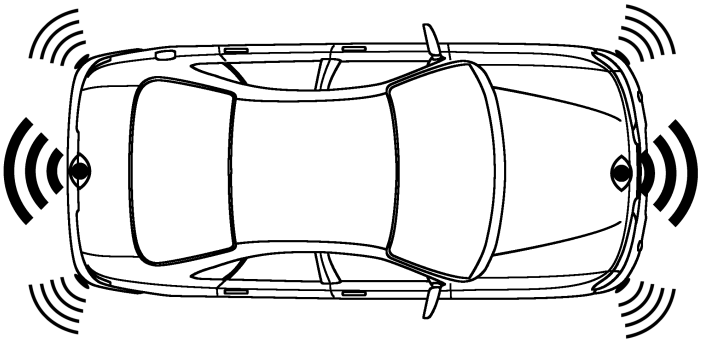


Figure 11.2.1: Overview of the System' Sensors

and the information that is sent to the cars control systems, there exist two systems that are used to interrupt the process of leaving a parking lot. If a driver sits in the car and presses the break pedal, the process will be interrupted immediately and the driver will regain the control over its vehicle. If the whole process is controlled remotely without the driver sitting in its car, the external application that controls the process should act as a dead mans switch that is operated by the user. If the signal from this application is no more retrieved by the system, the process should be interrupted.

11.4 Activity Diagram Perpendicular Parking

11.5 Activity Diagram Parallel Parking

11.6 Design Sketches

A first design sketch has been developed (see figure 10.2.1) and the customers feedback on the design has been gathered, this feedback is used to create refined mockups. Since the customer requests two designs – one for the day

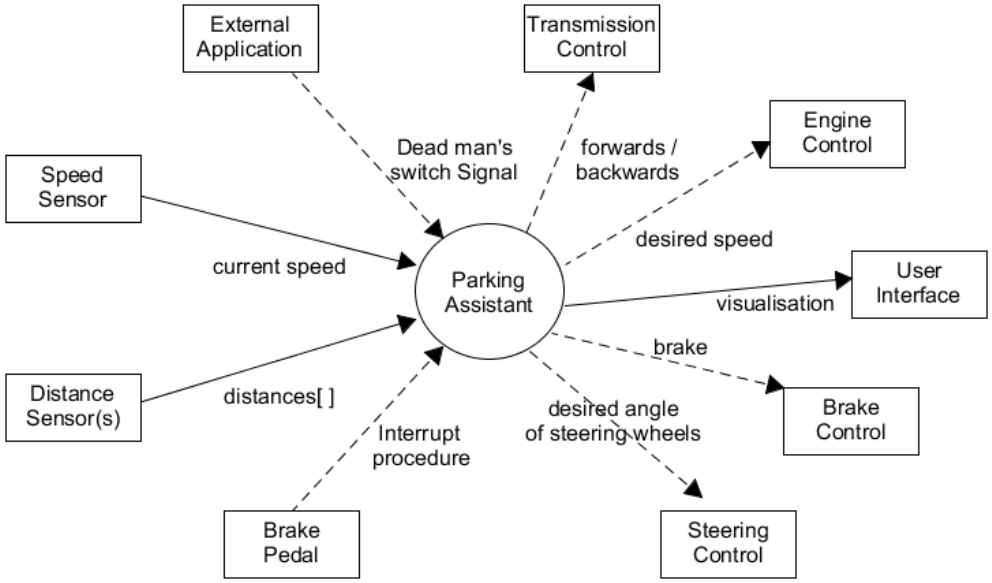


Figure 11.3.1: Context Diagram of the System

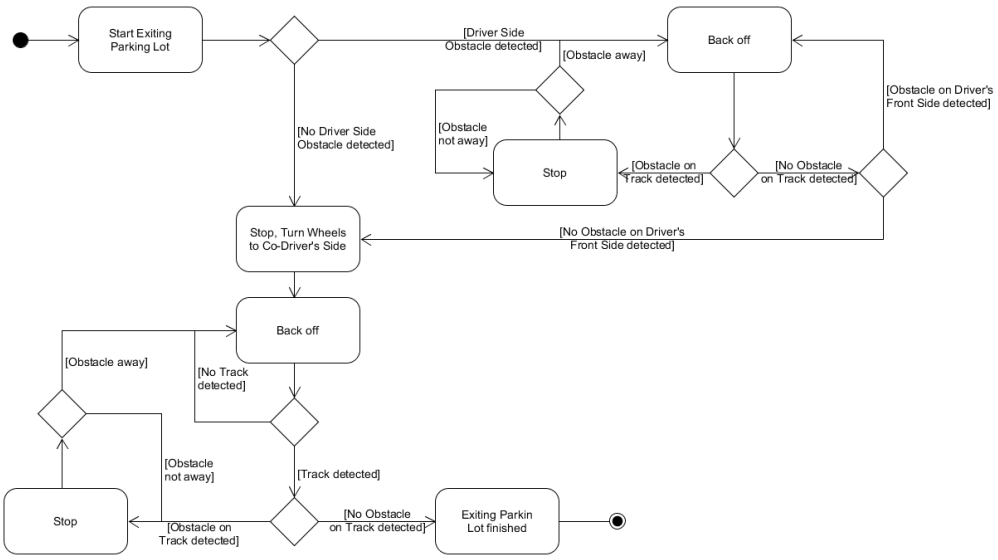


Figure 11.4.1: Algorithm for leaving a perpendicular Parking Situation

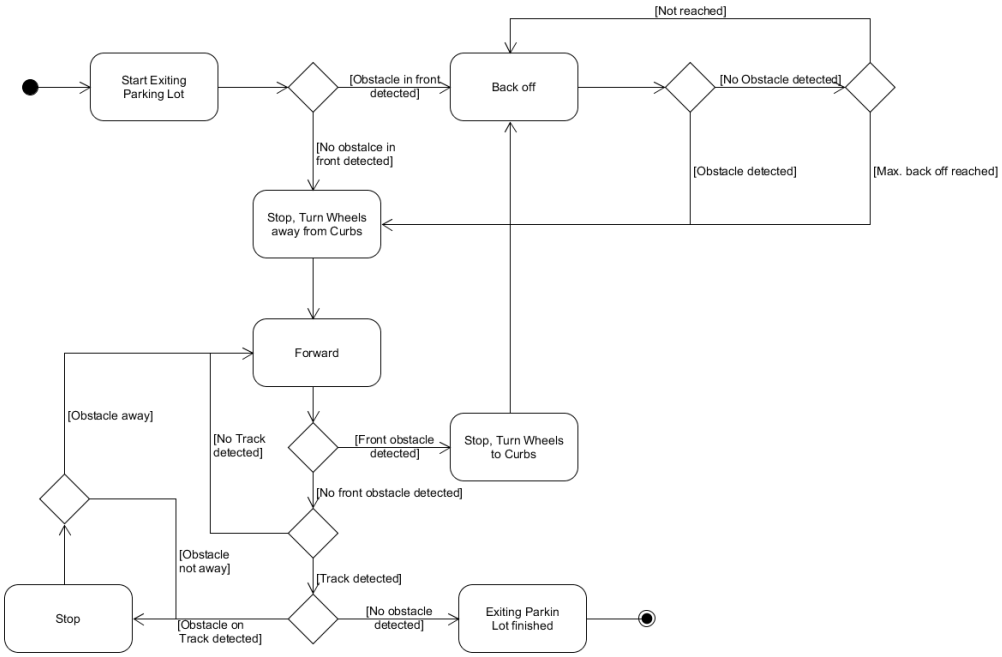


Figure 11.5.1: Algorithm for leaving a parallel Parking Situation

and one for the night-mode – two of these refined designs are developed.

These newly designed mockups also take the customers feedback into account that some outputs should be simplified and that the area where the sensor information is presented should not be reduced. Instead, the area presenting the aerial view is reduced and the sensor information are presented in a wider area.

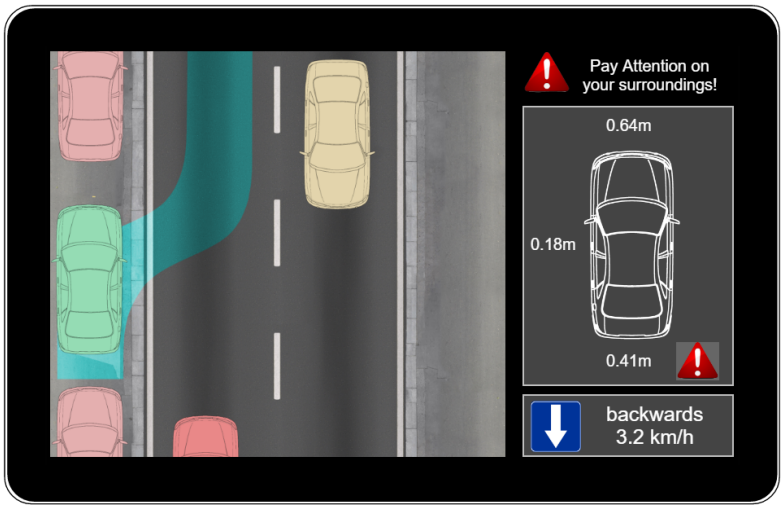


Figure 11.6.1: Dark Skin of the final Design Sketch

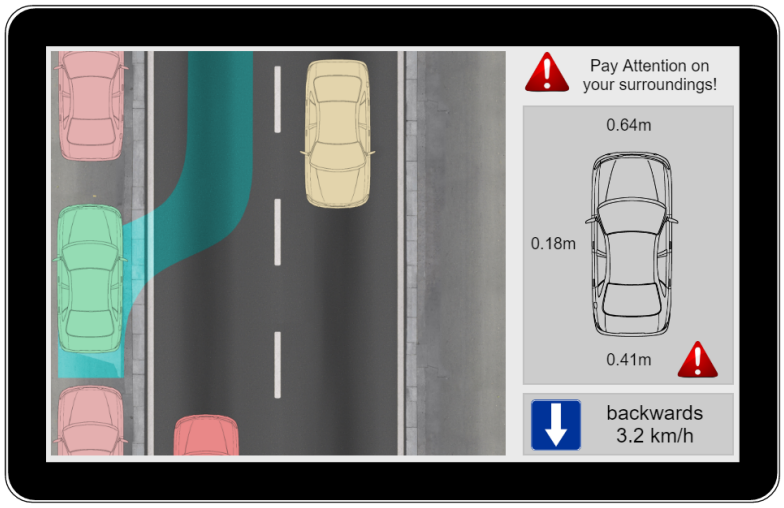


Figure 11.6.2: Bright Skin of the final Design Sketch

Chapter 12

Facilitation and Monitoring of the Process

Author: Hans
Contributor(s): Wurst

Chapter 13

Conclusions

Author: Hans
Contributor(s): Wurst

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