



Elektrobit



UDACITY

Functional Safety Concept Lane Assistance

Document Version: [Version]

Template Version 1.0, Released on 2017-06-21



Document history

[Instructions: Fill in the date, version and description fields. You can fill out the Editor field with your name if you want to do so. Keep track of your editing as if this were a real world project.

For example, if this were your first draft or first submission, you might say version 1.0. If this is a second submission attempt, then you'd add a second line with a new date and version 2.0]

Date	Version	Editor	Description
01.04.2018	1.0	Siddarth Kothiwale	First Trial

Table of Contents

[Instructions: We have provided a table of contents. If you change the document structure, please update the table of contents accordingly. The table of contents should show each section of the document and page numbers or links. Most word processors can do this for you. In Google Docs, you can use headings for each section and then go to Insert > Table of Contents. Microsoft Word has similar capabilities]

[Document history](#)

[Table of Contents](#)

[Purpose of the Functional Safety Concept](#)

[Inputs to the Functional Safety Analysis](#)

[Safety goals from the Hazard Analysis and Risk Assessment](#)

[Preliminary Architecture](#)

[Description of architecture elements](#)

[Functional Safety Concept](#)

[Functional Safety Analysis](#)

[Functional Safety Requirements](#)

[Refinement of the System Architecture](#)

[Allocation of Functional Safety Requirements to Architecture Elements](#)

[Warning and Degradation Concept](#)

Purpose of the Functional Safety Concept

[Instructions: Answer what is the purpose of a functional safety concept?]

Answer: The functional safety concept looks at item from higher level without going too deep in technicalities.

We need to allocate these safety requirements to the relevant parts of the system diagram.

Allocation means defining which part of the system architecture will implement each requirement. This could involve expanding the system architecture with new element blocks.

We will then refine the system architecture to handle the new requirements.

This all information is handled in Functional safety concept.

Inputs to the Functional Safety Concept

Safety goals from the Hazard Analysis and Risk Assessment

[Instructions:

REQUIRED:

Provide the lane departure warning and lane keeping assistance safety goals as discussed in the lessons and derived in the hazard analysis and risk assessment.

OPTIONAL:

If you expanded the hazard analysis and risk assessment to include other safety goals, include them here.

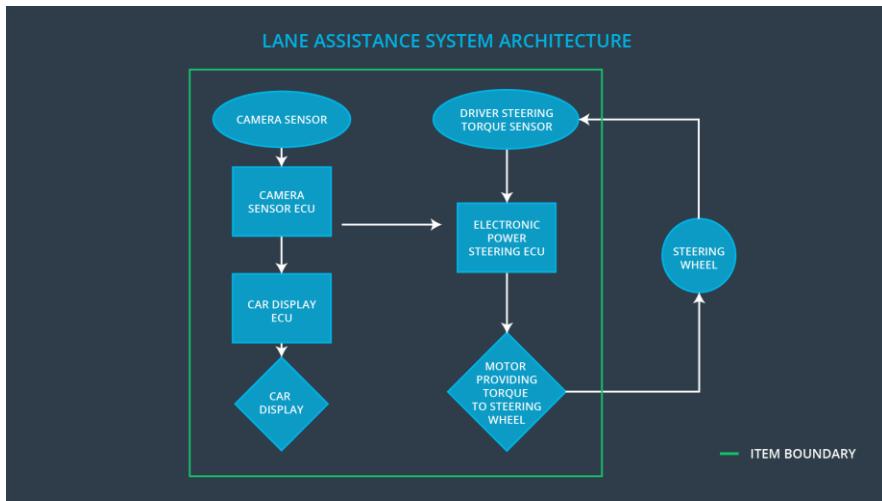
]

ID	Safety Goal
Safety_Goal_01	The Oscillating steering torque from the lane departure warning function

	shall be limited.
Safety_Goal_02	The Lane keeping assistance function shall be time limited and the additional steering torque shall end after a given time interval so that the driver cannot misuse the system for autonomous driving

Preliminary Architecture

[Instructions: Provide a preliminary architecture for the lane assistance item. Hint: See Lesson 3: Item Definition]



Description of architecture elements

[Instructions: Provide a description for each of the item elements; what is each element's purpose in the lane assistance item?]

Element	Description
Camera Sensor	To record the video of the road ahead
Camera Sensor ECU	To process the video from Camera Sensor and detect

	the lane lines
Car Display	To Display the warnings such as lane departure
Car Display ECU	Car Display processes the input from the Camera sensor ECU and provides different warnings
Driver Steering Torque Sensor	It detects the torque that the driver is providing
Electronic Power Steering ECU	The ECU calculates the necessity and the amount of torque that needs to be provided to keep the car in the lane
Motor	The Motor is the actuator here. It takes the input from the ECU and then provides the required torque to the steering wheel

Functional Safety Concept

The functional safety concept consists of:

- Functional safety analysis
- Functional safety requirements
- Functional safety architecture
- Warning and degradation concept

Functional Safety Analysis

[Instructions: Fill in the functional safety analysis table below.]

Malfunction ID	Main Function of the Item Related to Safety Goal	Guidewords (NO, WRONG, EARLY, LATE, MORE, LESS)	Resulting Malfunction

	Violations		
Malfunction_01	Lane Departure Warning (LDW) function shall apply an oscillating steering torque to provide the driver a haptic feedback	MORE	The lane departure warning function applies an oscillating torque with very high torque amplitude
Malfunction_02	Lane Departure Warning (LDW) function shall apply an oscillating steering torque to provide the driver a haptic feedback	MORE	The lane departure warning function applies an oscillating torque with very high torque frequency
Malfunction_03	Lane Keeping Assistance (LKA) function shall apply the steering torque when active in order to stay in ego lane	NO	The lane keeping assistance function is not limited in time duration which leads to misuse as an autonomous driving function.

Functional Safety Requirements

[Instructions: Fill in the functional safety requirements for the lane departure warning]

Lane Departure Warning (LDW) Requirements:

ID	Functional Safety Requirement	A S I L	Fault Tolerant Time Interval	Safe State
Functional Safety Requirement 01-01	The lane keeping item shall ensure that the lane departure oscillating torque amplitude is below Max_Torque_Amplitude	C	50 ms	Turn off the system
Functional Safety Requirement 01-02	The lane keeping item shall ensure that the lane departure oscillating torque frequency is below Max_Torque_Frequency	C	50 ms	Turn off the system

Lane Departure Warning (LDW) Verification and Validation Acceptance Criteria:

ID	Validation Acceptance Criteria and Method	Verification Acceptance Criteria and Method
Functional Safety Requirement 01-01	test how drivers react to different torque amplitudes to prove that we chose an appropriate value	when the torque amplitude crosses the limit, the lane assistance output is set to zero within the 50 ms fault tolerant time interval. Method: test inserting a fault into the system and seeing what happens.
Functional Safety Requirement	test how drivers react to different torque Frequencies to prove that we chose an appropriate value	when the torque Frequency crosses the limit, the lane assistance output is set to zero within the 50 ms fault

01-02		tolerant time interval. Method: test inserting a fault into the system and seeing what happens.
-------	--	--

[Instructions: Fill in the functional safety requirements for the lane keeping assistance]

Lane Keeping Assistance (LKA) Requirements:

ID	Functional Safety Requirement	A S I L	Fault Tolerant Time Interval	Safe State
Functional Safety Requirement 02-01	the electronic power steering ECU shall ensure that the lane keeping assistance torque is applied for only Max_Duration	B	500 ms	Turn off the system

Lane Keeping Assistance (LKA) Verification and Validation Acceptance Criteria:

ID	Validation Acceptance Criteria and Method	Verification Acceptance Criteria and Method
Functional Safety Requirement 02-01	the max_duration chosen really did dissuade drivers from taking their hands off the wheel	verify that the system really does turn off if the lane keeping assistance every exceeded max_duration

Refinement of the System Architecture

[Instructions: Include the refined system architecture. Hint: The refined system architecture should include the system architecture from the end of the functional safety lesson including all of the ASIL labels.]

Allocation of Functional Safety Requirements to Architecture

Elements

[Instructions: Mark which element or elements are responsible for meeting the functional safety requirement. Hint: Only one ECU is responsible for meeting all of the requirements.]

ID	Functional Safety Requirement	Electronic Power Steering ECU	Camera ECU	Car Display ECU
Functional Safety Requirement 01-01	The lane keeping item shall ensure that the lane departure oscillating torque amplitude is below Max_Torque_Amplitude	x		
Functional Safety Requirement 01-02	The lane keeping item shall ensure that the lane departure oscillating torque frequency is below Max_Torque_Frequency	x		
Functional Safety	the electronic power steering ECU shall ensure that the lane	x		

Requirement 02-01	keeping assistance torque is applied for only Max_Duration			
----------------------	--	--	--	--

Warning and Degradation Concept

[Instructions: Fill in the warning and degradation concept.]

ID	Degradation Mode	Trigger for Degradation Mode	Safe State invoked?	Driver Warning
WDC-01	Turn off the function	Amplitude> Max_Torque_Amplitude and Frequency> Max_Torque_Frequency	Yes	Warning sign in Kombi
WDC-02	Turn off the function	If LKA active for time > Max_Duration	Yes	Warning sign in Kombi