Elektrobit

UDACITY

Technical Safety Concept Lane Assistance

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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
2017-09-19	1.0	Sundeep Tuteja	Technical Safety Concept

Table of Contents

[Instructions: We have provided a table of contents. If the table of contents is not showing up correctly in your word processor of choice, please update it. 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]

Purpose of the Technical Safety Concept

[Instructions: Answer what is the purpose of a technical safety concept?]
The technical safety concept defines how the different subsystems interact at the message level and describes how the ECUs communicate with each other.

Inputs to the Technical Safety Concept

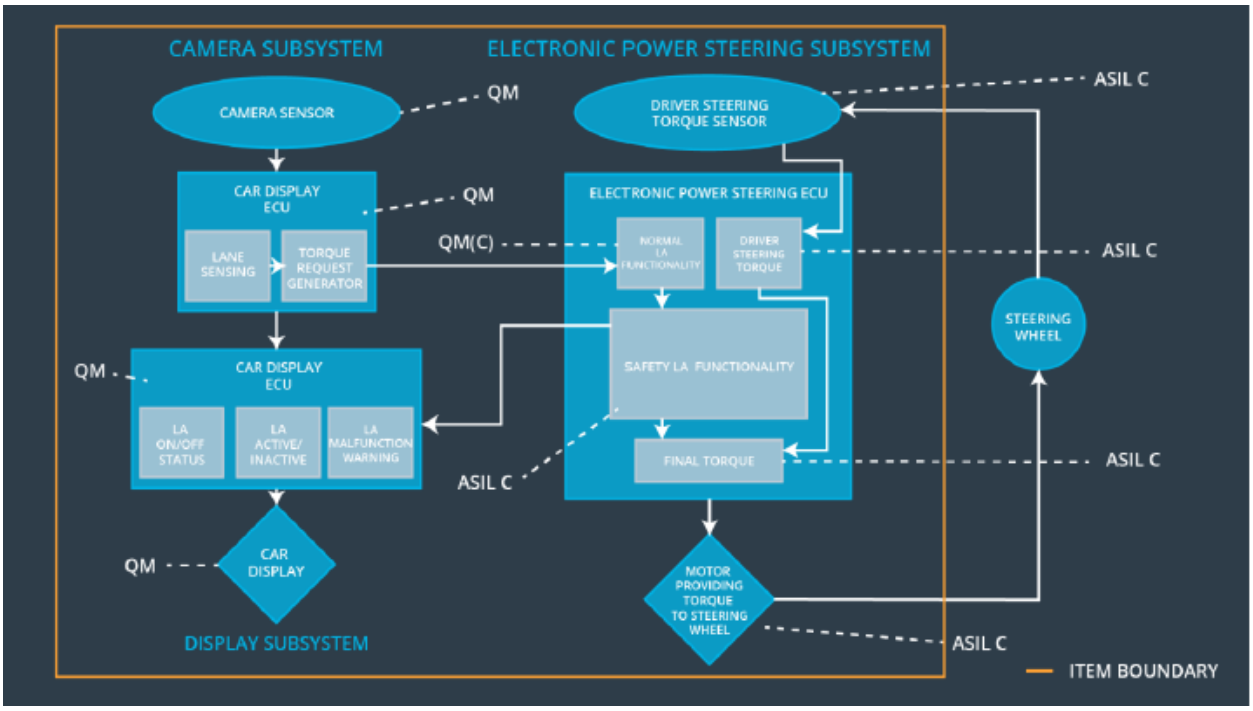
Functional Safety Requirements

[Instructions: Provide the functional safety requirements derived in the functional safety concept]

ID	Functional Safety Requirement	ASIL	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	The lane keeping item shall be disabled, output should be zero
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	The lane keeping item shall be disabled, output should be zero
Functional Safety Requirement 02-01	The lane keeping item shall ensure that the lane keeping assistance function torque is applied for only Max_Duration	B	500 ms	The lane keeping item shall be disabled, output should be zero

Refined System Architecture from Functional Safety Concept

[Instructions: Provide the refined system architecture from the functional safety concept]



Functional overview of architecture elements

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

NOTE: The diagram above is incorrect. It shows Car Display ECU twice. The two ECUs are camera sensor ECU and car display ECU

Element	Description
Camera Sensor	The camera sensor captures images from the road
Camera Sensor ECU - Lane Sensing	The Lane Sensing component of the camera sensor ECU processes the image received from the camera sensor and identifies the position of the lanes that the vehicle is closest to
Camera Sensor ECU - Torque request generator	The Torque Request Generator component of the camera sensor ECU accepts the position of the lane from the lane sensing component relative to the vehicle, and computes an appropriate torque

	request for the steering wheel that would be used for both lane departure warning and lane keeping assistance.
Car Display	The car display displays information about the lane assistance system to the driver.
Car Display ECU - Lane Assistance On/Off Status	The lane assistance on/off status component in the car display ECU will determine whether or not the lane assistance system is turned on by the driver
Car Display ECU - Lane Assistant Active/Inactive	The lane assistant active/inactive component in the car display ECU will read messages from the camera sensor ECU to determine whether or not the lane assistance system has been activated
Car Display ECU - Lane Assistance malfunction warning	The lane assistance malfunction warning component in the car display ECU will read messages from the electronic power steering ECU to determine whether or not a malfunction has occurred in the lane assistance system
Driver Steering Torque Sensor	The driver steering torque sensor reads the torque applied to the steering wheel
Electronic Power Steering (EPS) ECU - Driver Steering Torque	The driver steering torque component of the electronic power steering (EPS) ECU reads the torque from the driver steering torque sensor and sends it to the final torque computation component in the EPS ECU as one of its inputs
EPS ECU - Normal Lane Assistance Functionality	The normal lane assistance functionality component will accept the torque from the torque request generator component of the car display ECU
EPS ECU - Lane Departure Warning Safety Functionality	The lane departure warning safety functionality in the EPS ECU will limit the torque amplitude and frequency to be applied
EPS ECU - Lane Keeping Assistant Safety Functionality	The lane keeping assistance safety functionality will limit the amount of time that the lane keeping assistance torque will be applied
EPS ECU - Final Torque	The final torque component in the EPS ECU will accept an input from the safety lane assistance functionality component and the driver steering torque component and process the torque value to be sent to the motor
Motor	The motor will apply the torque received from the

	EPS ECU to the steering wheel

Technical Safety Concept

Technical Safety Requirements

[Instructions: Fill in the technical safety requirements for the lane departure warning first functional safety requirement. We have provided the associated functional safety requirement in the first table below. Hint: The technical safety requirements were discussed in the lesson videos. The architecture allocation column should contain element names such as LDW Safety block, Data Transmission Integrity Check, etc. Allocating the technical safety requirements to the "EPS ECU" does not provide enough detail for a technical safety concept.]

Lane Departure Warning (LDW) Requirements:

Functional Safety Requirement 01-01 with its associated system elements (derived in the functional safety concept)

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		

Technical Safety Requirements related to Functional Safety Requirement 01-01 are:

ID	Technical Safety Requirement	ASIL	Fault Tolerant Time Interval	Architecture Allocation	Safe State
Technical Safety Requirement 01	The LDW safety component shall ensure that the amplitude of the LDW_Torque_Request sent to the ‘Final electronic power steering Torque’	C	50 ms	LDW safety component	LDW_Torque_Request should be set to 0.0

	component is below Max_Torque_Amplitude				
Technical Safety Requirement 02	As soon as the LDW function deactivates the LDW feature, the 'LDW Safety' software block shall send a signal to the car display ECU to turn on a warning light	C	50 ms	LDW Safety	LDW_Torque_Request should be set to 0.0
Technical Safety Requirement 03	As soon as a failure is detected by the LDW function, it shall deactivate the LDW feature and the 'LDW_Torque_Request' shall be set to zero	C	50 ms	LDW Safety	LDW_Torque_Request should be set to 0.0
Technical Safety Requirement 04	The validity and integrity of the data transmission for 'LDW_Torque_Request' shall be ensured	C	50 ms	Data Transmission Integrity Check	LDW_Torque_Request should be set to 0.0
Technical Safety Requirement 05	Memory test shall be conducted at start up of the EPS ECU to check for any faults in memory	A	Ignition cycle	Safety Startup (Memory Test)	LDW_Torque_Request should be set to 0.0

[Instructions: Fill in the technical safety requirements for the lane departure warning second functional safety requirement. We have provided the associated functional safety requirement in the table below. Hint:. Most of the technical safety requirements will be the same. At least one technical safety requirement will have to be slightly modified because we are talking about frequency instead of amplitude. These requirements were not given in the lessons]

Functional Safety Requirement 01-2 with its associated system elements (derived in the functional safety concept)

ID	Functional Safety Requirement	Electronic Power Steering ECU	Camera ECU	Car Display ECU
Functional Safety	The lane keeping item shall	X		

Requirement 01-02	ensure that the lane departure oscillating torque frequency is below Max_Torque_Frequency			

Technical Safety Requirements related to Functional Safety Requirement 01-02 are:

ID	Technical Safety Requirement	ASIL	Fault Tolerant Time Interval	Architecture Allocation	Safe State
Technical Safety Requirement 01	The LDW safety component shall ensure that the frequency of the LDW_Torque_Request sent to the 'Final electronic power steering Torque' component is below Max_Torque_Frequency	C	50 ms	LDW safety component	LDW_Torque_Request should be set to 0.0
Technical Safety Requirement 02	As soon as the LDW function deactivates the LDW feature, the 'LDW Safety' software block shall send a signal to the car display ECU to turn on a warning light	C	50 ms	LDW Safety	LDW_Torque_Request should be set to 0.0
Technical Safety Requirement 03	As soon as a failure is detected by the LDW function, it shall deactivate the LDW feature and the 'LDW_Torque_Request' shall be set to zero	C	50 ms	LDW Safety	LDW_Torque_Request should be set to 0.0
Technical Safety Requirement 04	The validity and integrity of the data transmission for 'LDW_Torque_Request' shall be ensured	C	50 ms	Data Transmission Integrity Check	LDW_Torque_Request should be set to 0.0
Technical Safety Requirement 05	Memory test shall be conducted at start up of the EPS ECU to check for any faults in memory	A	Ignition cycle	Safety Startup (Memory Test)	LDW_Torque_Request should

					be set to 0.0

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

[OPTIONAL: For each technical safety requirement, identify both the verification and validation acceptance criteria. “Validation” asks whether or not you chose the appropriate parameters. “Verification” involves testing to make sure the vehicle behaves as expected when the parameter value is crossed. There is not necessarily one right answer. Look at your verification and validation acceptance criteria from the functional safety concept for inspiration.]

Lane Keeping Assistance (LKA) Requirements:

[Instructions: Fill in the technical safety requirements for the lane keeping assistance functional safety requirement 02-01. We have provided the associated functional safety requirement in the table below. Hint:. You can reuse the technical safety requirements from functional safety requirement 01-01. But you need to change the language because we are now looking at a different system. The ASIL and Fault Tolerant Time Interval are different as well.]

Functional Safety Requirement 02-1 with its associated system elements
(derived in the functional safety concept)

ID	Functional Safety Requirement	Electronic Power Steering ECU	Camera ECU	Car Display ECU
Functional Safety Requirement 02-01	The lane keeping item shall ensure that the lane keeping assistance torque is applied for only Max_Duration	X		

Technical Safety Requirements related to Functional Safety Requirement 02-01 are:

ID	Technical Safety Requirement	AS	Fault Tolerant	Allocation to Architecture	Safe State

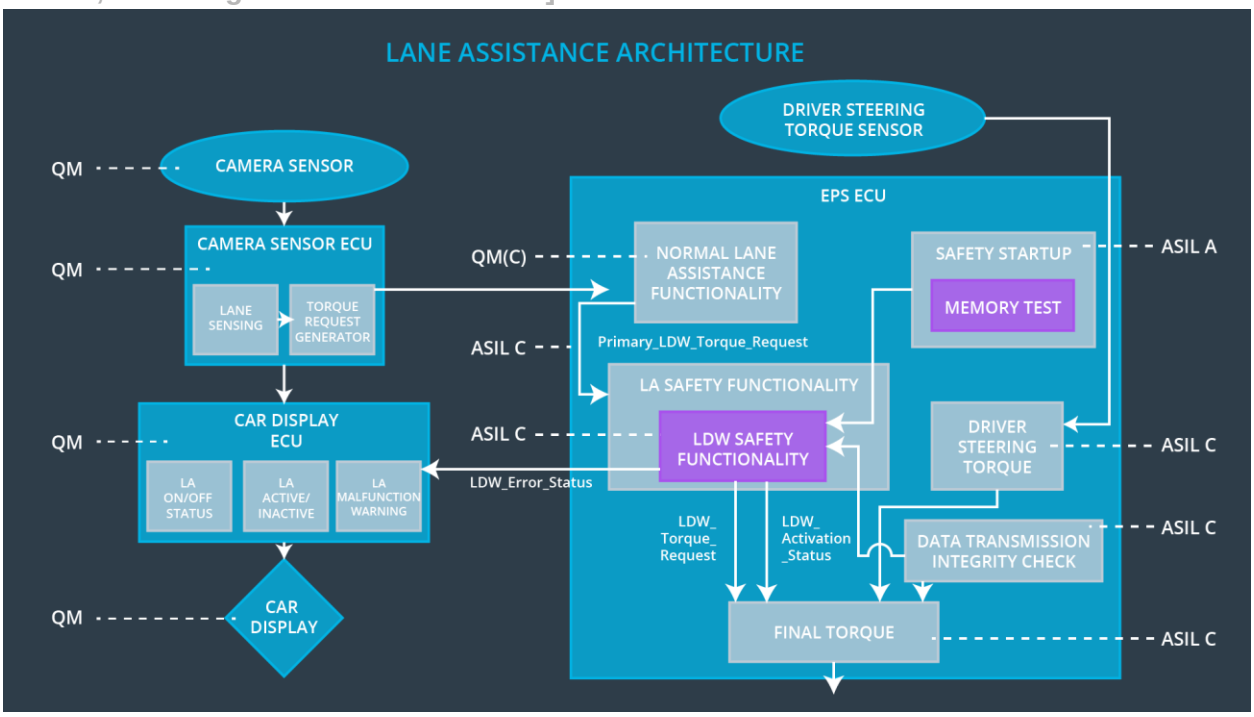
		IL	Time Interval		
Technical Safety Requirement 01	The LDW safety component shall ensure that the duration of the LDW_Torque_Request sent to the 'Final electronic power steering Torque' component is below Max_Duration	B	500 ms	LDW safety component	LDW_Torque_Request should be set to 0.0
Technical Safety Requirement 02	As soon as the LDW function deactivates the LDW feature, the 'LDW Safety' software block shall send a signal to the car display ECU to turn on a warning light	B	500 ms	LDW Safety	LDW_Torque_Request should be set to 0.0
Technical Safety Requirement 03	As soon as a failure is detected by the LDW function, it shall deactivate the LDW feature and the 'LDW_Torque_Request' shall be set to zero	B	500 ms	LDW Safety	LDW_Torque_Request should be set to 0.0
Technical Safety Requirement 04	The validity and integrity of the data transmission for 'LDW_Torque_Request' shall be ensured	B	500 ms	Data Transmission Integrity Check	LDW_Torque_Request should be set to 0.0
Technical Safety Requirement 05	Memory test shall be conducted at start up of the EPS ECU to check for any faults in memory	B	Ignition cycle	Safety Startup (Memory Test)	LDW_Torque_Request should be set to 0.0

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

[OPTIONAL: For each technical safety requirement, identify both the verification and validation acceptance criteria. "Validation" asks whether or not you chose the appropriate parameters. "Verification" involves testing to make sure the vehicle behaves as expected when the parameter value is crossed. There is not necessarily one right answer. Look at your verification and validation acceptance criteria from the functional safety concept for inspiration.]

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 technical safety lesson, including all of the ASIL labels.]



Allocation of Technical Safety Requirements to Architecture Elements

[Instructions: We already included the allocation as part of the technical requirement tables. Here you can state that for this particular item, all technical safety requirements are allocated to the Electronic Power Steering ECU]

For the lane assistance item, all technical safety requirements are allocated to the electronic power steering ECU.

Warning and Degradation Concept

[Instructions: We've already identified that for any system malfunction, the lane assistance functions will be turned off and the driver will receive a warning light indication. The technical safety requirements have not changed how functionality will be degraded or what the warning will be.

So in this case, the warning and degradation concept is the same for the technical safety requirements as for the functional safety requirements. You can copy the functional safety warning and degradation concept here.

Oftentimes, a technical safety analysis will lead to a more detailed warning and degradation concept.]

ID	Degradation Mode	Trigger for Degradation Mode	Safe State invoked?	Driver Warning
WDC-01	Turn off functionality	The lane departure warning function applies an oscillating torque with very high torque amplitude (above limit)	Yes	Warning light on the dashboard
WDC-02	Turn off functionality	The lane departure warning function applies an oscillating torque with very high torque frequency (above limit)	Yes	Warning light on the dashboard