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
9/22/2018	1.0	George V. Paul	Version 1

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 subsystems interact at the message level and describes how the ECUs communicate with each other with safety in mind.

Inputs to the Technical Safety Concept

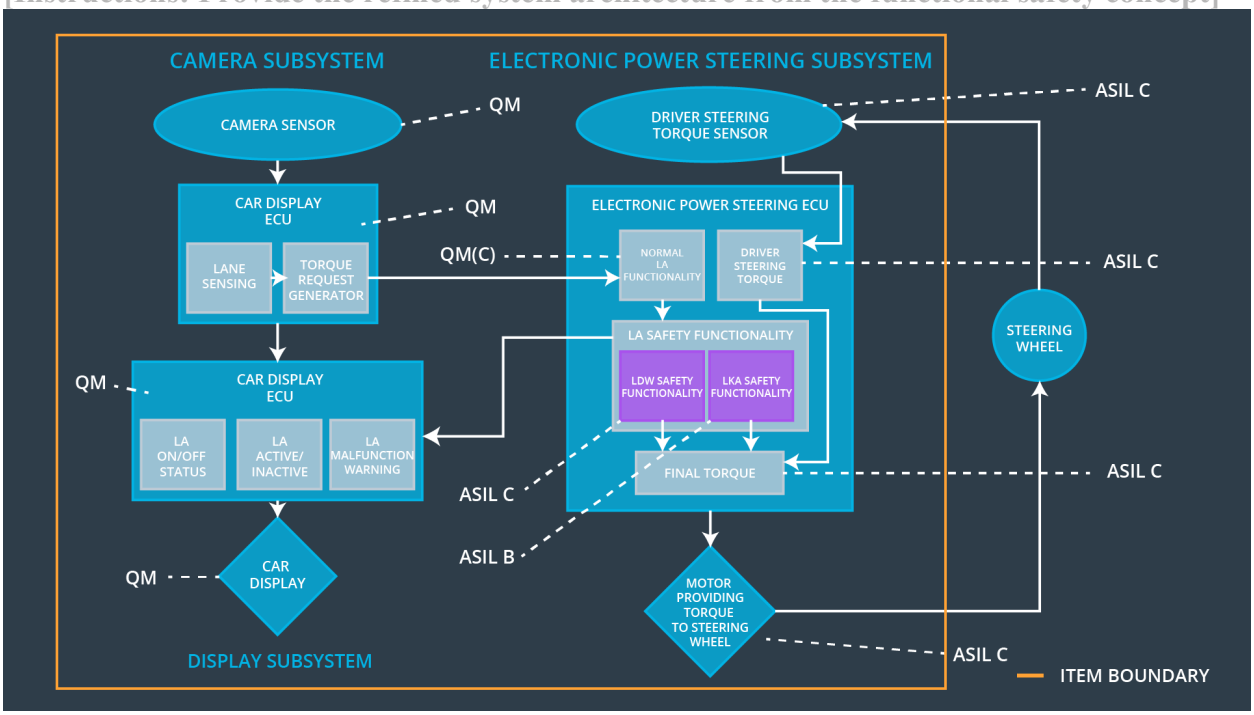
Functional Safety Requirements

[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 Electronic Power Steering ECU shall ensure that the oscillating torque amplitude requested by the LDW function is below Max_Torque_Amplitude	C	50ms	Oscillating torque value is set to 0.
Functional Safety Requirement 01-02	The Electronic Power Steering ECU shall ensure that the oscillating torque frequency requested by the LDW function is below Max_Torque_Frequency	C	50ms	Oscillating torque value is set to 0
Functional Safety Requirement 02-01	The Electronic Power Steering ECU shall ensure that the torque requested by the LKA function is applied only for Max_Duration.	B	500ms	Set the torque from the LKA to 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?]

Element	Description
Camera Sensor	Captures the images of the road and sends it to the Camera Sensor ECU.
Camera Sensor ECU - Lane Sensing	The software that detects the driving lane from the images it gets from the Camera Sensor.
Camera Sensor ECU - Torque request generator	The software that computes the torque needed to drive the Electronic Power Steering to keep the car in the lane.
Car Display	Visual display that warns the driver of the LDW and LKA systems.

Car Display ECU - Lane Assistance On/Off Status	Visual indicator that shows if the LKA system is on or off.
Car Display ECU - Lane Assistant Active/Inactive	Visual sign that indicates if the LKA is active or not.
Car Display ECU - Lane Assistance malfunction warning	Visual sign that indicates if the LKA is not functioning correctly.
Driver Steering Torque Sensor	Sensor that measures the driver steering input.
Electronic Power Steering (EPS) ECU - Driver Steering Torque	The value of the torque transmitted to the Electronic Power Steering from the driver.
EPS ECU - Normal Lane Assistance Functionality	Software responsible for operating the LKA system normally.
EPS ECU - Lane Departure Warning Safety Functionality	The software module that keeps the LDW functionally safe.
EPS ECU - Lane Keeping Assistant Safety Functionality	The software module that keeps the LKA functionally safe.
EPS ECU - Final Torque	Output of the Electronic Power Steering ECU to the motor.
Motor	The final actuator of 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' component is below 'Max_Torque_Amplitude.	C	50ms	LDW Safety Functionality	Torque output is set to 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	50ms	LDW Safety Functionality	Torque output is set to 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	50ms	LDW Safety Functionality	Torque output is set to 0.
Technical Safety Requirement	The validity and integrity of the data transmission for 'LDW_Torque_Request' signal shall be ensured.	C	50ms	Data Integrity Check	Torque output is set to 0.

04					
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 system initialization	Torque output is set to 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 Requirement 01-02	The lane keeping item shall ensure that the lane departure oscillating torque frequency is below Max_Torque_Frequency	X		

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	C	50ms	LDW Safety Functionality	LDW Torque output is set to

	power steering Torque' component is below 'Max_Torque_Frequency.				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	50ms	LDW Safety Functionality	LDW Torque output is set to 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	50ms	LDW Safety Functionality	LDW Torque output is set to 0.
Technical Safety Requirement 04	The validity and integrity of the data transmission for 'LDW_Torque_Request' signal shall be ensured.	C	50ms	Data Integrity Check	LDW Torque output is set to 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 system initialization	LDW Torque output is set to 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	ASIL	Fault Tolerant Time Interval	Allocation to Architecture	Safe State
Technical Safety Requirement 01	The LKA safety component shall ensure that the frequency of the 'LKA_Torque_Request' sent to the 'Final electronic power steering Torque' component last only for a period less than 'Max_Duration.	B	500ms	LKA Safety Functionality	LKA Torque output is set to 0.
Technical Safety Requirement 02	As soon as the LKA function deactivates the LKA feature, the 'LKA Safety' software block shall send a signal to the car display ECU to turn on a warning light.	B	500ms	LKA Safety Functionality	LKA Torque output is set to 0.
Technical	As soon as a failure is detected	B	500ms	LKA Safety	LKA

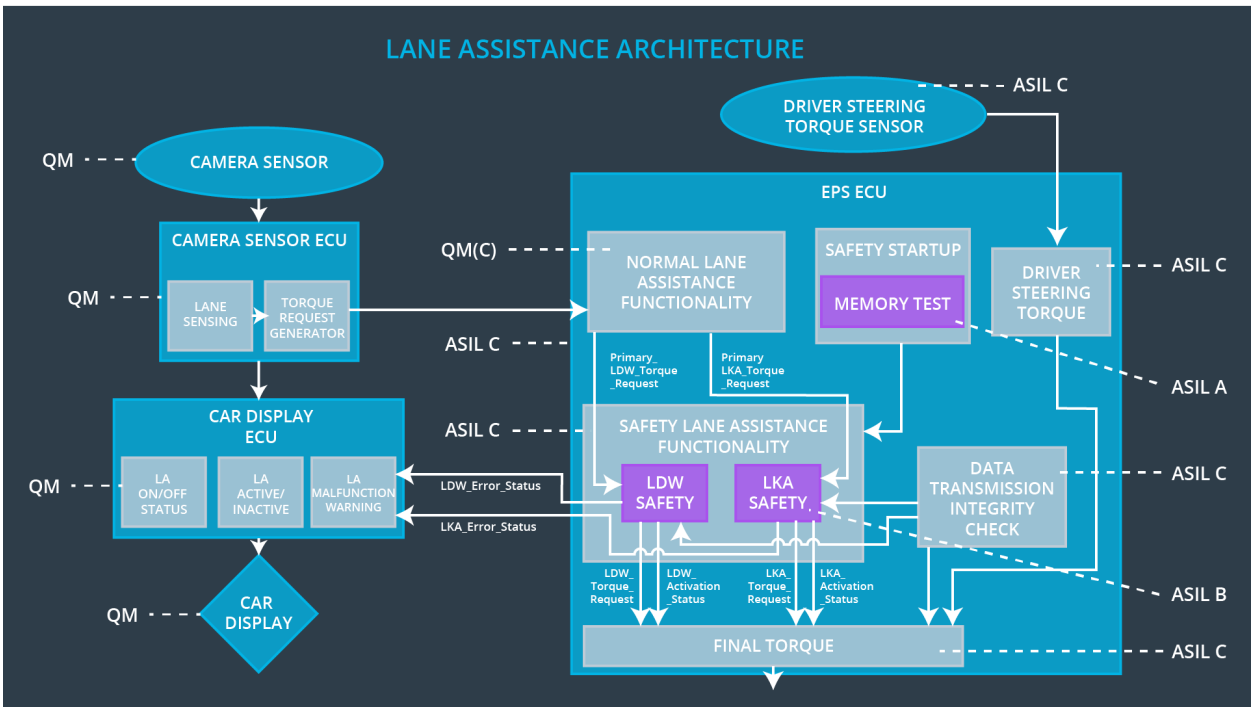
Safety Requirement 03	by the LKA function, it shall deactivate the LKA feature and the 'LKA_Torque_Request' shall be set to zero.			Functionality	Torque output is set to 0.
Technical Safety Requirement 04	The validity and integrity of the data transmission for 'LDW_Torque_Request' signal shall be ensured.	B	500ms	Data Integrity Check	LKA Torque output is set to 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 system initialization	LKA Torque output is set to 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]

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	Safe State invoked?	Driver Warning

		Mode		
WDC-01	LDW function is switched off.	Malfunction_01 Malfunction_02	Yes	Malfunction warning with the LDW indicator on.
WDC-02	LKA function is switched off.	Malfunction_03	Yes	Malfunction warning with the LKA indicator on.