Elektrobit

UDACITY

Technical Safety Concept Lane Assistance

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Document history

Date	Version	Editor	Description
2018/9/26	1.0	Jiang Yue	First attempt

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Purpose of the Technical Safety Concept

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

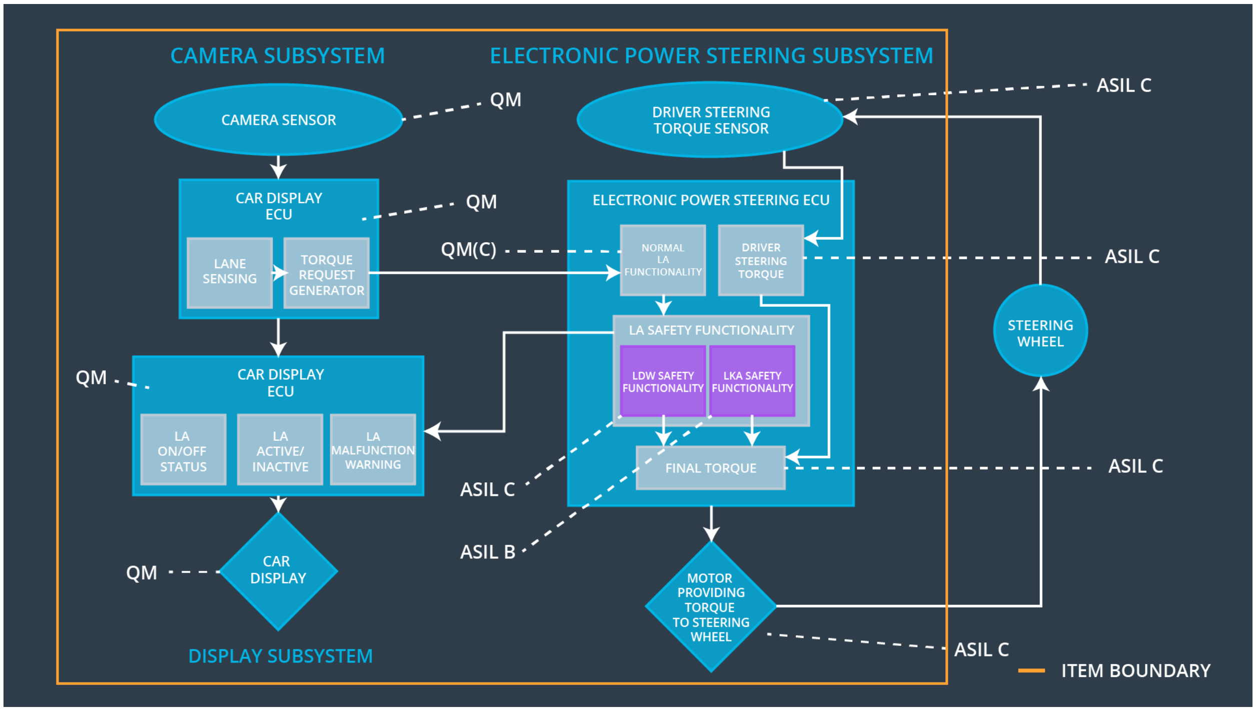
The Technical Safety Concept defines how the subsystems interact at the message level and describes how the ECUs communicate with each other.

Inputs to the Technical Safety Concept

Functional Safety Requirements

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	50 ms	LDW will set the oscillating torque amplitude to 0.
Functional Safety Requirement 01-02	The electronic power steering ECU shall eusure that the lane departure warning oscillating torque frequency is below Max_Torque_Frequency	C	50 ms	LDW will set the oscillating torque frequency to 0.
Functional Safety Requirement 02-01	The electronic power steering ECU shall ensure that the lane keeping assistance torque is applied within Max_Duration	B	500 ms	Turn off the system and warning.

Refined System Architecture from Functional Safety Concept



Functional overview of architecture elements

Element	Description
Camera Sensor	Capture road image data and send to Camera sensor ECU.
Camera Sensor ECU - Lane Sensing	Identifying accidental departure from the road and sending information to the Car Display ECU
Camera Sensor ECU - Torque request generator	Generator torque and send to Electronic Power Steering ECU
Car Display	Display the messages and warnings send from Car Display ECU to the driver
Car Display ECU - Lane Assistance On/Off Status	Indicate the status of the Lane Assistance Functionality
Car Display ECU - Lane Assistant Active/Inactive	Indicate if the Lane Assistance Functionality is active
Car Display ECU - Lane Assistance malfunction warning	Indicate if the Lane Assistance Functionality is malfunction
Driver Steering Torque Sensor	Measure the steering wheel torque applied by the driver

Electronic Power Steering (EPS) ECU - Driver Steering Torque	Measure the steering wheel torque applied by the EPS
EPS ECU - Normal Lane Assistance Functionality	Receive torque request from Camera Sensor ECU
EPS ECU - Lane Departure Warning Safety Functionality	Send malfunction warning to Car Display ECU. send LDW Torque Request and LDW Action Status to Final Torque ensure the torque amplitude and frequency is below limit.
EPS ECU - Lane Keeping Assistant Safety Functionality	Receive Primary_LDW_Torque_Request and ensure Assistance function is not exceed Max_Duration
EPS ECU - Final Torque	Combine torque request and send to motor
Motor	Apply torque to steering wheel

Technical Safety Concept

Technical Safety Requirements

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**	**ASI**	**Fault Tolerant Time**	**Architecture Allocation**	**Safe State**

		L	Interval		
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	50 ms	LDW Safety	LDW torque amplitude shall 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	50 ms	LDW Safety	LDW torque amplitude shall 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	50 ms	LDW Safety	LDW torque amplitude shall set to 0.
Technical Safety Requirement 04	The validity and integrity of the data transmission for 'LDW_Torque_Request' signal shall be ensured.	C	50 ms	Data Transmission Integrity Check	LDW torque amplitude shall 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	Memery Test	LDW torque amplitude shall set to 0.

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 amplitude of the 'LDW_Torque_Request' sent to the 'Final electronic power steering Torque' component is below 'Max_Torque_ Frequency	C	50 ms	LDW Safety	LDW torque frequency shall 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	50 ms	LDW Safety	LDW torque frequency shall 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	50 ms	LDW Safety	LDW torque frequency shall set to 0.
Technical Safety Requirement 04	The validity and integrity of the data transmission for 'LDW_Torque_Request' signal shall be ensured.	C	50 ms	Data Transmission Integrity Check	LDW torque frequency shall 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	Memery Test	LDW torque frequency shall set to 0.

Lane Keeping Assistance (LKA) Requirements:

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

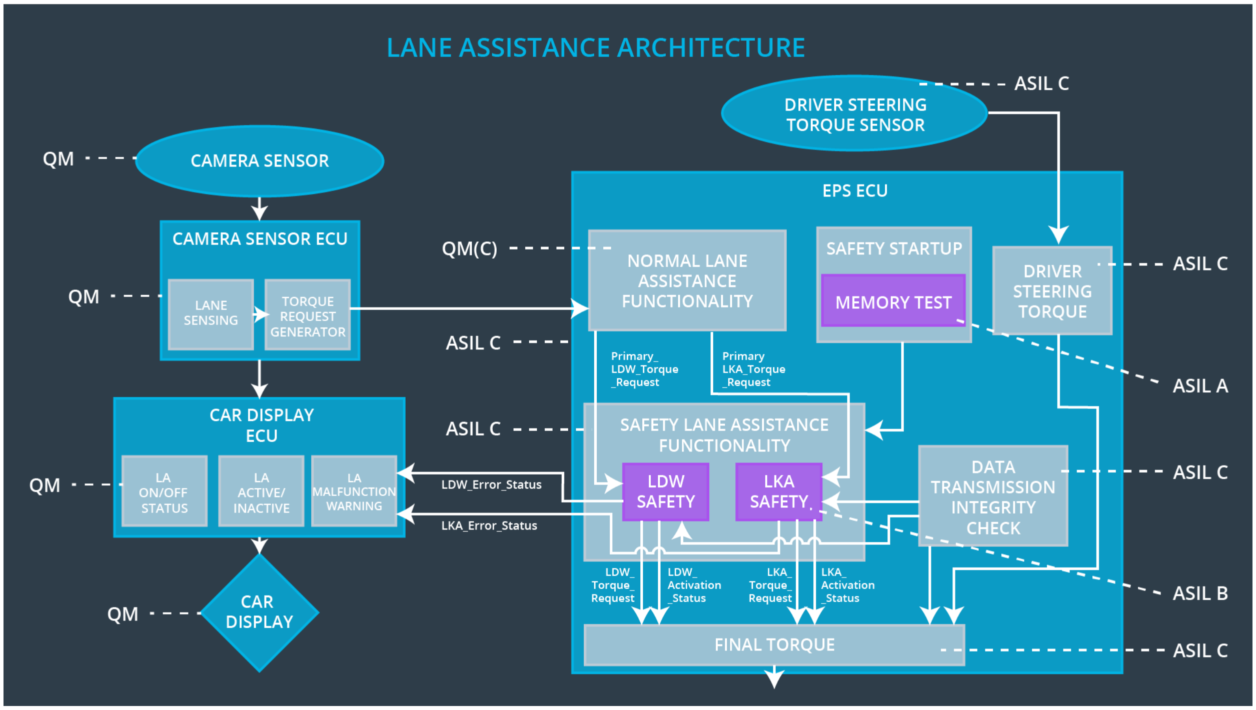
ID	Functional Safety Requirement	Electronic Power	Camera ECU	Car Display ECU

		Steering 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 lane keeping item shall ensure that the lane keeping assistance torque is applied less than Max_Duration	B	500 ms	LKA Safety	LKA torque request shall 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	500 ms	LKA Safety	LKA torque request shall 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 'LKA_Torque_Request' shall be set to zero.	B	500 ms	LKA Safety	LKA torque request shall set to 0
Technical Safety Requirement 04	The validity and integrity of the data transmission for 'LKA_Torque_Request' signal shall be ensured.	B	500 ms	Data Transmission Integrity Check	LKA torque request shall 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.	B	ignition cycle	Memery Test	LKA torque request shall set to 0

Refinement of the System Architecture



Allocation of Technical Safety Requirements to Architecture Elements

ID	Functional Safety Requirement	Electronic Power Steering ECU	Camera ECU	Car Display ECU
Technical Safety Requirement 01-01-01	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.	X		
Technical Safety Requirement 01-01-02	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.	X		
Technical	As soon as a failure is detected	X		

Safety Requirement 01-01-03	by the LDW function, it shall deactivate the LDW feature and the 'LDW_Torque_Request' shall be set to zero.			
Technical Safety Requirement 01-01-04	The validity and integrity of the data transmission for 'LDW_Torque_Request' signal shall be ensured.	**X**		
Technical Safety Requirement 01-01-05	Memory test shall be conducted at start up of the EPS ECU to check for any faults in memory.	**X**		
Technical Safety Requirement 01-02-01	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_ Frequency	**X**		
Technical Safety Requirement 01-02-02	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.	**X**		
Technical Safety Requirement 01-02-03	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.	**X**		
Technical Safety Requirement 01-02-04	The validity and integrity of the data transmission for 'LDW_Torque_Request' signal shall be ensured.	**X**		
Technical Safety Requirement 01-02-05	Memory test shall be conducted at start up of the EPS ECU to check for any faults in memory.	**X**		
Technical Safety Requirement	The lane keeping item shall ensure that the lane keeping	**X**		

02-01-01	assistance torque is applied less than Max_Duration			
Technical Safety Requirement 02-01-02	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.	**X**		
Technical Safety Requirement 02-01-03	As soon as a failure is detected by the LDW function, it shall deactivate the LDW feature and the 'LKA_Torque_Request' shall be set to zero.	**X**		
Technical Safety Requirement 02-01-04	The validity and integrity of the data transmission for 'LKA_Torque_Request' signal shall be ensured.	**X**		
Technical Safety Requirement 02-01-05	Memory test shall be conducted at start up of the EPS ECU to check for any faults in memory.	**X**		

Warning and Degradation Concept

ID	**Degradation Mode**	**Trigger for Degradation Mode**	**Safe State invoked?**	**Driver Warning**
WDC-01	Turn off the torque and warning.	Malfunction_01 Malfunction_02	YES	Warning light on dashboard with warning noise.
WDC-02	Turn system off and warning.	Malfunction_03	YES	Warning light on dashboard with warning noise.