Elektrobit

UDACITY

Technical Safety Concept Lane Assistance

Document Version: 1.0

Template Version 1.0, Released on 2017-06-21

Document history

Date	Version	Editor	Description
24-Aug-2018	1.0	Mohamed ZIEDAN	Initial Release

Table of Contents

Purpose of the Technical Safety Concept

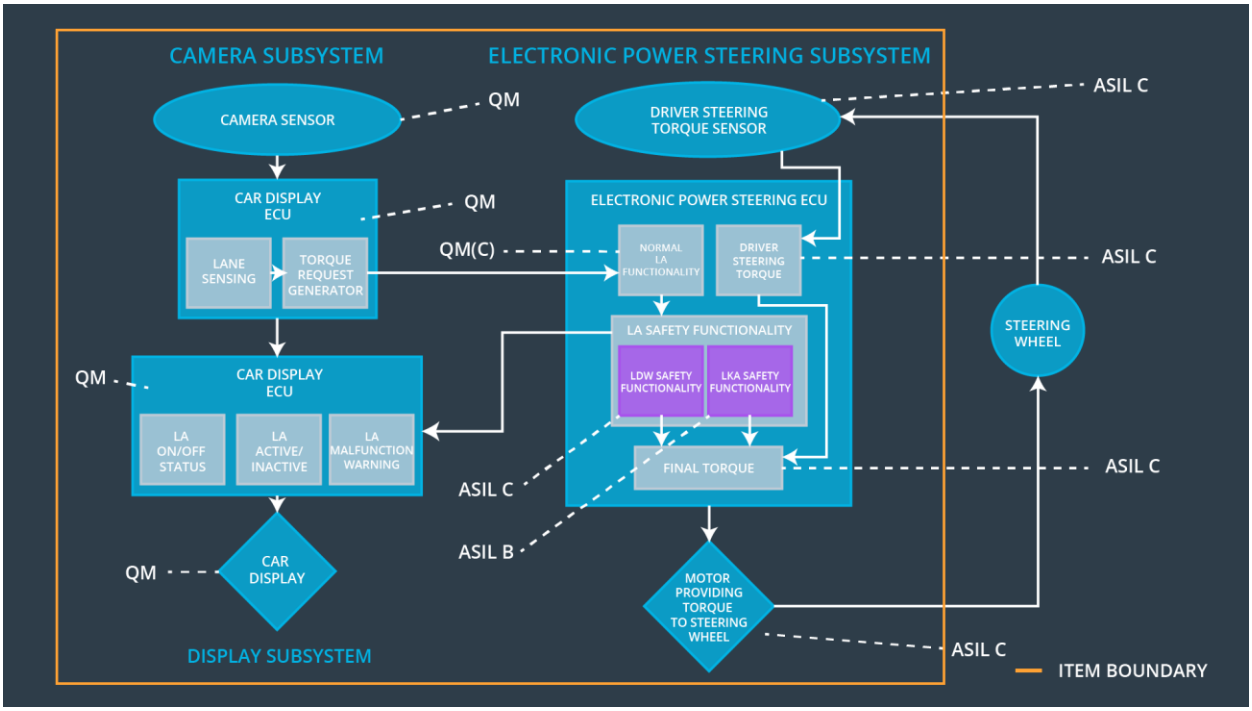
The technical safety concept defines how the subsystems interact at the message level and describes how the ECUs communicate with each other.

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	Electronic Power Steering ECU shall ensure that the lane departure oscillating torque amplitude is below *Max_Torque_Amplitude*	C	50ms	LDW will set the oscillating torque amplitude to 0
Functional Safety Requirement 01-02	Electronic Power Steering ECU shall ensure that the lane departure oscillating torque frequency is below *Max_Torque_Frequency*	C	50ms	LDW will set the oscillating torque frequency to 0
Functional Safety Requirement 02-01	Electronic Power Steering ECU shall ensure that the lane keeping assistance torque is applied for only *Max_Duration*	B	500ms	LKA will set the oscillating torque Duration to 0

Refined System Architecture from Functional Safety Concept



Functional overview of architecture elements

Element	Description
Camera Sensor	Take images of the road
Camera Sensor ECU - Lane Sensing	Detects lanes on road, and lane departures
Camera Sensor ECU - Torque request generator	tells the Electronic Power Steering ECU how hard to turn , and Car Display ECU to display a warning`
Car Display	show a warning for the driver
Car Display ECU - Lane Assistance On/Off Status	receives a warning from Electronic Power Steering (EPS) ECU, show Lane Assistance status
Car Display ECU - Lane Assistant Active/Inactive	receives a warning from Electronic Power Steering (EPS) ECU, show Lane Assistant Activity state
Car Display ECU - Lane Assistance malfunction warning	receives a warning from Electronic Power Steering (EPS) ECU, show Warning on Lane Assistance malfunction
Driver Steering Torque Sensor	Detect how hard the driver is turning the steering Wheel

Electronic Power Steering (EPS) ECU - Driver Steering Torque	Analyze how hard the driver is turning the steering wheel, and contribute at the 'FINAL TORQUE'
EPS ECU - Normal Lane Assistance Functionality	receives a warning from Camera Sensor ECU, it then decides the vibration required to warn driver and how much steering torque is required
EPS ECU - Lane Departure Warning Safety Functionality	Analyze and decides the vibration required to warn driver and how much steering torque is required, then send contribute at the 'FINAL TORQUE', and alert Car Display ECU
EPS ECU - Lane Keeping Assistant Safety Functionality	Analyze and decides the duration required to run the LKA item, then send contribute at the 'FINAL TORQUE' and Alert Car Display ECU
EPS ECU - Final Torque	Receives inputs from LKA Safety, LDW Safety , and Driver Steering Torque to product the FINAL TORQUE amount that will be passed to steering Motor
Motor	motor will provide the 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	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	Lane Assistance Safety Functionality	Deactivate functionality (reset Amplitude 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	Deactivate functionality (reset Amplitude 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	Deactivate functionality (reset Amplitude 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 Transmission Integrity Check	Deactivate functionality (reset Amplitude to 0)
Technical Safety Requirement 05	Memory test shall be conducted at startup of the EPS ECU to check for any faults in memory	A	ignition cycle	SAFETY STARTUP	*Max_Torque_Amplitude* is correct and Deactivate Functionality will reset Amplitude 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 Frequency of the '*LDW_Frequency_Request*' sent to the 'Final electronic power steering Torque' component is below *Max_Torque_Frequency*	C	50ms	Lane Assistance Safety Functionality	Deactivate functionality (reset Frequency 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	Deactivate functionality (reset Frequency 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_Frequency_Request*' shall be set to zero	C	50ms	LDW Safety Functionality	Deactivate functionality (reset Frequency to 0)
Technical Safety	The validity and integrity of the data transmission for	C	50ms	Data Transmission	Deactivate functionalit

Requirement 04	'*LDW_Frequency_Request*' signal shall be ensured			Integrity Check	y (reset Frequency to 0)
Technical Safety Requirement 05	Memory test shall be conducted at startup of the EPS ECU to check for any faults in memory	A	ignition cycle	SAFETY STARTUP	*Max_Torque_Frequency* is correct & Deactivate Functionality will reset Frequency to 0

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

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 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		

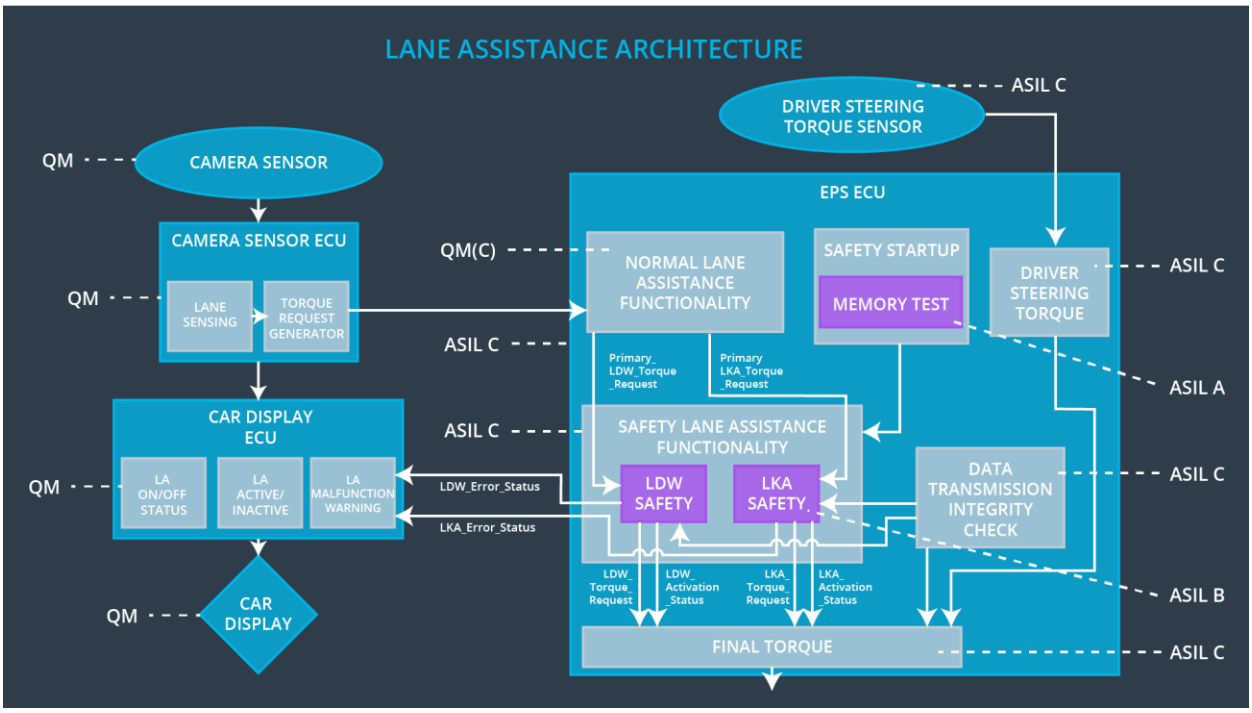
Technical Safety Requirements related to Functional Safety Requirement 02-01 are:

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 Duration of the '*LKA_Duration_Request*' sent to the 'Final electronic power	C	50ms	Lane Assistance Safety Functionality	Deactivate functionality (reset Duration to 0)

	steering Torque' component is below *Max_Duration*				
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	C	50ms	LKA Safety Functionality	Deactivate functionality (reset Duration to 0)
Technical Safety Requirement 03	As soon as a failure is detected by the LKA function, it shall deactivate the LKA feature and the '*LKA_Duration_Request*' shall be set to zero	C	50ms	LKA Safety Functionality	Deactivate functionality (reset Duration to 0)
Technical Safety Requirement 04	The validity and integrity of the data transmission for '*LKA_Duration_Request*' signal shall be ensured	C	50ms	Data Transmission Integrity Check	Deactivate functionality (reset Duration to 0)
Technical Safety Requirement 05	Memory test shall be conducted at startup of the EPS ECU to check for any faults in memory	A	ignition cycle	SAFETY STARTUP	Max_ Duration is correct, and Deactivate Functionality will reset Duration to 0

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

Refinement of the System Architecture



Allocation of Technical Safety Requirements to Architecture Elements

All technical safety requirements are allocated to the Electronic Power Steering ECU

Warning and Degradation Concept

ID	Degradation Mode	Trigger for Degradation Mode	Safe State invoked?	Driver Warning
WDC-01	turn off the functionality	Functional Safety Requirement 01-01 is violated	YES	Display Warning on display system, and different Haptic feedback on the steering wheel
WDC-02	turn off the functionality	Functional Safety Requirement 02-01 is violated	YES	Display Warning on display system, and beep sound.