Elektrobit

UDACITY

Software Safety Requirements and Architecture

Lane Assistance

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Document history

Date	Version	Editor	Description
2018-05-24	1.0	Yogesh Mahawar	Initial Draft for software requirement and Architecture

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Purpose

This document identifies the new requirements for the software components at a component level to identify potential problems on software design and architecture that could lead to a violation of safety goals. These requirements are more detail oriented than the technical safety concept requirements.

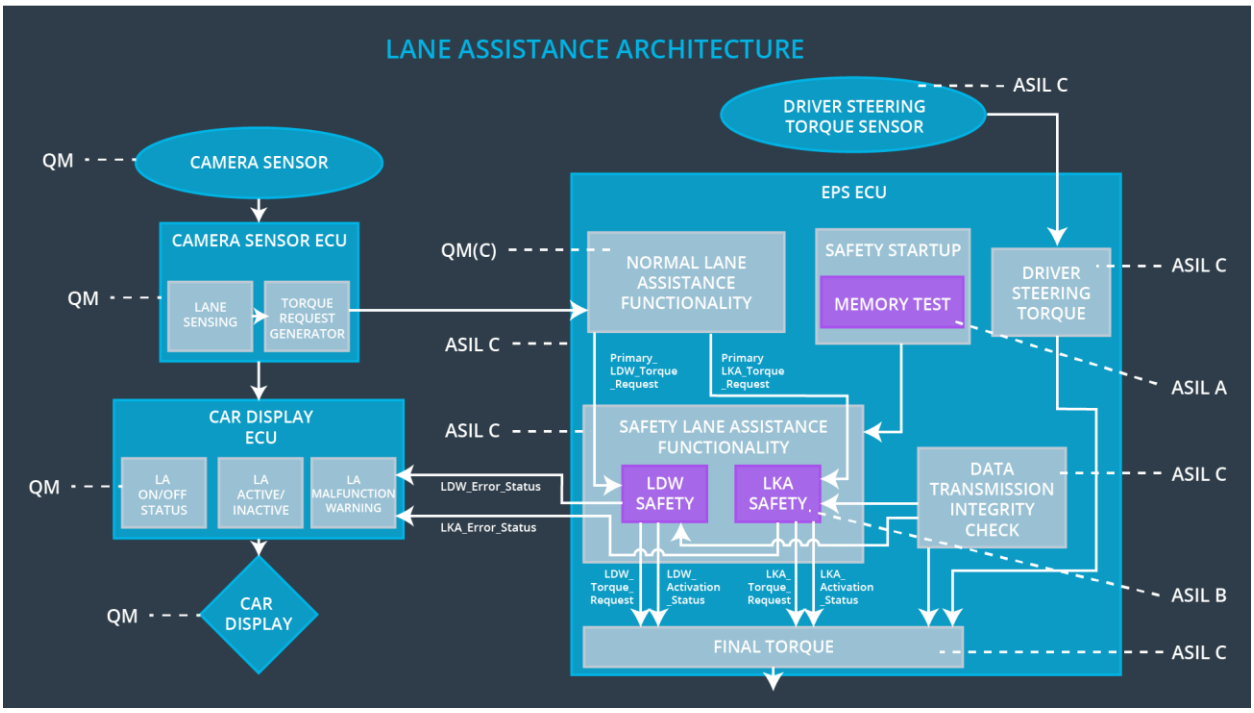
Inputs to the Software Requirements and Architecture Document

Technical safety requirements

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	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	Lane Departure Warning torque to set zero.
Technical Safety Requirement 02	When the LDW is deactivated, the 'LDW Safety' software module shall send a signal to the Car Display ECU to turn on a warning signal.	C	50ms	LDW Safety	Set Lane Departure Warning torque to zero.
Technical Safety Requirement 03	When a failure is detected by the LDW functionality, it shall deactivate the LDW feature and set 'LDW_Torque_Request' to zero.	C	50ms	LDW Safety	Set Lane Departure Warning torque to zero.
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	Set Lane Departure Warning torque to zero.
Technical Safety Requirement 05	Memory test shall be conducted at startup of the EPS ECU to check for any memory problems	A	Ignition cycle	Data Transmission Integrity Check	Set Lane Departure Warning torque to zero.

Refined Architecture Diagram from the Technical Safety Concept



Software Requirements

Lane Departure Warning (LDW) Amplitude Malfunction Software Requirements:

ID	Technical Safety Requirement	ASIL	Fault Tolerant Time Interval	Allocation to Architecture	Safe State
Technical Safety Requirement 01	The Lane Departure Warning 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	Lane Departure Warning torque to zero.

ID	Software Safety Requirement	ASIL	Allocation Software Elements	Safe State
Software Safety Requirement 01-01	The input signal ‘Primary_LDW_Torq_Req’ shall be read and pre-processed to determine the torque request coming from the ‘Basic/Main LAFunctionality’ SW Component. Signal ‘processed_LDW_Torq_Req’ shall be generated at the end of the processing.	C	LDW_SAGETY_INPUT_PROCESSING	N/A
Software Safety Requirement 01-02	In case the ‘processed_LDW_Torq_Req’ signal has a value greater than ‘Max_Torque_Amplitude_LDW’ (maximum allowed safe torque), the torque signal ‘limited_LDW_Torq_Req’ shall be set to zero, else ‘limited_LDW_Torq_Req’ shall take the value of ‘processed_LDW_Torq_Req’	C	TORQUE_LIMITER	‘limited_LDW_Torq_Req’ = 0 (Nm=Newton-meter)
Software Safety Requirement 01-03	The ‘limited_LDW_Torq_Req’ shall be transformed into a signal ‘LDW_Torq_Req’ which is suitable to be transmitted outside the LDW Safety component (‘LDW Safety’) to the ‘Final EPS Torque’ component.	C	LDW_SAFETY_OUTPUT_GENERATOR	LDW_Torq_Req = 0 (Nm)

ID	Technical Safety Requirement	ASIL	Fault Tolerant Time Interval	Allocation to Architecture	Safe State
Technical Safety Requirement 02	The validity and integrity of the data transmission for LDW_Torque_Request signal shall be ensured	C	50ms	Data transmission integrity check	N/A

ID	Software Safety Requirement	ASIL	Allocation Software Elements	Safe State
Software Safety Requirement 02-01	Any Data to be transmitted from LDW Safety component including “LDW_Torque_Req” and “activation_status” shall be protected by End2End(E2E) Protection Mechanism	C	E2E Calculation	LDW_Torque_ Req = 0 (Nm)
Software Safety Requirement 02-02	The E2E protection protocol shall contain and attach the control data: alive counter SQC and CRC to the Data to be transmitted.	C	E2E Calculation	LDW_Torque_ Req = 0 (Nm)

ID	Technical Safety Requirement	ASIL	Fault Tolerant Time Interval	Allocation to Architecture	Safe State
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	LDW_Activation_Status is zero

ID	Software Safety Requirement	ASIL	Allocation Software Elements	Safe State
Software Safety Requirement 03-01	Each Software element shall output a signal to indicate any error which is detected by the element. Error signal = error_status_input (LDW_SAFETY_INPUT_PROCESSING), error_status_torque_limiter(TORQUE_LIMITER), error_status_output_gen(LDW_SAFETY_OUTPUT_GENERATOR)	C	All	N/A
Software Safety Requirement 03-02	A software element shall evaluate the error status of all other software elements and in case any one of them indicates an error, it shall deactivate the Lane Departure Warning feature (‘activation_status’=0)	C	LDW_SAFETY_ACTIVATION	Lane Departure Warning function deactivated (‘activation_status’ =0).
Software Safety Requirement 03-03	In case of a no error from the software elements, the status of the Lane Departure Warning feature shall be set to activated (‘activation_status’=1).	C	LDW_SAFETY_ACTIVATION	N/A
Software Safety Requirement	In case an error is detected by any of the software elements, it shall set the value to its	C	All	LDW_Torq_Req = 0

03-04	corresponding torque to zero so that ‘LDW_Torq_Req’ is set to zero			
Software Safety Requirement 03-05	Once the Lane Departure Warning functionality has been deactivated, it shall stay deactivating until the time the ignition is switched from off to on again.	C	LDW_SAFETY_ACTIVATION	Lane Departure Warning function deactivated (‘activation_status’ =0).

ID	Technical Safety Requirement	ASIL	Fault Tolerant Time Interval	Allocation to Architecture	Safe State
Technical Safety Requirement 04	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	LDW_Error_Status is zero

ID	Software Safety Requirement	ASIL	Allocation Software Elements	Safe State
Software Safety Requirement 04-01	When The LDW Function is Deactivated (acticvation_status set to 0), the Activation status shall be sent to car display ECU	C	LDW_SAFETY_ACTIVATION, Car Display ECU	N/A

ID	Technical Safety Requirement	ASIL	Fault Tolerant Time Interval	Allocation to Architecture	Safe State
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	Memory Test	LDW_Activation_Status is zero

ID	Software Safety Requirement	ASIL	Allocation Software Elements	Safe State
Software Safety Requirement 05-01	A CRC verification check over the software code in the Flash memory shall be done every time the ignition is switched from off to on to check for any content corruption.	A	MEMORYTEST	Activation_status = 0
Software Safety Requirement 05-02	Standard RAM test to check the data bus, address bus and device integrity shall be done every time the ignition is switched from off to on (e. G. walking 1s test, RAM pattern test, Refer to RAM and processor vendor recommendations)	A	MEMORYTEST	Activation_status = 0
Software Safety Requirement 05-03	The test result of the RAM or Flash memory shall be indicated to the LDW_Safety component via the ‘test_status’ signal.	A	MEMORYTEST	Activation_status = 0
Software Safety Requirement 05-04	In case any fault is indicated via the ‘test_status’ signal the	A	LDW_SAFETY_INPUT_PROCESSING	Activation_status = 0

Refined Architecture Diagram