Elektrobit

UDACITY

Software Safety Requirements and Architecture

Lane Assistance

Document Version: 1.0

Template Version 1.0, Released on 2017-06-21

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
25/05/2018	1.0	Shubhadeep	First Attempt

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]

Software Requirements

Refined Architecture Diagram

Purpose

[Instructions: Answer what is the purpose of this document?]

The purpose of this document is to identify requirements and metrics against which the item can be verified, that will insure its functional safety. These requirements are more detail oriented than the technical safety concept requirements.

Inputs to the Software Requirements and Architecture Document

[Instructions:

REQUIRED:
You are only required to develop this document for the LDW (lane departure warning) amplitude malfunction. So here, provide the technical safety requirements for the LDW amplitude malfunction as well as the refined system architecture diagram from the technical safety concept.

OPTIONAL:
Expand this document to include software safety requirements for the LDW frequency malfunction as well. Go even further and document software safety requirements for the Lane Keeping Assistance (LKA) function as well.
]

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	The Lane Departure	C	50 ms	Lane	Lane

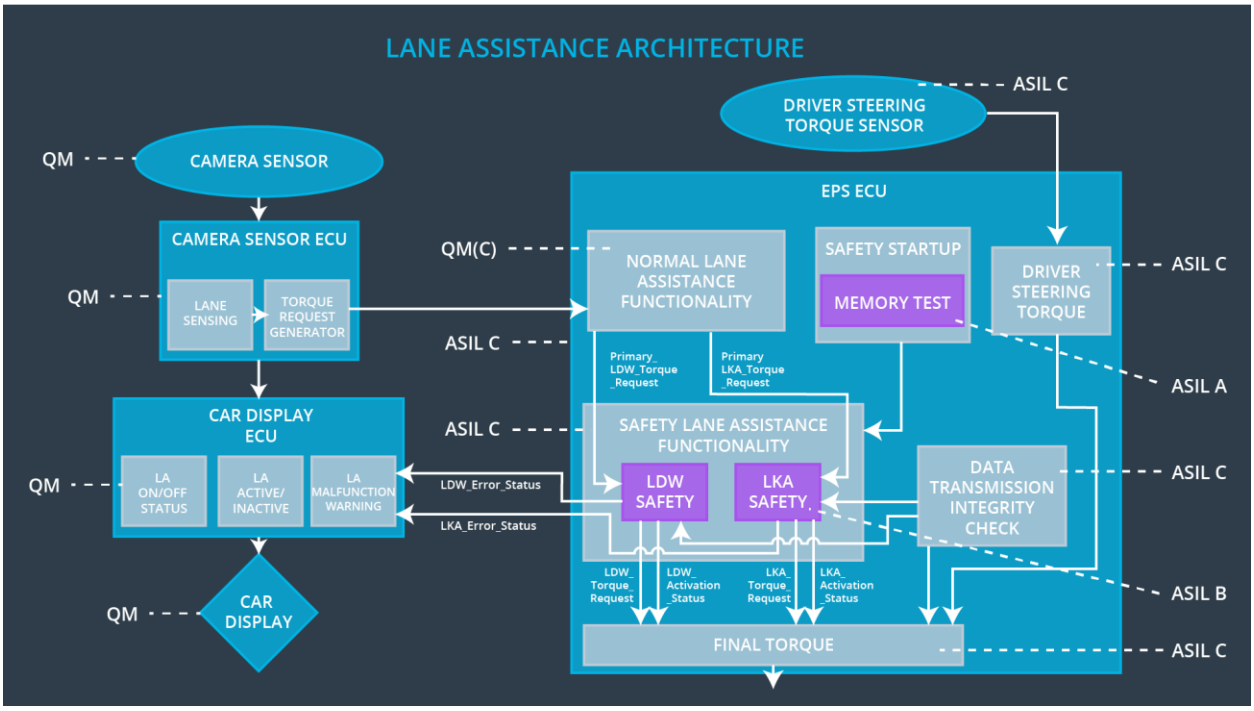
Requirement 01	Warning safety component shall ensure that the amplitude of the 'LDW_Torque_Request' sent to the 'Final electronic power steering Torque' component is below 'Max_Torque_Amplitude'.			Departure Warning Safety	Departure Warning torque is 0.
Technical Safety Requirement 02	As soon as the Lane Departure Warning is deactivated, the 'LDW Safety' software module shall send a signal to the Car Display ECU to turn on a warning signal.	C	50 ms	Lane Departure Warning Safety	Lane Departure Warning torque to zero.
Technical Safety Requirement 03	As soon as a failure is detected by the Lane Departure Warning functionality, it shall deactivate the Lane Departure Warning feature and the 'LDW_Torque_Request' shall be set to zero.	C	50 ms	Lane Departure Warning Safety	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	50 ms	Data Transmission Integrity Check	Lane Departure Warning torque to zero.
Technical Safety Requirement 05	Memory test shall be conducted at start up of the EPS ECU to check for	A	Ignition cycle	Safety Startup	Lane Departure Warning

	faults in memory.				torque to zero.

Refined Architecture Diagram from the Technical Safety Concept

[Instructions:

REQUIRED: Provide the refined system architecture diagram from the technical safety concept
]



Software Requirements

Lane Departure Warning (LDW) Amplitude Malfunction Software Requirements:

[Instructions: Fill in the software safety requirements for the LDW amplitude malfunction technical safety requirements. We have provided the associated technical safety requirements. Hint: The software safety requirements were discussed in the text from the software and hardware lesson.

OPTIONAL:

CHALLENGE ONE
Develop software safety requirements for the Lane Departure Warning (LDW) frequency function and modify the system architecture as needed.

CHALLENGE TWO
Develop software safety requirements for the Lane Keeping Assistance (LKA) function and modify the system architecture as needed.
]

ID	Technical Safety Requirement	ASIL	Fault Tolerant Time Interval	Allocation to Architecture	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	50 ms	Lane Departure Warning 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	50 ms	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 outside the LDQ Safety component ('LDW Safety') including 'LDW_Torque_Req' and 'activation_status' shall be protected by an End-2-End protection mechanism.	C	E2C Calc	LDW_Torq_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 Calc	LDW_Torq_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	50 ms	LDW Safety	Lane Departure Warning torque to 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	C	LDW_SAFETY_ACTIVATION	Lane Departure Warning function deactivated (‘activation_status’ =0).

	(‘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 03-04	In case an error is detected by any of the software elements, it shall set the value to its corresponding torque to 0 so that ‘LDW_Torq_Req’ is set to 0	C	All	LDW_Torq_Req = 0
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	50 ms	LDW Safety	Lane Departure Warning torque to zero.

ID	Software Safety Requirement	ASIL	Allocation Software Elements	Safe State
Software Safety Requirement 04-01	When the Lane Departure Warning function is deactivated ('activation_status' set to 0), the activation_status shall be sent to the 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	Lane Departure Warning torque to 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	A	MEMORYTEST	Activation_status = 0

	‘test_status’ signal.			
Software Safety Requirement 05-04	In case any fault is indicated via the ‘test_status’ signal the INPUT_LDW_PROCESSING shall set an error on the error_status_input(=1) so that the Lane Departure Warning functionality is deactivated and the LDW_Torque_Req is set to 0.	A	LDW_SFETY_INPUT_PROCESSING	Activation_status = 0

Refined Architecture Diagram

[Instructions: Include the refined system architecture. Hint: The refined system architecture should include the system architecture from the end of the software and hardware lesson, including all of the ASIL labels.]