Elektrobit

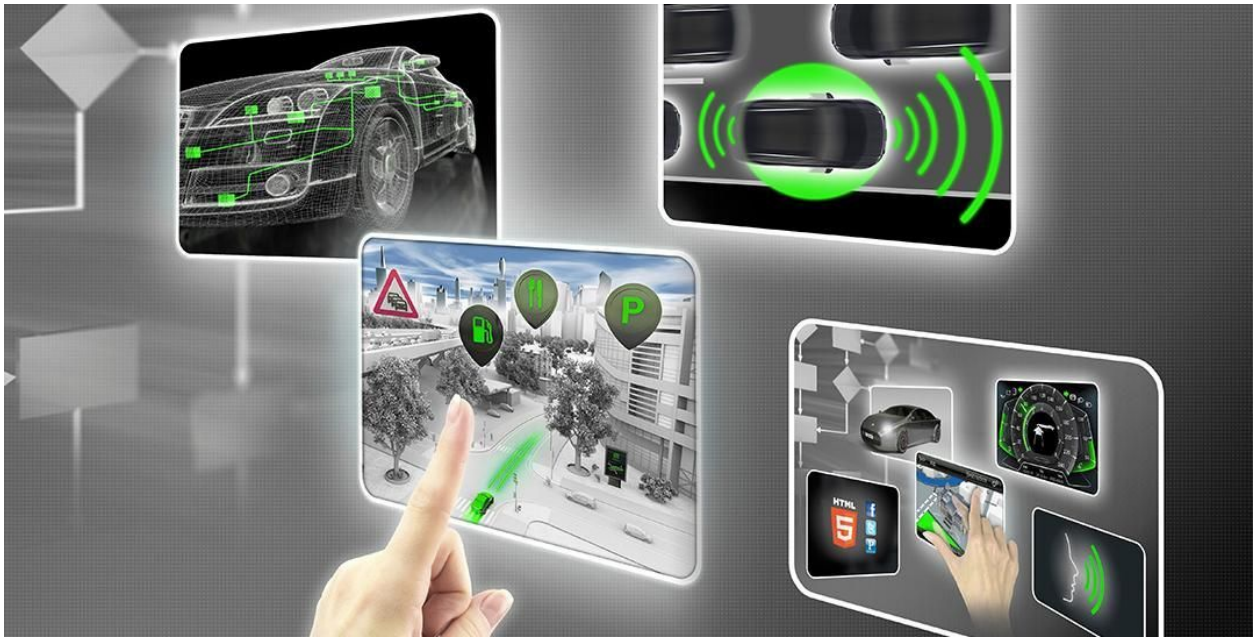
UDACITY

Software Safety Requirements and Architecture

Lane Assistance

Document Version: 1.0

Template Version 1.0, Released on 2017-06-21



Document history

Date	Version	Editor	Description
28.10.2017	1.0	Simon Ritzel	First Draft and Submission

Table of Contents

Document history

Table of Contents

Purpose

Inputs to the Software Requirements and Architecture Document

- Technical safety requirements
- Refined Architecture Diagram from the Technical Safety Concept

Software Requirements

Refined Architecture Diagram

Purpose

The purpose of this document is to software requirements which are easy to implement and are clearly connected to the technical safety requirements.

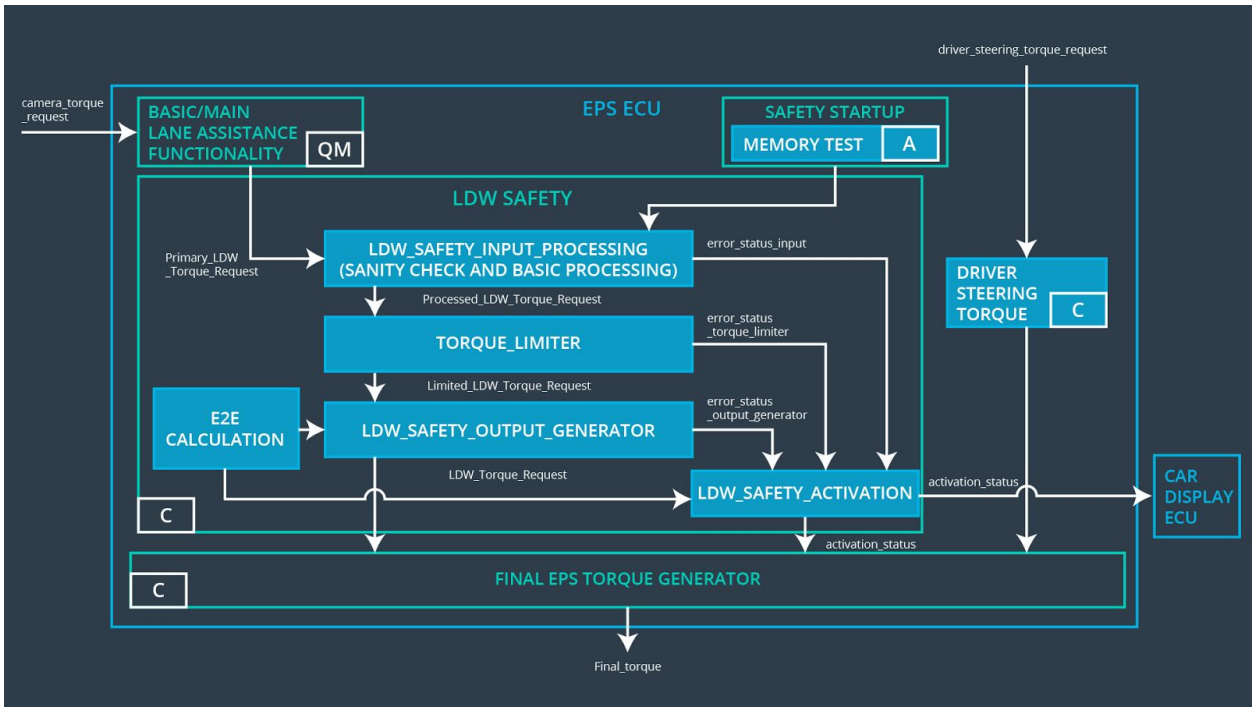
Inputs to the Software Requirements and Architecture Document

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	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 turned off and Requested Torque set to zero.
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.		50 ms	LDW Safety	LDW turned off and Requested Torque set to zero.
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.		50 ms	LDW Safety	LDW turned off and Requested Torque set to zero.
Technical Safety Requirement 04	The validity and integrity of the data transmission for 'LDW_Torque_Request' signal shall be ensured.		50 ms	Data Transmission Integrity Check	N/A
Technical Safety Requirement 05	Memory test shall be conducted at start up of the EPS ECU to check for any faults in memory.		Ignition Cycle	Memory Test	LDW turned off and Requested Torque set 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 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	LWD Safety	LDW torque output is set 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 LA Functionality software component. Signal processed_LDW_Torq_Req shall be generated at the end of the processing.	C	LDW_SAFETY_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)
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 of the LDW Safety component (LDW Safety) to the Final EPS Torque component. Also see Software Safety Requirements 02-01 and 02-02	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 of the LDW Safety component (LDW Safety) including LDW_Torque_Req and activation_status (see Software Safety Requirement 03-02) shall be protected by an End2End (E2E) protection mechanism	C	E2ECalc	LDW_Torq_Req= 0 (Nm)
Software Safety Requirement 02-02	The E2E protection protocol shall contain and attach the control data: a live counter (SQC) and CRC to the data to be transmitted	C	E2ECalc	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	LDW torque output is set to zero

ID	Software Safety Requirement	ASIL	Allocation Software Elements	Safe State
Software Safety Requirement 03-01	Each of the Software elements 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 the other software elements and in case any one of them indicates an error, it shall deactivate the LDW feature (activation_status = 0)	C	LDW_SAFETY_ACTIVATION	activation_status = 0 (LDW function deactivated)
Software Safety Requirement 03-03	In case of no errors from the software elements, the status of the lDW 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 of its corresponding torque to zero so that LDW_Torq_Req is set to zero	C	All	LDW_Torq_Req = 0
Software Safety Requirement 03-05	Once the LDW functionality has been deactivated, it shall stay deactivated till the time the ignition is switched from off to on again	C	LDW_SAFETY_ACTIVATION	activation_status = 0 (LDW function deactivated)

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	LDW torque output is set to zero

ID	Software Safety Requirement	ASIL	Allocation Software Elements	Safe State
Software Safety Requirement 04-01	When the LDW function is deactivated (activation_status = 0), the *activation_status* shall be sent to the Car Display ECU	C	LDW_SAFETY_ACTIVATION, CarDisplay 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	50 ms	Ignition Cycle	LDW torque output is set 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 corruption of content	A	MEMORYTEST	activation_status = 0
Software Safety Requirement 05-02	Standard RAM tests 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 first test, RAM pattern test. Refer 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 INPUT_LDW_PROCESSING shall set an error on *error_status_input* (=1) so that the LDW functionality is deactivated and the LDW Torque is set to zero	A	LDW_SAFETY_INPUT_PROCESSING	activation_status = 0

Refined Architecture Diagram