



Elektrobit



UDACITY

Technical Safety Concept Lane Assistance

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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
9/9/2018	1.0	Terry Lu	First Submission

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[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]

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Purpose of the Technical Safety Concept

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

Technical concept turning functional safety requirements into technical safety requirements, And allocating technical safety requirements to the system architecture.

Inputs to the Technical Safety Concept

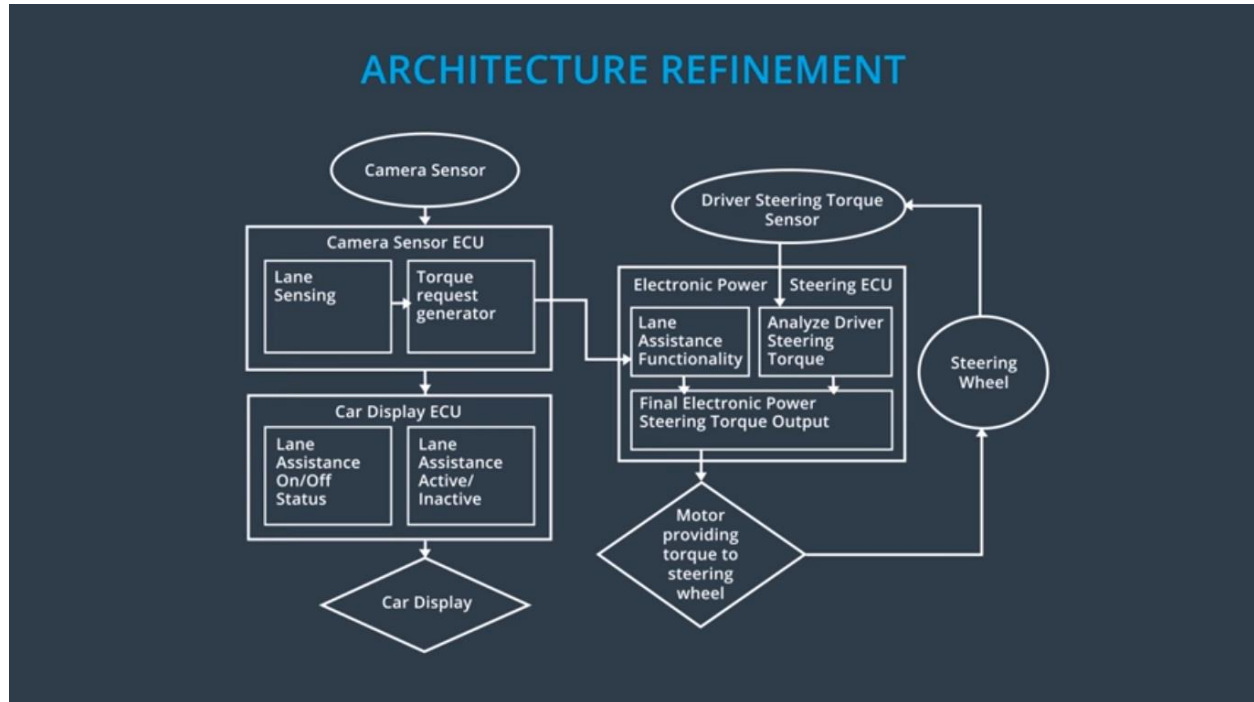
Functional Safety Requirements

[Instructions: Provide the functional safety requirements derived in the functional safety concept]

ID	Functional Safety Requirement	A S I L	Fault Tolerant Time Interval	Safe State
Functional Safety Requirement 01-01	The line keeping item 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	The line keeping item shall ensure that the lane departure oscillating torque frequency is below Max_Torque_frequency.	C	50ms	LDW will set the oscillating torque amplitude to 0.
Functional Safety Requirement 02-01	The Electronic Power Steering ECU shall ensure that the lane keeping assistance torque is applied for only Max_Duration	B	500ms	LKA will set oscillating torque amplitude to 0.

Refined System Architecture from Functional Safety Concept

[Instructions: Provide the refined system architecture from the functional safety concept]



Functional overview of architecture elements

[Instructions: Provide a description for each functional safety element; what is each element's purpose in the lane assistance item?]

Element	Description
Camera Sensor	Get road image data.
Camera Sensor ECU - Lane Sensing	Detect the lane.
Camera Sensor ECU - Torque request generator	Output a reasonable torque value.
Car Display	Display the system status.
Car Display ECU - Lane Assistance	It controls a light that tells the driver if the lane

On/Off Status	keeping item is on or off.
Car Display ECU - Lane Assistant Active/Inactive	It can tell driver if the lane departure warning is activated.
Car Display ECU - Lane Assistance malfunction warning	It can receive a status signal,the signal indicates whether or not the lane assistance item is active and functioning properly.
Driver Steering Torque Sensor	It can get actual torque value from steering wheel.
Electronic Power Steering (EPS) ECU - Driver Steering Torque	It can sense how much the driver is turning the steering wheel.
EPS ECU - Normal Lane Assistance Functionality	It receives the vibrational request from the camera subsystem,and it limits amplitude and frequency to be low max torque amplitude and max torque frequency.
EPS ECU - Lane Departure Warning Safety Functionality	It can apply an oscillating steering torque to provide the driver a haptic feedback.
EPS ECU - Lane Keeping Assistant Safety Functionality	It can apply the steering torque when active in order to stay in ego lane.
EPS ECU - Final Torque	It adds the torque requests together to output a final torque to the motor
Motor	It moves the steering wheel.

Technical Safety Concept

Technical Safety Requirements

[Instructions: Fill in the technical safety requirements for the lane departure warning first functional safety requirement. We have provided the associated functional safety requirement in the first table below. Hint: The technical safety requirements were discussed in the lesson videos. The architecture allocation column should contain element names such as LDW Safety block, Data Transmission Integrity Check, etc. Allocating the technical safety requirements to the "EPS ECU" does not provide enough detail for a technical safety concept.]

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 Electronic Power Steering ECU shall ensure that the oscillating torque amplitude requested by the LDW function is below Max_Torque_Amplitude.	C	50ms	LDW Safety block	The lane departure warning talk request amplitude shall be 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	50ms	LDW Safety block	The lane departure warning talk request amplitude shall be 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	50ms	LDW Safety block	The lane departure warning talk request amplitude shall be set 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.	The lane departure warning talk request amplitude

					shall be set 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	Memory Test	The lane departure warning talk request amplitude shall be set to 0.

[Instructions: Fill in the technical safety requirements for the lane departure warning second functional safety requirement. We have provided the associated functional safety requirement in the table below. Hint:. Most of the technical safety requirements will be the same. At least one technical safety requirement will have to be slightly modified because we are talking about frequency instead of amplitude. These requirements were not given in the lessons]

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	The Electronic Power Steering ECU shall	C	50ms	LDW Safety block	The lane

Requirement 01	ensure that the oscillating torque amplitude requested by the LDW function is below Max_Torque_Frequency..				departur e warning talk request amplitud e shall be 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	50ms	LDW Safety block	The lane departur e warning talk request amplitud e shall be 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	50ms	LDW Safety block	The lane departur e warning talk request amplitud e shall be set 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.	The lane departur e warning talk request amplitud e shall be set 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	Memory Test	The lane departure warning request amplitude shall be set to 0.
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Lane Departure Warning (LDW) Verification and Validation Acceptance Criteria:

[OPTIONAL: For each technical safety requirement, identify both the verification and validation acceptance criteria. “Validation” asks whether or not you chose the appropriate parameters. “Verification” involves testing to make sure the vehicle behaves as expected when the parameter value is crossed. There is not necessarily one right answer. Look at your verification and validation acceptance criteria from the functional safety concept for inspiration.]

Lane Keeping Assistance (LKA) Requirements:

[Instructions: Fill in the technical safety requirements for the lane keeping assistance functional safety requirement 02-01. We have provided the associated functional safety requirement in the table below. Hint:. You can reuse the technical safety requirements from functional safety requirement 01-01. But you need to change the language because we are now looking at a different system. The ASIL and Fault Tolerant Time Interval are different as well.]

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
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Functional Safety Requirement 02-01	The lane keeping item shall ensure that the lane keeping assistance torque is applied for only Max_Duration	X		
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Technical Safety Requirements related to Functional Safety Requirement 02-01 are:

ID	Technical Safety Requirement	A S I L	Fault Tolerant Time Interval	Allocation to Architecture	Safe State
Technical Safety Requirement 01	The LKA safety component shall ensure that the frequency of the lane keeping assistance torque sent to the 'Final electronic power steering Torque' component is below Max_Duration.	C	50ms	LKA Safety block	the lane assistance system should stop applying extra torque after a certain amount of time.
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 block	the lane assistance system should stop applying extra torque after a certain amount of time.
Technical Safety Requirement 03	As soon as a failure is detected by the LKA function, it shall turn off the lane keeping assistance function.	C	50ms	LKA Safety block	the lane assistance system should stop applying extra torque after a certain amount of time.
Technical Safety Requirement	The validity and integrity of the data transmission for ' the lane keeping assistance torque ' signal shall be ensured.	C	50ms	Data Transmission Integrity Check.	the lane assistance system should stop

04					applying extra torque after a certain amount of time.
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	Memory Test	the lane assistance system should stop applying extra torque after a certain amount of time.

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

[OPTIONAL: For each technical safety requirement, identify both the verification and validation acceptance criteria. “Validation” asks whether or not you chose the appropriate parameters. “Verification” involves testing to make sure the vehicle behaves as expected when the parameter value is crossed. There is not necessarily one right answer. Look at your verification and validation acceptance criteria from the functional safety concept for inspiration.]

Refinement of the System Architecture

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

ID	Degradation Mode	Trigger for Degradation Mode	Safe State invoked?	Driver Warning
WDC-01	LDW disabled; torque request will be set to 0.	The LDW warning is giving MORE torque than what is safe.	Yes	Warning light appears on dashboard.
WDC-02	LKA disabled; torque request will be set to 0.	The LKA function had run above time limit.	Yes	Warning light appears on dashboard.