CSC436-800

SUNY Oswego

This template is based on the template provided in:
Cliffton Ericson III: Hazard Analysis Techniques for System Safety, 1st Ed., Wiley, 2005, p. 250.

Software & Safety Requirements Engineering   Spring 2022

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Failure Mode and Effects Analysis										
Version:		1	**Safety Engineers:**		Tyler West, Sven Kappeler, Anubhav Sigdel, Umang Patel					
System		RCCA & Smart Trunk		**Subsystem:**		*<Class / Unit Name or ID>*				
Identification Number:	**Function**	**Failure Mode**	**Trigger Conditions**	**Immediate Effect**	**System Effect**	**Method of Detection**	**Current Controls**	**Hazard**	**Risk**	**Safety Goal**
1	Camera Failure	Not streaming	Rear-view camera feed not played in screen to the driver RCCW warning may not display on camera screen	user cant get the feed of the rear view	no warning	None	None	Rear-end collision leading to human death, injury,	3D	The system shall have automatic brake system which depends on sensors
2	Camera Clearity	Dust on camera	Rear-view camera is obfuscated by objects or inclement weather covering it	User can't clear see the rear view	no warning	Display on the dash shows unclear view	None	poor visibility causing the driver to engage in risky behavior and/or have a collision (without Active Assist)	2D	Operability of camera and systems must be able to persist through partial obfuscation to maintain safety of driver

3	Sensor Failure	Not detecting	Audio to alert driver is not working and system does not display alert	User will not be able to receive alert on the surrounding	unable to sense and no warning	None	None	Rear-end collision leading to human death, injury,	3D	The system shall have two sensors working independent from each other.
4	Blind Spot in Sensing Capabilities	Sensor blocked	The car does not have a full radar covering the whole back	User will not be able to receive alert on the surrounding	Unable to sense and no warning	None	None	Collision to approaching vehicle in speed	4E	The system shall have full range of sensor to alert the driver and safely brake
5	Changing warning volume	Option muted	If you change the warning volume, the warning volume of other systems may change.	User will not be able to hear alert	Unable to send sound output	Sensor	None	rear collision and the driver does not hear the sound alert	3E	The system shall be able to change the volume to a specific limit
6	The brake activation by the system lasts for about 2 seconds	Occurs erroneously	The user keeps their foot on the accelerator while and after the 2 second of automatic braking is over	User unable to receive alert on ESC	No warning	Sensor/alert	None	Driver mistakenly keeps accelerating the car without knowing the system is braking	3B	The system shall be able to alert the driver of its braking and the car control will be given over back.

7	The system might be turned off due to strong electromagnetic waves.	Fails 10 issue	Sensor failure and RCCW error	User will not be able to receive alert on the surrounding	Unable to sense and no warning	None	None	RCCW fails leading to rear collision, human death or injury	1D	Rear camera could have a system that could predict the distance/ sense object through image recognition to alert the driver of the surrounds
8	Damaged Sensor	Not detecting	The sensor might not be connected to the system or could be physically broken	User will not be able to receive alert on the surrounding	Unable to sense and no warning	None	None	The system would not be able to warn the driver leading to collision	3D	The system shall alert the driver when the system component is broken/ damaged/ not connected
9	System disabled/ radar blocked	Sensor blocked	Blind spot collision/ not detected	User will not be able to receive alert on the surrounding	Unable to sense and no warning	Sensor/ alert	None	BCW would not be able to alert the driver of the blind spot leading to collision	3D	The system shall be able to alert the driver if the radar systems are blocked or if the BCW system is unable

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10	A trailer is attached to the back of the car	Sensor blocked	RCCA system sensor would be turned off as the sensor wouldn't be able to detect behind the trailer	User will not be able to receive alert on the surrounding	Unable to sense and no warning	None	None	RCCA failed and the trailer crashed	2D	The system could have portable sensors that could be attached to the trailer.
11	When the sensors are blocked by other vehicles, walls or parking-lot pillars	Sensor blocked	The driver might turn off the system due to sensors reading the object near which are not in the path of the driver	User will not be able to receive alert on the surroundings	Unable to sense and no warning	None	None	The system might send alert to the driver while the car is parked nearby an object	3A	The sensor should be trimmed to a specific setting that driver don't get annoyed with the alerts/warning
12	The entire RCCA system is rendered useless due to elevation differences	Not detecting	Car is approaching from an incline causing the sensor to not be able to sense the others car's presence	User will not be able to receive alert on the surrounding	Unable to sense and no warning	None	None	The RCCA fails and the driver is involved in a side-on collision	1D	The sensor should sense the the road and if there's a severe enough elevation change, informs the user that the RCCA is unable to work in the current conditions

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13	The vehicle height gets lower or higher due to heavy loading in a trunk, abnormal tire pressure	Not detecting	The system will not give accurate safety directions	User will not be able to receive alert on the surrounding	Unable to sense and no warning	Sensor	None	System might give error due to sensor not align in the specified height	4C	The car should have a system on the suspension of the car to alert the driver the sensor are too low of too high
14	Small objects don't get sensed by the car sensor	Not detecting	RCCA can't see an object and the RCCW is not raised.	User will not be able to receive alert on the surrounding	Unable to sense and no warning	None	None	The car would crash in the small object such as shopping carts or a baby stroller	2D	The system sensor should be very sensitive to detect any small object on the rear
15	ESC (Electronic Stability Control) malfunctions	Oecurs erroneously	ESC fails to apply brakes on the car	User unable to receive alert on ESC	No warning	Sensor	None	Rear-end collision leading to human death, injury,	1D	The system be able to alert the driver that the ESC system is malfunctioning so that the driver pays attention to the roads

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16	When pulling out diagonally from a parking space, the system may not detect the vehicle approaching from the rear left/right	Not detecting	ESC does not apply brakes	User will not be able to receive alert on the surrounding	Unable to sense and no warning	None	None	Rear-end collision leading to human death, injury,	2C	RCCW should be able to warn the driver that the angle of the sensor is being blocked
17	When opening and closing, if the power liftgate is blocked by an object or body part, the power liftgate will detect the resistance and the	Sensor Blocked	Object is too near the smart liftgate door and safety release	Will close automatically	No warning	None	None	It might injure the person while closing and opening	3D	The smart trunk should detect if someone is on the way before closing and opening

	liftgate will stop and move in the opposite direction.								