Blundai Blind-Spot Detection System with "Safe-Exit" Feature

Software Requirements Specification (SRS) Template v1.0

This document is an annotated outline intended for specifying software requirements and is adapted from IEEE 29148-2018.

Version 2.0
Prepared By: Jack Anzalone & Brandon LaPointe
Prepared For CSC436 – SUNY Oswego
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Change Log

Name	Date	Reason For Changes	Version
Initial Draft	02/20/2024	Creation of the SRS Document	v1.0
Feedback Revisions	04/01/2024	Feedback received on changes needed to Initial Draft	v1.1
KAOS / UML Diagrams	04/04/2024	Addition of KAOS Goal Diagram and UML Diagrams required	v1.2
Diagrams Revised	05/05/2024	Revisions of KAOS Goal Diagram and UML Diagrams.	v1.3
FMEA / GSN	05/05/2024	Addition of FMEA and GSN.	v1.4
Table of Contents	05/05/2024	Fixed Table of Contents	v2.0

1. Introduction

The Blind-Spot Detection system with "Safe-Exit", an optional feature in Blundai's vehicles, plays a critical role in enhancing driver safety by detecting and notifying the driver of objects or vehicles in their blind spot. Utilizing indicator lights and predictive algorithms, the system aims to prevent collisions by providing timely alerts to the driver and, if necessary, autonomously applying the brakes.

1.1 Purpose

The purpose of the Blind-Spot Detection system is to improve the safety of the driver, vehicle occupants, and the system in its entirety by warning and assisting the driver to prevent accidental blind-spot related collisions.; The system does so by collecting information on the vehicle's surroundings, providing the driver with warnings of potential blind-spot related collisions and automatically applying braking force when necessary to prevent or mitigate a collision.

1.2 Scope

This document delineates the specifications governing the functionality of the blind spot detection system and its associated subsystems. It delves into the intricacies of how the system operates within the vehicle context, its capabilities, and limitations. However, it does not extend to encompassing other vehicular functions beyond the purview of the blind spot detection system.

System Scope:

- Detailed specifications governing the blind spot detection system's operation.
- Interactions with other vehicle subsystems necessary for seamless integration and functionality.
- Limitations and constraints pertinent to the blind spot detection system's design and operation.

1.3 Product Overview

1.3.1 Product Perspective

The blind spot detection system is a subsystem of the overall vehicle’s functions. It works in tandem with the vehicle’s other systems to improve the safety of the users. The system utilizes rear-mounted radar sensors and data processing capabilities to detect potential collision threats and communicate pertinent information to the driver through visual and auditory cues displayed on the dashboard and played through the vehicle’s sound system, respectively.

1.3.1.1 System Interfaces

The blind spot detection system interfaces with various components within the vehicle's ecosystem, including radar sensors, the gauge cluster, the audio system, and the braking system. These interfaces allow the system to gather real-time data on surrounding objects, display warnings to the driver, deliver auditory alerts and initiate braking interventions when necessary. Effective integration with these interfaces ensures seamless communication and enhances the system's ability to enhance driver safety.

1.3.1.2 User Interfaces

The user can interact with the system through a button on the vehicle's dashboard to the left of the steering wheel and on the LCD screen. The user can enable and disable the system. In the vehicle's settings, the user is able to change the warning activation time between certain values.

Modes of operation include:

- **Active Assist**: *Both the Blind-Spot Collision Assist and Blind-Spot Collision Warning Systems are active.*
- **Warning Only**: *Only the Blind-Spot Collision Warning System is active.*
- **Off**: *Both the Blind-Spot Collision Assist and Blind-Spot Collision Warning Systems are inactive.*

Modes of operation for Blind-Spot Collision Warning:

- **Normal**: *The initial Blind-Spot Collision Warning is activated normally.*
- **Later**: *Recommended if the normal setting is too sensitive or if driving at low speeds in light traffic.*

1.3.1.3 Hardware Interfaces

- **Radar Sensors Interface:**
  - The Blind-Spot Detection System interfaces with the vehicle's radar sensors, which are positioned to detect objects in the vehicle's vicinity from the rear and within the blind spot zones.
  - Radar sensors provide real-time data on surrounding objects, enabling the system to accurately identify potential collision threats and initiate appropriate response measures.

- **Front Window Camera Interface:**
  - The Blind-Spot Detection System interfaces with the front window camera installed on the upper front windshield.
  - The front window camera assists in detecting the front lane during lane changes, providing crucial data for the system's operation.

- **Gauge Cluster Information Interface:**
  - The Blind-Spot Detection System communicates with the vehicle's gauge cluster to relay visual alerts and notifications to the driver.
  - By utilizing the gauge cluster interface, the system enhances driver awareness by displaying intuitive visual warnings that indicate the presence of objects in blind spot areas.

- **Audio System Interface:**
  - In addition to visual alerts, the Blind-Spot Detection System interfaces with the vehicle's audio system to deliver auditory cues to the driver.
  - Auditory alerts serve as supplementary warnings, providing an additional layer of awareness to the driver, especially in situations where visual attention may be compromised.

- **Braking System Interface:**
    - The Blind-Spot Detection System interfaces with the vehicle's braking system to initiate braking interventions when an imminent collision is predicted.
    - In critical situations where the system predicts a collision with an object detected in the blind spots or behind the vehicle while reversing, it sends signals to the braking system to apply brakes autonomously. This action aims to mitigate the severity of collisions or, ideally, prevent them altogether by reducing the vehicle's speed.

1.3.1.4 Software Interfaces

The Blind-Spot Detection System integrates with various software components within the vehicle's ecosystem to ensure compatibility and seamless operation including:

- **Controller Area Network (CAN)**: A standard communication protocol used in automotive applications for communication between various electronic control units (ECUs) within the vehicle.
- **Automotive Ethernet**: Provides high-speed communication between different vehicle systems and components.
- **Vehicle Diagnostics (OBD-II)**: On-Board Diagnostics (OBD-II) is a standard protocol used for diagnostics and reporting within vehicles. Integration with OBD-II allows for diagnostic information exchange and monitoring of system health.
- **Embedded Software Development Kits (SDKs)**: These kits provide development tools, libraries, and APIs for integrating the blind spot detection system with the vehicle's embedded software platform.
- **Human-Machine Interface (HMI)**: This interface includes the graphical user interface (GUI) or other means through which the driver interacts with the blind spot detection system, such as warning displays or audible alerts.
- **Middleware Platforms**: Middleware platforms provide a framework for integrating various software components within the vehicle's ecosystem, facilitating communication and data exchange between different systems.

These software interfaces facilitate communication between the blind spot detection system and other onboard systems, enabling data exchange, event triggering, and coordinated actions. By effectively integrating with software interfaces, the blind spot detection system enhances its functionality, interoperability, and overall performance within the vehicle's environment.

1.3.1.5 Communication Interfaces

The BSDS does not interact with any other systems over the network; the BSDS only communicates with other local systems within the vehicle.

1.3.1.6 Memory Constraints

The blind spot detection system operates within memory constraints to ensure efficient utilization of the vehicle's resources. By optimizing memory usage, the system minimizes resource consumption, maximizes performance, and maintains compatibility with the vehicle's hardware specifications. Memory constraints dictate the system's design, implementation, and operation, guiding decisions related to data storage, processing, and management.

1.3.1.7 Site Adaptation

The Blind-Spot Detection System (BSDS) may require specific adaptations based on the operational model or site conditions. These adaptations could include specialized initialization procedures or protocols tailored to particular environments. For example, in regions prone to extreme weather conditions such as heavy snow or rain, the BSDS may need adjustments to ensure optimal performance and accuracy. Similarly, operational models involving unique driving scenarios, such as urban environments with dense pedestrian traffic, may necessitate fine-tuning of the system's algorithms to account for distinct challenges and hazards.

1.3.1.8 Interfaces with Services

The BSDS does not interact with any SAAS or cloud-based services.

1.3.2 Product Functions

The Blind Spot Detection System serves to alert the driver of any objects detected within the blind spot range. This is achieved by illuminating symbols visible to the driver or emitting an audible alert for the driver to perceive. In cases where the system anticipates a collision between the vehicle and the detected object, it engages the brakes to either prevent the collision or reduce its severity.

1.3.3 User characteristics

A car buyer who is interested in extra safety features and is willing to pay more to upgrade from the base trim (~ $2k+). While the system will function automatically so technical expertise is not required, it is recommended that the buyer is willing to read about the system in the manual.

1.3.4 Limitations

The Blind-Spot Detection System is implemented to assist the driver, not for the driver to rely on. It is strictly advised to always be aware of your surrounding environment (other vehicles, pedestrians, road conditions, speed limits, etc.) when operating a motor vehicle on public roads.

The blind spot detection system has many limitations. The system may not detect a vehicle or object under these circumstances.

- A trailer or carrier is installed
- The vehicle is driving in inclement weather such as heavy snow or rain
- The sensor on the rear bumper is covered with a foreign object
- The rear bumper is damaged, or the sensor is out of the original position
- The vehicle height gets lower or higher
- The temperature of the rear bumper is high
- The sensors are blocked by other vehicles, walls, or parking lot pillars
- The vehicle drives on a curved road
- The road pavement or ground abnormally contains metallic components
- There is a fixed object near the vehicle, such as a guardrail
- While going down or up a steep road where the height of the lane is different
- Driving in rural areas where the sensor does not detect another vehicle for an extended period of time
- Driving on a wet road
- Driving on a road where the guardrail or wall is in double structure
- A large vehicle is nearby, such as a bus or truck
- When the other vehicle approaches very close
- When the other vehicle passes at a very fast speed
- While changing lanes
- If the vehicle has started at the same time as the vehicle next to you has accelerated.
- When the vehicle in the next lane moves two lanes away from you OR when the vehicle two lanes away moves to the lane next to you
- A motorcycle or bicycle is near
- A flat trailer is near
- If there are small objects in the detecting area such as a shopping cart or a baby stroller
- If there is a low height vehicle such as a sports car.
- The brake pedal is depressed

- ESC is activated
- ESC malfunctions
- The tire pressure is low or a tire is damaged
- The brake is reworked
- The vehicle sharply stops
- Temperature is extremely low around the vehicle
- The vehicle severely vibrates while driving over a bumpy/uneven road
- The vehicle drives on a slippery surface due to snow, water, or ice
- Driving where there is a vehicle or structure near

1.4 Definitions

Term	Definition
System Under Development	The system which is actively being developed.
Failure Mode and Effect Analysis (FMEA)	A systematic approach to recognize and tackle potential issues with a system, along with their subsequent impacts on the system or workflow, proactively averting adverse outcomes.
Blind-Spot Detection (BSD)	A vehicle safety feature that uses sensors to monitor the areas alongside and behind the vehicle that may not be visible to the driver, alerting them if another vehicle is in their blind spot.
Blind-Spot Collision-Avoidance (BCA)	An advanced safety system that not only detects vehicles in the blind spot but also actively manipulates the mechanical functions of the vehicle to avoid a collision.
Blind-Spot Collision Warning (BCW)	Similar to blind-spot detection, this system alerts the driver when another vehicle enters their blind spot, typically through visual or auditory warnings, helping the driver to be more aware of surrounding traffic.
Safe Exit Feature	Aids to prevent vehicle occupants from accidentally opening a door while there is another vehicle detected to be approaching from the rear of the Blundai vehicle.
Electronic Stability Control (ESC)	A vehicle safety feature that helps drivers maintain control of their vehicles during extreme maneuvers or slippery conditions by automatically applying brakes to individual wheels and sometimes reducing engine power to prevent skidding or loss of control.
Federal Communications Commission (FCC)	Federal agency that authorizes and oversees broadcast radio and television stations in the United States through rules and regulations within the FCC guidelines.

2. References

- Hyundai Motor America. (2020). 2020 Santa Fe Owner's Manual. [Manual].
- Hyundai Motor America. (2020). 2020 Santa Fe Quick Reference Guide. [Manual].

3. Requirements

- The Blind-Spot Detection System (BSDS) must provide Blundai vehicle drivers with visual and auditory alerts in the event of a detected object within the blind spots of the vehicle while in motion.
- The BSDS must provide Blundai vehicle drivers with automated braking when the system detects a potential blind-spot related collision.
- The BSDS will provide real-time alerts to the driver if a vehicle is detected within the boundary by illuminating an icon on the outer side view mirror and the heads-up display (if equipped).
- The BSDS must automatically deactivate if any of the following conditions are met:
    - The vehicle within the blind spot drives a certain distance away.
    - The Blundai vehicle's direction changes away from the predicted collision point.
    - The steering wheel is abruptly moved.
    - The brake pedal is depressed.
    - A calculated period of time has passed.
- If the vehicle is moving at least approximately 40mph, both lanes are detected, and an oncoming vehicle is detected, the Blind-Spot Collision Avoidance (BCA) system must activate.
- The BSDS shall utilize the Lane Keeping Assist System (LKAS).
- If the vehicle is moving at least approximately 40mph and the system is able to detect both lanes, the LKAS shall activate.
- The BSDS shall display a warning message to the user if it is being limited by its surroundings.
- The BSDS shall play a warning chime and display visual indication of detected vehicles.
- The warning chime shall cease if it no longer detects a vehicle.
- The BSDS must follow part 15 of the FCC guidelines.
    - Part 15 states:
    - This device may not cause harmful interference.
    - This device must accept any interference received, including interference that may cause undesired operation.
- The BSDS must comply with FCC radiation exposure limits for an uncontrolled environment.
- If the Blind-Spot Collision Warning (BCW) is malfunctioning, the BCW must display a warning message informing the user on the gauge cluster.

- If the Blind-Spot Collision Avoidance (BCA) is malfunctioning, the BCA must display a warning message informing the user on the gauge cluster.
- If the BCW sensor is blocked, the vehicle must display a warning message informing the user of the blocked sensor on the gauge cluster.
- If the BCA detects a colliding possibility with an approaching vehicle while changing lanes, the BCA must activate the Electronic Stability Control (ESC).

3.1 Functions

- The BSDS shall include a Safe Exit Feature that prevents vehicle occupants from inadvertently opening doors when another vehicle is detected approaching from the rear.
- Upon detecting an approaching vehicle, the Safe Exit Feature shall activate a visual and auditory warning to alert vehicle occupants of the potential hazard.
- The system shall automatically disable the Safe Exit Feature once the approaching vehicle has passed or a safe distance is maintained to allow for safe egress from the vehicle.

3.2 Performance Requirements

- The BSDS shall detect objects within the blind spot range with a minimum accuracy of 95% under normal weather and lighting conditions.
- The system shall initiate braking within 500 milliseconds of detecting a potential blind-spot collision threat.
- Visual and auditory warnings provided by the BSDS shall have a response time of less than 200 milliseconds from the detection of an object in the blind spot.

3.3 Usability Requirements

- The BSDS and BSW will promptly notify the driver of any detected limitations affecting the system's functionality through visual and auditory warnings.
- The BSDS shall offer multiple user options for system control, including the ability to deactivate the system, adjust assistance levels (warn-only mode or full assistance), and customize warning preferences.
- The BCA and BCW functionalities must be easily enabled and disabled via a designated button on the front dashboard, providing convenient access to the driver.
- Warning chimes generated by the BCW should offer customizable volume settings to accommodate user preferences and ensure clear audible alerts without causing distraction.

3.4 Interface Requirements

- **User Interaction:** Interaction with the system is facilitated through a dashboard button, providing intuitive access for users.
- **Menu Presentation:** All available options are visually presented within the gauge cluster, ensuring clarity and ease of navigation.
- **Notification Display:** System notifications are prominently displayed in the gauge cluster, ensuring timely awareness of important information.
- **Steering Wheel Controls:** Users can efficiently navigate system menus using dedicated buttons integrated into the steering wheel, enhancing user convenience and safety.

3.5 Logical Database Requirements

The BSDS shall maintain a log of detected blind-spot events, including timestamps, object characteristics, and system responses, for diagnostic and analysis purposes. The database shall be capable of storing this information securely and efficiently, with access controls to ensure data integrity and confidentiality.

3.6 Design Constraints

- The BSDS must follow Part 15 from the FCC guidelines stating:
    - This device may not cause harmful interference.
    - This device must accept any interference received, including interference that may cause undesired operation.
- The BSDS must comply with FCC radiation exposure limits for an uncontrolled environment.
    - Compliance with FCC radiation exposure limits is essential to ensure the safety and well-being of both vehicle occupants and individuals in the surrounding environment.

3.7 Software System Attributes

- Reliability: The BSDS shall demonstrate high reliability in detecting and alerting drivers of blind-spot hazards, with a mean time between failures (MTBF) of at least 10,000 hours.
- Security: The system shall employ encryption protocols to secure communication interfaces and prevent unauthorized access or tampering with critical functions.
- Maintainability: The BSDS shall support remote diagnostics and software updates to facilitate timely maintenance and troubleshooting of system components.
- Portability: The system architecture shall be modular and platform-independent, allowing for seamless integration with different vehicle models and manufacturers.

3.8 Supporting Information

- The BSDS shall undergo rigorous testing and validation procedures in accordance with industry standards and regulatory requirements to ensure compliance with safety and performance specifications.
- User manuals and training materials shall be provided to educate vehicle owners and operators on the proper use and maintenance of the BSDS, including troubleshooting tips and recommended best practices.

4. Verification

4.1 Functions

4.1.1 Functional Hazard Analysis

System Functions:

1. Blind-Spot Collision-Avoidance Assist (BCA) System:
    - Hazard: Unexpected activation or deactivation of the BCA system leading to driver confusion.
        - Resolution: Implement clear user interface feedback for system activation/deactivation and conduct user testing to ensure intuitive operation.
        - External Systems' Expectations: Integration with vehicle's electronic stability control (ESC) system for coordinated lane tracking and collision avoidance maneuvers. Compatibility with lane detection sensors for improved accuracy.

- External Users' Expectations: Drivers expect consistent performance across different lane configurations and driving conditions. Vehicle stability control systems expect reliable input for proactive intervention in collision scenarios.

2. Blind-Spot Collision Warning (BCW) System:
    - Hazard: Inaccurate detection of vehicles due to adverse weather conditions or sensor obstruction.
        - Resolution: Enhance sensor capabilities to mitigate the impact of adverse weather conditions and implement sensor cleaning mechanisms to prevent obstruction.
        - External Systems' Expectations: Compatibility with vehicle's external lighting systems for synchronized visual warnings. Integration with turn signal indicators for coordinated alerts during lane changes.
        - External Users' Expectations: Drivers expect timely warnings during lane changes or merging maneuvers. External lighting systems expect proper signaling to ensure visibility to other road users.

3. Safe Exit Feature:
    - Hazard: False alarms leading to passenger frustration and potential disregard for warnings.
        - Resolution: Implement algorithms to minimize false alarms and improve system reliability through sensor fusion techniques.
        - External Systems' Expectations: Integration with vehicle's central control unit (CCU) for coordinated override functionality. Compatibility with vehicle security systems to prevent unauthorized access.
        - External Users' and Expectations: Passengers expect reliable operation of the override mechanism in emergency situations. Vehicle security systems expect proper coordination to maintain overall vehicle security.

4. Blind-Spot Collision-Avoidance Assist (BCA) System:
    - Hazard: Dependency on proper lane positioning for accurate detection, leading to missed detections or false positives.

- Resolution: Develop algorithms to account for variations in lane positioning and conduct thorough testing in diverse driving conditions to validate system robustness.
- External Systems' Expectations: Integration with vehicle's forward collision warning (FCW) system for comprehensive threat detection and avoidance. Compatibility with pedestrian detection systems for enhanced safety in urban environments.
- External Users' and Expectations: Drivers expect the system to reliably detect and react to all types of vehicles, including motorcycles and bicycles. Pedestrian detection systems expect proper integration to prevent collisions with vulnerable road users.

5. Blind-Spot Collision Warning (BCW) System:
    - Hazard: System failure to detect vehicles during critical driving maneuvers such as lane changes or merging.
        - Resolution: Integrate additional sensors or cameras to enhance detection capabilities and optimize sensor placement for maximum coverage.
        - External Systems' Expectations: Compatibility with vehicle's entertainment and communication systems to prevent interference with sensor signals. Integration with electronic control units (ECUs) for coordinated electromagnetic interference mitigation.
        - External Users' and Expectations: Drivers expect consistent performance without interference from other electronic devices. Entertainment and communication systems expect proper shielding to prevent signal degradation.
6. Safe Exit Feature:
    - Hazard: Malfunction of override mechanism leading to inability to exit vehicle in emergency situations.
        - Resolution: Implement fail-safe mechanisms and redundant override options to ensure passenger safety in all scenarios.
        - External Systems' Expectations: Integration with vehicle's telematics systems for real-time communication of warning messages. Compatibility with audio systems for clear and audible warning sounds.

- External Users' and Expectations: Passengers expect prompt and clear warning messages under all circumstances. Telematics systems expect reliable communication to ensure timely delivery of warning messages.

7. Blind-Spot Collision-Avoidance Assist (BCA) System:
    - Hazard: Limited effectiveness in detecting vehicles with certain characteristics such as motorcycles or bicycles.
        - Resolution: Enhance sensor algorithms to improve detection of smaller vehicles and conduct extensive testing with diverse vehicle types to validate performance.
        - External Systems' Expectations: Integration with vehicle's navigation system for dynamic adjustment of detection parameters based on road and traffic conditions. Compatibility with vehicle's telematics systems for data exchange and remote diagnostics.
        - External Users' and Expectations: Drivers expect accurate detection of all types of vehicles, including motorcycles and bicycles. Navigation systems expect seamless integration for enhanced situational awareness and route optimization.
8. Blind-Spot Collision Warning (BCW) System:
    - Hazard: System interference with other electronic devices leading to degraded performance.
        - Resolution: Shield sensor components from electromagnetic interference and conduct electromagnetic compatibility testing to identify potential sources of interference.
        - External Systems' Expectations: Integration with vehicle's navigation system for coordinated display of warnings and route adjustments. Compatibility with vehicle's infotainment system for audiovisual alerts and user preferences synchronization.
        - External Users' and Expectations: Drivers expect consistent performance without interference from other electronic devices. Navigation systems expect proper integration to enhance driver awareness and facilitate safe navigation.
9. Safe Exit Feature:
    - Hazard: Delayed response of warning messages or sounds leading to unsafe conditions during rapid vehicle approach.

- Resolution: Optimize system response time and conduct real-world testing to validate warning message delivery under varying vehicle approach speeds.
- External Systems' Expectations: Integration with vehicle's parking assist systems for coordinated warning activation during parking maneuvers. Compatibility with vehicle's driver assistance systems for enhanced situational awareness and proactive safety measures.
- External Users' and Expectations: Passengers expect timely and clear warning messages under all circumstances. Parking assist systems expect proper coordination to prevent accidents during vehicle approach.

4.2 Performance Requirements

- The BSDS shall detect objects within the blind spot range with a minimum accuracy of 95% under normal weather and lighting conditions.
- The system shall initiate braking within 500 milliseconds of detecting a potential blind-spot collision threat.
- Visual and auditory warnings provided by the BSDS shall have a response time of less than 200 milliseconds from the detection of an object in the blind spot.
- The Safe Exit Feature shall activate visual and auditory warnings upon detecting an approaching vehicle to prevent vehicle occupants from inadvertently opening doors.
- The Safe Exit Feature shall automatically disable once the approaching vehicle has passed or a safe distance is maintained.

4.3 Usability Requirements

- The BSDS and BSW will promptly notify the driver of any detected limitations affecting the system's functionality through visual and auditory warnings.
- The BSDS shall offer multiple user options for system control, including the ability to deactivate the system, adjust assistance levels (warn-only mode or full assistance), and customize warning preferences.
- The BCA and BCW functionalities must be easily enabled and disabled via a designated button on the front dashboard, providing convenient access to the driver.
- Warning chimes generated by the BCW should offer customizable volume settings to accommodate user preferences and ensure clear audible alerts without causing distraction.

4.4 Interface Requirements

- **User Interaction:** Users can engage with the system through a designated dashboard button, facilitating intuitive interaction.
- **Menu Presentation:** The system presents a comprehensive menu of available options in the gauge cluster, ensuring clear visibility and accessibility for users.
- **Notification Display:** All system notifications are prominently displayed within the gauge cluster, ensuring users are promptly informed of relevant information.
- **Steering Wheel Navigation:** Users can navigate system menus conveniently using dedicated steering wheel buttons, enhancing usability while driving.

4.5 Logical Database Requirements

- The BSDS shall maintain a log of detected blind-spot events, including timestamps, object characteristics, and system responses, for diagnostic and analysis purposes.
- The database shall securely and efficiently store this information, with access controls ensuring data integrity and confidentiality.

4.6 Design Constraints

- The BSDS must adhere to Part 15 of the FCC guidelines, ensuring it does not cause harmful interference and accepts any interference received, including interference that may cause undesired operation.

- Compliance with FCC radiation exposure limits for an uncontrolled environment is essential for safety and well-being.

4.7 Software System Attributes

- Reliability: The BSDS shall demonstrate high reliability, with a mean time between failures (MTBF) of at least 10,000 hours.
- Security: The system shall employ encryption protocols to secure communication interfaces and prevent unauthorized access or tampering.
- Maintainability: The BSDS shall support remote diagnostics and software updates for timely maintenance.
- Portability: The system architecture shall be modular and platform-independent for integration with various vehicle models.

4.8 Supporting Information

- The BSDS shall undergo rigorous testing and validation to ensure compliance with safety and performance specifications.
- User manuals and training materials shall be provided to educate vehicle owners on proper use and maintenance, including troubleshooting and best practices.

5. Appendix A – Tailoring Policies

5.1 Assumptions and dependencies

- **Vehicle Operating System Compatibility**: The proper functioning of the Blind-Spot Detection System (BSDS) assumes compatibility with the vehicle's operating system. Any major updates or changes to the vehicle's operating system may impact the implementation and execution of BSDS features.
- **Sensor Calibration**: It is assumed that the sensors used in the BSDS are properly calibrated during manufacturing and installation. Any deviations or inaccuracies in sensor calibration could affect the accuracy and reliability of the system's detection capabilities.
- **Environmental Conditions**: The effectiveness of the BSDS may be influenced by various environmental factors such as weather conditions (e.g., heavy rain, snow), road conditions (e.g., slippery surfaces), and ambient light levels. While the system is designed to operate under typical driving conditions, extreme environmental conditions may impact its performance.
- **Maintenance and Service**: The BSDS relies on proper maintenance and periodic service to ensure optimal performance. Any lapses in maintenance schedules or service procedures may affect the system's functionality over time.
- **Integration with Vehicle Systems**: The BSDS depends on seamless integration with other vehicle systems, such as the braking system, electronic stability control (ESC), and lane-keeping assist system (LKAS). Changes or updates to these systems may require corresponding adjustments to the BSDS implementation to maintain compatibility and functionality.
- **Regulatory Compliance**: The implementation of the BSDS assumes compliance with relevant regulatory standards and requirements, including but not limited to FCC guidelines for electromagnetic radiation exposure limits and automotive safety standards.
- **Driver Awareness and Training**: It is assumed that drivers are adequately trained and aware of the limitations and capabilities of the BSDS. Driver education and awareness campaigns may be necessary to ensure proper usage and understanding of the system's features.
- **Supplier Reliability**: The reliability and availability of components and subsystems supplied by external vendors may impact the manufacturing and delivery schedule of vehicles equipped with the BSDS. Dependencies on third-party suppliers should be managed to minimize potential disruptions to production.

5.2 Acronyms and Abbreviations

Term	Definition	Abbreviation	Source (if applicable)
System Under Development	The system which is actively being developed.	SUD	
		FMEA	
Blind Spot Detection System	The blind spot detection system used by the Blundai vehicle	BSDS	2020 Sante Fe Owner's Manual
Electronic Stability Control	The system responsible for maintaining the stability of the Blundai vehicle	ESC	2020 Sante Fe Owner's Manual
Blind Spot Collision Avoidance	The system responsible for manipulating the mechanical functions of the Blundai vehicle to avoid a collision	BCA	2020 Sante Fe Owner's Manual
Blind Spot Collision Warning System	The system responsible for alerting the driver of detections and active limitations	BCW	2020 Sante Fe Owner's Manual
Federal Communications Commission	The system responsible for alerting the driver of detections and active limitations	FCC	2020 Sante Fe Owner's Manual

5.3 Tailoring Policies

Tailoring is not a requirement to bring the document into compliance with the standards set by IEEE 29148-2018. Tailoring should only occur when conformance to the standard is not possible or practical. The act of tailoring is the modification and/or removal of one of the content sections outlined in this document, adding additional information items for organization is not considered tailoring. Tailoring should only occur when factors or circumstances:

- surround an organization that is using the document

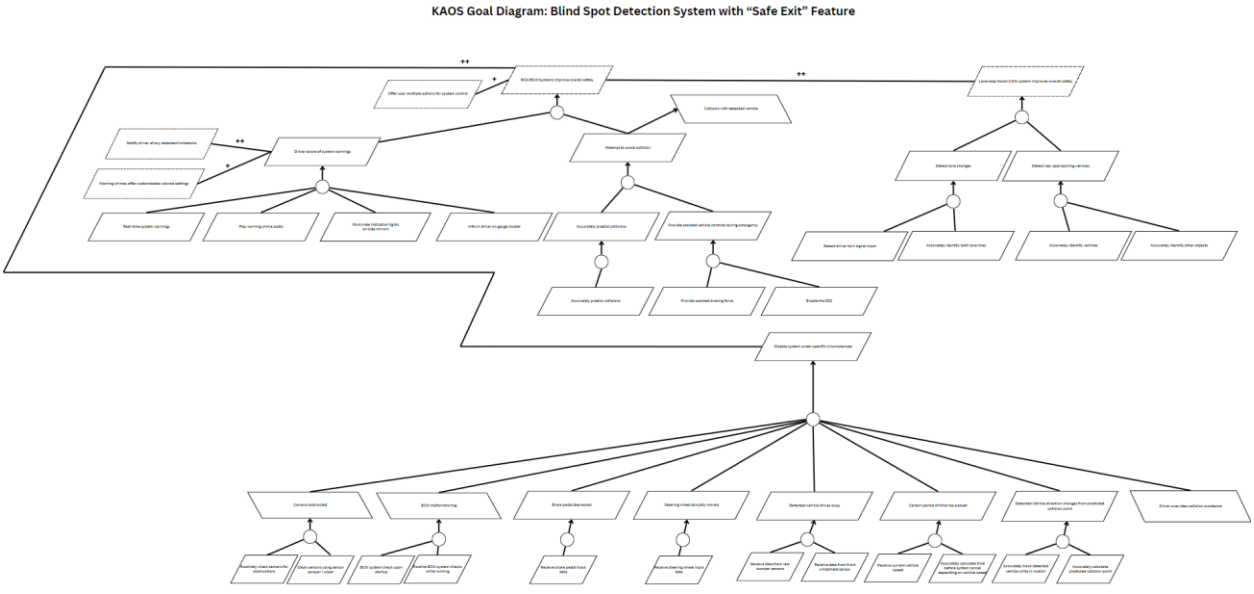
- influence a project using this document to meet an agreement
- reflect the needs of an organization.

When tailoring the document, the following activities shall be implemented:

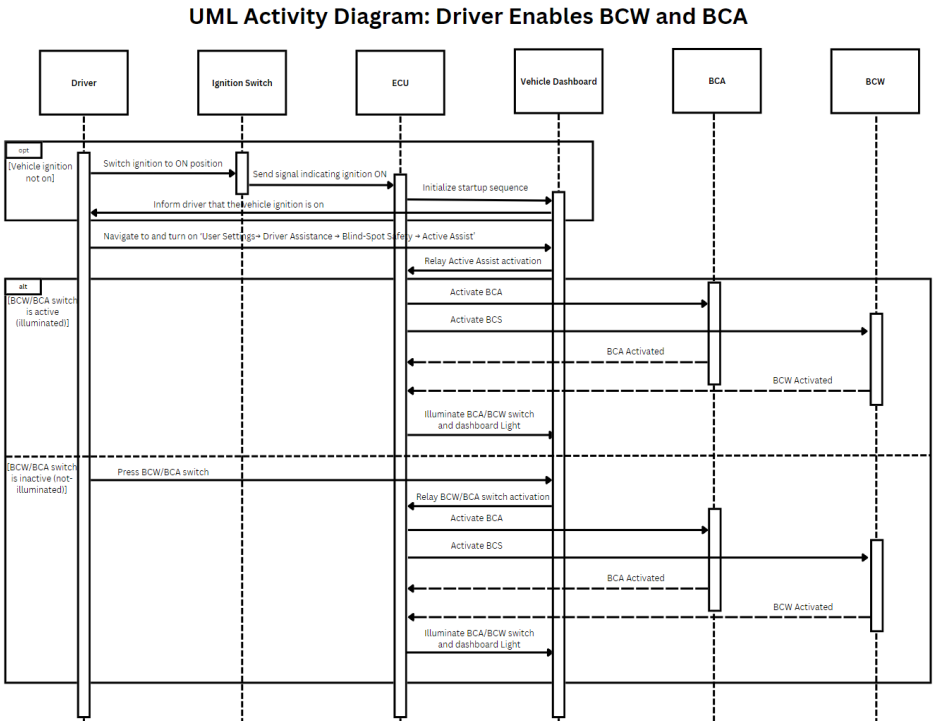
- Identify and document the circumstances that may influence tailoring.
    - novelty, size and complexity
    - stability of operating environments
    - variety in operating environments
    - starting date and duration
    - emerging technology
    - availability of services of enabling systems
    - other standards with which the document needs to conform.
- Identify and get input from all parties impacted by the tailoring process.
    - Such as stakeholders, contributors, and other interested parties
- Delete the information contents that require tailoring.

6. Appendix B – KAOS Goal and UML Diagrams

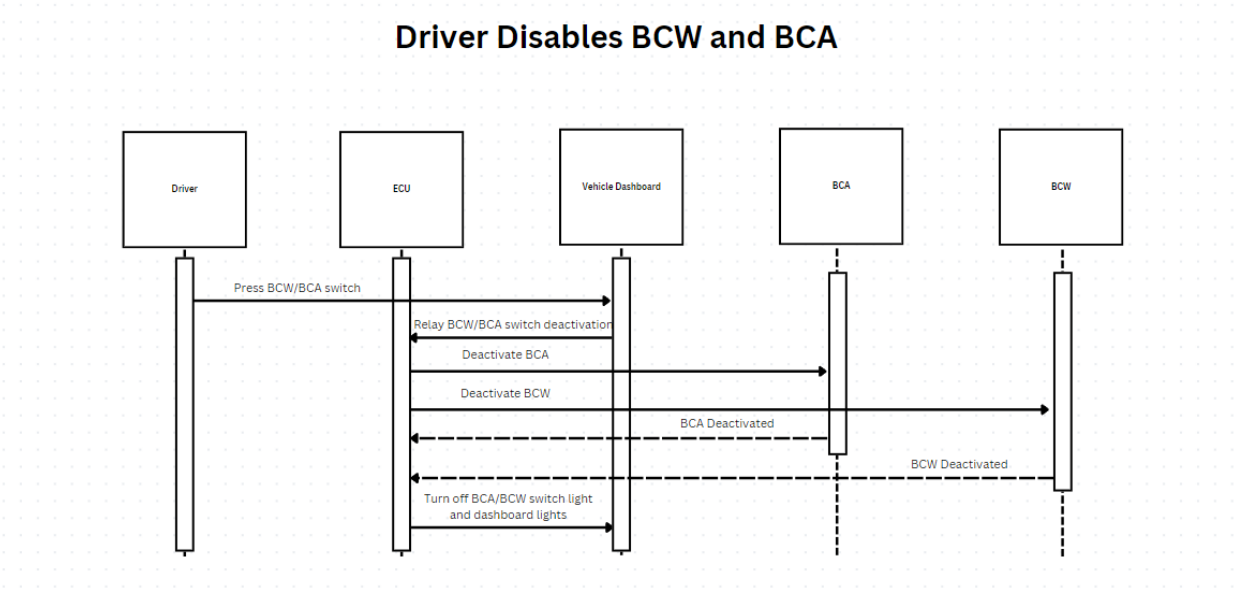
6.1 KAOS Goal Diagram : Blind Spot Detection System with "Safe Exit" Feature



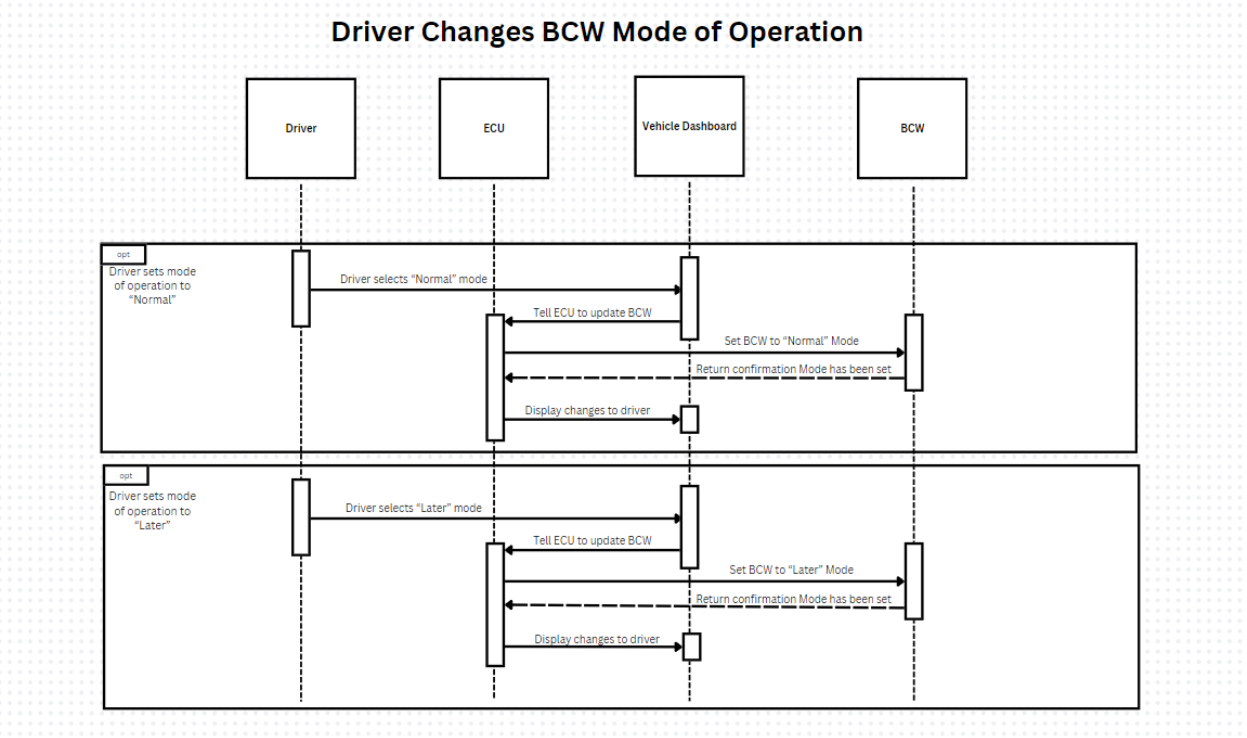
6.2 UML Sequence Diagram : Driver Enables BCW and BCA



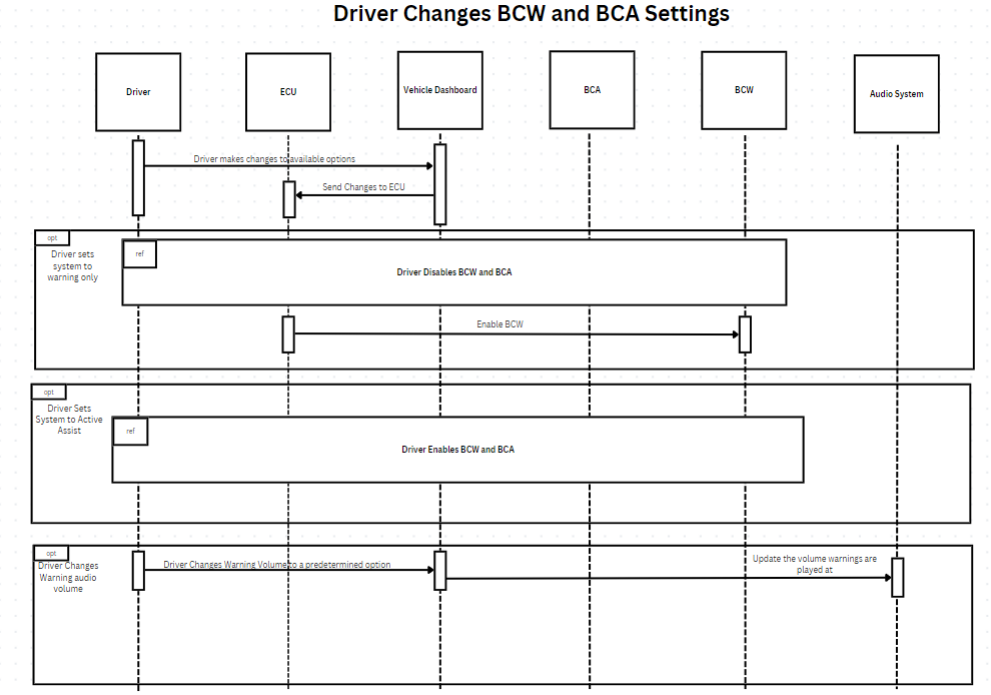
6.3 UML Sequence Diagram : Driver Disables BCW and BCA



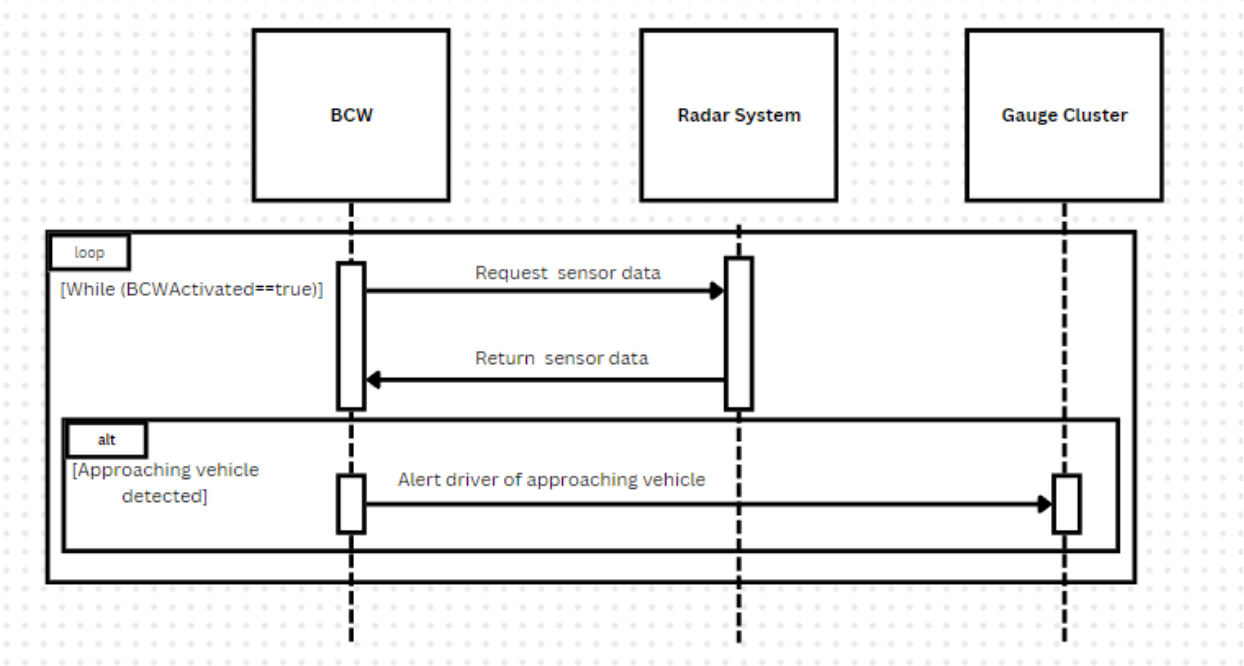
6.4 UML Sequence Diagram : Driver Changes BCW Mode of Operation



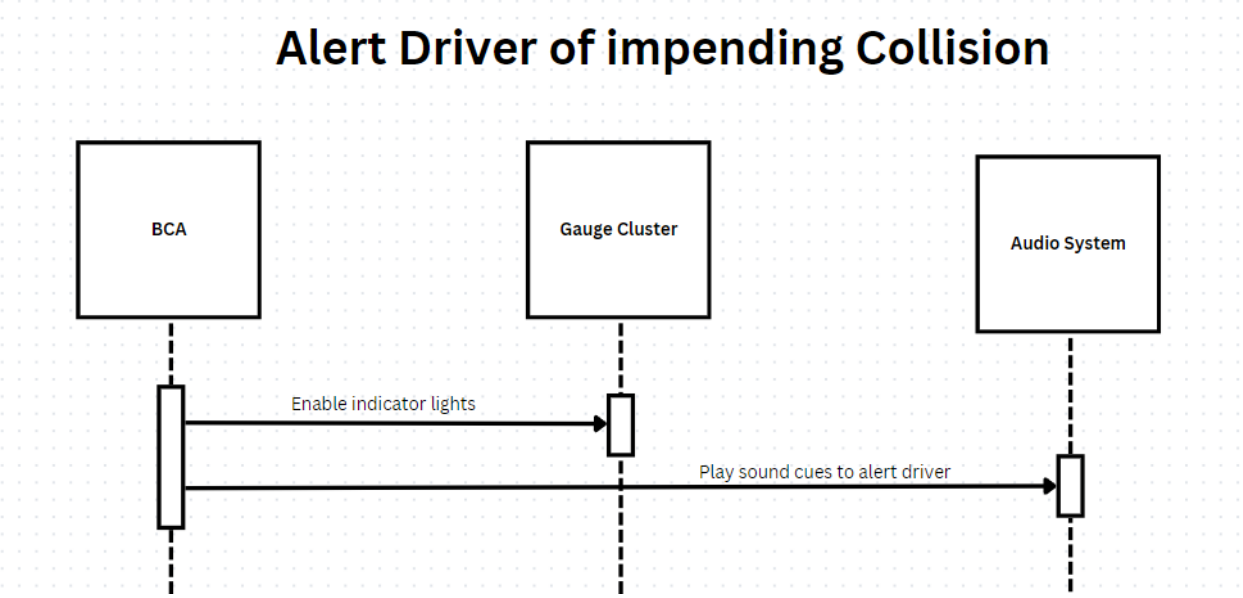
6.5 UML Sequence Diagram : Driver Changes BCW and BCA Settings



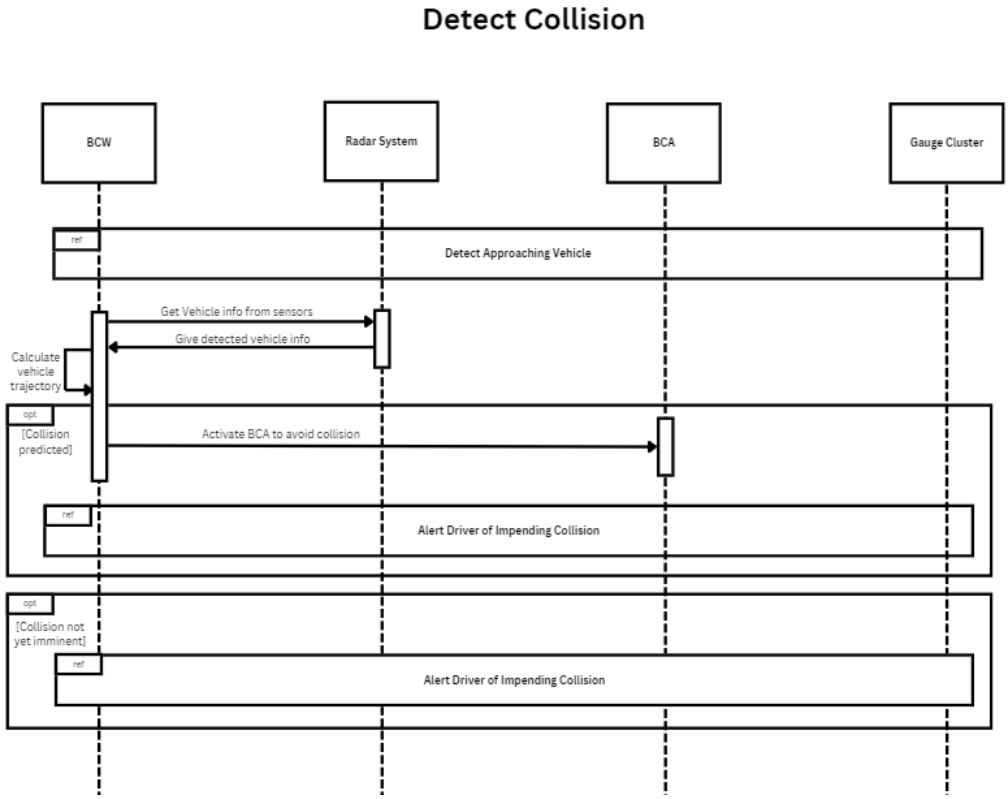
6.6 UML Sequence Diagram : Detect Approaching Vehicle



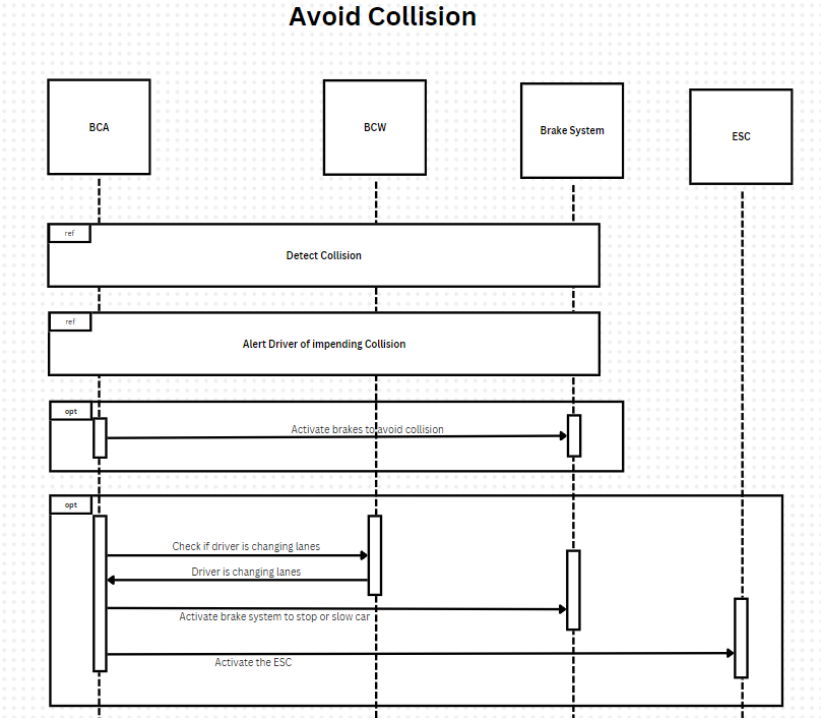
6.7 UML Sequence Diagram : Alert Driver of Impending Collision



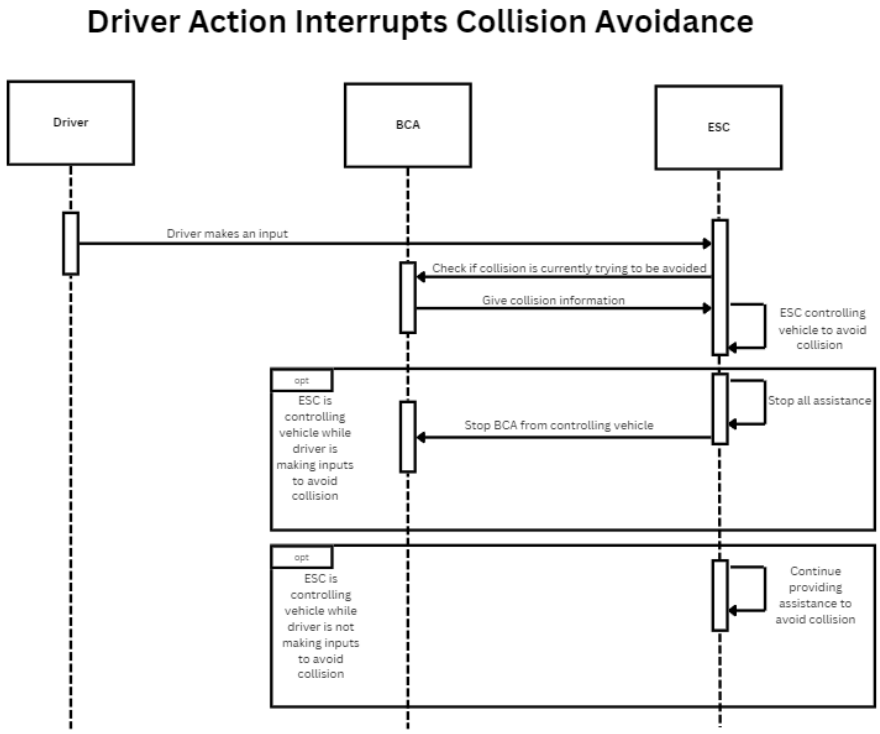
6.8 UML Sequence Diagram : Detect Collision



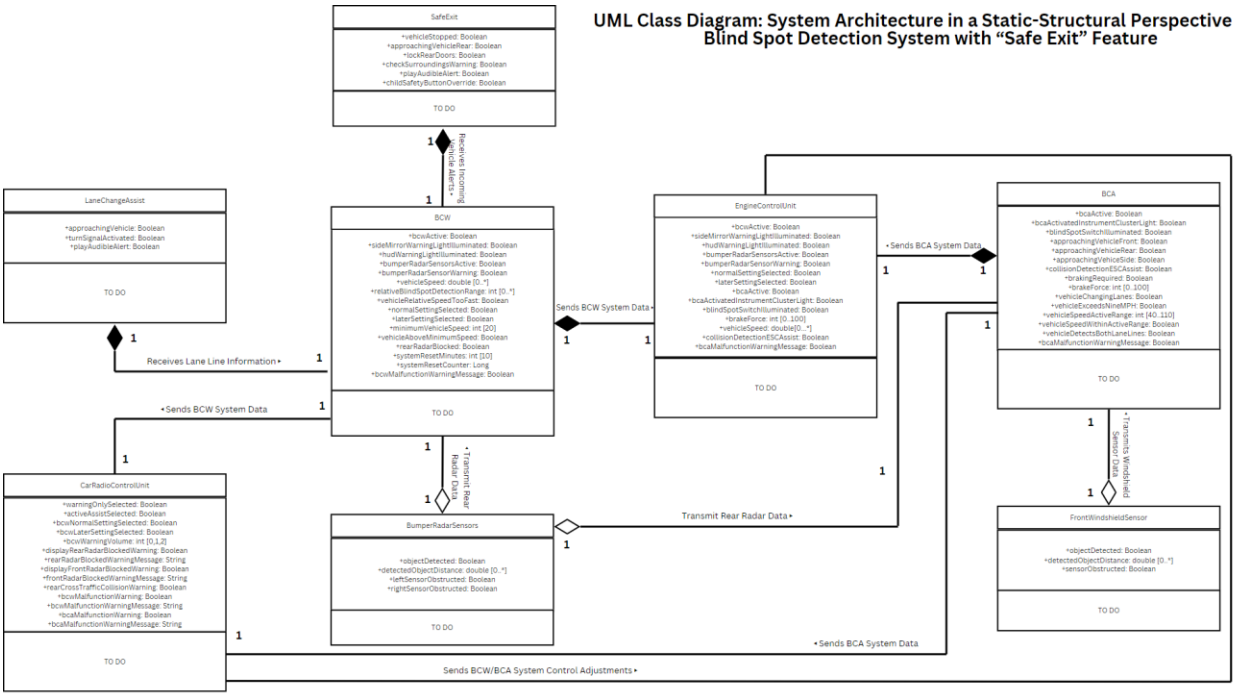
6.9 UML Sequence Diagram : Avoid Collision



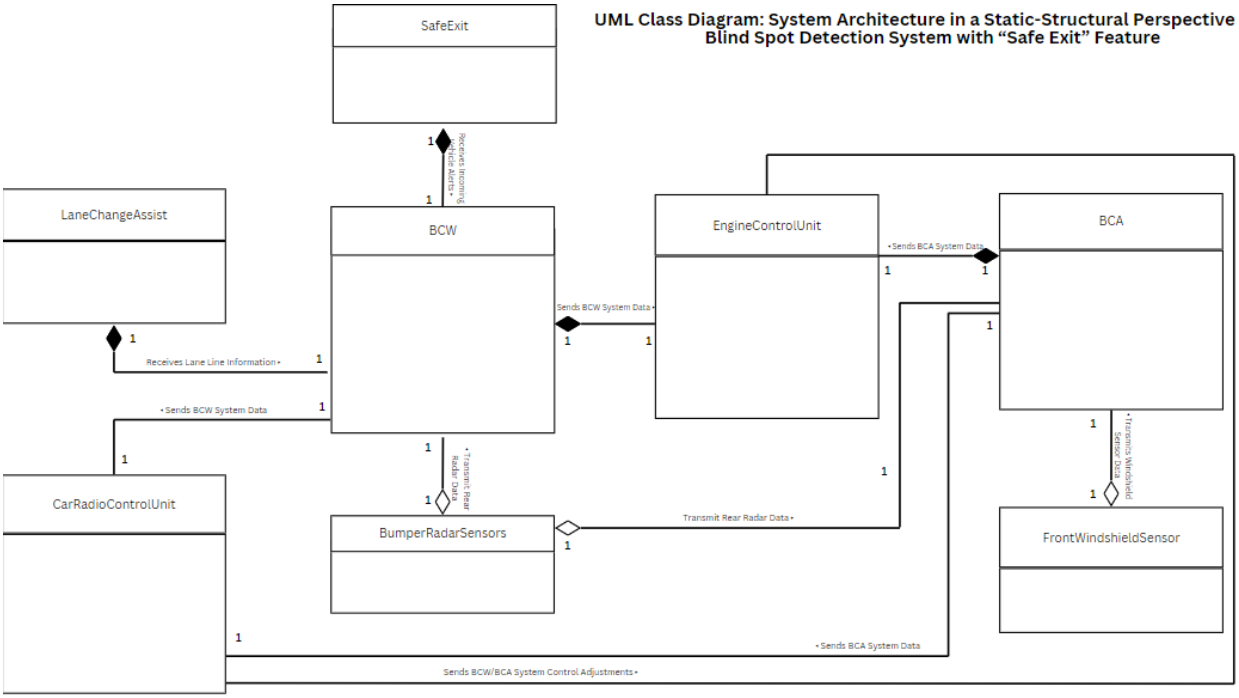
6.10 UML Sequence Diagram : Driver Action Interrupts Collision Avoidance



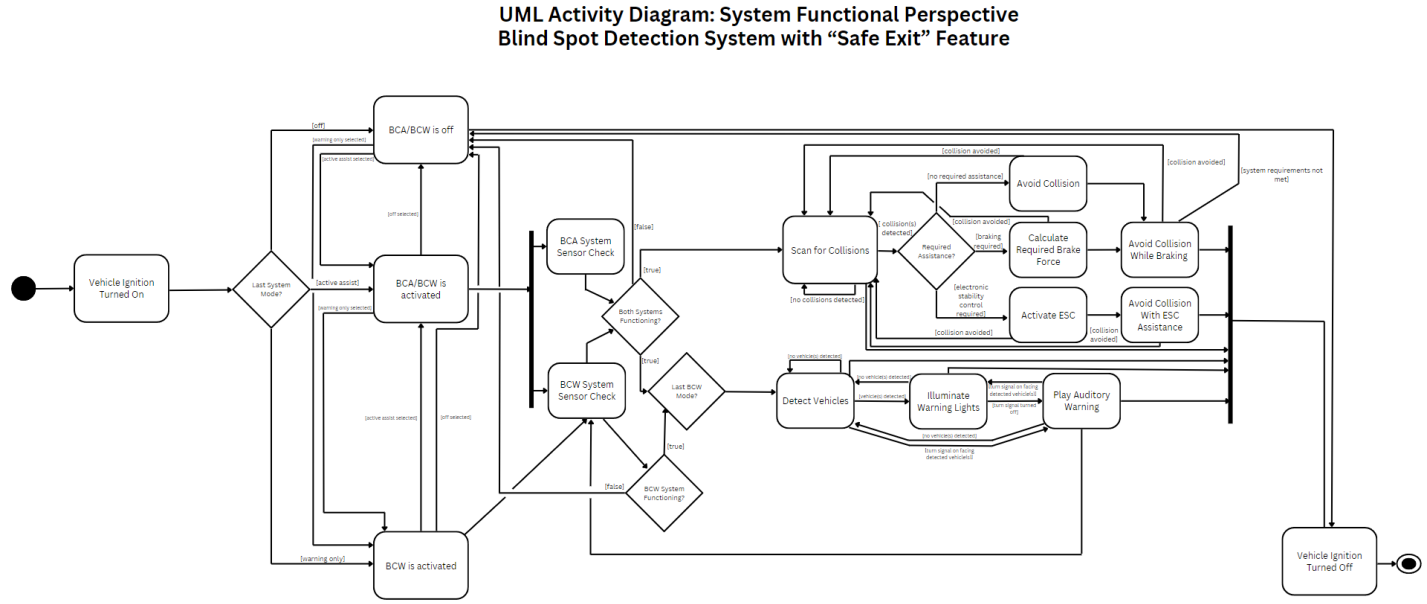
6.11 UML Class Diagram : System's Data in a Static-Structural Perspective



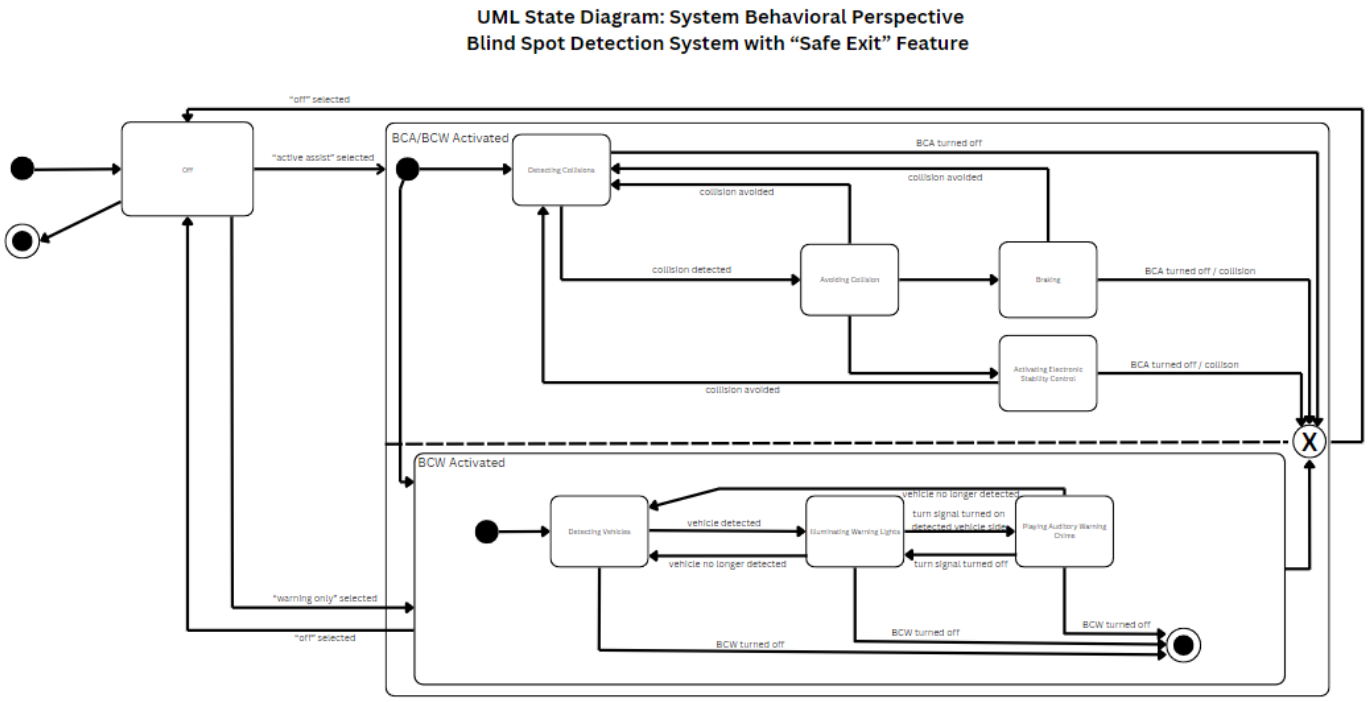
6.12 UML Class Diagram : System Architecture in a Static-Structural Perspective



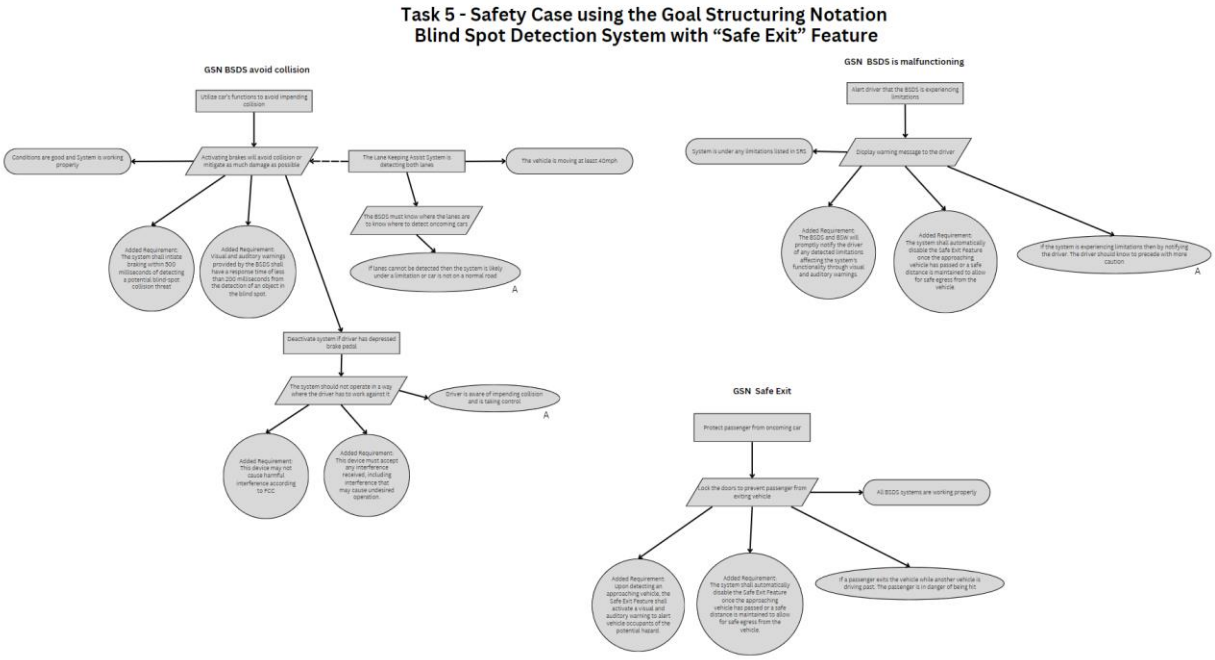
6.13 UML Activity Diagram : System Functional Perspective



6.14 UML State Diagram : System Behavioral Perspective



6.15 Safety Case using the Goal Structuring Notation



6.16 Failure Mode and Effect Analysis (FMEA)

Task 3 FMEA

Failure Mode and Effects Analysis									
ITEM	Failure Mode	Causal Factors	Immediate Effect	System Effect	Method of Detection	Current Controls	Hazard	Risk	Reccomended Action
H1	System	Unexpected activation or deactivation of BCA	Could lead to driver confusion	Vehicle suddenly begins to operate differently than the driver is expecting	BCA activates/deactivates under strange or uncertain conditions	Prevent activation/deactivation under certain conditions to avoid unexpected behavior	Driver might make a mistake operating the vehicle trying to adapt to the sudden change	C3	Implement stricter conditions the system must meet before activating or deactivating the BCA
H2	System	Adverse weather and/or road conditions	Impaired detection capabilities	System is reporting incorrect information	Detect irregularities and errors	Alert driver that assistance will be not be able to be provided in an emergency	BSDS system will not work	B2	Driver should take measures to clear debris from the sensors if that is the issue. If the factors causing this is the weather or road then there is nothing that can be done
H3	System	Safe Exit system falsely detects oncoming car	Locks doors when no car is approaching	System is reporting false information	Is the information reported by the safe exit system consistent with other data	Use multiple sensors to avoid false positives	Car does not let passengers out for a short period of time	C4	Be patient with the system
H4	System	BCA failure to activate	vehicle crashes	Other systems may not know that the BCA is malfunctioning and provide false information to driver	BSDS should routinely check on status of BCA	It should attempt to restart itself if it fails	BCA will be unable to assist the driver in avoiding collisions	C1	Driver should always be attentive so in the case where the BCA fails to activate the driver is still able to take action to avoid the collision
H5	Process	Sensors or Cameras installed incorrectly	Systems that rely on them will not work	BSDS and similar systems will not function	The systems will notify the driver that the cameras/sensors are not functioning	Make sure the vehicle passes QA and inspection before going to customer	All assistance systems like BSDS and LKAS will not be functional	D1	Take car to dealer or mechanic shop to have the issues addressed.
H6	Process	BCW fails to warn driver of the presence of a vehicle in the blind spot	Driver is unaware there is a vehicle in their blind spot	This may cause the BCA to also not activate	BSDS routinely checks that the BCW is operationable	When the BCW is no longer operational a restart should be attempted	Driver may make an action if they do not realize there is a car in their blind spot putting both vehicles in danger	C2	BSDS should warn driver the BCW is malfunctioning. Driver should also check the blind spots themselves and not rely solely on the system
H7	System	BCA errors in timing of functions	safety operations occur later than intended	The expected operation of things falls apart	Make sure the time operations take are monitored	Systems should re calibrate if the become inaccurate	Safety assistance triggers to late i.e. BCA braking	C1	The electronics may be faulty after a long time and could use replacing

7. Appendix C – Copyright

This document is based on a template meeting the ISO/IEC/IEEE 29148-2018 standard, available at https://www.iso.org/standard/72089.html. Template authors are:

Dr. rer. nat. Bastian Tenbergen,
Associate Professor of Software Engineering
bastian@tenbergen.org

Mikayla Conner-Spagnola, MA
Independent Consultant
mconner@oswego.edu

Department of Computer Science
State University of New York at Oswego
Oswego, NY 13126, United States

8. Appendix D – Team Reflection Essay

- With the team project coming to an end, we can reflect upon the requirements engineering process and how the implementation of our system was influenced by our learning and understanding of the process.

  The in-depth research of our system was priority number one when it came to the start of our project. With our understanding of the requirements engineering process going into the project, we both had decided to each do the assignment and then merge our findings afterwards, checking for conflicts and agreeing upon the final output of our team to effectively get "more eyes" on and make sure that we had covered the entirety of the system at hand. This method proved to be a solid way of working and we continued to use this method. As we did not have a four-person group, this meant significantly more work for us individually as we were not splitting it up. This method benefitted us by ensuring we both had a solid understanding of the systems and that we both were able to practice making every diagram.

  Our understanding of the requirements engineering process continued to advance over the semester as we continued to improve the SRS document with supporting KAOS goal diagrams and UML diagrams. We had a lot to learn about the proper usages of each but seemed to have made some good progress with the improvement of the system design / depiction through the use of the diagrams as our understanding of each advanced throughout the semester.

  With the semester and project at its end, the progression of our SRS document pertaining to the detail of the system at hand and how our understanding of the requirements engineering process has advanced and influenced the improvement has become evident when comparing the initial document and the current SRS document.