Software Requirements Specification (SRS)

Project Active Park Assist 2

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1 Introduction

This document will specify the overall description, specific requirements, modeling requirements, and prototype models for the Active Park Assist system.

This document is intended to specify:

1. The perspective: how the product fits with the entire system of the vehicle.
2. The function: what the product will be used for.
3. User Characteristics: the type of customer and level of understanding of the system they should have in order to operate it.
4. Constraints of the system.
5. Assumptions about the uses of the product.
6. Approportioning of Requirements: how the system relates to the customer-specified requirements.
7. The specific requirements met by the system.
8. Modeling requirements for the prototype.
9. The prototype models.
10. A description of how the system will run as described by how to run the prototype.
11. Sample scenarios.
12. References.

1.1 Purpose

This document is intended to give an in-depth view of the components, key elements and key functions of the Active Park Assist system. Components of the system will include radar sensors, object-detecting cameras, a Human-Machine Interface, and the Active Park Assist system. Key Elements will include the phases involved the execution of the system. Key functions are the tasks to be executed for the elements to communicate with each other.

The system is developed to provide the Active Park Assist feature for automotive manufacturers to add to new automobiles. This document will provide a detailed outline

of the requirements of the software system for developers intending to implement the system.

1.2 Scope

Products to be developed include the component of the Human-Machine Interface that will send operational signals to the Active Park Assist, as well as the Active Park Assist system itself. The product will simplify the task of parking a vehicle for drivers. The software simplifies parking by completely automating the parking process of both parallel spaces and perpendicular spaces. For the vehicles that feature it, Active Park Assist is available as an on-board automation system to be used at the disposal of the driver.

1.3 Definitions, acronyms, and abbreviations

Following are terminology, acronyms, and abbreviation used throughout this document.
- The **Driver** is the person who is sitting in the seat behind the steering wheel and controls the vehicle.
- **Active Park Assist (APA**) is the system to be designed and implemented.
- **The Human Machine Interface (HMI)**, is the interface which the Driver interacts with the Active Park Assist system.
- **Sensor** refers to a device that primarily detect distance between itself and an object.
- **MPH** is abbreviation for miles per hour.
- **Signals** are the network communication between **HMI** and **APA**.

1.4 Organization

Software Requirements Specification consists of 7 sections. Section 1 details the document and the project by which this document was created. The following sections form the specification.

Section 2 gives the context of the system, constraints defining interfaces and behavior of the system are provided. A detailed description of the functionality of the system is given. Section 2 forms a depiction of the product in the context of its use.

Section 3 is an integral part of the Active Park Assist System. The requirements of the product are listed in this section. Each requirement was used when defining the constraints and the functionality and is used in later sections.

Section 4 provides models representing Active Park Assist. Sequence diagrams, a use case diagram, and the domain model diagram are included.

Section 5 is the prototype. It is a representation of how the final product should interact with the Driver and its immediate observed environment.
Section 6 has the references used in this document.
Section 7 contains contact information for the project organizer.

2 Overall Description

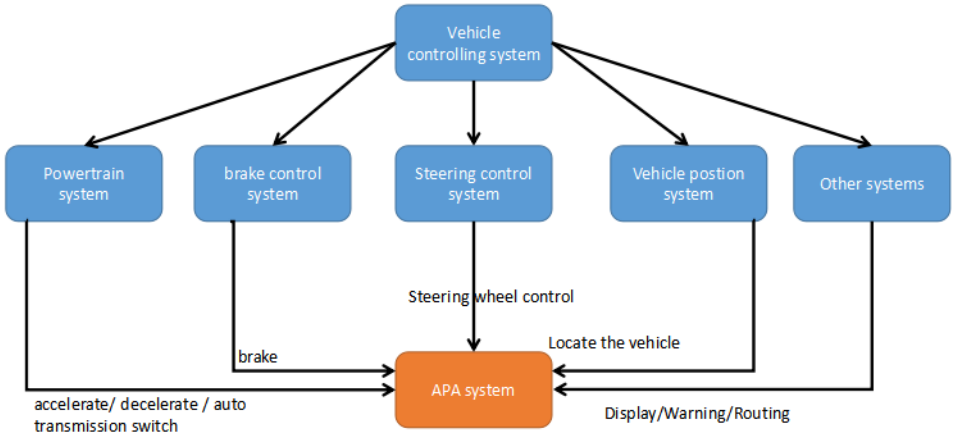
This section includes the description of the APA system, the constraints of the system, the functions it provides and the user characteristics requirements.

2.1 Product Perspective

Context:

The Active Parking Assist (APA) system is a subsystem in the control system of a vehicle that assists the driver to automatically park on the vehicle. During the APA operation, it will work with multiple subsystems and hardware to achieve the goal of automatically parking the vehicle. The hardware and subsystems include but are not limited to the following: powertrain management subsystem, brake control subsystem, steering control subsystem, vehicle position subsystem and other auxiliary systems.

Diagram:



Complete description:

In order to activate the APA system, the vehicle speed needs to be less than 7 mph (this preset value of the speed of each model may differ). Furthermore, the driver needs to specify the parking preference through the HMI interface. When the above operations are completed, the vehicle will start detecting available parking spots with the omnidirectional sensors. The parking spot will be confirmed only when the dimensions of the detected parking area fit the preset value in the system.

When the APA system finds a suitable parking spot, the driver will confirm the parking spot and press a button to start the automatic parking. After the confirmation, the APA system will take control of the vehicle and start the parking with the help of adaptive cruise control system to accelerate/decelerate. The HMI will show the planned route for the vehicle. During this process, the parking process can be paused if driver turns the steering wheel, applies the brake or presses the Abort button on the HMI. If an obstacle is detected during the parking process, the parking will be aborted automatically. Both abort actions will display a message on the HMI to notify the driver.

When the parking process is completed, the APA system will put the vehicle in park, notifies the driver of the completion on the HMI and turn the APA system off.

The system can be upgraded to obtain further functions, the upgrade message will only be displayed when the driver first turned on the vehicle and is in park. The upgrade will happen between midnight and 6 am, local time, and will be paused if the vehicle is turned on during this time.

Constraints:

System interfaces:

The auto parking is mostly based on powertrain system, brake control system, steering control system and vehicle position system, any of these system's failure will causes the APA system loses its primary function.

User interfaces:

The APA should only be accessed by the driver, any other person in the vehicle should not access the APA system during the APA operations.

Hardware interfaces:

The APA system will take control of the sensors/steering wheel/brake through the subsystems such as Sensor Control System/Steering Control System/Brake Control System.

Software interfaces:

The APA system interacts with the driver through the HMI, there will be buttons on the touch screen for the driver to either start detecting the parking spots or abort the parking process, etc. The HMI will display images during the parking process.

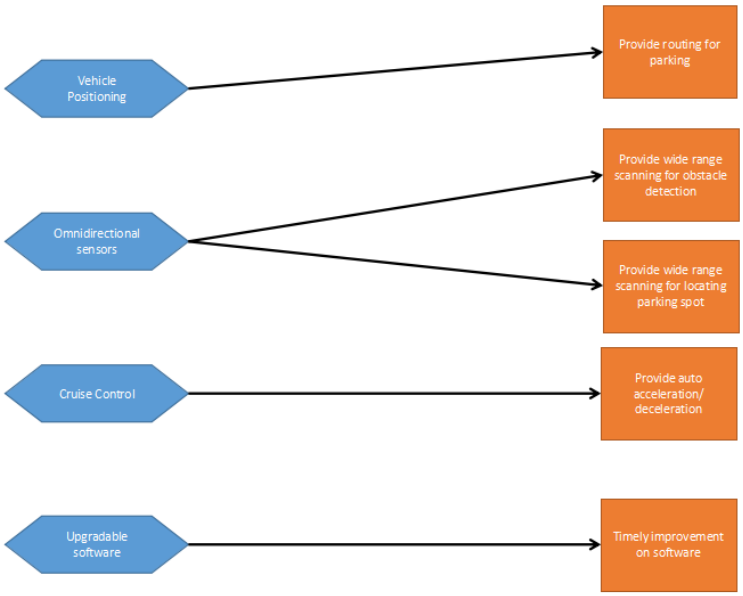
Communication interfaces:

There are no communication interfaces for APA system.

2.2 Product Functions

The APA system has the function of vehicle positioning, cruise control, and omnidirectional scanning. During the APA selected options, the APA system should have the function to locate parking spot based on the parking preferences, calculate parking trajectory of the vehicle, auto parking, cancel/abort the parking and detect obstacle or approaching pedestrians.

At the software level, the APA system has the function to upgrade its controlling software and can also be interact with the driver through the HMI.



2.3 User Characteristics

The user of the APA system is the driver of the vehicle. Under the premise of having a driver's license, drivers need to have basic driving knowledge and basic understanding of electronic products. Also, the driver should have the ability to read the instruction on the owner's manual. During the APA operation, the driver is required to pay attention to the surroundings of the vehicle and can react in time to cancel/pause the operation if needed.

2.4 Constraints

a) Regulatory policies

- Various state and federal laws regulating testing and functionality of the APA system.

b) Hardware limitations (e.g., signal timing requirements)

- Sensors and cameras fit on the vehicle.
- Sensors and cameras are properly aligned.

c) Interfaces to other applications

- Park Control Subsystem (PCS)
  - Only able to accept driver's input through HMI.
  - Functions properly.
- Powertrain Management Subsystem (PMS)
  - Given accurate PCS input to accelerate and select proper transmission gear to match the trajectory.
- HMI Subsystem
  - Touch screen is responsive and accurate.
  - Screen display is functioning properly.

- Brake Control Subsystem (BCS)
    - Car brakes are fully functional.
    - Connection to PCS is secure and open in order to brake as necessary to meet the trajectory.
- Steering Control Subsystem (SCS)
    - Steering wheel has is unimpeded.
    - Connection to PCS is secure and open in order to steer as necessary to meet the trajectory.

2.5 Assumptions and Dependencies

- Hardware fits on the vehicle.
- Driver can recognize if the parking space found is an appropriate spot to park in.
- Searching function of APA class finds valid parking spots.
- Vehicle is less than 9 feet wide for perpendicular parking.
- There are parallel parking spots 1.2 times the length of the vehicle.
- HMI is responsive and accurate.
- Sensors are responsive, accurate, and aligned properly.
- Camera view is clear and aligned properly.

2.6 Approportioning of Requirements

- Security research to further improve APA's security.
- Sensor research to improve APA's accuracy.

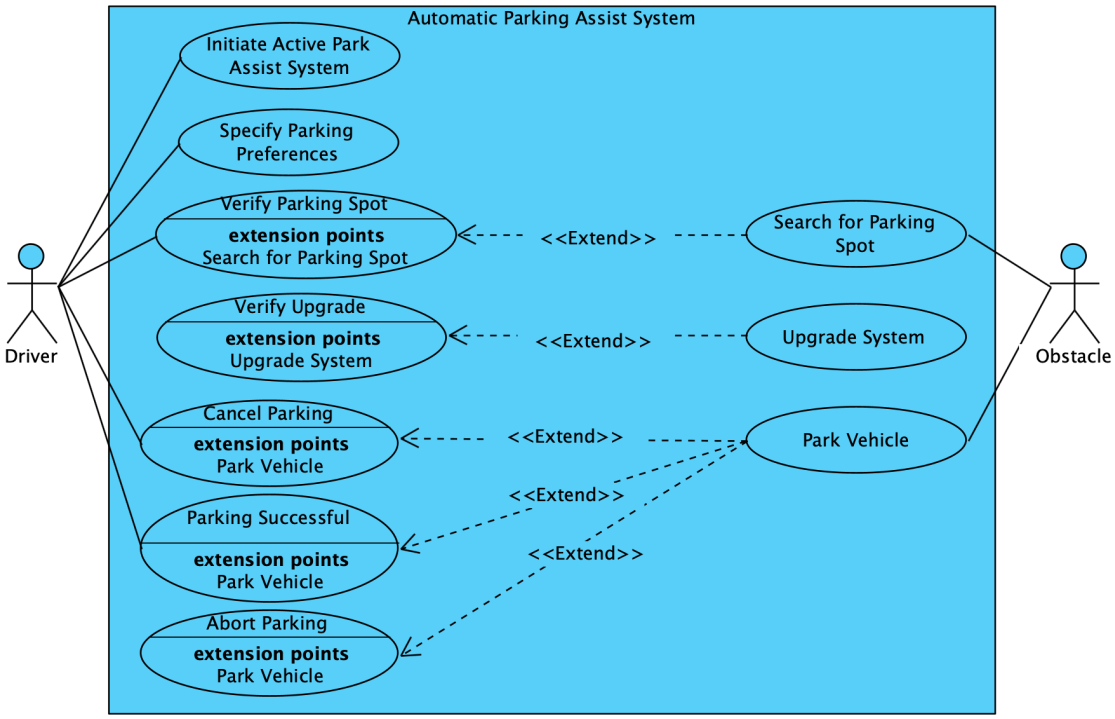
3 Specific Requirements

1. Automatic Park Assist (APA) activated through the infotainment system. This will be the only way to turn APA on.
2. The Human Machine Interface (HMI) is in the infotainment system, which is an 8-inch touch screen in the vehicle. This will display APA's state, prompt and receive inputs from the driver, and allow driver to abort the system at any time.
3. Communication between APA and HMI must be encrypted to prevent malicious attempts to control the vehicle.
4. APA and HMI firmware needs to be upgradable.
5. APA needs to be able to detect the status of sensors and cameras.
6. If a faulty sensor or camera is detected, APA will alert the Driver of the problem through the HMI and APA will be disabled until there are no faults detected.
7. In the HMI, there will be two parking options to choose from: parallel and perpendicular parking.
8. APA needs to be able to identify parking spots that are a minimum of 1.2 times the length of the vehicle when parallel parking, and 9 feet wide when perpendicular parking.
9. While APA is active, vehicle is traveling 7 mph or slower.
10. Front and rear cameras will be used to identify parking spots.
11. Ultrasonic sensors, mounted on both sides of the vehicle (front, midsection, and rear), will be used to identify parking spots.

12. APA will notify the driver through the HMI, along with an audible beep, when a parking spot is found.
13. The driver will verify the parking spot through the HMI after APA has found one. In the HMI, the trajectory of the vehicle will be displayed to the driver.
14. APA will not start parking until the driver has accepted the action through the HMI.
15. APA will take control of the vehicle when the driver has verified the parking spot.
16. APA will shift the transmission between drive and reverse as needed to match the verified trajectory.
17. APA will brake as needed to match the verified trajectory.
18. APA will turn the steering wheel as necessary to meet the verified trajectory.
19. Radar/cameras will be used during APA to prevent collisions.
20. The driver may cancel APA by braking, obstructing the steering wheel, or by hitting 'abort' through the HMI.
21. APA will turn off once the vehicle has parked successfully.
22. If obstacles are detected in the parking trajectory (while APA is parking) APA will stop the vehicle, put the vehicle in park and turn itself off. It will leave a notification for the driver through the HMI of why the system was turned.
23. APA must detect and track objects in all directions of the vehicle.
24. Detectable obstacles include, but are not limited to: vehicles, trucks, motorcycles, mopeds, bicycles, scooters, pedestrians, traffic cones, shopping carts, wheelchairs.
25. APA will include visual and audible prompts when the system is interrupted to alert the Driver.

4 Modeling Requirements

Use Case Diagram



1.

Use Case:	Abort Parking
Actors:	None
Description:	An obstacle has been detected in the trajectory the vehicle was going to take to park the vehicle. APA will pause the parking process and alert the driver with the HMI that an obstacle has been detected. The driver will be allowed to either resume the parking process or abort the parking process with buttons in HMI. If the driver resumes the parking process and the obstacle is still detected, APA will abort the parking process.
Type:	Primary
Includes:	None
Extends:	None
Cross-refs:	19, 22, 23, 24, 25
Use cases:	None

2.

Use Case:	Cancel Parking
Actors:	Driver
Description:	The driver can cancel the parking process manually by applying the brakes, turning the steering wheel or by pressing the “abort” button on the panel. The vehicle will stop and turn to “park” mode, along with turning off the APA system.
Type:	Primary
Includes:	None
Extends:	None
Cross-refs:	2, 3, 20, 25
Use cases:	None

3.

Use Case:	Initiate Active Park Assist System
Actors:	Driver
Description:	Driver starts APA by tapping a button on the HMI (Human Machine Interface). APA will respond to HMI if sensors/cameras are not working properly, letting the driver know there is an error and APA will then proceed to abort and not allow the driver to use it. After the button is pressed, parking options will be presented to the driver through the HMI.
Type:	Primary
Includes:	None
Extends:	None
Cross-refs:	1, 2, 5, 6
Use cases:	7

4.

Use Case:	Park Vehicle
Actors:	Obstacle
Description:	After a parking spot has been verified by the driver, the map created while searching for parking spots is used to park the vehicle. This map will be a trajectory created by the cameras and sensors of where the ideal parking space is along with the obstacles the vehicle must avoid. Once the parking process begins, APA takes control of the steering wheel, transmission, throttle, and brake. APA drives the vehicle at max speed of 5mph following the path that was created in the map. APA will actively scan for obstacles in the path using rear and front view cameras along with the ultrasonic sensors. The system will abort if an obstacle is detected.
Type:	Primary
Includes:	None
Extends:	Cancel Parking, Abort Parking, Parking Successful
Cross-refs:	14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25

Use cases:	1, 2, 5

5.

Use Case:	Parking Successful
Actors:	Driver
Description:	APA has successfully parked the vehicle. After the vehicle has completed the parking process, APA will put the vehicle in park, notify the driver in the HMI that the system has completed the parking process and turn off the APA system. Control of the vehicle will return to the driver.
Type:	Primary
Includes:	None
Extends:	None
Cross-refs:	21
Use cases:	None

6.

Use Case:	Search for Parking Spot
Actors:	Obstacle
Description:	Having received a Boolean value for “parallel”, APA’s Searching is activated. The system searches for parallel parking spots given a true Boolean value, perpendicular parking for a false value. In this state the HMI displays a message directing the driver to drive 7mph or slower while it searches for a parking spot. Sensors and the cameras on the vehicle are then building maps of the parking spaces and checking if the vehicle could fit. Upon driving by a spot that the vehicle could park in, a message alert is made to the HMI asking the user to Verify the parking spot. During any operation the Driver is able hit Abort on the HMI to exit the APA completely. Additionally, they can hit Cancel on the HMI to go back and re-specify “right_side” and “parallel” options.
Type:	Primary
Includes:	None

Extends:	Verify Parking Spot
Cross-refs:	8, 9, 10, 11, 12
Use cases:	9

7.

Use Case:	Specify Parking Preference
Actors:	Driver
Description:	After the APA has been initiated and the parking options are presented to the driver, the driver will be able to select the options within the system if they wish to parallel park or perpendicular park. This will allow the cameras/sensors to focus on one side of the road for greater functionality.
Type:	Primary
Includes:	None
Extends:	None
Cross-refs:	7
Use cases:	6

8.

Use Case:	Upgrade System
Actors:	Driver
Description:	Software upgrade will be displayed to the user in the HMI. This upgrade message will only appear when the driver has first turned on the vehicle and is in park. This message will never show up while the driver is driving the vehicle or reversing the vehicle, only when the driver has initially turned the vehicle on. If the driver verifies the software upgrade, the upgrade will happen between midnight and 6am, local time. If the vehicle is turned on during this time, the system will pause the upgrade request and continue with the upgrade the next day.
Type:	Secondary

Includes:	None
Extends:	Verify Upgrade
Cross-refs:	4
Use cases:	10

9.

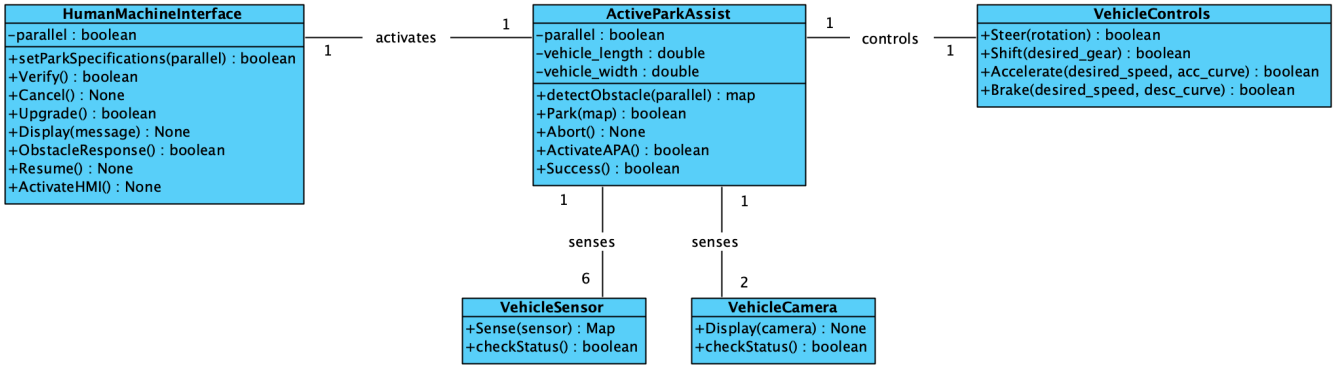
Use Case:	Verify Parking Spot
Actors:	Driver
Description:	Driver can accept or deny parking requests that are made by APA. After a parking spot is found, the driver will be asked to verify whether they want to park in the spot or not. If they accept the parking spot, APA will start the parking process. If they deny the parking request, the system will continue to search.
Type:	Primary
Includes:	None
Extends:	None
Cross-refs:	2, 3, 12, 13, 14, 15
Use cases:	None

10.

Use Case:	Verify Upgrade
Actors:	Driver
Description:	If the system needs an update to its software, it will ask the driver to verify it first. If the driver accepts the software upgrade request, the system will perform the software upgrade during the night and if the user denies the software upgrade request, it won't perform an automatic update overnight.
Type:	Secondary
Includes:	None
Extends:	None

Cross-refs:	2, 3, 4
Use cases:	None

Domain Model



Element Name		**Description**
ActiveParkAssist		Control the parking of the vehicle.
Attributes		
	parallel:boolean	If the driver wants to parallel park, this will be True. If the driver wants to perpendicular park, this will be False.
	vehicle_length:double	Constant specifying the length of the vehicle.
	vehicle_width:double	Constant specifying the width of the vehicle.
Operations		
	detectObstacle (parallel): map	Scans specified area around the vehicle for a parking spot that would be acceptable to park in. Returns a 3D map of where the location is relative to the vehicle.
	Park (map): boolean	Parks the vehicle based on the map that is provided.
	Success(): boolean	Returns True if the vehicle was parked successfully without any incidents.
	Abort(): None	Stops the vehicle, puts it in park, and disables ActiveParkAssist.
	ActivateAPA(): None	System starts APA depending on the specifications the Driver has specified.

Relationships	Has a 1 to 1 relationship with human machine interface. Uses 6 ultrasonic sensors and 2 cameras and also has a 1 to 1 relationship with the vehicle's drive options.
UML Extensions	None.

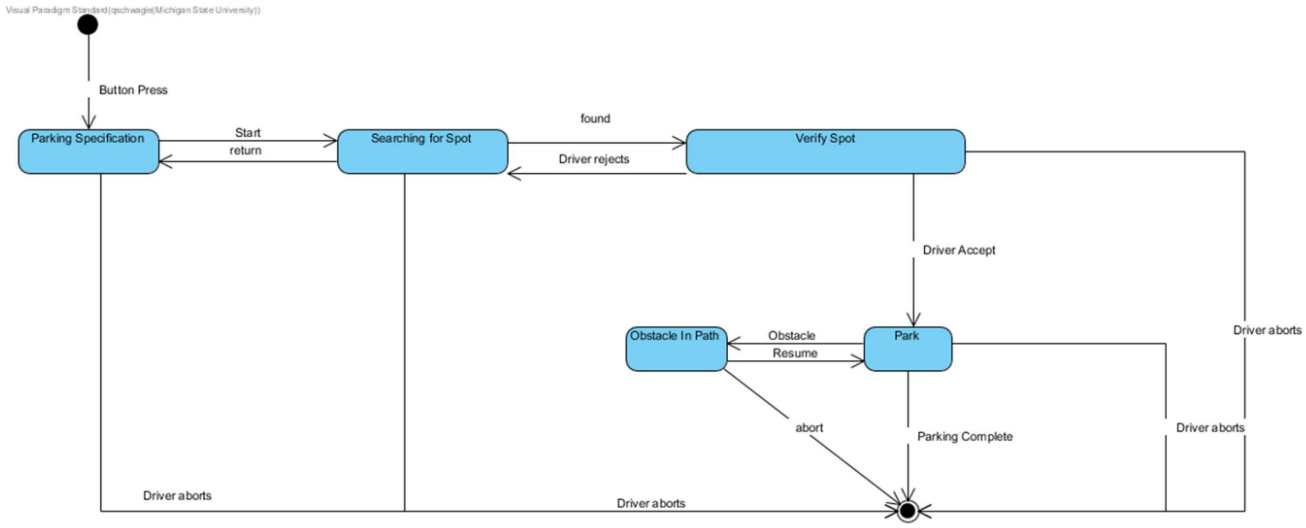
Element Name		**Description**
HumanMachineInterface		Handles the interaction between driver and ActiveParkAssist
Attributes		
	parallel:boolean	If the driver wants to parallel park, this will be True. If the driver wants to perpendicular park, this will be False.
Operations		
	ActivateHMI(): None	Driver initiates the start of APA. Driver is asked what side of the street to park on and what kind of parking style they want.
	setParkSpecifications(parallel): boolean	HMI communicates with APA to start the parking process based on the specifications the driver requested.
	Verify(message):boolean	Driver accepts/declines the message. This message can be in regards to software upgrades or a message regrading whether they want to park in the spot that is found by APA.
	Cancel():None	Driver cancels the APA, this gives control of the vehicle back to driver and stops APA.
	Upgrade():boolean	Scans for a new version to upgrade, returns true if successful.
	DisplayMessage(message):None	Based on the message passed, this will display in the HMI so the driver knows what is currently going on in the system.
	ObstacleResponse():boolean	When an obstacle is found, the driver is asked whether they would like to abort the parking process or resume the parking process.
	Resume():None	Signals to APA that the driver would like to resume the parking process.
Relationships	Has a 1 to 1 relationship with ActiveParkAssist.	
UML Extensions	None.	

Element Name		Description
VehicleCamera		Controls the output of the vehicle cameras.
Attributes		
Operations		
	Display(camera):None	Turns the desired camera on.
	checkStatus():boolean	Detects the statuses of the cameras to detect any faults.
Relationships	2 cameras have a relationship with 1 ActiveParkAssist.	
UML Extensions	None.	

Element Name		Description
VehicleControls		Vehicle controls. Access to vehicle's transmission, brakes, steering, and acceleration.
Attributes		
Operations		
	Steer (rotation): boolean	Controls the steering of the vehicle.
	Shift (desired_gear): boolean	Controls shifting the vehicle into different gears.
	Accelerate (desired_speed, acc_curve):boolean	Controls Acceleration of Vehicle in m/s^2 to a speed in miles per hour.
	Brake (desired_speed, desc_curve):boolean	Controls braking of the vehicle.
Relationships	Has a 1 to 1 relationship with ActiveParkAssist.	
UML Extensions	None.	

Element Name		Description
VehicleSensor		Controls the input and output of the vehicle sensors.
Attributes		
Operations		
	Sense (sensor): map	Will send out a high-frequency sound wave to detect obstacles around vehicle and return a 3D map of the area.
	checkStatus():boolean	Detects the statuses of the sensors to detect any faults.
Relationships	6 ultrasonic sensors have a relationship with 1 ActiveParkAssist.	
UML Extensions	None.	

State Diagram



States:

Parking Specification: After the APA button is pressed, the driver is asked to specify how they want to park (parallel or perpendicular) and on what side of the road they would like to park on (left or right side). After this, the system will transition to start searching for a spot to park in.

Searching for Spot: With the parking specifications from the driver, the system will know what side of the road scan and how the driver would like to park the vehicle. If a parking spot if found, the driver is asked to verify the spot. If the driver no longer wants to use APA, they can abort the system which will end the process. If the driver would like to go back to parking specifications to change their options, then they can return to parking specifications.

Verify Spot: When a parking spot is found, the driver is asked to verify the parking spot. If the driver rejects the parking spot, the system returns to the searching for parking spot state. If the driver would like to halt the APA system, they can abort by tappinng the "Abort" button on the HMI.

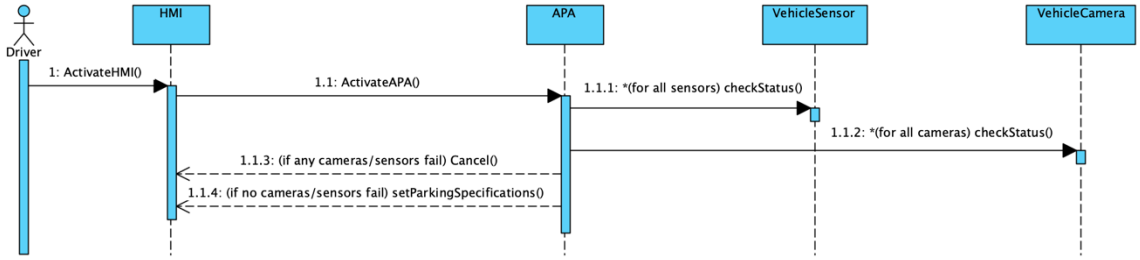
Park: Upon verification, APA can begin parking the vehicle. While the vehicle is being parked, if the system detects an obstacle in the path, the system will stop the vehicle and display a message to the driver. If the system successfully parks, the system will reach its final state. If the driver wants to abort the system at any time, they can abort by tapping the "Abort" button on the HMI.

Obstacle in Path: When an obstacle is detected in the path of the vehicle, the system will stop the vehicle and ask the driver how they would like to proceed. The driver will have two options, abort or resume. Resume will presumably mean the driver no longer sees in

obstacle in the path and believes the vehicle can continue parking and go back to the park state. If the driver would like to abort, then the system will turn off and reach its end state.

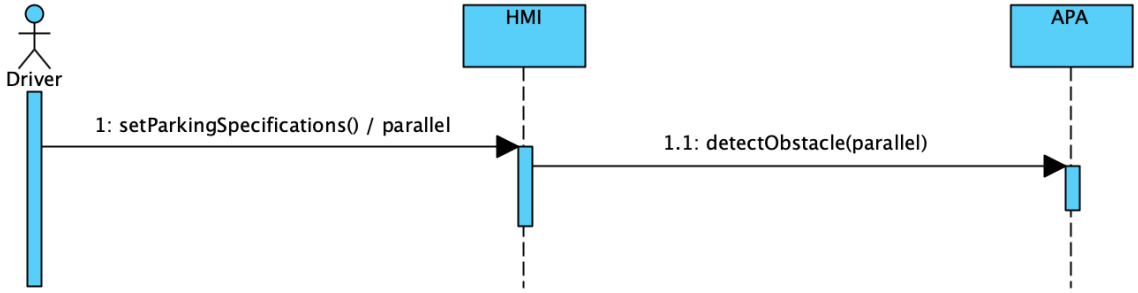
Sequence Diagrams

Sequence diagram: Initiate Active Park Assist System



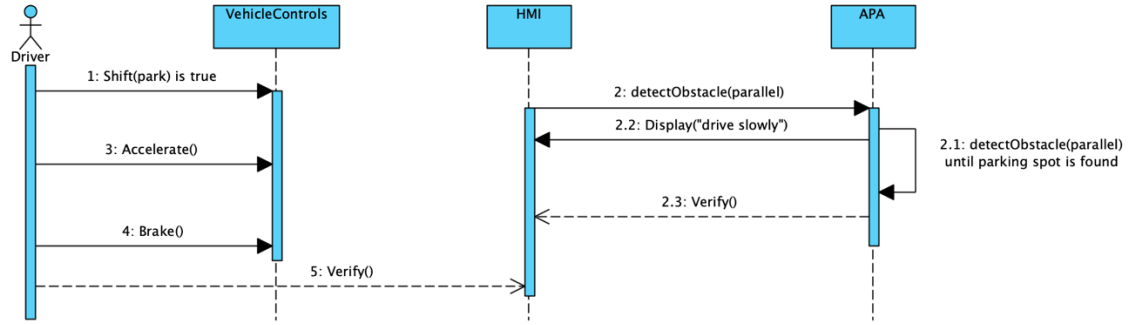
The driver activates the HMI which will activate the APA system. Once activated, the APA system will start checking the status of all the sensors and cameras, if no camera or sensor fails, the APA system will go to the next stage that will let the driver give a parking preference, the APA system will be cancelled otherwise if any camera or sensor fails.

Sequence diagram: Specify Parking Preferences



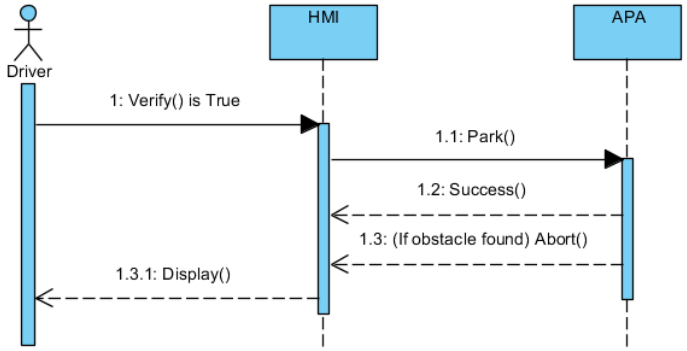
When the driver is required to give a parking preference on the HMI, the HMI will give options to the driver, either perpendicular parking or parallel parking. Once the option is selected, the HMI will tell the APA system to start searching process.

Sequence diagram: Search for Parking Spot



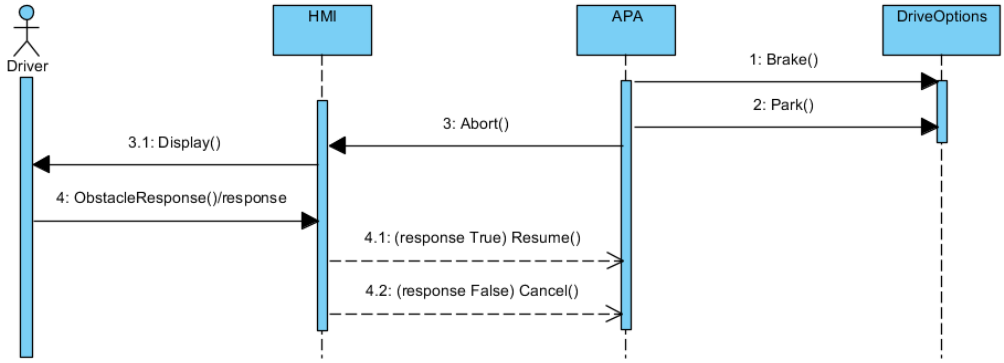
When the HIM tells the APA system to start searching process, the driver has the control of the vehicle to either accelerate/decelerate. During the searching process, the APA system will display a message on the HMI to tell the driver to drive slowly. Once the parking spot is found, the driver should apply the brake and shift to park, the HMI will display a button to let the driver verify the spot.

Sequence diagram: Park Vehicle



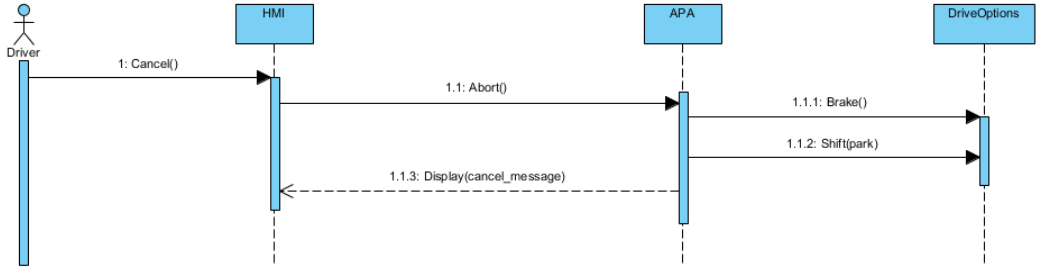
The driver verifies the parking spot on the HMI, the HMI will tell the APA system to start parking process and the APA system will take control of the vehicle. The APA system will respond Success or Abort to the HMI so the HMI can display corresponding message to the driver.

Sequence diagram: Abort Parking



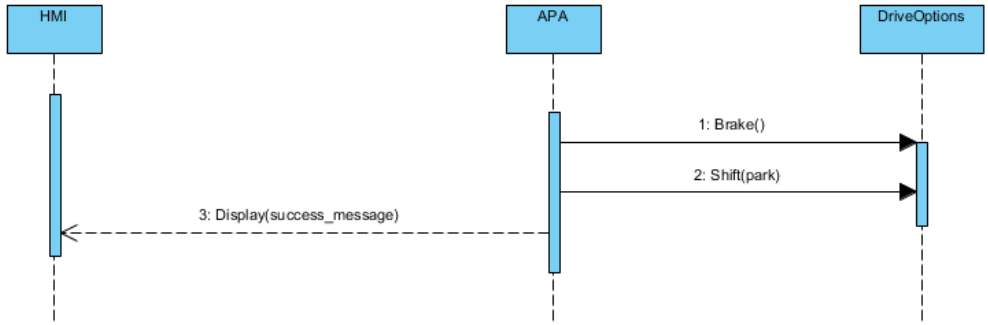
In the case of Abort, the APA system will apply the brake and shift the vehicle in park when it detects obstacle in the path. At the same time, the APA system tells the HMI that the parking process is aborted, the HMI will display a message to the driver. The driver will choose to resume or cancel this parking process on the HMI and the HMI will tell the APA system to take corresponding operations.

Sequence diagram: Cancel Parking



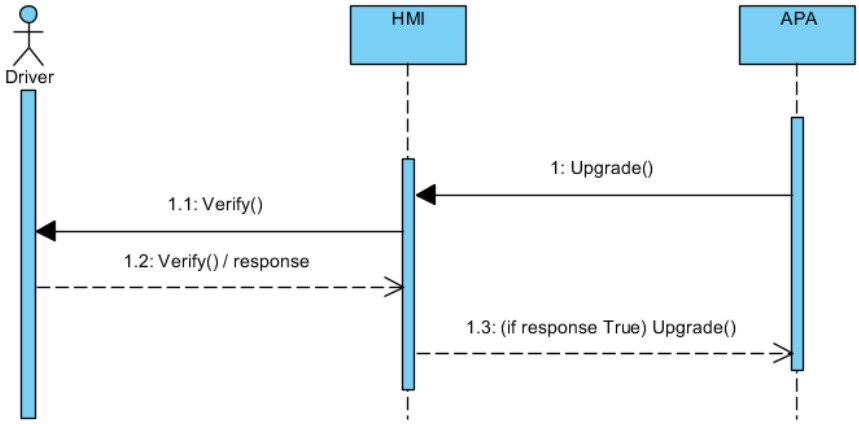
In the case of Cancel Parking, the driver presses the Cancel button on the HMI, the HMI tells the APA system to abort this parking process. The APA system will apply the brake and shift the vehicle in park. The HMI will display the cancel message to the driver.

Sequence diagram: Parking Successful



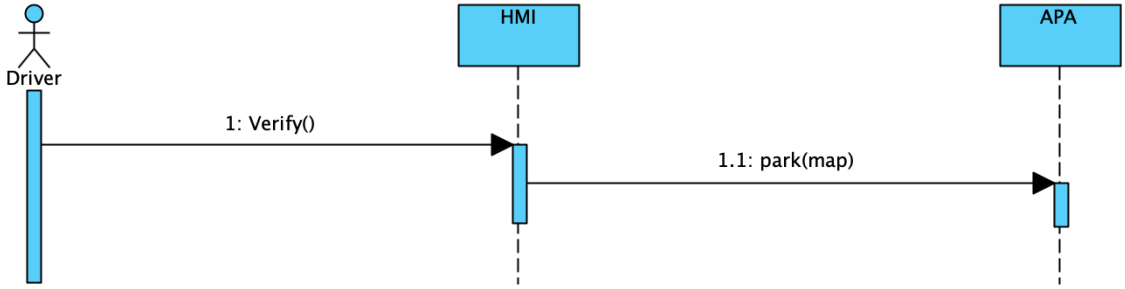
The APA system successfully parks the vehicle in the right spot, the APA system will apply the brake and shift the vehicle in park. The HMI will display a message of successful parking to the driver.

Sequence diagram: Upgrade System



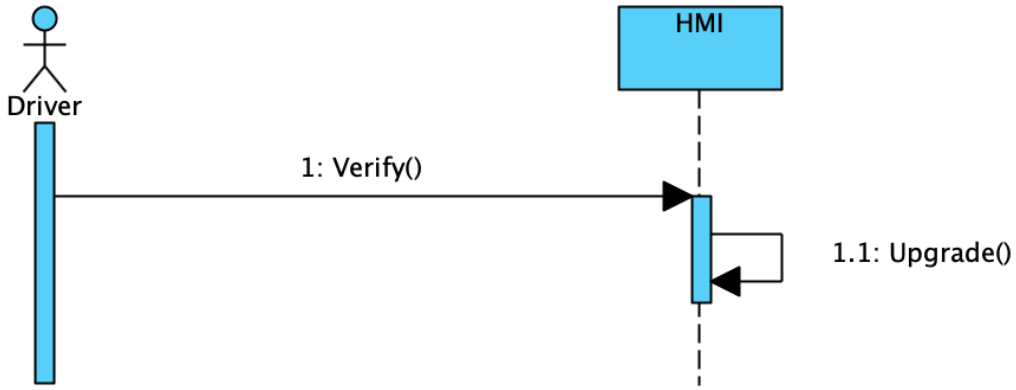
The APA system will check the upgrades itself. Once the APA system finds an available upgrade, it tells the HMI to let the driver verify the upgrade. The driver responds to the request and the HMI will tell the APA system to either apply the upgrade or not.

Sequence diagram: Verify Parking Spot



The driver will verify a parking spot after one has been found and then APA will begin the parking process.

Sequence diagram: Verify Upgrade



The driver will verify an upgrade to the system and then the system will begin to upgrade itself.

5 Prototype

5.1 How to Run Prototype

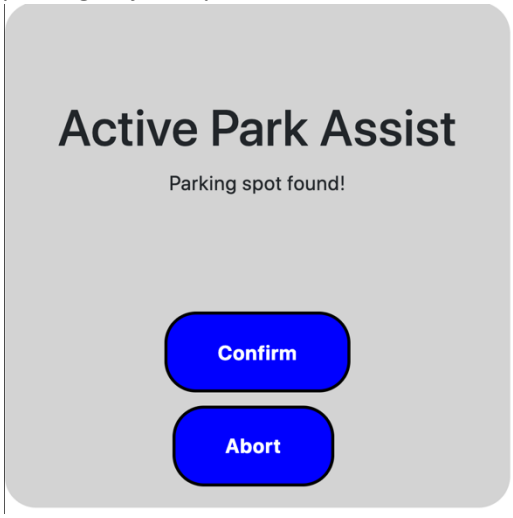
To run our prototype, the user must have a computer with internet access, a modern version of Chrome or Firefox, and JavaScript enabled. The prototype can be seen here (https://www.cse.msu.edu/~schmi703/Prototype/CSE-435-APA2-Prototype-master-ff9dfc67edfde2f14a3b07f46c026be0fdc940c4/CSE435-Prototype/), As the user progresses through the prototype, they will be presented with various screens that the user will see while they are parking the vehicle with Active Park Assist.

5.2 Sample Scenarios

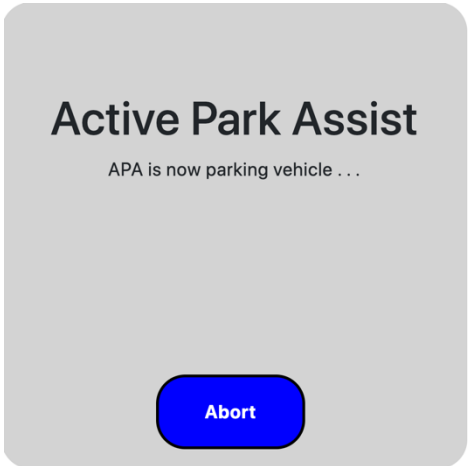
Scenario One:

The driver presses the APA button on the HMI interface and selects ‘parallel park’.

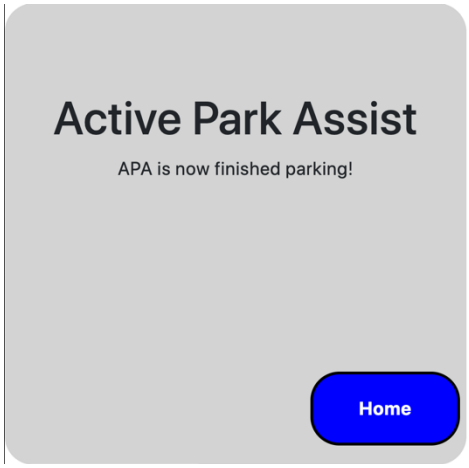
After driving down the road, vehicle is going 4mph, the HMI alerts the driver a parking spot was found (an audible sound over the speaker system plays and a visual prompt on the HMI appears).The HMI’s prompt asks the user to verify the spot found, with an animation of the parking trajectory shown.



The driver accepts this parking spot. New notification is shown over the HMI, indicating that it is parking.

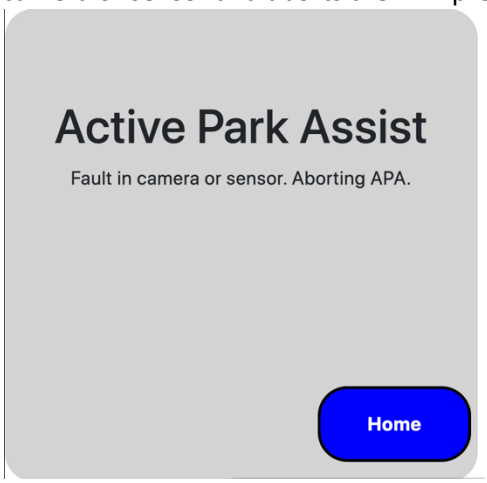


The driver removes their hands from steering wheel and removes their feet from the gas and brake pedal. APA parks the car successfully and alerts the driver it has completed parking through the HMI. Upon completing the parking, APA also put the car in park.



Scenario Two:

The driver presses the APA button on the HMI interface. However, APA detected a fault in a camera or sensor and aborts the APA process.



Scenario Three:

Someone has attempted to remotely hijack the vehicle. To prevent anyone from taking control of the vehicle, APA has a failsafe to only allow control of the vehicle to be handed over if the user physically verifies in the HMI. Being as the Driver will not verify to allow APA to take over control of the vehicle while they are not using API, the hijacker will not have full control.

6 References

Project Description:

https://www.cse.msu.edu/~cse435/Projects/F2019/ProjectDescriptions/2019-APA-Ford-Davidson.pdf

Project Website:

https://www.cse.msu.edu/~schmi703/

Start of your text.

[1] D. Thakore and S. Biswas, "Routing with Persistent Link Modeling in Intermittently Connected Wireless Networks," Proceedings of IEEE Military Communication, Atlantic City, October 2005.

7 Point of Contact

For further information regarding this document and project, please contact **Prof. Betty H.C. Cheng** at Michigan State University (chengb at msu.edu). All materials in this document have been sanitized for proprietary data. The students and the instructor gratefully acknowledge the participation of our industrial collaborators.