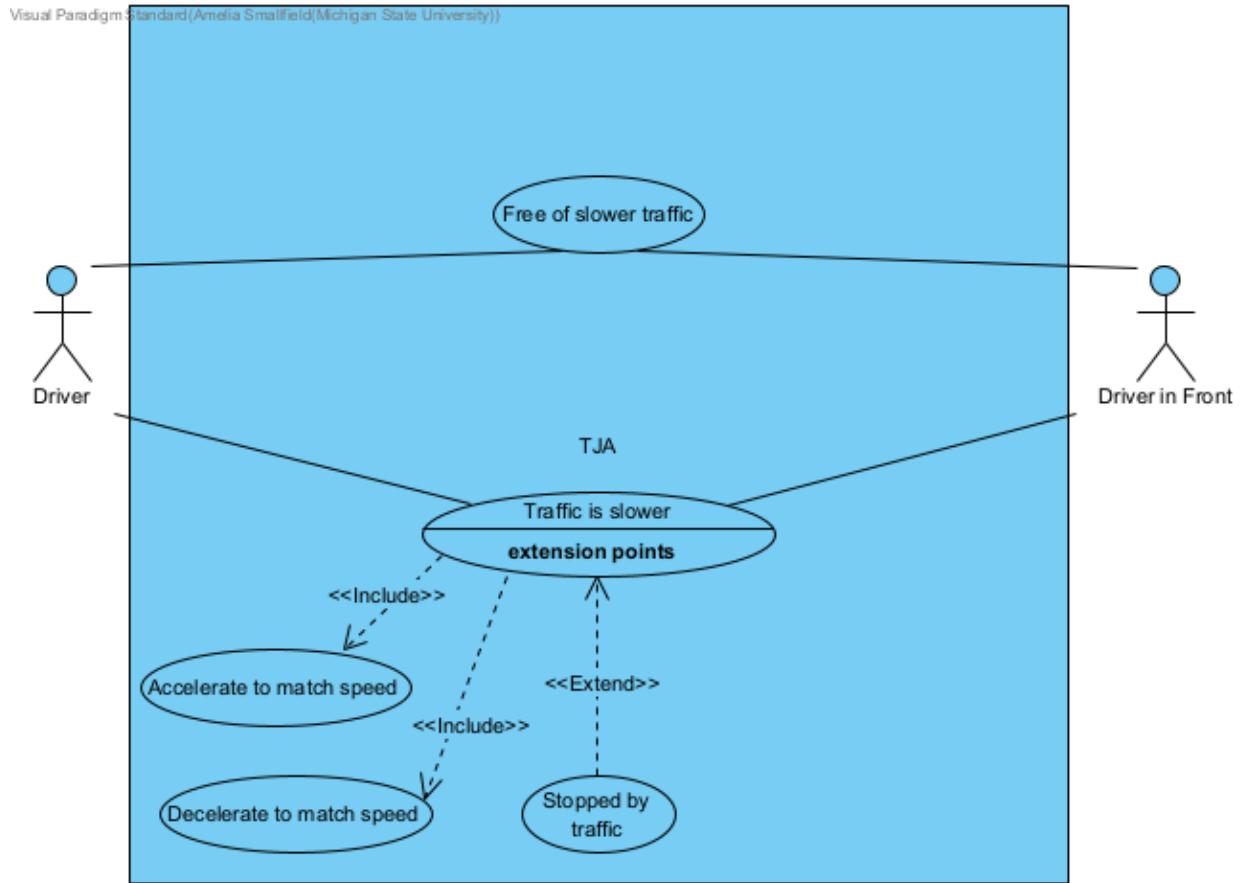


CSE 435 Software Engineering - Intermediate Project Assignment

1. Use Case Diagram:



Use case description:

| | |
|-------------|--|
| Use Case: | Driver is stopped by traffic |
| Actors: | Driver, Driver in Front |
| Description | Completely stop behind traffic, resume following on the Driver in Front's acceleration and maintain following distance |
| Type: | Primary (essential) |
| Includes: | N/A* |

| | |
|--------------------|-----------------------------|
| Extends: | Driver is slowed by traffic |
| Cross-refs: | 7 |
| Use cases: | N/A* |

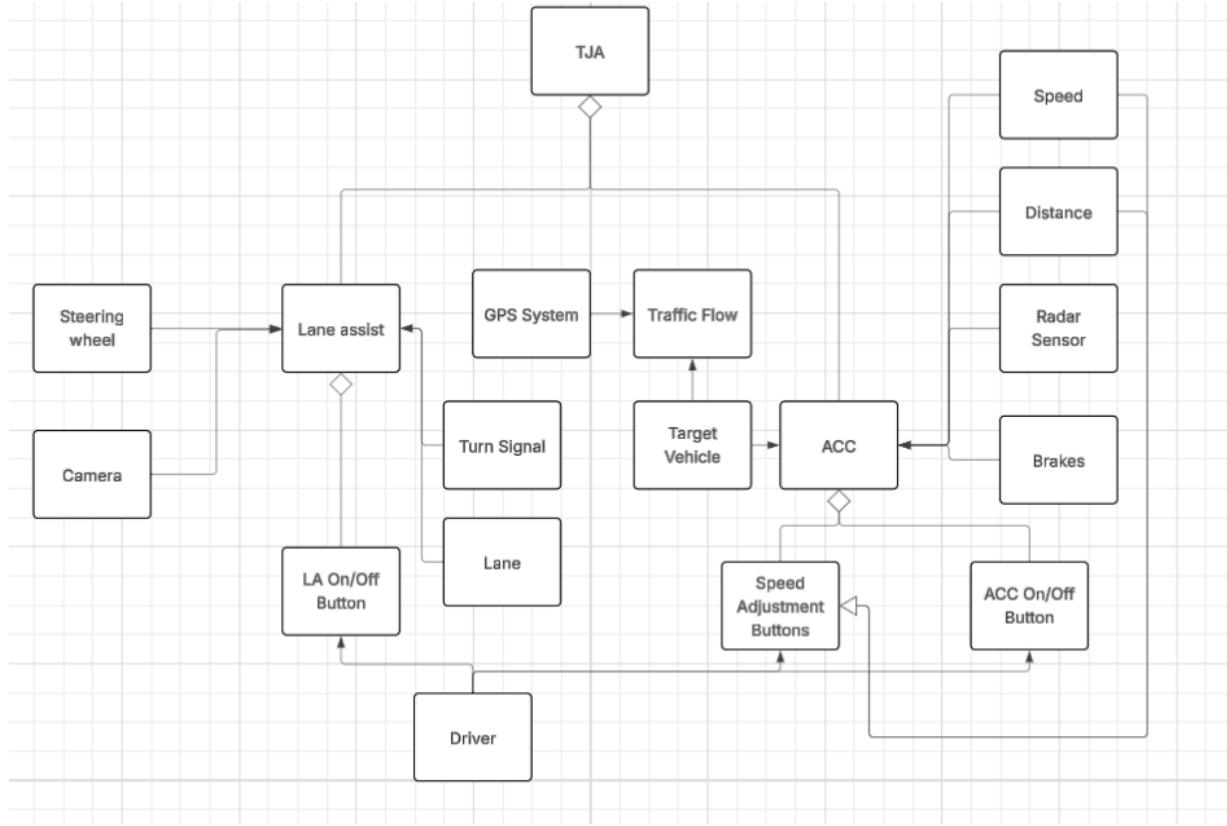
| | |
|--------------------|--|
| Use Case: | Driver is slowed by traffic |
| Actors: | Driver, Driver in Front |
| Description | Accelerate or decelerate with Driver in Front's movement in order to maintain constant following distance behind Driver in Front |
| Type: | Primary (essential) |
| Includes: | Accelerate to match speed, Decelerate to match speed |
| Extends: | N/A* |
| Cross-refs: | 7 |
| Use cases: | N/A* |

| | |
|--------------------|------------------------------------|
| Use Case: | Driver is free of traffic in front |
| Actors: | Driver, Driver in Front |
| Description | Maintain set cruise speed |
| Type: | Primary (essential) |
| Includes: | N/A* |
| Extends: | N/A* |
| Cross-refs: | 7 |
| Use cases: | N/A* |

| | |
|--------------------|--|
| Use Case: | Accelerate to match speed |
| Actors: | Driver |
| Description | Engage the engine to match a speed faster than the speed the car is currently moving |
| Type: | Primary (essential) |
| Includes: | N/A* |
| Extends: | N/A* |
| Cross-refs: | 7 |
| Use cases: | N/A* |

| | |
|--------------------|--|
| Use Case: | Decelerate to match speed |
| Actors: | Driver |
| Description | Engage the braking system to match a speed slower than the speed the car is currently moving |
| Type: | Primary (essential) |
| Includes: | N/A* |
| Extends: | N/A* |
| Cross-refs: | 7 |
| Use cases: | N/A* |

2. Domain Model:



| CLASS | | | |
|---|-----------------------|--|--|
| | | Holds information about the vehicle in front of the Driver | |
| Description (responsibilities) | | | |
| Export control (public: yes/no) | yes | | |
| | Associations | Traffic Flow, ACC | |
| | Aggregations | | |
| Relationships | Generalization | | |
| List of attributes and their primitive types | | Position, speed | |

Target Vehicle

| | | | |
|--|--|--|--|
| | List of operations (include parameters and results) | | |
|--|--|--|--|

| CLASS | | | |
|--------|--|---|---|
| Driver | Description (responsibilities) | Handles input from Driver to car | |
| | Export control (public: yes/no) | yes | |
| | Associations | LA On/Off, Speed Adjustment Buttons, ACC On/Off | |
| | Aggregations | | |
| | Relationships | Generalization | |
| | List of attributes and their primitive types | | position |
| | List of operations (include parameters and results) | | IncreaseSpeed(int amount):void, DecreaseSpeed(int amount), ToggleACC():void, Toggle LA():void |

| CLASS | | | |
|---------------------------------|--|---------------------------------|--------------|
| | Description (responsibilities) | Adjust the set speed of the ACC | |
| | Export control (public: yes/no) | yes | |
| | | Associations | |
| | | Aggregations | ACC |
| | Relationships | Generalization | |
| | List of attributes and their primitive types | | currentSpeed |
| Speed Adjustment Buttons | List of operations (include parameters and results) | | |

| CLASS | | | |
|------------|--|--------------------------------|---|
| | Description (responsibilities) | Applies set CC settings to TJA | |
| | Export control (public: yes/no) | yes | |
| | | Associations | Target Vehicle, Speed, Breaks, Distance, Radar Sensor |
| | | Aggregations | TJA |
| | Relationships | Generalization | |
| | List of attributes and their primitive types | | |
| ACC | List of operations (include parameters and results) | | |

| CLASS | | | |
|-----------------------|--|-----------------------|-----------------------|
| | Description (responsibilities) | Control steering | House buttons for TJA |
| | Export control (public: yes/no) | yes | |
| | | Associations | Lane assist |
| | | Aggregations | |
| | Relationships | Generalization | |
| | List of attributes and their primitive types | | |
| Steering Wheel | List of operations (include parameters and results) | | |

| CLASS | | | |
|---------------|--|-----------------------|----------------------------------|
| | Description (responsibilities) | Detects lane lines | Sends information to Lane assist |
| | Export control (public: yes/no) | yes | |
| | | Associations | Lane assist |
| | | Aggregations | |
| | Relationships | Generalization | |
| | List of attributes and their primitive types | | |
| Camera | List of operations (include parameters and results) | | |

| CLASS | | | |
|-------------|--|--------------------------|---|
| | Description (responsibilities) | Center the car in a lane | |
| | Export control (public: yes/no) | yes | |
| | | Associations | Steering wheel, camera, turn signal, and lane |
| | | Aggregations | LA On/Off Button |
| | Relationships | Generalization | |
| Lane assist | List of attributes and their primitive types | | |
| | List of operations (include parameters and results) | | |

| CLASS | | | |
|-------------|--|------------------------------|---------------------------------------|
| | Description (responsibilities) | Indicates the car is turning | Will temporarily turn off Lane Assist |
| | Export control (public: yes/no) | yes | |
| | | Associations | Lane Assist |
| | | Aggregations | |
| | Relationships | Generalization | |
| Turn Signal | List of attributes and their primitive types | | |
| | List of operations (include parameters and results) | | |

| CLASS | | | |
|---|--|---|------------------|
| TJA | Description (responsibilities) | Allow the driver to use lane assist and ACC | |
| | Export control (public: yes/no) | yes | |
| | | Associations | |
| | | Aggregations | Lane Assist, ACC |
| | Relationships | Generalization | |
| | List of attributes and their primitive types | | |
| List of operations (include parameters and results) | | | |

| CLASS | | | |
|--|--|----------------|--|
| Speed | Description (responsibilities) | | Represents vehicle velocity and manages acceleration and deceleration commands. |
| | Export control (public: yes/no) | | yes |
| | | Associations | ACC |
| | | Aggregations | ACC |
| | Relationships | Generalization | None |
| | List of attributes and their primitive types | | currentSpeed : float setSpeed : float maxSpeed : float minSpeed : float |
| List of operations (include parameters and | | | setSpeed(value : float) : void adjustSpeed(delta : float) : void |

| | | |
|--|-----------------|----------------------------------|
| | results) | maintainSetSpeed() : void |
|--|-----------------|----------------------------------|

| CLASS | | | |
|-----------------|--|------------------------|--|
| Distance | Description (responsibilities) | | Calculate and maintain distance between driver and target vehicle. |
| | Export control (public: yes/no) | | yes |
| | Associations | ACC and Target Vehicle | |
| | Aggregations | ACC | |
| | Relationships | Generalization | None |
| | List of attributes and their primitive types | | currentDistance: float safeDistance: float closingSpeed: float |
| | List of operations (include parameters and results) | | updateDistance(sensorData: float): void isSafeDistance(): bool adjustFollowingDistance(targetSpeed: float): void getClosingSpeed(): float |

| CLASS | | | |
|---------------------|---|-----------------------|--|
| Radar Sensor | Description (responsibilities) | | Detection of surrounding vehicles and other objects. Measures distance and speed. |
| | Export control (public: yes/no) | | yes |
| | Associations | ACC | |
| | Aggregations | ACC | |
| | Relationships | Generalization | None |
| | List of attributes and their primitive types | | detectedObjects: list objectRange: float objectAccuracy: float |
| | List of operations | | measureDistance(target: |

| CLASS | | | |
|--------|--|---------------------|---|
| Brakes | Description (responsibilities) | | Controls braking commands to decelerate and stop driver vehicle safely when needed. |
| | Export control (public: yes/no) | | yes |
| | Relationships | Associations | ACC |
| | | Aggregations | ACC |
| | Generalization | | None |
| | List of attributes and their primitive types | | isEngaged: bool responseTime: float brakeApply: float |
| | List of operations (include parameters and results) | | applyBrakes(force: float): void releaseBrakes(): void brakeStatus(): bool automaticBrake(): void |

| CLASS | | | |
|------------|---------------------------------------|--|--|
| GPS SYSTEM | Description (responsibilities) | | Satellite navigation system that provides real life location of vehicle and complements sensor and camera to allow activation of system only on highways |
| | Export control | | yes |

| | | |
|---------------|--|---|
| | (public: yes/no) | |
| Relationships | Associations | Traffic flow,TJA |
| | Aggregations | |
| | Generalization | |
| | List of attributes and their primitive types | x coordinate : real y coordinate : real Compass: String |
| | List of operations (include parameters and results) | On Highway(x,y,Compass) : True if the vehicle is currently on a highway. False if not. |

| CLASS | | | |
|--------------|--|--|--|
| TRAFFIC FLOW | Description (responsibilities) | | System that analyzes how vehicles around interact with each other and calculate closing distance with vehicle in front |
| | Export control (public: yes/no) | | yes |
| | Relationships | Associations | GPS System, Target Vehicle |
| | | Aggregations | |
| | | Generalization | |
| | List of attributes and their primitive types | x coordinate : real y coordinate : real Compass: String | |
| | List of operations (include parameters and results) | Closing Distance(sensor, front vehicle, speed) :Closing distance | |

| CLASS | | | |
|--------------------|--------------------------------|--|--|
| LANE ASSIST ON/OFF | Description (responsibilities) | | Control used to turn on and set lane assist. Also used to turn off the system. The button is located in the steering |

| | | |
|--|----------------|---|
| | | wheel. |
| Export control (public: yes/no) | | |
| | Associations | Driver, Lane Assist |
| | Aggregations | Lane Assist |
| Relationships | Generalization | |
| List of attributes and their primitive types | | switch: int |
| List of operations (include parameters and results) | | Turn on(switch) :Activates Lane Assist and shows in the dashboard as a small icon on the right side. |

| CLASS | | | |
|------------|--|----------------|--|
| | Description (responsibilities) | | Control used to turn on and set adaptive cruise control. Also used to turn off Lane Assist. The button is located in the steering wheel. |
| | Export control (public: yes/no) | | |
| ACC ON/OFF | Associations | ACC, Driver | |
| | Aggregations | ACC | |
| | Relationships | Generalization | |
| | List of attributes and their primitive types | | switch: int |
| | List of operations (include parameters and results) | | Turn on(switch) :Activates Adaptive Cruise Control and awaits for speed set up before its on |

3. Requirements:

1. The driver will turn on the system by activating the ACC ON button
 - a. When the system is activated, the dashboard should indicate to the user that the system is on with an ACC ON icon

2. The system will by default set the current speed as the maximum speed and have the maximum following distance set
 - a. The vehicle will not surpass the speed limit set by the driver at any time
3. The system shall allow the driver to deactivate Traffic Jam Assist by pressing the cancel/OK button on the steering wheel, or by braking.
 - a. Upon deactivation, the driver will have to be aware of traffic ahead.
4. The user can change the maximum speed and following distance with buttons on the steering wheel
5. The Traffic Jam Assist System shall only work if the driver is engaged. The system must only work if it detects contact in the steering wheel at all times.
 - a. If the driver is not engaged(not in contact with the steering wheel) the vehicle will alert the driver on the console until hands are in the steering wheel.
 - b. After one minute of disengagement the TJA will alert the driver and shut off.
6. If the vehicle has a front camera, when activated, TJA will keep the vehicle centered in the lane.
 - a. If the vehicle drifts to the side, the vehicle will alert the driver on the console and TJA will center the vehicle by manipulating the steering wheel.
 - b. TJA will not manipulate the vehicle if turning lights are on.
7. Completely stop behind target vehicle slowly in case traffic stopped
 - a. Break immediately an object is detected within the emergency braking zone
 - b. If car in front is only slowing down the car will slow down at the same speed
8. Start vehicle back up when stopped traffic resumes with the flow of traffic, at set speed and distance
9. Provide status on the overhead dash and enable/disable alerts for vehicles when TJA is active.

Global Invariant Requirements:

1. Pressing the ACC button will activate the ACC system
2. When TJA is enabled, the vehicle never surpasses the maximum speed set by the driver.
3. The system shall always deactivate when breaking and pressing the “OFF” button.
4. The system should not accelerate if the measured distance between the driver and vehicle ahead is below the selected following distance.
5. The driver inputs are primary, meaning they override any TJA controls and inputs.
6. Vehicle will maintain speed until another vehicle is detected
7. Forward looking radar will identify a target and determine closing rate
8. If the vehicle gets too close to the target in front of it, it will slow down and maintain a set distance

Questions for customer:

1. If the vehicle is driving at high speeds on the highway and the vehicle in front suddenly brakes what should TJA do?
2. If a collision on the highway is imminent what should the system do?
3. What happens if a vehicle's engine shuts you off, but the electronic system is still on? How should TJA behave?
4. What is the sensor set given to us and what if one of them (radar or sensor) fails? Will there be a fallback to other forms of sensors or will TJA just be deactivated?
5. What are, if any, legal specifications/regulations that are important and must be honored?
6. How close is too close?
7. What is the difference between the three distances?
8. How strong is the lane stay assistance, or could it be disabled/ how much input would end up overriding it?
9. How should the system respond if the sensors are obstructed?
10. What objects is it expected to detect, how should it respond to other objects?