**Diagram

Description automatically generated**

**PCAS1 Use-Case Documentation**

Use Case: **Pedestrian Detected**

Actors: Pedestrian Detection Sensor (initiator)

Type: Primary and essential

Description: When the vehicle’s pedestrian sensor detects a pedestrian, it will provide the PCA algorithm with the pedestrian’s (x,y) location relative to the vehicle with an accuracy +/- .5m as well as the pedestrian’s velocity +/- .2 m/s, +/- % deg. The algorithm will use these inputs to calculate the vehicle’s and pedestrian’s trajectory to determine what avoidance maneuvers, if any, are needed to avoid collision.

Cross Ref.: Requirements 1

Use Cases: N/A, no prior use cases required.

Use Case: **Calculate Trajectory**

Actors: System (initiator)

Type: Primary and essential

Description: When a pedestrian is detected, the system calculates if the vehicle and pedestrian have come within the minimum specified distance of each other. If the vehicle and pedestrian are within that minimum distance of each other, the minimum deceleration needed to avoid collision will be calculated, and the Brake-by-Wire system will be engaged. If the vehicle and pedestrian are not within the minimum distance of each other, the system will ensure the vehicle maintains its steady state velocity, this could mean disengaging the Brake-by-Wire system.

Cross Ref.: Requirements 1.1, 1.2, 1.5, 2.1, and 3.

Use Cases: The Pedestrian Detected use case must first be completed by the Pedestrian Detection Sensor.

Use Case: **Slow Down**

Actors: System (initiator), Brake-by-Wire System

Type: Primary and essential

Description. When the vehicle has entered within the minimum distance of a detected pedestrian, the Brake-by-Wire system will be engaged to avoid collision.

Cross Ref.: Requirements 2 and 3.

Use Cases: The Pedestrian Detected and Calculate Trajectory use cases must first be completed.

Use Case: **Fail Safe Slow Down**

Actors: System (initiator), Brake-by-Wire System

Type: Extended

Description: When the vehicle is in fail safe mode and has entered within the minimum distance of a detected pedestrian, the Brake-by-Wire system will be engaged with the fail-safe deceleration constraints to avoid collision.

Cross Ref.: Requirements 2,3, and 4

Use Cases: The vehicle must be in fail safe mode in addition to the Pedestrian Detected and Calculate Trajectory uses cases being completed.

Use Case: **On Alert**

Actors: System (initiator), Pedestrian, Driver

Type: Secondary

Description: When the vehicle has entered within the minimum distance of a detected pedestrian, both the driver and pedestrian will be alerted. The driver will receive a notification from inside informing them that the Brake-by-Wire system has been engaged to take avoidance action. The pedestrian will be subtly notified through dimly flashing the vehicles headlights.

Cross Ref.: Requirements 1.3, 1.4, and 2.4.

Use Cases: The Pedestrian Detected, Calculate Trajectory, and Slow Down use cases must first be completed.

Use Case: **Steady State Velocity**

Actors: System (initiator), Brake-by-Wire System

Type: Primary and essential

Description: When a pedestrian is detected by the Pedestrian Detection Sensor, but the pedestrian and vehicle are not within the specified minimum distance of each other, the vehicle will maintain or return to steady state velocity.

Cross Ref.: Requirement 2.1, 2.3

Use Cases: The Pedestrian Detected and Calculate Trajectory use cases must first be completed.

Use Case: **Off Alert**

Actors: System (initiator), Driver

Type: Secondary

Description: When the system has calculated that it no longer needs to take avoidance maneuvers to avoid collision with a pedestrian, it will tell the Brake-by-Wire system to return to steady state velocity, notifying the Driver that avoidance maneuvers are no longer necessary and collision has been avoided.

Cross Ref.: Requirement 2.5

Use Cases: The Pedestrian Detected, Calculate Trajectory, and Steady State Velocity use cases must first be completed.

Use Case: **Hardware Malfunction**

Actors: Pedestrian Detection Sensor (initiator), Brake-by-Wire System (initiator)

Type: Primary and essential

Description: If either the Pedestrian Detection Sensor or the Brake-by-Wire system malfunction or the system senses that the data the Pedestrian Detection Sensor is sending is corrupt, the collision avoidance algorithm will be blocked from running and the Driver will be notified that the collision avoidance system has been turned off.

Cross Ref.: Requirement 5

Use Cases: N/A, no prior use cases required.

Use Case: **Block Algorithm**

Actors: System (initiator)

Type: Primary and essential

Description: If they system deems that a malfunction in either the Pedestrian Detection Sensor or Brake-by-Wire system has occurred, or it has received corrupt data, the collision avoidance algorithm will be blocked from executing.

Cross Ref.: Requirement 5

Use Cases: The Hardware Malfunction use case must first be completed.

Use Case: **System Off Notification**

Actors: System (initiator)

Type: Secondary

Description: If the collision avoidance algorithm has been blocked from executing, the user will be notified that the collision avoidance system has been turned off.

Cross Ref.: Requirement 5.1

Use Cases: The Hardware Malfunction use case must first be completed.

**Additional Customer Questions List:**

1. Do you have information on how to brake-by-wire system and camera sensor send information to the control system? Does it use packets?
2. How should we calculate time when the pedestrian stops in the middle of the road?
3. The car stops indefinitely in those cases, should we stop the simulation after a certain length of time, or would it be better to calculate lost time every time step?