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Class Diagram Data Dictionary for PBAS (Homework 4 parts 5 and 6)

Overview

The Pedestrian Backup Assist System (PBAS) comprises four main features: sensors, warnings, information, and mitigation. These main features and their specific components are shown in the attached class diagram, also called a domain model. In addition to these main components, we also show how the PBAS communicates between other subsystems of the vehicle for vital information, such as, gear position, throttle control, and brake capabilities. Though not shown, it should be noted that all electronic control units (ECUs) of the vehicle communicate through the controller area network (CAN bus). More information can be found on the CAN bus in the attached SRS document in Section 1.3. Finally, we also allow the driver to disable the mitigation with an override button. The description of each aspect of our system is shown in the following data dictionary. This dictionary should serve as a companion to the class diagram.

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| Class |  | |
| Pedestrian Backup Assist System (PBAS) | Description: The PBAS employ sensors, warnings, and an infotainment system to help drivers avoid backup collisions. In addition, the system itself can slow down and stop the vehicle. In particular, the vehicle’s throttle can be limited and brakes can be engaged to avoid an imminent collision. However, these mitigative features can be disabled if the override button is engaged. The override button status is relayed to the PBAS via the PBAS ECU. | |
| Export control: public | |
| Relationships | Associations: sends display to the Infotainment System  issues a Warning  activates/deactivates Sensor |
| Aggregations: PBAS ECU, Sensor, Warning, Infotainment System |
| Generalization: N/A |
| List of attributes: N/A | |
| List of operations:  updateInfotainment(display : 3Darray)  issueWarning(distanceToClosestObstacle : double)  activateSystem()  deactivateSystem() | |

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| Class |  | |
| Sensor | Description: The sensors in the system receive information about objects in the driving path of the vehicle. The camera sensors retrieve video of the back-up area while the ultrasonic sensors can capture distance information about potential obstacles. | |
| Export control: public | |
| Relationships | Associations: N/A |
| Aggregations: N/A |
| Generalization: Rear-view camera, Ultrasonic sensors, and Infrared camera |
| List of attributes:  status : String  image : 3Darray | |
| List of operations:  enable()  disable() | |

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| Class |  | |
| Rear-view Sensor | Description: This camera records a video feed of the area behind the vehicle. This feed is monitored by the PBAS ECU along with the other sensors for object detection. | |
| Export control: public | |
| Relationships | Associations: N/A |
| Aggregations: N/A |
| Generalization: N/A |
| List of attributes: N/A | |
| List of operations: N/A | |

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| Class |  | |
| Ultrasonic Sensor | Description: This sensor measures the distance to objects behind the vehicle using sound waves. This feed is monitored by the PBAS ECU along with the other sensors for object detection. | |
| Export control: public | |
| Relationships | Associations: N/A |
| Aggregations: N/A |
| Generalization: N/A |
| List of attributes: N/A | |
| List of operations: N/A | |

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| Class |  | |
| Infrared Sensor | Description: This camera records a video feed of the area behind the vehicle. This feed is monitored by the PBAS ECU along with the other sensors for object detection. The infrared works well in low visibility environments by detecting heat. | |
| Export control: public | |
| Relationships | Associations: N/A |
| Aggregations: N/A |
| Generalization: N/A |
| List of attributes: N/A | |
| List of operations: N/A | |

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| Class |  | |
| Override Button | Description: The override button allows the driver to disable the mitigation features of the system. In particular, it can engage or disengage the speed limitation and braking of the system. | |
| Export control: private | |
| Relationships | Associations: N/A |
| Aggregations: N/A |
| Generalization: N/A |
| List of attributes:  isOn : boolean | |
| List of operations:  enable()  disable() | |

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| Class |  | |
| Warning | Description: The Warnings class serves as a generalization for the audio and visual warnings of the system. These warnings inform the driver and pedestrians of a potential hazard while the vehicle is in reverse. As the distance between the rear of the vehicle and an obstacle behind the vehicle decreases, warning frequency will increase. | |
| Export control: private | |
| Relationships | Associations: N/A |
| Aggregations: N/A |
| Generalization: Audio, Visual |
| List of attributes:  frequency : integer | |
| List of operations:  activateWarning(frequency : integer) | |

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| Class |  | |
| Audio Warning | Description: In the case that an object is detected in the driving path, an audio warning message will be sent to the speakers which notify the driver through the vehicle’s speakers. | |
| Export control: private | |
| Relationships | Associations: N/A |
| Aggregations: N/A |
| Generalization: N/A |
| List of attributes:  volume : integer | |
| List of operations: N/A | |

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| Class |  | |
| Visual Warning | Description: In the case that an object is detected in the driving path, a visual LED warning will flash on the rear view mirror and side mirrors. Additionally, the rear hazard warning lights will flash. | |
| Export control: private | |
| Relationships | Associations: N/A |
| Aggregations: N/A |
| Generalization: N/A |
| List of attributes: N/A | |
| List of operations: N/A | |

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| Class |  | |
| Infotainment System | Description: The infotainment system displays information useful to the driver while backing up. This includes the driving path of the vehicle and other data from the sensors which has been retrieved and processed by the PBAS. | |
| Export control: private | |
| Relationships | Associations: N/A |
| Aggregations: N/A |
| Generalization: N/A |
| List of attributes and their primitive types:  image : 3Darray | |
| List of operations:  displayImage(image : 3Darray) | |

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| Class |  | |
| Electronic Control Unit | Description: An electronic control unit is a general class used to model the subsystems of the vehicle. A ECU does the processing necessary for each subsystem. Information is relayed between ECUs through the CAN bus [6]. The status of an ECU shows whether that subsystem is active or not. | |
| Export control: public | |
| Relationships | Associations: N/A |
| Aggregations: N/A |
| Generalization: PBAS ECU, Gear Position ECU, Brake ECU, Throttle ECU |
| List of attributes:  status : String | |
| List of operations: N/A | |

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| Class |  | |
| Pedestrian Backup Assist System Electronic Control Unit (PBAS ECU) | Description: The PBAS ECU processes signals received from the sensors as well as enables and disables parts of the system. The PBAS can trigger warnings as well as mitigation to avoid backup collisions. | |
| Export control: public | |
| Relationships | Associations: monitors Sensor  restricts Throttle  engages/disengages Brake  monitors Gear Position  sends information to the PBAS |
| Aggregations: N/A |
| Generalization: N/A |
| List of attributes:  distanceToNearestObstacle: double | |
| List of operations:  detectObject(ultrasonicImage: 3Darray, cameraImage: 3Darray, infraredImage: 3Darray) : displayImage: 3Darray, distanceToNearestObstacle: double  mitigate(distanceToNearestObstacle: double) | |

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| Class |  | |
| Gear Position ECU | Description: The gear position ECU monitors the current gear that the vehicle’s transmission is in and relies this information to the PBAS ECU. | |
| Export control: public | |
| Relationships | Associations: N/A |
| Aggregations: N/A |
| Generalization: N/A |
| List of attributes:  gearPosition : integer | |
| List of operations:  detectPosition() : integer | |

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| Class |  | |
| Brake ECU | Description: The brake ECU directly controls the mechanical brakes of the vehicle. This class accepts signals sent from the PBAS ECU when a potential collision is detected in attempts to mitigate the collision. | |
| Export control: public | |
| Relationships | Associations: N/A |
| Aggregations: N/A |
| Generalization: N/A |
| List of attributes: N/A | |
| List of operations:  engage() | |

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| Class |  | |
| Throttle ECU | Description: The throttle ECU is responsible for connecting the accelerator pedal to the vehicle’s engine throttle. This class accepts a signal from the PBAS ECU to limit the maximum throttle while the PBAS system is active. | |
| Export control: public | |
| Relationships | Associations: N/A |
| Aggregations: N/A |
| Generalization: N/A |
| List of attributes: N/A | |
| List of operations:  limitThrottle() | |