Team: PCAS1

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Primary Requirements:

1. The system must avoid pedestrians automatically without human driver intervention among the 10 given scenarios.
2. System should simulate a vehicle with the following specifications:
    a. Width of 2 m
    b. Normal state speed of 50 kph
    c. Acceleration to normal state speed is .25x the force of gravity
    d. Originates at the (0m, 0m) position
    e. Vehicle moves on the +x axis
3. System should simulate pedestrian with the following specifications:
    a. Can be static or in motion
    b. Can change velocity with infinite acceleration
    c. Each pedestrian is a .5 m wide circle on the x-y plane
    d. Only moves at right angle to vehicle path
    e. Originates at the (35m, -7m) position
4. Sensors must send signal to the system every 100ms with the following information
    a. The relative location and velocity of the pedestrian in relation to the car
        i. The velocity has an uncertainty of +/-.5 m and the velocity has uncertainties of +/-.2 m/s for the speed and +/-5 degrees for the direction
5. For breaking the system should use a Brake-by-Wire sub-system using the following specifications:
    a. The deceleration accuracy has an uncertainty of +/-2%
    b. The response time to decelerate is 200 ms
    c. The release time of 100 ms
    d. The maximum deceleration is 0.7x the force of gravity
6. The system shall minimize any time loss experienced by the vehicle due to safety maneuvers
    a. This includes safety maneuvers related to cybersecurity
    b. “Lost Time” = Time difference (in seconds) between system on and system off to reach a common point beyond the pedestrian with controlled vehicle back again at steady state velocity.
7. System must include a failure operational mode for the brake system that increases the “response time to reach requested decel” from 200 ms to 900 ms. In this mode, the algorithm should adjust to maintain zero collisions in trade for lost time.

8. The system shall not suffer a security breach that can endanger the human driver or pedestrians, this can be implemented by using a multilayer approach.
    a. It shall use encryption and authentication protocols to protect against potential cyber threats.
9. Sensors must be able to identify nearby pedestrians/risks using a pedestrian sensor (stereo camera)
10. If there is a potential vehicle-pedestrian collision, the system shall run deceleration commands to initiate automatic braking.
    a. The PCAS shall override any velocity changes not controlled by the PCAS while the PCAS is active.
11. After the risk of possible collision has passed the system must accelerate the vehicle back to normal state velocity.
12. Maneuvers of the vehicle should not endanger the safety of anyone else
    a. Driver and passengers of the vehicle should not be put at risk
    b. Vehicle maneuvers should not put the vehicle in the path of any other vehicles on the road.

Secondary Requirements:

1. The system must stay within the constraints set by laws
    a. Location of intended use
2. PCAS should account for potential debris in the road that could be mistaken for a pedestrian
3. The PCAS should be scalable to accommodate different autonomous automotive vehicle types.
4. The system must be prepared to handle unpredictable situations. This could include variances in road/weather conditions that would make it more difficult for our system to detect a pedestrian.
5. Limit unnecessary Evasive Maneuvers, our system cannot behave erratically.
6. Account for erratic human behavior

Global Invariant Requirements

1. Prevent collisions with pedestrians
2. Constant sensor feedback to the system, scanning for nearby pedestrians
3. Keep the human driver/passengers safe
4. Observe and adjust for potential cybersecurity issues

Questions for the Customer

1. The project plan says that we should be activating our system in “emergency situations”. What exactly is considered an “emergency situation” and should our system include preemptive measures to anticipate a possible emergency situation?
    a. If the main concern is distance between car and pedestrian what is the minimum distance between them which is allowed before the breaking should start?
2. What is the worst-case scenario that the customer would like to be modeled?
    a. Assuming a worst case situation, what exactly should happen if the car can’t avoid the pedestrian with the maximum deceleration?
    b. In a situation where breaking may cause a car behind the vehicle to crash into it, should the system prioritize avoiding hitting the pedestrian or a collision with the car behind?
3. Does the customer just want the vehicle to stop or make a path to go around the pedestrian?
    a. If a path, is there a specific path (left or right) that the customer would like the vehicle to steer towards?
    b. If the only way to avoid a collision is to come to a stop, should the car ever come to a full stop?
        i. If so, how far away should the vehicle stop from the pedestrian?
4. How does or should the PCAS system predict pedestrian behavior, such as changes in direction or speed?
5. Are weather conditions a factor? For example should we take into consideration road conditions such as ice making it take more time for brasking, or rain making it harder for sensors to accurately pick up a pedestrian.
6. To what extent can we rely on the radar/lidar systems in our vehicle? In practice the radar will certainly face a series of difficulties, so how should we reflect this in our models?
7. What is deceleration accuracy and how would the differing values affect the outcome of the slowing mechanism?
8. What is a potential situation where the system would enter its fail operational mode?
9. What is the current state of this software? Will we be adding onto any existing software or will our research be completely independent?
10. As stated, cybersecurity is an important factor with regards to effectiveness. What are some of the cybersecurity requirements that are needed for your company to accept our Software Requirements Specification (SRS).
    a. In the event of a detected security breach should the system give control back to the user or stop the vehicle?
11. Should there be other models tested beside the 0.5 m circle shape to account for perhaps a ball rolling into the street or an animal obstructing the path of the autonomous vehicle?