Requirements, Invariants, and Questions for Hands-Free Driving System

Requirements

1. HFDS allows vehicle to be able to drive in its existing lane without needing to control the steering wheel.
2. The system initially turns on once a button is pressed in the vehicle.
3. The system will not exceed the speed limit set by the driver and will remain in the same lane - slowing as necessary to avoid collisions with vehicles that are ahead.
4. Warnings are issued if:
    a. The system needs the driver to reclaim control.
    b. The driver is deemed distracted.
        i. Final warning will send vibrations to the driver to reengage.
5. Lane detection and adaptive cruise control are pre-existing features.
6. Adequate LiDAR mapping of highways.
7. Driver must be on a highway that has been enabled by the Path Prediction Subsystem.
8. Driver Assist System must validate road conditions, current trajectory, sensory input, and predicted path.
    a. If above condition is met, only then can the driver enter hands-free mode.
9. Driver Attention System must have hardware and sensor redundancies in place.
10. Once HFD is engaged:
    a. The hands-free mode must enter an adaptive cruise control state and stay within its existing lane for the duration of the session.
    b. The Driver Attention System must monitor the driver's eyes and head movements to ensure proper engagement with the road.
    c. Camera monitoring must work in all lighting conditions.
    d. The system can identify if the driver is not engaged with the road.
11. If the system identifies the driver as inactive, the system aborts hands-free mode, and the vehicle may come to a stop.
12. System must monitor for attentive eyes and head placement.
13. Driver can intervene and regain control of the vehicle by either controlling the steering wheel, braking, or throttle.
14. Do not irritate the driver with false warnings.
15. The system shall maintain a safe following distance to cars ahead.
16. Lane changing will be done through Lane Change on Demand and the system will look for an acceptable opening.
    a. Turn signal will be on.
    b. Merge will be complete only after the system has determined it to be safe.
    c. If the merge is unable to be completed, the system will relinquish control to the Driver.

Invariants

1. The system shall detect any single point of failure, then relinquish control to the driver.
2. Safety measures must be in place and ensure safety of driver, other drivers, and pedestrians.
3. Driver must be able to reclaim control of the vehicle through the steering wheel, braking, or throttle.
4. Avoid no-good-option situations by preemptively responding to potential hazards.

Questions

1. What driver activity constitutes sending a warning?
    a. How accurate are these warnings?
2. Why is it that if the driver is deemed inactive, that the vehicle “may” come to a stop? Why is the vehicle not guaranteed to come to a stop?
3. Where is the Driver Attention System, and how does it identify drive disengagement?
4. How come attentive eyes and head placement are the only two factors being monitored for driver engagement?
5. What is the fail-safe state if a system fails?
6. What defines a safe following distance?
7. After coming to a stop due to driver disengagement, what dangers are present with stopping?
8. What should occur in scenarios such as stop-and-go, construction, or lane obstruction?
9. How aggressive is the automatic braking?
10. What should happen if the driver is deemed distracted when they activate HFD?

Bibliography

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