Team TJA3

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Requirements

1. The vehicle must have a Global Positioning System (GPS) tracking device.
   1.1. The GPS tracking device must be able to communicate with the Global Navigation Satellite System (GNSS) network [1, pp. 2].
   1.2. The GPS tracking device must be able to retrieve information from the GNSS network about the vehicle's current location and traffic on the road.
2. The Traffic Jam Assist (TJA) system should only activate when the GPS tracking device indicates that the vehicle is on a limited access highway and that there is traffic on the highway.
3. Assuming the vehicle has an Adaptive Cruise Control (ACC) system, the TJA system must use the forward-looking radar.
   3.1. The radar should determine the target vehicle up to 50 feet in front of the vehicle.
   3.2. The radar should calculate the closing rate to the target vehicle.
   3.3. The radar must be durable to all types of weather conditions.
4. Assuming the vehicle has an Adaptive Cruise Control (ACC) system, the TJA system must use the forward-looking camera.
   4.1. The camera determines if the vehicle is lane following (in the middle of its lane).
   4.2. The camera must use image processing to decipher between different kinds of weather conditions.
5. The TJA system will alert the driver of warnings when the closing distance is negative, the vehicle speed is too high, or the vehicle is not lane following.
   5.1. The TJA system will display warnings on the dashboard.
   5.2. The TJA system will have an auditory warning system consisting of beeps.
6. The vehicle must perform autonomous operations that actively manipulate actuators.
   6.1. The vehicle must control longitudinal acceleration and deceleration.
   6.2. The vehicle must control lateral direction.
   6.3. The vehicle must control vertical displacement.
7. The vehicle must use autonomous operations to regulate lane following, the vehicle speed, and closing distance to the target vehicle.
   7.1. If the camera determines the vehicle is not centered, the vehicle will center itself.
   7.2. If the camera determines the weather to be hazardous, the vehicle will go half its current speed.

7.3. If the radar determines the target vehicle is not moving, the vehicle must slow down and maintain a reasonable distance that allows the driver to see the rear tires of the target vehicle (default is 3 feet).
7.4. If the radar determines the target vehicle is moving, the vehicle must follow at a set distance (default is 6 feet) and continuously recalculate the closing rate.

8. The vehicle must have a radar sensor in each side door and rear corner of the vehicle to aid the driver during lane changing.
8.1. The sensors only activate when the driver signals to merge lanes, assuming the vehicle resists attempts to lane change without signaling.
8.2. The sensors must determine the target vehicles up to 50 feet on each side, especially the target vehicles directly behind the driver and in the lane the driver plans to merge into.
8.3. The sensors must adjust the vehicle's set speed, set distance, and the closing rate based on the speed and distance of the detected target vehicles before, during, and after lane changing.

Global Invariants

1. The vehicle shall not exceed 10 mph if a target vehicle is detected within 15 feet.
2. The vehicle shall be at most 3 feet to a target vehicle that is not moving.
3. The vehicle shall maintain a distance of at least 6 feet to a target vehicle that is moving.
4. The vehicle shall never surpass 100 mph.
5. The vehicle shall cut its current speed by half in hazardous weather conditions.

Questions

1. How does the TJA system activate?
2. What parts of the vehicle should the system have access to?
3. How does the user interact with the TJA system?
4. How does the model of the car impact the parameters?
5. What are the speed limitations for the TJA system?
6. What do you mean by autonomous systems and how do you want it to operate? What parts of the system should or should not be autonomous?
7. What level of control should the driver have over the autonomous components of the system? How will the driver always be able to take control of the system?
8. The TJA system is based on the ACC system. What additional features should be added and removed to TJA system when compared to the ACC system?
9. How does the TJA system know if the driver is attentively watching the road while the system is active?
10. What, if any, are the limitations to the camera? Is its night vision good enough to see cars and lanes at night? Will rain impact its' accuracy? Etc....
11. What should the system do during hazardous weather conditions?
12. What would be the preferred way for the vehicle to decipher between a clear data or inclement weather conditions?

References

[1] “What is GPS tracking and how does it work?”, mixtelematics.com. [Online]. Available: https://www.mixtelematics.com/us/resources/blog/what-is-gps-tracking-and-how-does-it-work#:~:text=GPS%20Tracking%20System%20Basics,of%20the%20vehicle%20being%20tracked.. [Accessed Oct. 28, 2022].