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CSE 435 Scalable Cruise Control Group 2
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Enumerated Requirements List

1. **Sensors:**
   - 1.1. Rpm sensor connected to the front axle.
   - 1.2. A sensor connected to the brake pedal which sends a signal when the pedal is pressed and another signal when it is released.
   - 1.3. Both short and long range RADAR sensors to detect nearby vehicles/obstacles.
   - 1.4. Both front and rear camera.
     - 1.4.1. Should record in at least 1080p
     - 1.4.2. Viewing angle of at least 160 degrees
     - 1.4.3. Ability to clean its own lens
     - 1.4.4. Minimum of 30 frames per second

2. **Security/Safety**
   - 2.1. Cruise control should be completely isolated from the entertainment and WiFi systems.
   - 2.2. Hardened Operating System to make the system less susceptible to attacks.
   - 2.3. Acceleration must be as smooth as possible.
   - 2.4. Braking should be quick, but as smooth as possible.
   - 2.5. Neither the sound or lights should be overly distracting as to hamper the driver's ability to concentrate, but should be loud and bright enough to be noticeable.
   - 2.6. System should perform in all weather conditions.

3. **System Electronic Control Unit (ECU)**
   - 3.1. ECU determines time and distance to the vehicle/object in front of the system to make the proper adjustments, and determines the probability of impact using sensor data, the vehicle's speed, the hazardous object's speed and size, braking pressure, and current acceleration.
   - 3.2. ECU produces corresponding alerts and braking pressure depending on threat level.
   - 3.3. Decision algorithms need to be of the highest efficiency to ensure the system has the capability to make real time calculations and decisions.
   - 3.4. ECU determines vehicle speed using Rpm sensor data.

4. **Automatic Emergency Brake (AEB) / Collision Avoidance**
   - 4.1. Hardware to control brakes
   - 4.2. Software to control brakes
   - 4.3. If car is approaching a detected threat, create audible beeping though car's audio system that increase in frequency as the car approaches nearer to the object it potentially could collide with.
   - 4.4. If driver fails to change the trajectory, automatically engage partial braking and begin flashing cabin lights to indicate that autonomous braking has occurred.
   - 4.5. If the car is still approaching threat and collision is determined to be likely, apply full brakes to bring the car to a stop.

4.6. Driver is always able to press a button to disengage warning signals and automatic braking functionality.

5. Following Distance Management

5.1. Hardware to control accelerator and brakes
5.2. Software to control accelerator and brakes
5.3. Driver set the following distance to vehicle represented by small, medium, large, and extra large.
5.4. Vehicle maintains maximum possible safe speed through throttle input and brake control, with real-time inputs from vehicle speed and lead vehicle tracking information from camera and radar, within the constraints of set speed, minimum following distance/time, and driver throttle input.
5.5. Driver may activate/deactivate following distance management through a button press.

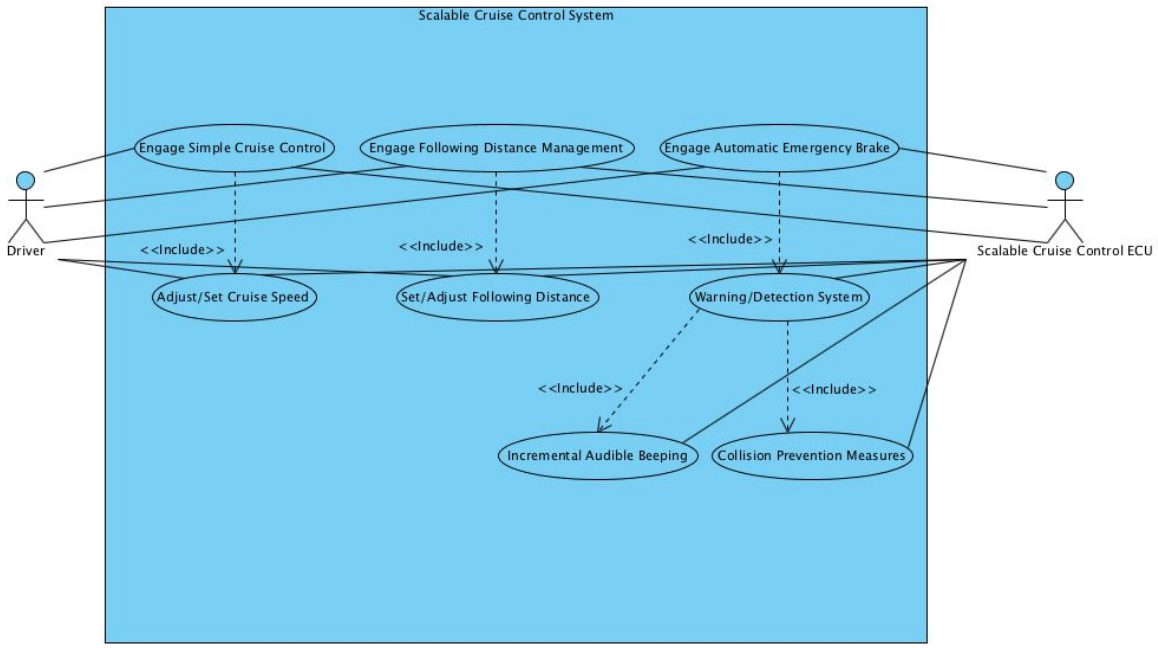
6. Simple Cruise Control

6.1. Driver enables the feature and sets a maximum speed to be maintained. Set speed must be greater than 25 mph.
6.2. Vehicle maintains the set speed through throttle control and vehicle speed feedback.
6.3. Driver may exceed the set speed though direct throttle inputs.
6.4. Driver may cancel (suspend) the feature through a button press or by depressing the brake pedal.
6.5. Driver may resume the previously set speed by a button press, and the vehicle must accelerate or decelerate at a safe rate to the set speed (in the absence of throttle input from the driver).
6.6. Driver my increase/decreases the set speed while active, through throttle input from the driver).
6.7. Driver may activate/deactivate simple cruise control through a button press.

7. Activation/Deactivation Buttons

7.1. All physical buttons have an indicator light on them to display if the respective system they control is activated or not.

Use-Case



Use Case:	Engage Simple Cruise Control
Actors:	Driver (Initiator), Scalable Cruise Control ECU
Description:	Simple cruise control system is activated whenever the driver presses the physical activation button.
Type:	Primary
Includes:	Adjust/Set Cruise Speed
Extends:	
Cross-refs:	1.1, 2.1, 2.2, 2.3, 2.4, 2.6, 3.4, 6.1, 6.2, 6.3, 6.4 , 6.5, 6.6, 6.7, 7.1
Use Cases:	

Use Case:	Adjust/Set Cruise Speed
Actors:	Driver (Initiator) , Scalable Cruise Control ECU
Description:	The driver may increase, decrease, or reset the desired cruise control speed through button presses.
Type:	Primary
Includes:	
Extends:	
Cross-refs:	6.1, 6.2, 6.3, 6.4, 6.5, 6.6
Use Cases:	Driver must have completed the *Engage Simple Cruise Control* use-case

Use Case:	Engage Following Distance Management
Actors:	Driver (Initiator), Scalable Cruise Control ECU
Description:	Following distance management system is activated whenever the driver presses the physical activation button.
Type:	Primary
Includes:	Set/Adjust Following Distance
Extends:	
Cross-refs:	1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 2.5,2.6, 3.1, 3.2, 3.3, 3.4, 5.1, 5.2, 5.3, 5.4, 5.5, 7.1
Use Cases:	

Use Case:	Set/Adjust Following Distance
Actors:	Driver (Initiator) , Scalable Cruise Control ECU
Description:	The driver can set the following distance to the the vehicle in front through button presses. The distances are represented by 4 steps: small, medium, large, and extra large.
Type:	Primary
Includes:	
Extends:	
Cross-refs:	1.1, 1.2, 1.3, 1.4, 3.1, 3.2, 3.3, 3.4, 5.1, 5.2, 5.3 , 5.4
Use Cases:	Driver must have completed the *Engage Following Distance Management* use-case.

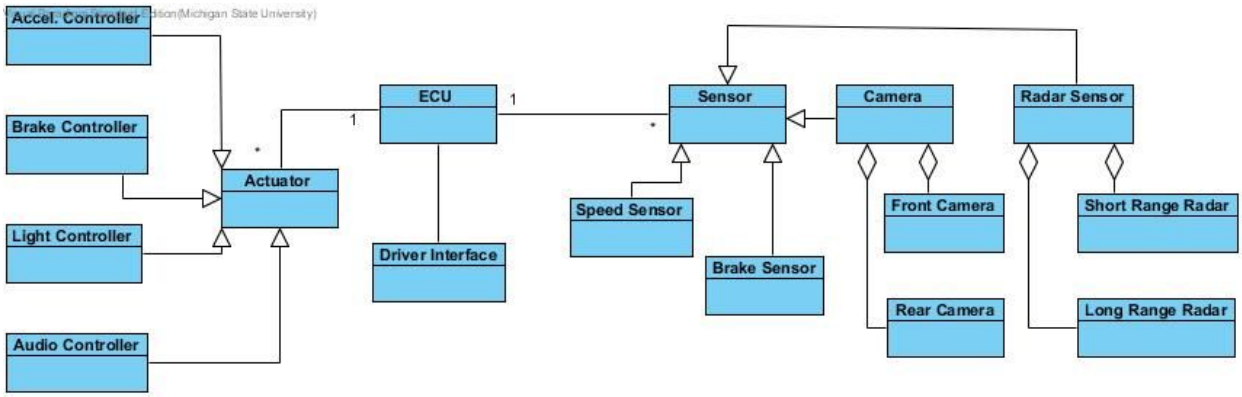
Use Case:	Engage Automatic Emergency Brake
Actors:	Driver (Initiator) , Scalable Cruise Control ECU
Description:	The automatic emergency braking system can be activated whenever the driver presses the physical activation button.
Type:	Primary
Includes:	Warning/Detection System
Extends:	
Cross-refs:	1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.4, 2.5, 2.6 , 3.1, 3.2 , 3.3 , 4.1 , 4.2 , 4.3 , 4.4 , 4.5 , 4.6 , 7.1
Use Cases:	

Use Case:	Warning/Detection System
Actors:	Scalable Cruise Control ECU
Description:	Produces appropriate safety measures based on the likelihood of a collision. This includes warning beeping and lights, as well as autonomous braking to prevent an impact.
Type:	Primary
Includes:	Incremental Audible Beeping, Collision Prevention Measures
Extends:	
Cross-refs:	1.1, 1.2, 1.3, 1.4, 2.1 , 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 3.3 , 4.1 , 4.2 , 4.3 , 4.4 ,4.5 , 4.6
Use Cases:	Driver must have completed the *Engage Automatic Emergency Brake* use-case.

Use Case:	Incremental Audible Beeping
Actors:	Scalable Cruise Control ECU
Description:	Audible beeping produced when vehicle is approaching a possible threat. Frequency of beeping increases as likelihood of collision increases.
Type:	Primary
Includes:	
Extends:	
Cross-refs:	4.3, 2.4
Use Cases:	Warning/Detection System

Use Case:	Collision Prevention Measures
Actors:	Scalable Cruise Control ECU
Description:	When a collision is determined to be likely and the driver has failed to respond to the threat, flashing cabin lights will be triggered and autonomous braking will be used in order to prevent a collision.
Type:	Primary
Includes:	
Extends:	
Cross-refs:	1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1 , 3.2 , 3.3, 4.1, 4.2 , 4.4, 4.5 , 4.6
Use Cases:	Warning/Detection System

UML



Description: All sensors including the speed sensor, brake sensor, camera , and radar sensor all derive from the parent class called sensor. The ECU (electronic control unit) uses data from one or more of these sensor classes in order to determine if a control signal needs to be sent to one or more of the actuators. The driver interface contains the software that is used by the ECU to control the actuators.

Questions:

1. If the vehicle's software has been compromised by a hacker, how should the scalable cruise control system respond?

2. What types of wireless communication methods should the system implement? (In order to know what type of security protocols to implement)

3. Does the internal software have a super user? Any backdoor possibilities?

4. How do you encrypt the information being sent?

5. How is the data/information sent?

6. What should happen if a car cuts in front of our vehicle and is too close to avoid a collision?

7. Should the system be able to detect if a collision has occurred, and if so what should be the vehicle's course of action? (Automatically contact authorities etc.)

8. How should the car slowdown if it is nearing another vehicle in front of it?

9. What types of objects should the AEB system be applied for?

10. What is considered a safe rate for vehicle acceleration or deceleration?

11. In following distance management, how do we handle sudden speed changes from the car in front of us?

12. Should we take into account traffic from the side of us?

13. What kind of warning does the vehicle emit when the vehicle becomes too close to an object (visual/audio)?

14. Is a hardened operating system permissible?

15. If Automatic Emergency Braking (AEB) is not enabled, should the system still apply braking pressure in order to maintain a proper following distance from the car in front of it or should it simply use coasting to accomplish this same feat?

16. If the vehicle is traveling at 70 mph, what would be considered a proper following distance for each of the 4 steps available ("small" up to "large")? What should the proper following distance be at 25 mph for these same steps?

17. Is there a maximum cruise speed that the driver can enable, if so what is this maximum speed?

18. Should any more object sensing technologies be added to the system to further enhance its abilities, such as infrared or ultrasonic sensors?

19. Where should the camera, radar sensor, and any additional sensors be implemented?

20. How early should the system begin detecting a vehicle in front of it?

21. Exactly how close should the car be allowed to get using Following Distance Management?

22. Under which conditions should the automatic brake be applied?

23. Can the emergency brake be overridden in case of system error?

24. How is the distance between vehicles measured?

25. Do brake lights turn on when Scalable Cruise Control slows down the vehicle?

26. What kind of objects can the system recognize?

27. Does the system offer braking assist if the driver doesn't apply enough force?

28. Does the system detect curves?

29. What if a motorcycle comes between the front car and yours?

30. When increasing speed, how close does the system let you come to the front car?

31. Does it have night-vision? Does it work at night?

Weekly Meeting Time and Place : Thursdays 8:45 Main Library