Project Work Proposal

SS 25

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Car Comfort Control Unit

1. System Overview

The Comfort Control Unit in a car is used to manage various comfort-related systems. Its purpose is to enhance the user experience in terms of heightened convenience, comfort, and safety of the passenger/driver. The comfort-related systems include Interior Lighting, Central Locking, Window Adjustments, Ventilation/Climate Control, and/or Seat adjustments. Using a Microcontroller Unit to control the logic and communication between components, the system can achieve the required goals of each system in normal operations.

1.1 General Information

The intended operational context of this unit depends on the current state of the car. Some systems will be operational in one state and others in a different state. These include when the

Car is on (The substates could be driving/parked) and when the Car is off. In the **off state**, Systems such as Central Locking will be on. The Central locking system is intended to keep the vehicle and the passenger secure for safety and/or security reasons. In the **on state**, systems like Window Adjustment, Interior Lighting, Ventilation/Climate Control, and/or Seat adjustment are on. The Window adjustment system is intended to provide a method for passengers to regulate airflow, visibility, and/or communication with the outside environment. The Interior Lighting system is intended to provide visibility for the passenger in periods of low light when there is limited visibility. The Ventilation/Climate Control focuses on providing the passenger with a comfortable and safe interior environment by regulating aspects such as temperature, airflow, humidity, and air quality. The Seat adjustment system aims to provide a simple way for the passenger to manage their posture while in the vehicle in either state. Through the mentioned systems, the Comfort Control Unit aims to solve the possible difficulties in a “closed-off” environment.

1.2 System Specifications

The Comfort Control Unit (CCU) is a system composed of both hardware and software components, designed to manage various comfort functions in a vehicle. It ensures proper operation at all times and provides fast response to user inputs, or in other words, has low latency, which should be less than **100 ms**. Key criteria also include energy efficiency and real-time performance to deliver a smooth and reliable user experience.

Hardware Components:

- **Microcontroller Unit (MCU):** Central controller for all comfort features (e.g., ARM Cortex-M, AVR).
- **Actuators:** For windows, seat motors, and door locks.
- **Sensors:** Temperature, seat position, ambient light.
- **Switches/Buttons:** For manual user input (like controlling the windows or airflow for the ventilation).

A power supply is also crucial for this system, but power is typically provided by the 12V car battery with voltage regulators.

Software Requirements:

- **Embedded C/C++ Firmware:** Ensures real-time control of subsystems.
- **Diagnostic/Logging Module:** For fault detection and service interface.

The software also includes a **Communication Protocol Stack**, used for data exchange between modules. This is done by CAN or LIN drivers, depending on the car model.

Design Considerations:

- **Automotive Compliance:** The system must meet standards for safety. They can vary between regions, but usually include standards like Electromagnetic Compatibility, ISO 26262, etc.
- **Temperature Range:** -40°C to +85°C operation.
- **Design constraints:** Space in a vehicle cabin/body is usually limited.
- **Robustness:** Must tolerate voltage spikes, vibrations, and moisture.
- **Fail-Safe Mechanisms:** Ensure basic functionality even during faults.

1.3 Expected Behavior

The Comfort Control Unit will respond to user inputs and change the related settings based on said inputs.

Inputs will be registered via touchscreens, dials, knobs or buttons depending on implementation.

It will send the settings data to related systems like the AC unit, window controllers, lighting systems, and seat positioning system.

Key scenarios include:

- The user changes the desired temperature. The CCU will register the change and send a signal to the AC unit telling it to change to said temperature.
- The user wishes to raise or lower the driver and passenger side windows. The CCU will register the input and send a signal to the window actuators to raise or lower based on how long the input is held.
- The user wishes to change the positioning of their seat. The CCU will register the input and send a signal to the seat actuators to raise/lower, move forward/backward, or rotate the seat based on how long the input is held.
- The user presses the lock or unlock button on the key fob. The Central Locking system will register the input and send signals to the door actuators to lock or unlock the vehicle doors accordingly. When the user exits the vehicle and the car transitions to the off state, the Central locking system will detect this change and send a signal to automatically lock all doors to ensure vehicle security.

1.4 Supporting Figures and Diagrams

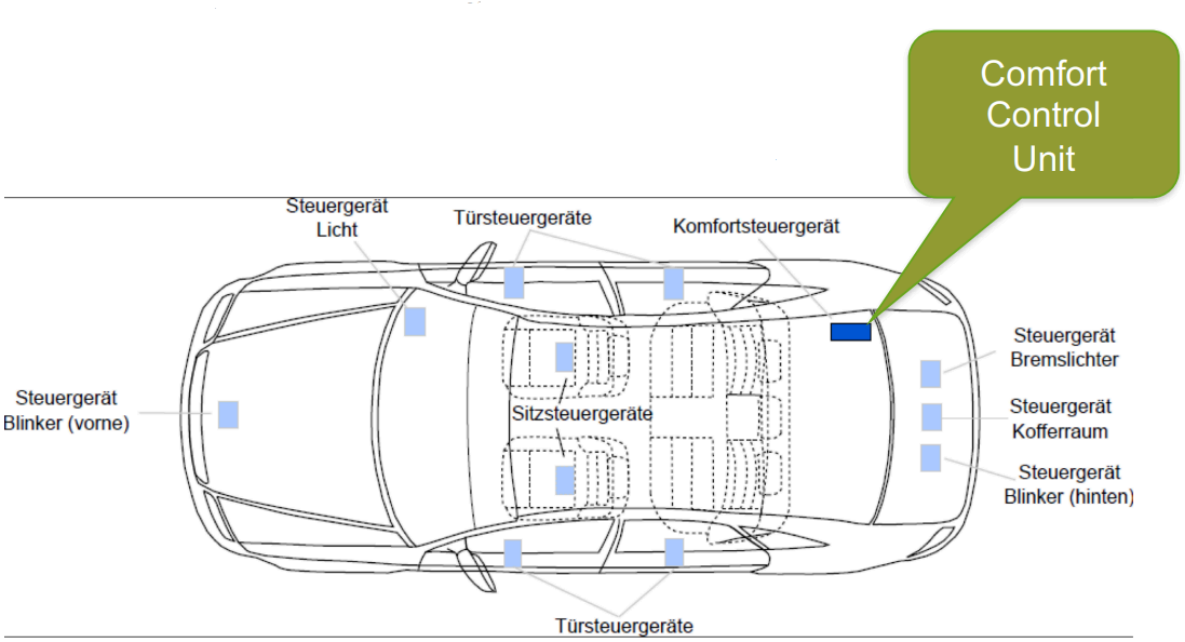
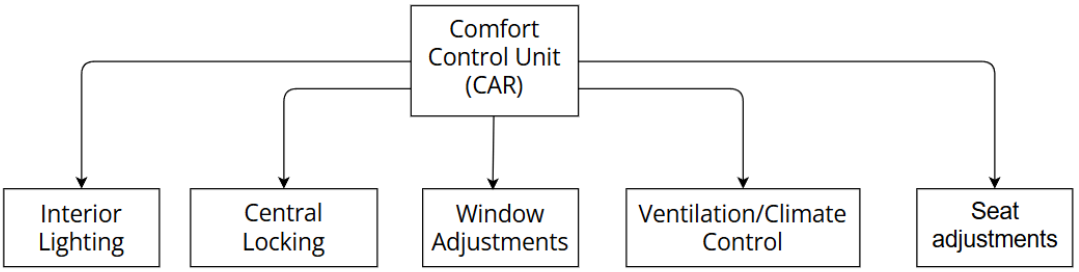
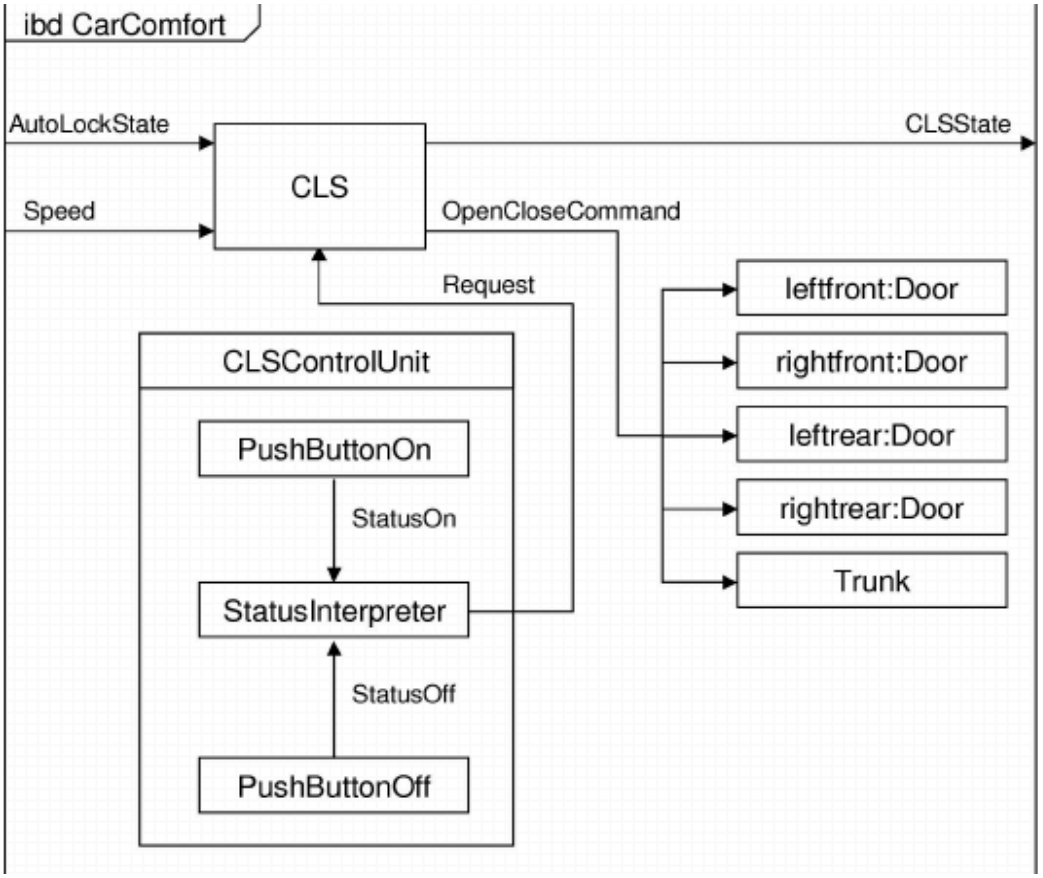
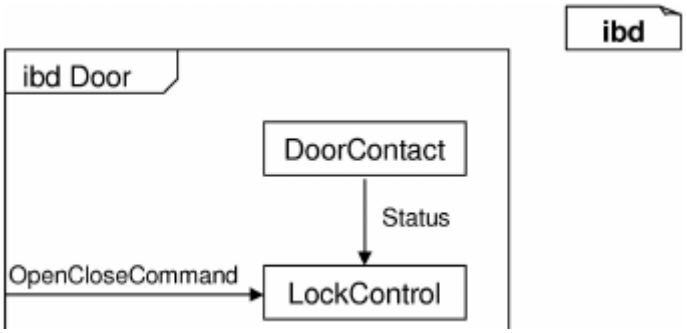


Image showing some of the features the CCU controls.



Simple breakdown of systems in the comfort control unit.

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