cs7074
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ePoly ECE-GY 5213 Introduction to Systems Engineering

Homework 1

1. For a passenger automobile, partition the principal parts into four subsystems and their components. For the subsystems, group together components concerned with each primary function. For defining the components, use the principles of significance, singularity and commonality. Indicate where you may have doubts. Draw a block diagram relating the subsystems and components to the system and to each other.

Solution 1:

In the field of engineering and design, there are several important principles that guide the creation of effective and reliable systems.

The **principle of significance** highlights the significance of only including those parts or subsystems that are crucial to a system's overall performance. This makes it possible to ensure that designs are as simple and effective as possible, free of extraneous or superfluous components. According to the **principle of singularity**, every element or subsystem in a design should serve a single purpose. It is simpler to understand, maintain, and repair designs when the jobs are clear and distinct. According to the **principle of commonality**, components or subsystems with comparable requirements or functions should be standardized or made as similar as practicable. This can simplify manufacture, cut costs, and lower the number of unique components in a design. Standardizing components also makes it simpler to repair or upgrade them, which can boost reliability.

A passenger automobile system can be partitioned into four subsystems as follows:

I. **Powertrain**: This subsystem includes the engine, transmission, driveshaft, differential, and axles. Its function is to generate power and transmit it to the wheels. The principle of significance is used here as only the essential parts are included, such as the engine and transmission, to ensure a simple and effective design. The principle of singularity is applied by giving each part a single function, like the engine for power generation and the transmission for speed regulation.

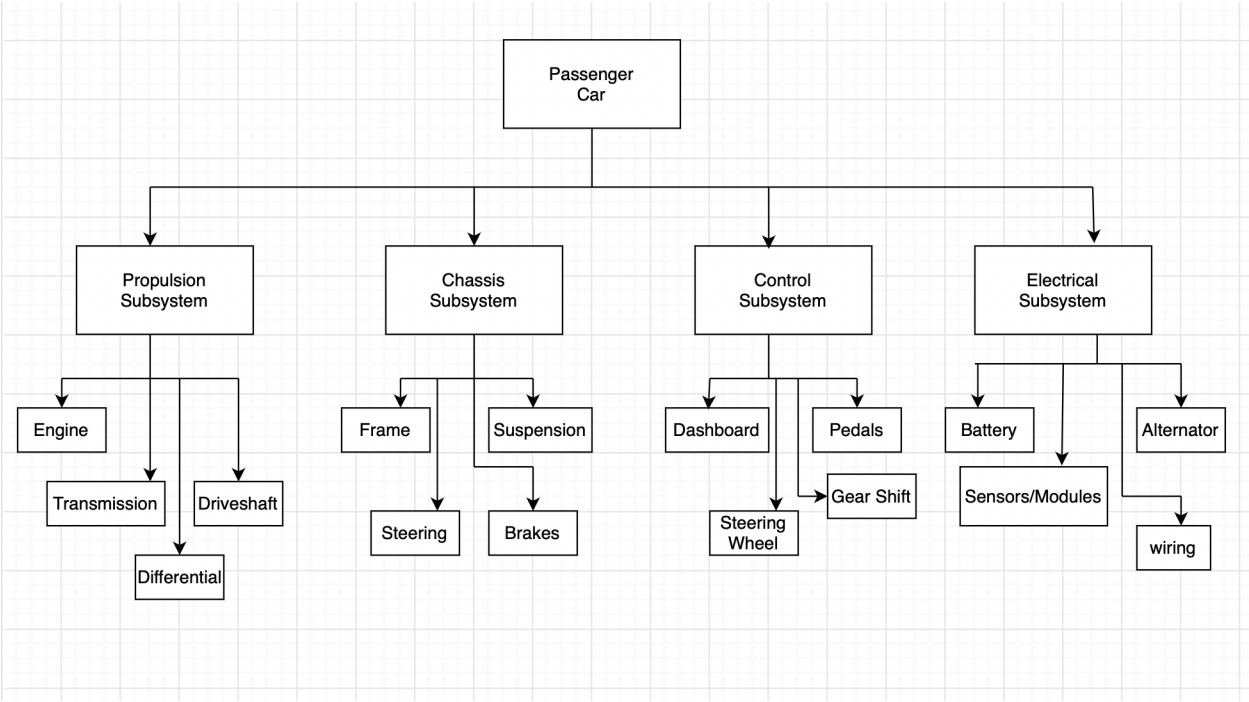
II. **Chassis/Vehicle Framework**: This subsystem includes the car's body, frame, and other parts that provide structural support and protection. The principle of commonality is used to standardize these parts to reduce manufacturing costs and increase reliability.

III. **Control System**: This subsystem includes the dashboard, steering wheel, pedals, and other controls. Its function is to allow the driver to control the car's movement and to provide information about the car's status. The principle of significance is used by including only necessary controls and indicators to keep the design simple.

IV. **Suspension Subsystem**: This subsystem includes the springs, shock absorbers, and other components that ensure a smooth ride and keep the car stable while driving. The principle of

singularity is applied by giving each component a specific function, such as springs for support and shock absorbers for dampening.

These four subsystems work together to make a complete passenger automobile system. The powertrain (I) generates power and transmits it to the wheels, while the chassis/vehicle framework (II) provides structural support and protection. The control system (III) allows the driver to control the car, and the suspension subsystem (IV) ensures a smooth ride.



Block diagram representing the relation of the subsystems and components to the system

2. List the test interfaces and built-in test indicators in an automobile that are available to the user (do not include those only available to a mechanic).

Solution 2:

1. Check Engine Light: This indicator light illuminates on the dashboard to notify drivers of potential issues with the car's engine or emissions system. It signifies that the car's computer system has detected an error code and that further attention may be required.
2. Tire Pressure Monitoring System (TPMS): The TPMS is a built-in indicator that monitors the pressure of the car's tires and alerts drivers if the pressure is too low. This can help prevent flat tires and improve fuel efficiency.
3. OBD-II Port: The OBD-II Port is a test interface that allows a diagnostic tool to be connected to the car's computer system. It provides information on the health of various systems and identifies potential issues that may need attention.

4. Fuel Economy Indicator: The Fuel Economy Indicator is a built-in indicator that displays information on the vehicle's fuel efficiency. This can help drivers adjust their driving habits to improve fuel economy and save money on gas.
5. Battery Voltage Meter: The Battery Voltage Meter is a built-in indicator that displays the voltage level of the car's battery. This can help drivers determine if the battery is charging properly and prevent a dead battery.
6. Thin Pedal Force Transducers: These are test interfaces that measure the force applied to the brake and accelerator pedals by the driver. This can help diagnose issues with the braking and acceleration systems.
7. Gear Change Lever Operator Transducer: This is a test interface that measures the force and position of the gear shift lever. It can help diagnose issues with the transmission system.
8. Hand Brake Operating Force Transducer: This is a test interface that measures the force applied to the hand brake by the driver. It can help diagnose issues with the hand brake system.
9. Slip Ring Type Transducer: This is a test interface that measures the speed and position of the steering wheel. It can help diagnose issues with the steering system.