Software Platforms for Automotive Systems

Tutorial 1: Basic Concepts

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Cost Sensitiveness

1) The automotive domain is highly cost-sensitive. To illustrate this let us consider the following example: An OEM sells 100 million units of a given car model in a year.

a) If 10 cents can be saved up per unit. How much is the total saving of the OEM for a period of 10 years considering an annual interest rate of 2%? Hint: Assume the OEM disposes on the saving on a yearly basis.

b) Compare this with the case of the aeronautic industry where only 10,000 units are sold in a year.

c) How do costs increase as errors are detected later in a car's life cycle? Consider the phases: i) design, ii) development, iii) production and iv) commercialization. Explain your answer.

State Automata

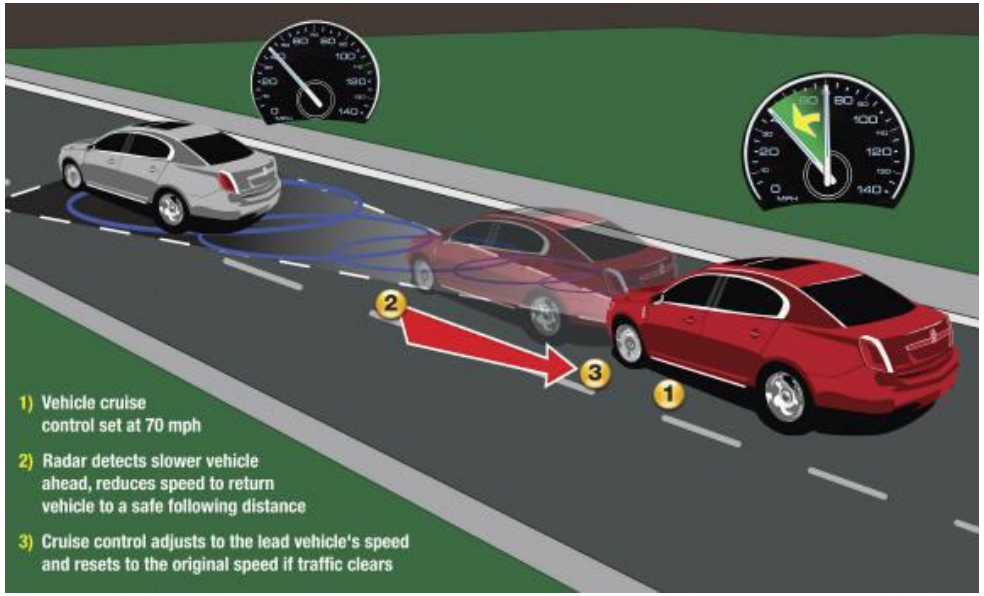
2) Let us consider the ACC (Adaptive Cruise Control) system. ACC keeps the car's speed at a desired constant value taking traffic flow into account.

Sketch a state automaton for ACC. For this consider the situation of the following picture with:

i) ACC set at 110 Km/h.

ii) ACC detects a car.

iii) If speed of leading car less than own speed, then ACC adapts its speed to keep a safe distance, and it resets to the configured speed if traffic clears.



Logical and Technical Architecture

3) Different modules/ECUs need to be integrated in order to achieve the desired behavior of ACC. Sketch the logical and technical architecture of the system. Consider that the modules/ECUs involved are as follows:

i) ACC: This ECU takes RADAR sensor data to determine the distance and speed of the leading car. It receives the desired speed from the driver and controls other modules/ECUs.

ii) ESP (Electronic Stability Program): This ECU controls the brakes and wheels. It provides ACC with the current speed.

iii) EC (Engine Control): This ECU controls the engine functions including speed.

Logical and Technical Architecture

4) Sketch the logical and technical architecture for following comfort electronics consisting of alarm system, central locking, remote control, electric windows, and locking control unit:

i) The alarm system should be activated when doors are forced to open.

ii) The central locking system should close and open doors on demand

iii) The remote control allows for a remote activation of the central locking system.

iv) Electric windows are closed automatically when car is closed by central locking.

v) The locking control unit activates the alarm when car‘s speed is zero and the driver leaves it unlocked. It locks doors automatically when speed is greater than a given threshold. It turns on the LEDs signalizing that doors are open/closed and that the alarm is engaged or disengaged.

Automotive Domains

5) Automotive applications are typically divided into different domains according to their functions.

a) How many automotive domain are there? Explain them briefly.

b) Which are the safety-critical domains in the automotive industry? Explain why?

c) What is the different between passive and active safety? Mention examples of passive- and active-safety systems.

d) Into which domain can we classify ACC?