# Assignment 1

- Identify at least 5 embedded systems that you might encounter in your room, your car or some other environment that you interact with on a regular basis.
- Identify whether these systems have any real-time performance requirements. If they do, identify the real-time requirements that exist for the system. What might happen if the real-time requirements were not met?
- Pick one system and research how it is or has been typically implemented.

| Embedded system | Are there any real-time requirements? | What are they? | Implications of failure to meet real-time requirements |
|---|---|---|---|
| 1. Automotive engine controller | Yes | Ignition spark is required a precise time w.r.t. TDC +/- a few degrees. At 2400 rpm, this equates to a small fraction of 25 msec, perhaps +/- 100 μsec | Loss of engine power, excessive engine emissions |
| 2. Automotive navigation system | Yes, but minimal | 1/second GPS position update, course and position display, verbal warning of upcoming turns | As long as update is sufficiently in advance of upcoming turn (~20 seconds), loss or real-time performance would not be noticed |
| 3. Vehicle instrument cluster display control | Not really | Gauges, speed, odometer, engine alerts should be updated before user notices change. Perhaps 1-5 second update | Slow responding controls might annoy user |
| 4. Home thermostat control | Not really | System must respond to heating needs before room temperature fluctuates noticeably, ~1-5 minute response time would be OK | Given thermal mass of house and insensitivity to small changes in room temperature, lack of real-time response is not noticeable. |
| 5. Wall clock synchronized to WWVB | No | Clock needs to synchronize to WWVB to within 1 second whenever signal is detected. | Natural drift of clock relative to precise time is small. As long as update occurs before drift is more than 1 sec, no one would notice |

# Assignment 1 - continued

| Automotive Engine Controller | | |
|---|---|---|
| **Function** | **Current (embedded system) implementation** | **Prior Implementation** |
| Ignition spark | Embedded controller senses RPM, engine temperature, throttle, and various other environmental inputs to determine optimum time to ignite fuel for best power/fuel efficiency/pollution tradeoff | Mechanical points determine engine rotational position. During acceleration, additional vacuum generated at intake manifold causes ignition to advance a fixed amount |
| Fuel mixture | Embedded controller senses $O_2$, temperature, engine speed, accelleration and emissions level to optimize fuel/air ratio | Fixed mixture set by mechanical venturi valve |
| Pollution control | Fuel mixture, ignition timing set by embedded system to optimize emissions level | Minimal |