Potential Topics for Embedded System Design and Synthesis Mini-Projects

Compiled by Robert Dick.

You are encouraged to choose your own topic. You are not limited to this list. If you are interested in any of the topics listed here, email or talk with me so I can provide more information.

1) Specify and model check a moderate-complexity medical device at a high level of abstraction. This would require contacting medical device manufacturers and begging for specifications for old devices. A fallback plan would be to work backward from documentation. There are many model checkers. One option would be to use TLA+ and TLC.

2) Determine whether it is appropriate to dynamically control the portion of applications running on portable embedded system and the portions running on a more powerful remote machine based on varying energy consumption and performance characteristics of machines, applications, and communication interfaces.

3) Design a sensing and control system to minimize the energy consumption of a building under a constraint on the comfort of the occupants. This would require finding models for human comfort in the literature and developing a distributed sensing system. "Task Ambient Conditioning" research may be helpful. There may be greater opportunities in inexpensively retrofitting existing buildings, such as houses.

4) Develop a proof-of-concept to use compact wireless sensing nodes containing accelerometers to estimate forces on internal structures of the human body during exercise and labor.

5) Develop a communication application for use atop a secure ad hoc network of smartphones. Some options include a contact storage daemon (e.g., program for storing the keys, lo cation caches, etc. of contacts) or a contact storage query interface (method for applications to query for and receive the stored contacts).

6) Design deployment plan for a mobile, distributed, air quality sensing system using sensors we have recently designed and fabricated.

7) Develop a web-based wireless sensor network programming system, perhaps using compiler technologies we have already developed.

8) Develop implicit environmental characterization algorithms for use in wireless sensor network design. It is difficult to design a wireless system without first understanding the wireless environment, but manual characterization of the environment is extremely difficult. Use a limited network deployment to automatically characterize the environment and then use this information to suggest design changes.

9) Develop languages for additional wireless sensor network archetypes.

10) Develop a modular library of distributed sensing and actuation hardware or software components, perhaps starting from an existing platform.

11) Proof of concept for inexpensive, adaptive, easy to install home automation and security system.