Student thesis project

A tool for constrained application programming in wireless sensor networks

The Department of Information Technology, Uppsala University has developed ProFuN Task Graph, a tool for programming wireless sensor network (WSN) applications that have user constraints on minimal levels of network's performance and quality of service.

The tool and the relevant middleware provide support for network performance prediction and diagnostics. The tools is based on Abstract Task Graph programming language [1], and is dependent on Contiki operating system and Cooja network simulator. It is capable of compiling application code and deploying it on real WSN nodes. For more information see `http://www.it.uu.se/research/profun/tools`.

We are looking to extend and optimize the capabilities of this tool. The project might take several directions, depending on student's background and type of the thesis. Combined approaches are also possible.

Direction 1: constraint programming optimizations for task allocation [2]. For example, exploiting symmetries in application's task graph, development of useful search heuristics, or comparison of different state space search strategies.

Requirements: basic theoretical knowledge of constraint programming and familiarity with a state-of-the-art constraint solver (such as Gecode). Basic C++ knowledge required. Sensornet knowledge desired, but is not critical.

Direction 2: extensions of the functionality of the tool that would allow to model and take into account more aspects of wireless sensor network environment. Some examples:

- adding sensor area coverage or radio area coverage models, and using these models in task allocation to make guarantees on network's coverage;
- adding realistic energy usage and battery lifetime models – and using them to make guarantees on network's lifetime;
- adding mobility model.

Requirements: Python and C hacking skills; SciPy knowledge very helpful. Experience with model fitting techniques / regression analysis. Familiarity with internals of Contiki desired.

Direction 3: Evaluation of the tool by using it for application development and/or measuring application performance. Steps: (1) selection of a practically relevant application; (2) requirement collection; (3) model development and implementation; (4) experimental evaluation.

Requirements: C and Python hacking skills, interest in experiment design and measurement-based research.

We are going to provide an indoor WSN testbed with around 20 nodes in Polacksbacken.

References:

1. A. Pathak and V.K. Prasanna. High-level application development for sensor networks: Data-driven approach. In: *Theoretical Aspects of Distributed Computing in Sensor Networks*, pp. 865-891

2. F. Hassani *et al.* A constraint programming approach for managing end-to-end requirements in sensor network macroprogramming. SENSORNETS, 2014

Contacts:

Dr. Atis Elsts, room 1352 ITC Polacksbacken: `atis.elsts@it.uu.se`
`http://user.it.uu.se/~atiel485/`