EECS 369 – Introduction to Sensor Networks

Department of Electrical Engineering and Computer Science

Fall 2012

Instructors (this is a jointly taught course)

Peter Scheuermann Office: Tech L452 Telephone: 847-491-7141 e-mail: peters@eecs.northwestern.edu Office hours: TBA	Goce Trajcevski Office: Tech L360 Telephone: 491-7069 e-mail: goce@eecs.northwestern.edu Office hours: Mon.3-4PM, Thu. 2-3PM

REQUIRED TEXT: : I. Akyildiz and M. Can Vuran, *Wireless Sensor Networks*, Wiley, Sept. 2010

REFERENCE TEXTS:

1. F. Zhao and L. Guibas, *Wireless Sensor Networks: An Information Processing Approach,* Morgan Kaufman, 2004.
2. W. Stallings, *Wireless Communications and Networks*, 2nd Edition, Prentice Hall, 2005.
3. I. Stojmenovic (editor**)** *Handbook of Sensor Networks: Algorithms and Architectures,* John Wiley and Sons, 2005.
4. P. Lewis and D. Gay *TinyOS Programming*. Cambridge Pub.s 2009

(Copies will be available under "Reserve" in the Engineering Library).

COURSE OBJECTIVES: This course will provide coverage of the basic hardware and software platforms for sensor networks and will address in detail several algorithmic techniques for data routing, query processing, and topology management. The students will get a hands-on experience through programming projects involving TinyOS or MantisOS, running on Telos/MicaZ platforms. In addition, a number of prototype systems, such as TinyDB will be studied, in the context of various application domains of sensor networks.

PREREQUISITES BY COURSES: EECS 343 or EECS 340 (or permission from the instructors).

DETAILED COURSE TOPICS:

1.Introduction/Applications	• Application domains of sensor networks. • Enabling technologies: hardware/software platforms. • Performance metrics.
2. Communication Model	• Wireless sensor architecture and protocol stack. • Basics of RF communication and the role of MAC. • Popular protocols (802.11, 802.15, Bluetooth).
3. Localization and Coverage	• Global location (GPS-based) and relative location (Beacon-based). • Localization methods: anchor-free, anchor-based, range-free, range-based. • Timing/synchronization • Coverage and connectivity: properties and quality aspects.
4. Routing	• Data centric-protocols: gossiping, rumor routing, directed

	diffusion. • Hierarchical protocols: LEACH. • Location-based (Geographical) protocols and energy-aware routing: GPSR, geometric spanners, distributed topology routing (PRADA). • Multipath-routing
5. Query Processing in Sensor Networks	• Fundamentals of query approaches: push vs. pull based processing. • Review of SQL. • In-network processing and aggregation: TinyDB and TAG. • Statistical approaches to computing aggregates: quantile-digest. • Robust aggregation: ODI synopses.
6. Mobility and Tracking	• Tracking with Binary Sensors Distributed trajectory tracking and data reduction Selection of tracking principals.
7. RFID Systems	Tag identification protocols Reader anti-collision algorithms In-door localization with RFIDs
8. "Potpourri" Topics	• Sensing and SmartPhones • Security in WSN. • Real-time query scheduling • Integrating event-streams with signal processing operations

WORKLOAD and EVALUATION[1]:

- **Programming Projects: (40-45%)** The first programming assignment will involve programming in nesC for the purpose of basic tasks being executed on actual TelosB motes under TinyOS. The second (and third) assignments will require an implementation of routing and/or network aggregation techniques, for the purpose of practicing a (elementary form of) collaboration in WSN.
- **Midterm (30%):**
- **Presentation of technical paper(s) and preparing written summaries (20%):** Papers from relevant recent conferences and journals addressing contemporary aspects related to the topics presented in the class/lectures. These presentations will take place in the last two/three weeks of the course.
- **Class participation (10%):** Students will be expected to read the papers covered in the last two weeks of class and participate in the discussions following the presentations. They will also have to submit concise write-ups summarizing the pros and cons of the (most, of the) papers presented during the student-presentation-session.

[1] Note that some minor variations are possible as the class evolves – however, they will be announced within a proper time-frame. Specifically, there may be an "extra" programming project that will lean more towards the specifics of a particular application scenario and/or platform, and another option is programming Android phones for applications involving sensing functionalities.

AFTER COMPLETING THE COURSE: the students should have a thorough understanding of the different issues involved in the information management in wireless sensor networks, and be comfortable with programming motes for actual applications.