New Course Proposal
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Course Number: CIS 4XX
Course Title: Wireless Sensor Networks
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Planned Offering:
Fall/Winter

Credits: 3 Hours (Lecture)

Program of Study: BS CIS
Level of Course: Undergraduate
Type of Course: Elective

Need for this Course:
Wireless sensor networks have received significant attention because of their important role and many conveniences in our lives. They have become cost-effective and more popular as a viable solution to a wide range of civilian, natural, and military applications, such as health and environmental monitoring, seism monitoring, and battlefields surveillance. This new course complements the existing courses in networking, namely CIS 427 and CIS 437, which are part of the curriculum and are being offered by our Department of Computer and Information Science at the University of Michigan-Dearborn. This course gives undergraduate students exposure to this new networking technology and enables them acquire knowledge and expertise in this area. This will definitely help them have diversity of background, experience, interests, perspective, thinking, and skills to integrate any institution/company in a very competitive job market. More importantly, this new course will offer our Department of Computer and Information Science as well as the University of Michigan-Dearborn a better exposure through our graduated students hiring. In particular, offering this course targets attracting new students to our majors, thus recruiting them to our department and increasing the enrollment rate in our undergraduate programs. Furthermore, this new course provides undergraduate students with an opportunity to gain hands-on experience in this hot area of networking, thus assisting the faculty with establishing his research lab in wireless sensor networks. This helps enhance the curricular offerings of our department, thus promoting it teaching-wise and research-wise and making it stronger.
Catalog Description: This is an introductory course that provides undergraduate students with an overview of wireless sensor networks and the challenging issues related to their design and implementation. It introduces state-of-the-art and present recent advances in wireless sensor networking, helps understand challenging problems in designing and deploying resource-limited sensor networks, and provides gain hands-on experience on the sensors and how to use them in the design and implementation of wireless sensor networks for real-world sensing applications. Students work in teams to design and implement their projects for real-life sensing applications. Students may also (if they wish) write survey papers on one of the topics related to wireless sensor networks.

Objective: Wireless sensor networks have merged as a new promising technology that consists of a new type of computing machines dedicated to run a variety of applications. Specifically, a wireless sensor network consists of a large number of tiny, low-powered devices, called sensors, which possess scarce resources, such as battery power (or energy), computation, communication, sensing, and storage capabilities, with energy being the most crucial one. Moreover, sensors are commonly battery-powered and hence have limited lifetime and are unreliable.

This course aims at providing the students with a thorough understanding of this new networking technology along with its constraints. Precisely, this course covers a wide range of topics, such as sensor deployment, sensing coverage, network connectivity, topology control, medium access control, data routing and dissemination, localization, architecture and protocol design, and real-world sensing applications.

The objectives of this course are three-fold:

- First, it introduces state-of-the-art and state-of-the-practice of this exciting still evolving networking technology to students interested in background material on this new technology as well as those interested in pursuing fundamental research in this area.

- Second, it helps students understand challenging problems in designing and deploying resource-limited sensor networks. In particular, this course assists students and introduces them to the area of research in wireless sensor networks through independent reading, group discussions, and recent research papers critics and presentations.

- Third, it enables students gain hands-on experience on the sensors, such MICAZ motes and Sunspot sensors, to implement simple yet challenging sensing applications, such as temperature/sound/light monitoring, using a real sensor testbed. Moreover, this experience helps students evaluate wireless sensor network protocols by using existing network simulators and through a series of experiments using off-the-shelf sensors, thus gaining a deeper and better understanding of wireless sensor networks. Students work in teams in the design and implementation of their sensing applications.

This course has lecture sessions.

Prerequisites: CIS 427 (or consent of instructor).


Recommended References:


**Reading List:**


**Online Resources:**


Outline:

Week 1  Course description: Schedule, presentations, projects, evaluation
Introduction: Overview of wireless sensor networks, driving applications, fundamental issues, technology constraints and major operational challenges, collaborative and cooperative behavior

Week 2  Sensor network applications and case studies: Real-world sensing applications, habitat monitoring, health monitoring, body sensor networks, seism monitoring, battlefields surveillance, environment monitoring and forecasting systems
Projects/Papers selection and assignment

Week 3  MAC and transport: Medium access control, transport
Class project and survey paper discussion

Week 4  Network deployment and configuration I: Sensor deployment, network connectivity, sensing coverage, connected coverage

Week 5  Network deployment and configuration II: Fault-tolerance, sensing k-coverage, scenarios, connected k-coverage, mobile k-coverage

Week 6  Network deployment and configuration III: Topology control, power management, sensor sleep-wake-up and scheduling, scheduling for k-coverage

Week 7  Sensor communication and collaboration I: Routing and data dissemination

Week 8  Sensor communication and collaboration II: Clustering, cluster election

Week 9  Sensor communication and collaboration II: Quality-of-Service (QoS) Routing and data dissemination, mobile routing

Week 10  Data centricity and in-network processing: Directed diffusion, aggregation

Week 11  Information management: Sensor database, storage, querying, publish/subscribe

Week 12  Localization and tracking: Sensor localization, single target tracking, multiple target tracking, potential scenarios and applications

Week 13  Network programming: Hardware platform, software tools, NesC programming language, TinyOS operating system, LabView, TinyDB

Week 14  Security and integration: Sensor network security, integration of wireless sensor networks and the Internet, scenarios

Week 15  Project/ Survey paper presentation

Week 16  Project/ Survey paper presentation
Course evaluation

Grading:

Homework and Presentations 40%
Discussion and Participation 10%
Implementation Project/Survey Paper 50%
Academic Integrity: The University of Michigan-Dearborn values academic honesty and integrity. Each student has a responsibility to understand, accept, and comply with the University's standards of academic conduct as set forth by the Code of Academic Conduct, as well as policies established by the schools and colleges. Cheating, collusion, misconduct, fabrication, and plagiarism are considered serious offenses. Violations will not be tolerated and may result in penalties up to and including expulsion from the University.

Mobile Phones and Beepers: No Student shall have active mobile phones or beepers while class is in session unless authorized by the instructor.

Departmental Attendance: All students shall attend classes as scheduled unless otherwise authorized by the instructor.

Disability: If you have any concerns regarding a physical, psychological and/or learning disability that may have an impact upon your performance in this course, appropriate accommodations can be made on an individual, as-needed basis after the needs, circumstances and documentation have been evaluated by the appropriate office on campus. The Disability Resource Services can be contacted at phone number (313) 593-5430 or email counseling@umd.umich.edu. Please see their website: http://www.umd.umich.edu/cs_disability/ All disabilities-related information will be kept confidential.