COURSE DESCRIPTION

The theoretical component of this course is designed to expose the students to the concepts underlying the design of robust and secure heterogeneous wireless networking of mobile robots (i.e., Internetworking, Security, Wireless Communication, Embedded Development, Mobile Phones Platforms). The course is mostly laboratory oriented with the goal of designing, and building rescue-mission oriented heterogeneous wireless systems operating in adversarial environments.

The class will be organized into small teams of 4 students. Each team will be provided with some equipment, and a small budget to extend its system. Each system will consist of three mobile robots based on "monster trucks" and/or "robosapien" (http://www.robosapienonline.com/) or other of the shelf robot kits (e.g., http://www.roboticsconnection.com), a low-power control and sensing embedded system (designed by the teams with the guidance of the instructor), and a low-power digital radio frequency communication network. The embedded system will most probably consist of Texas Instruments' MSP430 ultra low-power micro-controller and Chipcon 2.4GHz transceivers (ZigBee compliant). The teams will also make use of a coordination unit connected to the internet and capable of communicating with the mobile robots. The course will culminate in a competition, where each team has to find and rescue an "object" that is hidden within the competition perimeter and might be located under some rubble. The object is what we call an RF-Egg or Ultrasound-Egg depending on the technology used to localize it. One robot does not have the capability to succeed in the mission alone, but needs the co-operation of at least another robot. For example the range of the radio interface will not allow single-hop communication from the coordination unit to the object to be rescued. Each team is allowed to jam the communication of the other teams (at the expense of depleting its batteries), or carry other physical or cyber denial of service attacks. During the competition the teams can only interact with the robots through a smart phone cell phone. The team members can establish data connections using the Bluetooth/GPRS/EDGE cellular network to their internetworked central node. The central node will process the inputs to help coordinate the mobile nodes actions and securely relay it over the sensor network to the mobile robots.

COURSE SCHEDULE

Week 1 (1/9):

1. Lecture (Tue.): course description, teams creation, schedule description, handoff equipment, tools presentation.
2. Lecture (Fri.): overview of embedded development on *moteiv* sensor nodes, demo of a blinking LED.
3. Assignments due: NONE.

Week 2 (1/16):

1. Lecture: Networking Fundamentals.
2. Lecture: Networking Fundamentals.

3. Assignments due (5%): teams, development environment setup, and simple application demos.

Week 3 (1/23):
1. Lecture: Networking Fundamentals.
2. Lecture: Networking Fundamentals.
3. Assignments due (10%): echo w/ blinking on motes.

Week 4 (1/30):
1. Lecture: Wireless Networks [LAN/PAN/SENSOR].
2. Lecture: Wireless Networks [Cellular].
3. Assignments due: NONE.

Week 5 (2/6):
1. Lecture: Cryptography.
2. Lecture: Cryptography.
3. Assignments due (15%): Bluetooth enumeration of devices/services, and RFCOMM chat application [sync/asynchronous].

Week 6 (2/13):
1. Lecture: Cryptography.
2. Lecture: Cryptography.
3. Assignments due: NONE.

Week 7 (2/20):
1. Lecture: Network Security.
2. Lecture: Network Security.
3. Assignments due: NONE.

Week 8 (2/27):
1. Lecture: Network Security.
2. Lecture: Network Security + Wireless DoS.
3. Assignments due (15%): remote control of robosapien from a cellphone.

Week 9 (3/6): SPRING BREAK – no class

Week 10 (3/13):
1. Students' presentations: teams design – communication/defense/discussion.
2. Demos of system + selection of reading/study topics (e.g., energy efficient sensor nets, localization, security of wireless communication).
3. Assignments due: NONE.

Week 11 (3/20):
1. Pre-competition [no inter-teams attacks].
2. Pre-competition [w/ attacks].
3. Assignments due: NONE.

Week 12 (3/20):

1. Students' presentations: what happened during the competition? How the design should be modified? Each member of the team should present one aspect e.g., improving Bluetooth, mobility/communication coordination, security, energy efficiency, localization.
2. Lecture: continued [10%].
3. Assignments due: NONE.

Week 13 (3/27):

1. Presentation of reading results [reverse order of previous presentation of teams]
2. Presentations continued [10%].
3. Assignments due: NONE.

Week 14 (4/3):

1. Research talk: Secure & Robust Heterogeneous Wireless Communication
2. Invited talk?
3. Assignments due: NONE.

Week 15 (4/10):

1. Final competition [no attacks].
2. Final competition [w/ attacks] (15%).
3. Assignments due: NONE.

Week 16 (4/17): [only one class]

No final: submit your final report (20%) by email.

ASSIGNMENTS SCHEDULE:

1. 1/20 (5%): teams, development environment setup, and simple application demos.
2. 1/27 (10%): echo w/ blinking on motes.
3. 2/10 (15%): Bluetooth enumeration of devices/services, and RFCOMM chat application [sync/asynchronous].
4. 2/24 (15%): remote control of robosapien from a cellphone.
5. Week 3/20 (10%): pre-competition briefing, and design modification.
6. Week 3/27 (10%): reading/study topic presentation.
7. Week 4/3 (15%): competition.
8. 4/21 (20%): final report.

Assignments are due on Friday after class. Each team should allocate some time to provide a demonstration to the teaching Assistant.

Penalties policy:

1. Each team has to demonstrate its results on the due date (Friday) after class to the teaching assistant.
2. A second chance is given on the following Tuesday after class. The resulting penalty is a reduction of the grade by 40%.

3. A third chance is given on the Friday following the due date (one week delay). The resulting penalty is a reduction of the grade by 70%.