

Sociable Objects
Summer 2008
NYU, Tisch School of the Arts
Interactive Telecommunications
Program

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<http://rob.faludi.com/classes/sociableobjects>

Course Description:

Sociable objects are devices that share. They can talk to each other, gain information about their context and react accordingly. Recent advances in wireless mesh networks have created the potential for a massively interconnected world of easy information sharing. Cheap communications, high reliability, unique addressing, small size, standardization, and routing features combine to enable exciting new interactions. Developers of toys, wearables, performance devices, portables, network objects and sensor arrays can take advantage of radio mesh networking to design more interesting, better informed and more complex behaviors for their projects. This course explores devices that connect with and respond to each other. The technical focus will be on 802.15.4/ZigBee wireless mesh networks. Interconnections with other platforms and devices will be examined as appropriate. Students will gain an expertise in all functions of the ZigBee system to facilitate smart and novel behaviors in their projects. Through a series of weekly exercises, students will build skills and explore the challenges and delights of mutual connectivity. As a final project, the class will construct dynamic device networks. Prior experience with basic electronics and physical computing is helpful, but not required. Most labs and projects involve group work, so students should be ready to collaborate extensively as they experiment on the cutting edge of device interaction.

Goals:

Students will learn technical skills in wireless networking, programming and serial communication. They will gain a deeper understanding of how collaboration can enrich information in devices and enhance creativity in people. Assigned projects will explore networking, collaborative efforts and the sharing of data and behaviors between disparate systems.

Class Schedule:

1. Intro and overview: introduction, introductions, overview & syllabus review, math for mesh.
2. Basics and Background: Network types and topographies, survey of radio communications technologies, terminal programs, 802.15.4 vs ZigBee.
3. XBee Configuration: Breakout board soldering, XBee software features, setup sample send/receive code, basic AT commands, remotely glowing the LED. Assignment Due: Find & Fix
4. Serial Communications: Buffers, handshakes. protocols: code and considerations for call/response, broadcast, polling. Firmware uploads.
5. Protocols & Libraries: Input & Gateways: Coding protocols, hardware and software serial on Arduino. Assignment Due: Glow The LED
6. Direct sensing: Types of networks, I/O commands, API.
7. Mesh Networking: Full ZigBee using XBee Series 2. Assignment Due: Rock Paper Scissors
8. A Bunch of Stuff: Direct, indirect, subtext. Gateways to the Internet, TCP/IP, HTTP, Daytime, Ranging with RSSI and output strength.
9. Everything Everywhere: GM862 mobile networking. Advanced AT commands. Sleeping the XBee. Assignment Due: Sensor Network
10. Production workshop with technical review
11. Production workshop with conceptual review
12. Final Presentations

Assignments:

Find & Fix: a one-week assignment: find a small problem in the ITP space and produce a physical computing solution. Don't take anything for granted. Everything can be improved in some way and the point of this exercise is two-fold. The first is to get me familiar with your current physical computing skills and the second is for you to begin the process of viewing everything as malleable. Think small and move quickly, it's only a week-long warm-up assignment. I don't want

you to dynamically show me the relative distribution of IQ in the ITP space. I'd prefer to know if we're running low on staples, prototype a method for turning a gallery project off at night or wake up someone who's been sleeping on the red couch too long. Try to use some programming in your solution. Don't make anything networked yet and have as much fun as you possibly can. This is the only assignment that you'll work on alone so savor your last moments of solitude.

Glow That LED: Set up a two-way wireless LED glower, using your new XBee radios as the communications link. Everyone should make their own but it is fine to work in groups on this project. Make sure you understand the programming, electronics and configuration well. It will form the basis for everything that follows. Ask plenty of questions!

Rock Paper Scissors: work in pairs to create two devices that play Rock, Paper Scissors <http://en.wikipedia.org/wiki/Rock,_Paper,_Scissors> with each other using a paired radio connection. Each group should try to develop their own code from scratch. We'll pair strong programmers with weaker programmers. I'd like the weaker programmer to write the code, with help from the better one. This may take longer, but both should try to learn as much as possible from the process. You'll need a way to choose your bet, indicate that bet, transmit it, read the other's bet and calculate whether you've won or lost.

Sensor Network: using the ZigBee mode on XBee Series 2 radios, create a simple sensor network. Work in groups of four to create a network of sensors that detect something about the world and generate a data feed. Display your data in a pleasing format if possible, but remember that this is a one-week project that should concentrate more on building the network than on data visualization.

Final Project: work in groups to create a system or device of your choosing. Your creation should use multiple nodes to create a sensing network, display network or complex interaction. This is potentially a challenging assignment in a short period of time so think about what you've learned about collaboration. Don't forget to enjoy yourselves!

Documentation:

- Class tumblr blog: <http://sociableobjects.tumblr.com>
This will also take RSS feeds from flickr, blogs or any other appropriate source.
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Warmups:

Some classes will include a warm-up intended to enhance the collaborative atmosphere.

Grading:

Class participation & attendance 30%
Presentations and assignments 20%
Projects and documentation 30%
Final Project 20%

Workshops:

Because much of the class requires building technical knowledge, workshops will be scheduled outside of class time to as help sessions to better explain tricky concepts or go into greater depth on issues of special interest. Hopefully these will be useful but they are absolutely optional. We'll try to vary the schedule a bit, so that everyone has an opportunity to attend at least some of the workshops.

Office Hours

To Be Announced

Making the Most of It:

For best results, come to class early, participate in discussions, ask lots of questions, offer copious and constructive feedback, stretch yourself and have fun.

READINGS & ASSIGNMENTS

CLASS 1

Introduction and Overview:

- Economist articles:
http://rob.faludi.com/classes/sociableobjects/readings/Economist_Wireless_articles_2007-4-26.pdf

- Weiser, M. *The Computer for the 21st Century*:
<http://www.ubiq.com/hypertext/weiser/SciAmDraft3.html>
There Will Come Soft Rains – Bradbury:
http://rob.faludi.com/classes/sociableobjects/readings/Bradbury_Soft_Rains_1950.pdf

Math and Communication Protocols:

- Binary: <http://www.swansontec.com/sbinary.htm>
- Binary in Pink: <http://www.mathsisfun.com/binary-digits.html>
- Binary Game:
http://forums.cisco.com/CertCom/game/binary_game_page.htm
- Hex Headquarters: <http://www.intuitor.com/hex/index.html>
- Finger Binary: http://en.wikipedia.org/wiki/Finger_binary
- <http://www.intuitor.com/counting/>
- Levity: <http://www.qwantz.com/archive/001038.html>

Assignments: Order XBees, Find & Fix

CLASS 2

- XBee Manual:
http://maxstream.net/hottag/index.php?ht=/products/xbee/manual_xb_oem-rf-modules_802.15.4.pdf
- Tom Igoe's "Making Things Talk", Chapter 6, pages 192-206:
http://rob.faludi.com/classes/sociableobjects/readings/MTT_Chp6_FI_ti04.pdf

CLASS 3

- *The Internet of Things*:
http://rob.faludi.com/classes/sociableobjects/readings/Nature_Everything_Everywhere_2006.pdf
- Vehicle Warning System Trialed:
<http://news.bbc.co.uk/2/hi/technology/6461831.stm>
- 'Smart dust' to explore planets:
<http://news.bbc.co.uk/2/low/science/nature/6566317.stm>

Assignment: Glow That LED

CLASS 4

- Everything, Everywhere:
http://rob.faludi.com/classes/sociableobjects/readings/Nature_Everything_Everywhere_2006.pdf
- Cooperative Artifacts:
http://rob.faludi.com/classes/sociableobjects/readings/Cooperative_Artefacts_2004.pdf
- "How Management Teams Can Have a Good Fight" from HBR:
http://rob.faludi.com/classes/sociableobjects/readings/How_Management_Teams_Can_Have_a_Good_Fight.pdf

CLASS 5

- Tom Igoe's "Making Things Talk", Chapter 7:
http://rob.faludi.com/classes/sociableobjects/readings/MTT_Ch7_F1_ti04.pdf

Assignment: Rock Paper Scissors

CLASS 6

- Zigbee: "Wireless Control that Simply Works":
http://rob.faludi.com/classes/sociableobjects/readings/Zigbee_Wireless_That_Works-ZMDAmerica.pdf
- <http://en.wikipedia.org/wiki/ZigBee>
- <http://www.zigbee.org/en/index.asp>

CLASS 7

- XBee Series 2 Manual: http://maxstream.net/products/xbee-series-2/product-manual_XBee_Series2_OEM_RF-Modules_ZigBee.pdf

Assignment: Sensor Network Project

CLASS 8

- Tinker: A Tool for Designing Data-Centric Sensor Networks, Jeremy Elson, 2006: <http://research.microsoft.com/nec/publications/spot6613-elson.pdf>

Assignment: Start working on your final project ideas

CLASS 9

Assignment: briefly present your final project plan

CLASS 10

CLASS 11

CLASS 12

Presentations