SoTL 2015: Enhancement of Netcentric Computing Course CSCI-470

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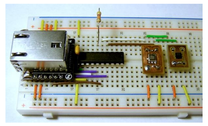
Wired Ethernet Labs

These labs were based on EZNet WIZ5200 Ethernet module controlled byTexas Instruments MSP430G2553 microcontroller. I showed and explained in details the code for implementing both Server and Client applications.

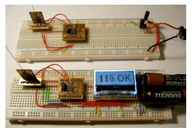
The Server application employed temperature and humidity sensor along with barometric pressure sensor and hosted a web page showing this data. The students were able to connect to the server from the Lab computers and observe dynamically updating data with the help of AJAX technology.

The Client application, in turn, posted temperature, humidity, and pressure data to a Linux server, where it was saved in a database. Both labs are implemented on the following hardware:



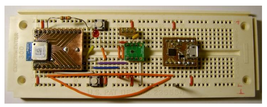
Custom Wireless Protocol Lab

This Lab was based on Silicon Labs Si4461 radios containing a receiver and transmitter in a single chip. Both radios were controlled by ARM Cortex-M3 microcontroller EFM32TG110 from Energy Micro. The students were able to learn how to wirelessly transmit sensor data and display it in on LCD.



Bluetooth Lab I

This Lab was based on Anaren/Broadcom module A20737A containing radio module and a microcontroller in a single chip. We have managed to develop and application for remote light control. Android smartphone application was designed with Anaren Atmosphere Studio. It also works with student's Android and iOS tablets.



Project Description

The goal of this project is to improve student learning outcomes in CSCI470 "Netcentric Computing" course offered in Fall 2015. Specifically, I wanted to provide the students a way to implement various features of networking algorithms in practice by using microcontrollers. This way the course would be even more practice oriented and help the students to understand various networking aspects. This is particularly important for the IoT (Internet of Things) movement which becomes more and more popular in the recent years in terms of new devices on market and job offerings in industry.

Implementation

Initial plan was to develop 5 new labs. I ended up with development of 7 following labs, presented on a top of 10 other (regular) labs in this course.

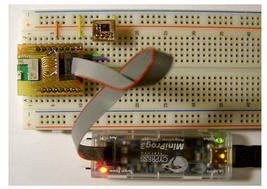
- Two wired Ethernet labs (for Sensor and Client)
- Wireless lab with custom protocol
- Bluetooth lab I (with Anaren A20737A module)
- Bluetooth lab II (with Cypress EzBLE PSoC)
- NFC lab with NXP device
- Multimedia lab with Freescale Kinetis microcontroller

Outcomes

I currently work with 4 students who took this course in FS16 and noticed their noticeably increased professionalism in terms of both networks and microcontroller expertise, compared to the students who took this course before. Some student comments:
"The hands-on labs were definitely more enriching than the Wireshark (regular) course labs."
"The Labs were the most engaging part of this class to me. I feel very lucky to have had the opportunity to experiment with the network technologies that were not mentioned in the book."
"NFC lab was my favorite one … I think I have a good start. Same goes for BLE labs."

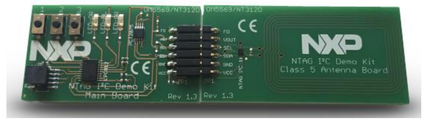
Bluetooth Lab II

In this lab we developed applications on a PSoC (Programmable System on Chip) from Cypress Semiconductor Corp. This chip contains a Cortex-M0 microcontroller that runs BLE (Bluetooth Low Energy) protocol stack along with the user code. We did several experiments with this chip, including implementation of one standard GATT BLE profile. The device listens for incoming connections and transmits back the ambient temperature and humidity data. The microcontroller development was done with PSoC Creator studio. We also used Cypress BLE Pioneer Kit and smartphones as BLE clients.



NFC Lab

NFC stands for Near Field Communication. This feature is provided today by many smartphones on the market and allows, in particular, a close range communication with battery-less devices such as utility sensors, access providers, and consumer electronics. In this lab we used NXB NTAG demo-board for recording into its memory a password and retrieving it with a smartphone along with ambient temperature measurement. The students learned NFC basics and its development trends.



Multimedia Lab

The purpose of this lab was to demonstrate how the speech digitizing and compression works in modern applications. The students compared the compression rate of ADPCM compression with MP3 one and observed the dependency between the sound quality and various sampling rates. Our self-made microcontroller device was able to record an play back speech at 8ksps sampling rate.