

## **ECE471: Embedded Systems – Final Project**

Updated 26 November 2013

**Due: Thursday, 12 December 2013 (Last day of Class)**

Overview:

- Design an embedded system that does something interesting. This is very open-ended, but some guidelines are below.

Guidelines:

- You may work either alone or in groups of two. If you work in a group your end project will have higher expectations.
- You may use any embedded board or microcontroller for this project. I may not be able to provide a full amount of help though if you use something other than a Gumstix or Raspberry Pi.
- You may use any programming language you like, but again if it's not in C or Assembler I might not be able to provide a full range of help.
- Your board will have to take input from a user, and display some manner of output. Both of these need to go through one of the low-level hardware interfaces discussed in class (i2c, SPI, 1-wire, GPIO, USB, A/D, PWM, audio in/out, HDMI, etc.)

### **Part 1: Topic Selection** (due 18 November 2013)

Each group should send a brief e-mail describing your project topic and listing group members.

### **Part 2: Progress Report** (due 3 December 2013)

A brief status update detailing progress your group has made.

- One paragraph describing your project. Mention the embedded board being used, the input/output being planned, and what programming language you are using.
- One paragraph describing the current status of the project. Have you successfully read from the input devices? Have you successfully written to the output devices? Are you on track to finish on time?
- You can submit the status update by e-mail. Only one submission is needed per group.

### **Part 3: Final Submission**

#### **1. In-class Presentation, 12 December 2013**

- You will have 15 minutes to present. Plan for 10 minutes of showing off the device and presenting plus 5 minutes for questions.
- You may present slides using the projector if you want, but that's not strictly necessary.
- Explain what your device does, how it works, how it is programmed, any issues you had with the implementation, any future work, etc. Basically summarize the material in your final writeup.

## 2. **Project Writeup**, Due 13 December 2013

This will be a short paper (6 pages?) that must contain all of the following:

- Introduction: What the device is and high level overview of what it does.
- Embedded Board Description: Describe the hardware, CPU (architecture, type, speed), RAM, and I/O. Also describe the operating system or other software (kernel version, etc.)
- Input device description: Describe the device you are interfacing with, how you access it in software, and document the protocol you use to communicate with it.
- Output Device description: same as for the input device.
- Programming Language: Which one did you use? Why? Briefly explain the tradeoffs between the language you chose and doing the same in assembly language. (If your project is in assembly language, the explain the tradeoffs versus C).
- Real Time: Does your device have real time constraints? What would happen if your code encountered an unexpectedly large delay?
- Security: Describe any computer security issues there might be with your device (can it be exploited?) If you say there are no security issues, make sure you explain why.
- Power Consumption: Explain any energy or power concerns with your application, and how you could optimize it to use less power.
- If you worked in a group: List who worked on what part.
- Future Work: List any improvements you might make if you had more time and resources to work on the project.
- The source code (this can be submitted as a separate file, does not have to be included in the report).
- **OPTIONAL** Make a short web-site or youtube video describing your project. Get it posted on an embedded projects website ([hackaday.com](http://hackaday.com) or similar). No extra points for this, just bragging rights.

You can e-mail your final report to me. pdf or word document is fine, the code can be attached too.

### Hardware Ideas:

- The LED display and Temperature sensor from HW#3 and HW#4
- i2c 8x8 LED grid (three available)
- i2c Temp/Altitude sensor (one available)
- i2c GPS (maybe available)
- i2c Light sensor (one available)
- i2c color sensor (one available)
- A/D distance sensor (one available)
- Other hardware you can obtain on your own. Some ideas:

- USB keyboard/mouse/disk
- Interface to SD card over SPI?
- Devices hooked to GPIOs (LEDs ? Motors?)
- USB web-cam
- i2c Wii Nunchuck
- Bluetooth devices

#### Project Ideas:

- Alarm Clock: set time with buttons, play wakeup sound/music over audio out
- Wii nunchuck (i2c accelerometer). Show orientation on LED display? Make a simple game? Log acceleration to disk?
- Temperature Display that remembers high/low temperatures
- Audio in on the sound input of Gumstix driving some sort of audio visualization on LED display
- Some sort of video game utilizing LED display
- Using the touchscreen/display of the Palo43 board in your Gumstix kit (may be difficult)
- Using the wireless or Bluetooth on the Gumstix in an interesting way?