UMass Lowell 16.480/552 Microprocessor Design II and Embedded Systems

Revision: 10/21/2017

Lab 3: Building Linux Kernel and Controlling an I^{2}C Device
Due Date: See the course syllabus and Piazza announcements.

Objectives:

- Understand I^{2}C bus protocol
- Be able to control an I^{2}C device using Linux on a Galileo board
- Be able to capture, store and process camera images on Linux

Description:
You should now have a working sensor device interfaced with the Galileo development board via GPIO ports. We would like to add a couple of new devices to the system so that your embedded system has richer functions. The devices are as follows:

(1) **(Undergrad Teams only)** A temperature sensor (TMP102). This is an I^{2}C device that measures ambient temperature to a resolution of 0.0625°C. The IC is provided on a breakout board for easy connection. Its details can be found in **[2]**.

(2) **(Grad Teams only)** A gesture sensor (APDS9960). This is an I^{2}C device that supports gesture detection, proximity detection and many advanced features. The IC is also provided on a breakout board for easy connection. Its details can be found in **[3]**.
{Required only for teams recruited by students in EECE.5520}

(3) A USB webcam to capture images and videos

This lab consists of three objectives:
(1) programming I^{2}C devices from Linux. You will use the same Galileo Linux image as Lab 2 to boot and operate your Galileo board in order to program the I^{2}C devices using Linux I^{2}C libraries and APIs. **Note: The gesture sensor is required only for students in EECE.5520.**

(2) programming on Linux to access and handle the provided webcam and capture images. Store the images on the SD card and prepare for further processing (in lab 4).

(3) use temperature sensor or gesture sensor to trigger the capture of images from webcam. You need to define a threshold and check if the sensor data exceed the threshold. If so, capture images and save them to the file system.

Connecting I^2C devices to Galileo

Refer to datasheets for the schematic. Your I^2C devices should be connected to A4 (SDA) and A5 (SCL) of Galileo's expansion I/O ports.

You **do not have** to wire the pull-up resistors or enable pull-up resistors on Galileo Board for the I^2C bus since the sensor breakout boards already have them.

Programming I^2C Devices from Linux

Linux has mature I^2C drivers and libraries for programming I2C devices. Please refer to the official documentation on I2C development:
`https://www.kernel.org/doc/Documentation/i2c/dev-interface`

There are also other related tutorials, for example:
`http://blog.chrysocome.net/2013/03/programming-i2c.html`

Programming webcam and connecting Wifi on Linux

Instructions are provided in a text file as a part of the github repo:
https://github.com/yanluo-uml/micro2/

Deliverables

A zipped file containing:

1. Schematic of the design (in png/jpg/pdf format)
2. Source code (for Galileo Board) written in C/C++
3. Lab Reports in PDF format (All the team members' Lab Reports)

Zip filename should be in the following format: "GroupXX_LAB3.zip"
(XX is the group number, for more details see at the Github posted Micro2_Lab_Introduction_version_4.pdf presentation and Piazza related announcements)

References

[1] Linux I^2C library documentation,
`https://www.kernel.org/doc/Documentation/i2c/dev-interface`
[2] Temperature sensor, `https://www.sparkfun.com/products/11931`
[3] Gesture sensor, `https://www.sparkfun.com/products/12787`