UMass Lowell 16.480/552 Microprocessor Design II and Embedded Systems

Revision: 03/2/2018

Lab 3: Building Linux Kernel and Controlling an I^{2}C Device
Due Date: See the course schedule web page.

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. 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 [3].

2. A USB webcam to capture images

This lab consists of three objectives:

(1) programming I2C 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 I2C devices using Linux I2C libraries and APIs.

(2) use temperature 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.

(3) programming on Linux to access and handle the provided webcam and capture images. Store the images in the SD card.

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. For Galileo Gen 2 "gpio60" is the MUX GPIO that should be LOW.
(Refer to the Galileo Gen2 Linux GPIO pin map: *https://communities.intel.com/thread/55920* , or check GitHub folder "Lab2").

You **do not have** to wire the pull-up resistors for the I^2C bus since the 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`

Further instructions are given in a text file as a part of the Github repo:
https://github.com/yanluo-uml/micro2/

Deliverables: *(Detailed instructions about soft-copies and Hard-copies are noted in "Micro2_Lab_Introduction_version.pdf" which is posted on GitHub repo)*

A zipped file containing:

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

Zip file should have the following format: "LAB3_GroupXX.zip" (XX is the group number)

References

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