UMass Lowell 16.480/552 Microprocessor Design II and Embedded Systems

Lab 4: Multithreaded Programming and Image Processing

Due Date: See the course schedule web page.

Objectives

- Learn how to design multithreaded programs for embedded multicore systems
- Understand the principles of synchronization and mutual exclusion
- Learn POSIX thread libraries.
- Learn HTTP protocol and libcurl library
- Understand image processing concepts
- Implement image processing functions

Description

You should by now have an embedded system with a variety of sensor devices such as light intensity, temperature, and images. In this lab, you are tasked to send these data to a web server. You will need to design a multithreaded software program that communicates with both the sensor and a web server.

Your program should meet the following requirements:

1. Use at least three threads to perform the following tasks respectively
   (a) User command interface: this thread allows for local user commands such as resetting the sensor, checking status, setting up interrupts and reading ADC values. This thread also facilitates debugging the program;
   (b) Sensor control: this thread is responsible for sending commands to the sensor and obtaining sensor responses. This thread also needs to check the sensor's status periodically and report its status to a web server (provided by the instructor);
   (c) Communication: this thread communicates with the provided web server using HTTP protocol and *libcurl* library. The web based communication protocol is defined in Section 2.
   (d) For EECE.5520 students only: Image processing using OpenCV library. Identify human faces and send only the images with a human face to the web server.

2. The sensor application (more specifically the communication thread) reports sensor status and data using HTTP POST method. That is, the senor application use the following URL to supply status and data:

   http://servername:portnumber/update?id=var_xxxx&password=var_xxxx&name=var_xxxx&data=var_xxxx&status=var_xxxx&timestamp=var_xxxx&filename=var_xxxx

The sensor application must provide the following information as part of the URL request

Id	A unique numerical identifier. To be assigned to each project group
Passwd	A unique password to authenticate the sensor app
Name	The project group name
status	The current status of the sensor as defined in “sensor.h” file
data	An integer value of the ADC value
timestamp	Timestamp
filename	Name of image file

Deliverables

A zipped file containing

1. Source code with comments
2. Reports

References

[1] Posix Thread programming. Available at https://computing.llnl.gov/tutorials/pthreads/
[2] libcurl APIs. Available at http://curl.haxx.se/libcurl/
[3] OpenCV image processing library. http://www.opencv.org/
[4] Intel® VTune Amplifier XE . https://software.intel.com/en-us/intel-vtune-amplifier-xe