Fall 2012 independent study proposal

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**Objectives and Content**

Small single board computers (SBCs) like the Gumstix [1], BeagleBoard [2], Raspberry Pi [3], and others are becoming common. These SBCs are well suited for robotics because they are small, use little power, and at the same time have good performance. Typically these boards run a Linux distribution, which is convenient for development and familiar to most. However, Linux is not designed with the real time requirements of robots in mind. This means that there is no timing guarantee on when user code is run, and so time sensitive tasks (real time controllers, sensor polling, etc) cannot be reliably accomplished.

The objectives of this independent study are:

1. Create a bare-bones non-RTOS Gumstix Linux image for control testing (IE: custom kernel with a minimal tool-chain and minimal background processes)
2. Verify that this is indeed a problem through experimentation with the non-RTOS Gumstix image
3. Research Real Time Operating Systems (RTOS) and find one suitable for the Gumstix SBC
4. Create a working version of said RTOS for the Gumstix
5. Characterize the performance of the RTOS through experimentation (no load jitter, high load jitter) using the non-RTOS linux control results from 1-2.
6. Write a library that enables users to take advantage of the RTOS to write high priority control code without having without having to know the particulars of the RTOS.
7. Write full, complete documentation for using the library, and creating the RTOS and non-RTOS Gumstix boot image.
8. Show that the implemented RTOS works as well as or outperforms existing RTOS systems available for real-time linux.

**Evaluation**

The following table illustrates the grading distribution:

|  |  |
| --- | --- |
| **Grade** | **Objectives Accomplished** |
| C | 1, 2, 3 |
| B | 1,2,3,4 |
| B+ | 1,2,3,4,5 |
| A- | 1,2,3,4,5,6 |
| A | 1,2,3,4,5,6,7 |
| A+ | 1,2,3,4,5,6,7,8 |

**References**

[1] <https://www.gumstix.com/store/index.php?cPath=33>

[2] <http://beagleboard.org/>

[3] <http://www.raspberrypi.org/>