Summer Olin-NASA Research Participation Report

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This summer, I participated in two projects for scientists at Goddard Space Flight Center. In the process, I feel I not only contributed to the development of a tool and potential satellite feature for NASA scientists, but also learned a great deal about software and hardware development, evaluation of electronic systems, communication, and team coordination.

One of the project teams I worked on developed a low-cost multichannel analyzer. These devices, intended to produce x-ray spectrum information from an incoming voltage pulse train, typically cost thousands of dollars. Our mentor at Goddard was interested in an inexpensive analyzer, one he could scatter throughout his laboratory to study the characteristics of x-ray radiation around a beamline. However, these pulses are extremely brief, and capturing them involves analog circuitry I was unfamiliar with. To help develop and interface this circuitry, I had to develop a foundation in some of the causes of electrical noise and how to build high-frequency components – an ongoing process that has taught me a great deal. I primarily worked with the construction of the device's firmware, where I gleaned a great deal about bus (particularly USB) topology and construction. My work also involved creating code for fast USB transfers that had not been implemented previously, and contributed not only to my understanding of drivers but also the future experience of others working with microcontrollers. In addition to the creation of these components, I had to document and describe them extensively so that they could be integrated into our system. This gave me invaluable experience in communicating with team members – and with Keith Gendreau, our mentor. Additional information can be found at http://nasa.ece.olin.edu/projects/2008/mca/.

The second project I engaged in was creation of a solar sensor based around a position-sensitive photodiode. Most satellites use some type of solar sensor to determine their orientation; the devices are inexpensive and accurate. The existing standard technology involves a pinhole camera and digital pixel array. To reduce system complexity and the need for image processing, scientists at Goddard proposed we investigate use of a pinhole camera based on an analog component. In order to evaluate the accuracy and effectiveness of this system, I engaged in extensive background research on sensor technologies, designed and debugged circuitry, and wrote software to analyze the output. In the process, I learned about system design and integration, in addition to finding where possible sources of error in measurement might arrive. In a more recent effort, I wrote over 15 pages of documentation that detailed the test system, our design decisions, and the analytic detail behind the sensor. In the end, we were proud to deliver a product that met its accuracy expectations. The well-encapsulated prototype was the result of continued effort, which also provided continued understanding for me. Documentation for the project can be found at http://nasa.ece.olin.edu/projects/2008/sos/.