



The collaboration on embedded computing between Intel and Texas Tech made possible a number of academic opportunities for students:

- **Texas Tech's first Embedded Systems course, CS4331:** Special Topics in Computer Science – Embedded Systems
- **Undergraduate Independent Study, through CS4000:** Individual Studies in Computer Science
- **Conference Research Poster Presentation, for which four CS 4000 students won an award as Top Poster Presenter**



Intel® Software Academic Program

Texas Tech University, Department of Computer Science

Bringing Embedded Systems into the Computer Science Curriculum

Professor Sunho Lim of Texas Tech University and the Intel® Software Academic Program have a shared vision. Both are dedicated to fostering top-tier expertise in the next generation of computer scientists.

Because embedded computing is increasingly important to the industry as a whole, a collaboration between Dr. Lim and the Intel® Software Academic Program set out to add development for embedded systems to Texas Tech's Computer Science curriculum. Two grants from Intel to Texas Tech formed a vital part of that effort:

- **August 2012 - May 2013:** Sunho Lim (Co-PI), Eunseog Youn (PI), "Modern Embedded Computing and Its Applications" (\$25,000)
- **July 2013 - June 2014:** Sunho Lim (PI), "Embedded Software Development and Debug Tools through Vitalized Project-based Learning" (\$25,000 and Intel® Galileo development boards)

Being awarded these grants provided Professor Lim with funds and equipment to launch the effort in earnest within Texas Tech's Computer Science department. As a result, the department has been training students in the theory and practice of development for embedded systems since spring semester of 2013.

In addition to providing the core development environments, the grants made it possible to obtain devices (such as Bluetooth* and GPS transceivers) and supplies (such as breadboards) that have made the effort as a whole more comprehensive.

A Wealth of Options and Opportunities

The ongoing collaboration between the Intel and Texas Tech has offered Computer Science students a variety of ways to engage with embedded technology. These have ranged from special-topics coursework and independent study opportunities to participation in the university's annual undergraduate research conference.

Coursework in Embedded Systems

In spring 2013 and spring 2014, Texas Tech offered CS4331, "Special Topics in Computer Science – Embedded Systems." In this seminar, 10 or so students are introduced to hardware and software aspects of special-purpose embedded systems.



Work done with the Intel® Galileo development boards at Texas Tech helped build proficiency with a number of supporting technologies, including:

- Embedded programming in C
- Proximity detection
- Arduino*
- GPS
- Bluetooth*

Using embedded C and the Intel® Atom™ processor architecture as the foundation, the course begins by exploring the fundamentals of embedded hardware and software. It then builds on that introduction with tools and techniques for programming embedded applications, including topics such as real-time operation and security for embedded systems and applications.

Hands-On Independent Study

Inspiration struck when Texas Tech received the Grove Starter Kit Plus – Intel® IoT Edition from the Intel Software Academic Program in the spring of 2014. The kits include sensors and a variety of other components to complement Intel Galileo development boards.

Built to power the Internet of Things, Intel Galileo boards house an Intel® Quark™ system-on-chip (SoC), plus memory, I/O, and storage components. The SoC itself packs an execution core, I/O interfaces, clocks, and a voltage regulator into a package just 15 millimeters square.



Flexibility, energy efficiency, and small stature for the Internet of Things.

Students working with Dr. Lim in CS4000, “Individual Studies in Computer Science” made innovative, hands-on use of the IoT developer kits.

- **SMARTx: An Embedded Proximity Detection System for Reducing Collisions** is intended to be carried by pedestrians, bicyclists, or road workers, alerting motorists to their presence by means of a beacon, broadcast to smartphones.
- **Intel Galileo Development Board-Based Embedded Applications** included four distinct Arduino* applications, designed to explore and showcase the capabilities of the Intel Galileo board.

Showcasing the Intel® Galileo Board at a Conference

The CS4000 project described above that combined four Arduino applications was presented at Texas Tech’s 2014 Undergraduate Research Conference. The team of Jacob Crabtree, Matthew Gattis, Nicholas Marler, and Joshua Williams was recognized for the top poster presented at the event.

Conclusion

The collaboration between the Intel® Software Academic Program and Texas Tech empowers the next generation of computer scientists, helping accelerate the emergence of the Internet of Things.

For more information on the Intel Software Academic Program, please visit:

<https://software.intel.com/en-us/academic>

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