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Introducing Students to microware

using ANSI C

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Abstract

Can resent releases of ANSI C compilers provide a more stimulating and productive tools for the learning of the capabilities of embedded systems than is available with the use of Assembler?

We had enquires from a student that had some C++ but no micro controller experience to complete a self-directed elective second year paper, programming micro controllers using C so we took the opportunity to test this often debated question once again. Traditional the School of Information Technology and Electro-engineering at Otago Polytechnic has taught Micro Controller technology with the use of the Assembler Programming Language.

Steaming from existing research programmes, we had already been working with a combination of products that we believed would make a good foundation of such a program. They are the mega128 AVR1 from Atmel, CodeVisionAVR2, and a recently released text, Embedded C Programming and the Atmel AVR3, Barnett4, Cox & O'Cull.

Barnett's text is aimed at the novice. It comprises of five chapters, a C Language Tutorial, introduction to Atmel RISC processors, introduction to CodeVisionAVR simple Project Development and is very readable. The text works through three projects, a slot machine, an engine monitoring system and a weather monitoring station with an outdoor and indoor unit linked by low power radio. It also has a CD, which contains an evaluation copy of CodeVisionAVR, sample code, and data sheets on a range of AVR micro controllers.

We decided on a reduced weather station project (temperature, wind speed and direction as a single unit) as a means of meeting our learning objectives. Our decision was based on the fact that acquiring the peripheral devices used in the text would have been very expensive and that the electrical engineering component was greater than what we required. Also we believed that by deviating from the text our student would need to explore directly the workings of the chosen devices and yet benefit indirectly from the examples given.

The peripheral devices we used where a Mast Head Unit from Navman NZ Ltd and a Dallas DS1820 1-wire digital thermometer. Between the two devices our student was required to count pulses per second, reference voltage readings to lookup tables, use a 1-wire interface and use serial communication from the micro controller, first to a PC then an LCD.

Outcomes

Micro Controllers

Our student has an increased enthusiasm for the micro controller world, which is demonstrated by him already formulating ideas for his third year project. He has worked with the three memory types built to the AVR, flash, RAM and EEEPROM, the ADC, the USART, internal interrupts via the 8 bit and Watch Dog timers, external interrupts and one wire interfaces.

Programming

His understanding of programming languages has been expanded to appreciate that the capabilities of a C command is limited to the hardware platform on which it runs, that sometimes we need to drop to a lower level language if direct hardware control is required and that interrupts, both internal and external can be used to provide a real time and event driven procedures. He has also been required to devise algorithms that translate sine / cosine ordinal voltage reading into angular degrees and pulses per second into kilometres per hour while taking into account the limitations of the hardware and environmental considerations.

Conclusion

For our student this was a very stimulating course of study. He already had C programming skills using the C language, which enabled him to focus on the micro controller environment that was the focus. Without his C skills this could easily be lost. Although C shielded him from needing to work directly with registers he was still required to enable services and define ports, which required a non-trivial understanding of the capabilities and functionality of the AVR. Having a project goal gave an extend sense of purpose to exploring how the micro controller and peripheral devices worked.

References

http://www.atmel.com/dyn/products/datasheets.asp?family_id=607

http://www.hpinfotech.ro/

http://www.amazon.com/exec/obidos/tg/stores/offering/list/-/1401812066/collectible/ref%3Dolp%5Ftab%5Fcollectible/103-4614914-5844660

http://www.tech.purdue.edu/Eet/Facstaff/rhbarnett/index.html