Micro-BLIP: A New Tool for Instrumentation Education

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Introduction: For the past ten years, every bioengineering student in the required undergraduate instrumentation course at the University of Pittsburgh has constructed a custom microprocessor we call the Breadboard Laboratory Interface Processor (BLIP), originally designed by undergraduate David Weiser and Professor George Stetten [1,2]. The BLIP has been programmed to function as a data acquisition system, signal generator, frequency counter, duration timer, digital event logger, and also supplies ±5V power. It has provided over 500 students with the experience of constructing their own instrumentation system, which they take with them after the course. With recent advances in microcontrollers and the growth of the Arduino community, we have decided to update our system to take advantage of these ubiquitous and user-friendly systems. We have therefore redesigned the BLIP to incorporate an Arduino microcontroller board while maintaining the instrumentation functions of the original BLIP, providing a system that is user-programmable and will therefore be more useful after the course.

Materials and Methods: An Arduino "Micro" microcontroller, an MCP4801 D/A converter, and a TC77662A charge pump (Fig. 1) were combined with male and female headers on a custom printed circuit board (PCB), to plug directly into the student's solderless breadboard. The new system, which we call the "Micro-BLIP", appears to a host computer via USB as a human typing on a standard computer keyboard. Thus, the data from the Micro-BLIP will be entered into any word processor or spreadsheet program. No special software is required, and the host computer can be based on any standard operating system.

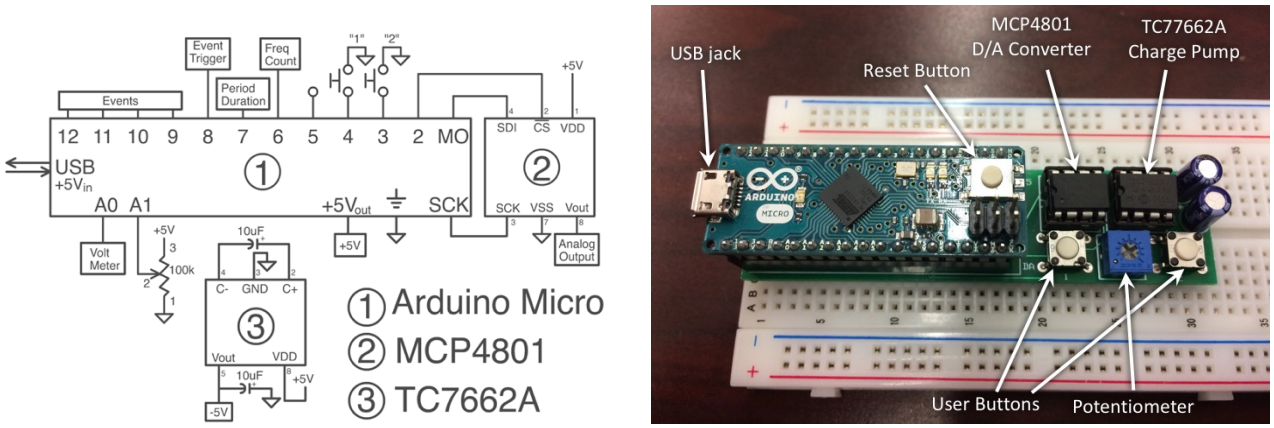

Fig. 1. Schematic of Micro-BLIP and assembled device plugged into a breadboard for use in the teaching laboratory.

Results and Discussion: As opposed to the original BLIP system, in which the custom program was permanently burned into the microcontroller, the Micro-BLIP is now easily reprogrammable by students using the Arduino integrated development environment (IDE). All of the existing Micro interface pins are passed through to the breadboard, where they are available for further development and experimentation. In Spring 2018, we will introduce the Micro-BLIP into the instrumentation course, where approximately ninety students will each be given a set of parts and step by-step instructions detailing how to solder them into the PCB. The Micro-BLIP will then be used to make measurements in weekly experiments involving analog and digital circuits in the laboratory portion of the course, culminating in a carotid artery pulse detector and rate monitor.

Conclusions: Based on our experiences, we expect students to enjoy the hands-on nature of building and using the Micro-BLIP, and that it will contribute a valuable experience to their education. We believe that by teaching students about microcontrollers and providing them with equipment that they will own, we will help to increase their potential for life-long-learning.

Acknowledgements: Funding was provided by the University of Pittsburgh Department of Bioengineering.

References:

[1] G. Stetten, et al., ASEE Conference, 2008; [2] D. Weiser, et al., BMES Annual Fall Meeting, 2005