Extending PCPU: A New, Practical, and Production-Ready Processor Core Written From Scratch

Wegrzyn, Piotr (School: Liceum Ogolnoksztatcace nr XIV im. Polonii Belgijskiej we Wroclawiu)

PCPU is a processor that I created from scratch as my previous work. Besides the processor, I provided a complete toolchain (including C language compiler, assembler, emulator), together creating a full computing system. The objective of this research was to design and implement a completely new, improved processor core that would be practical for use in real-world scenarios and for production, based on the previous PCPU external architecture. The new core is based on pipelined architecture, introduces instruction and data caches, and supports multi-core operation. The processor was implemented in hardware on an FPGA circuit first, after which a design for the production on silicon was created. Support for the new core was included in the existing tools and operating system. A unique characteristic of the project is while being a simple design, it includes features found only in expensive processors, that may be not optimal for use in every project. This includes basic safety features, that are often not available but are especially important, in the processors used in IoT or industrial devices - which project is focusing on. Leveraging the new micro-architecture design, the core performance has been improved over 50 times. The project was proven by extensive verification on multiple levels, and implementation of example use case demonstrations. As the processor and all the necessary tools were created in-house, the project is fully self-contained. With its cost-effectiveness, it is available to a broad range of devices, creating new possibilities which could significantly improve software of control systems.

Awards Won:
Third Award of $1,000