CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

George D. Morgan

Project Number

S0917

Project Title

A Multi-Architectural Approach to the Development of Embedded Hardware: A Second Year Study

Abstract

Objectives/Goals

Last year#s research explored a multi-architectural approach to the development of embedded hardware. While a small portion of the study was dedicated to the fabrication of a software framework to accompany the device itself, many related topics were not thoroughly covered and left many questions unanswered. This study attempts to fill in those gaps and pick up where last year#s left off, starting with the hardware that was designed.

Methods/Materials

While robust in core design, the first hardware prototype developed lacked supporting circuity for adequate voltage regulation, straightforward reprogramming, and expandability. These issues were addressed with the arrival of the second prototype. With new hardware that was easier to work with and debug, a software infrastructure was laboriously crafted. Designed for compatibility across the x86, AVR, and ARM architectures, a universal communications protocol, a filesystem, device drivers, firmware, and a toolchain were meticulously woven together to form an integrated platform that has since become known as Flipper: Carbon Edition.

Results

In conclusion, the hardware fabricated in last year#s project was updated by having a printed circuit board professionally manufactured. The software architecture proposed in last year#s research was realized to it#s fullest potential. Firmware was developed for the device, alongside operating system software for the main processor. Both codebases incorporated the data infrastructure needed to create a dynamic and expandable communications protocol that enables functions to be invoked inter-architecturally. Using two data transmission functions invoked using the proposed architecture, data can be transmitted from a host to the device and a function executed giving the user the illusion that both entities share the same RAM address space.

Conclusions/Discussion

The endeavors of this research were a huge success, and their implications in extending the proposed use-cases of last year#s research are more real than ever. The fabrication done to improve the design and expand the software backend make this multi-architectural approach to the development of embedded hardware a more consumer product than it was last year, preparing it for launch and review by the public.

Summary Statement

I set out to design a development board that would make hardware and software development available to the public so that anyone can learn how to program and make every-day objects come to life.

Help Received

None. All of the work done on this project was my own.