CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

George D. Morgan

Project Number

S1418

Project Title

Efficient Operating System Design and Development for the ARM Architecture

Abstract

Objectives/Goals

The objective of my project was to determine if a mobile operating system could be developed to run on a wide variety of ARM based mobile processors while remaining portable to any new core revision, efficient, consuming minimal power, and keeping a short instruction runtime.

Methods/Materials

~ ARM based development platforms. Platforms of choice: Atmel's SAM7S128 (ARMv7TDMI) ARM based micro controller and Qualcomm's Scorpion with the Snapdragon S1 chipset with QSD8650 (ARMv7TDMI): (found in many HTC phones). Each processor architecture will be emulated and is not specifically mapped during compiling. This ensures that the code will run with the same efficiency level on any revision of the processor. Each of these are just an example of what platform the mobile operating system can be run on.

~ An ARM emulator. Emulator of choice: QEMU, a powerful open source processor emulator that can be adapted to many applications, and used to simulate the execution of ARM code on many processors. Allows the emulation of the generic ARM infrastructure so we can test run the code before it goes onto a platform itself.

~ An ARM development toolchain (complete with an assembler, compiler, linker, and debugging tools). Toolchain of choice: the GNU ARM Toolchain for Linux. Allows the compiling and linking of ARM assembly and C into a binary executable by the generic ARM infrastructure - the basis of emulation with QEMU.

Results

The initialization code developed using static instruction set commands, when compiled, is not only fully backwards compatible with all the previous versions of the ARM architecture, but executable on future revisions of the processor with maximum efficiency. This proves that the initialization code and the various components of the OS written in assembly will be versatile enough to be executed on any member of the ARM family, old or new; this confirms that the operating system will remain universal.

Conclusions/Discussion

By analyzing the variation of different processor core revisions from a couple of ARM family members and by undertaking a series of development procedures that consisted of writing the various parts of a mobile operating system, observing their interaction with each other when linked, and simulating the execution of the OS in its entirety on the basic infrastructure of the chosen architectures, it became clear that it was indeed possible.

Summary Statement

My project is about the development of a basic mobile operating system to accompany the wide variety of ARM processor revisions on the market today while retaining portability and efficiency.

Help Received

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