Grant proposal to the Independent Project/Research Opportunities program

for a project on

Development of A Simple Computer

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Executive Summary

Project based learning is essential due to the multidisciplinary nature of embedded systems[1]. For this reason, it is important to have detailed information available on the design and creation of hardware. The purpose of this project is to create detailed information and documentation on the creation of embedded systems through the creation of an example microcontroller system. This documentation should be able to be used for anyone interested in the design of embedded systems.

From a more technical side the project will consist of three main tasks. The first, will be designing the instruction set architecture and processor, the second is developing the operating system, BIOS, and programs for the device, and the third and most important is ensuring that the design is documented and all design decisions are justified in a clear way.

Project Overview

We are requesting IP/ROP project funding during Spring

We are requesting $321.50

The student will be doing this project for academic credit: ECE498.

This work does not require any lab space.

Detailed Project Description

The project will consist of designing a basic computer that is complex enough to be used as a reference for multiple techniques common to undergraduate computer design courses (multicycle processors, interrupts, kernel user memory separation etc.). The project will involve creating a basic operating system and programs that will run on it. This entire system should be

capable of performing complicated mathematical operations, and will be able to implement basic forms of security.

During each stage, all major design decisions, such as the number of registers, or why particular instruction formats were used should be documented, and will be published at the end. Along with this, all of the verilog source code as well as the source code for programs shall be commented to ensure readability, and explain certain minor design choices. To ensure the processor is functional, a few test programs would need to be made, ensuring the various features and instructions work.

As part of the preparation for this project, the documentation on the Instruction Set Architecture, verilog for the ALU and other components has begun. The goals and timeline seem to be very achievable despite the challenge.

Project Timeline:

Week 3: Have the datapath designed, and verilog modules for each component completed and individually unit tested.

Week 6: Have the processor simulated with tests programs (arithmetic software like euclid's algorithm and input/output signal simulation).

Week 8: Have the electrical work and wiring completed for the processor.

Week 10: Have a functioning BIOS, basic drivers for the PS/2 device and screen completed and tested, and have example programs to run on the device.

Finals Week: Have the project ready to present

Budget

Supplies/Consumables

FPGA	**$280.00**
Breadboard and misc. components	**$39.50**
Breadboard	**$10**
LCD Display	**$15**
Connectors	**$6.50**
SD Memory	**$8**
Total Request	**$319.50**

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Academic References

[1] Akash Kumar et al, *Project-Based Learning in Embedded Systems Education Using an FPGA Platform,* IEEE TRANSACTIONS ON EDUCATION, Vol 56 No. 4 (2013), pp. 407-415. Online

Budgetary References/Links

[1] Reference on Display Price 64128K COG FA BW by Mouser electronics

[2] Reference on FPGA Cost ALINX SoM AC6045: Spartan-6 XC6SLX45 Industrial Grade Module

[3] Simple electronic component costs are based on prices from mouser.com

COVID-19 Feasibility & Adaptability Statement

This project does not have any requirements affected by COVID or the Rose-Ready policies. The only concern is possible supply chain delays caused by COVID slowing the shipment of parts.