

# NES Console Emulator

## ECE 153B Final Project Proposal

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### OVERVIEW

We plan to implement a NES game emulator. This involves writing a virtualized version of a CPU and picture processing unit (PPU) that will run on the microcontroller. We will support loading games via SD card, playing these games with external controllers, and viewing the game on an external display. To do this, data lines from the controller ports will need to be processed and trigger interrupts on the emulated CPU. The video data will need to be converted with a DAC to output VGA. Given extra time, we plan to port our emulation system to a custom PCB running LPC4088 and STM32 microcontrollers.

### PERIPHERALS

- SD card reader
- VGA output
- ADC / DAC
- DMA
- SPI / I2C
- LCD screen
- Game controllers
- External memory
- LEDs

### SOFTWARE DESIGN

First we will implement the entire system in Python. This will serve as a proof-of-concept of our design. After this is achieved, we will port the code to C on a microcontroller development board. If all goes well, we will port the code to our customized PCB board. The system runs as follows:

Boot up the emulated CPU/PPU. The SD reader code will allow the user to choose a game from the SD card. When a game is selected, the parser will convert the game into instructions for the emulated CPU. The CPU will call an update to the PPU 3 times every cycle which will update the display. The controllers will cause emulated interrupts in the system and update the game state. Fortunately, there is an abundance of documentation on the MOS6502 (CPU to be emulated) and NES console operation.

## **GOALS**

1. Design a customized PCB including all the peripherals on the board.
2. Implement the CPU and PPU emulators and test them.
3. Write a parser that reads from the SD card slot and test ROMs.
4. Write the low level drivers for DAC, DMA, LCD, SD card and the IO interrupts.
5. Implement the VGA and LCD displays.
6. Test and debug the system.

## **GROUP RESPONSIBILITIES**

Both of us will work on designing the PCB boards. We will design a motherboard first, and then design modules individually. For the software level, Jeff will be in charge of the implementation of CPU, SD Card, etc. Boning will handle the implementation of PPU and the graphics related drivers, such as VGA and the LCD.