

Project Proposal: Game Boy Emulator

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1 Introduction

The Game Boy and its successor, the Game Boy Color, have sold over 118 million units worldwide to date, ranking 2nd most in sales among handheld game consoles.

This project aims to recreate the video, audio, and control features of the original Game Boy using the DE1-SoC development board. The emulator should ultimately be able to play classic Game Boy games such as *Tetris*, *Pokemon Yellow*, etc. Many teams have attempted similar projects that are well-documented and available online [1, 2, 3]; the goal of this project is to build upon these past efforts and perfect the emulator's functions.

2 Overview

2.1 System

Fig. 1 shows the high-level system diagram of the Game Boy [1]. The CPU will imitate the original Game Boy CPU, the 8-bit Sharp LR35902, which is a hybrid of the Intel 8080 and Zilog Z80. The visual graphics will be passed on to fit the resolution of a monitor via a VGA connector. The user inputs will be a user-configurable set of keys on a keyboard connected to the DE1-SoC. Instead

of a physical game cartridge, the game ROM will be loaded into the system through a ROM file.

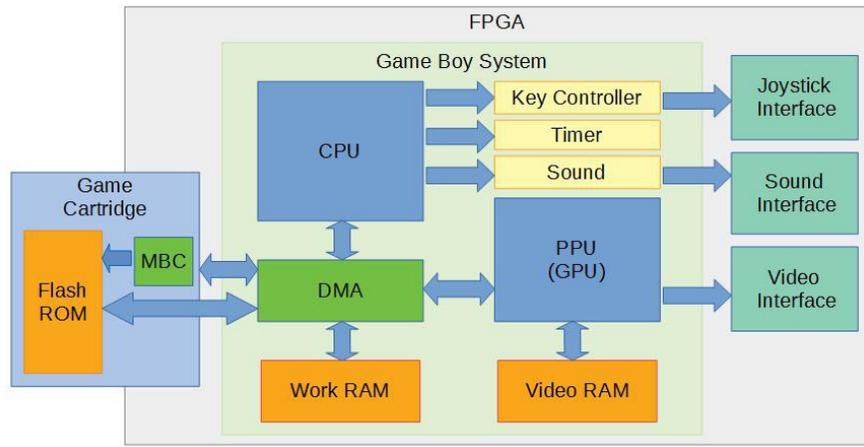


Figure 1: Game Boy system diagram [1]

2.2 Technical Specifications

Table 1 summarizes the technical specifications of the Game Boy.

Specification	Value
CPU	8-bit Sharp LR35902
Clock	4.194304 MHz
Work RAM	8 kiB
Video RAM	8 kiB
Screen Size	2.6 inches (diagonal)
Resolution	160 × 144 pixels (20 × 8 tiles)
Max Sprites	40 per screen, 10 per line
Sprite Sizes	Max 8 × 16 pixels; min 8 × 8 pixels
Color Palette	2-bit (4 shades of grey)
Horizontal Sync	9198 kHz
Vertical Sync	59.73 Hz
Sound	4 channels with stereo sound
Power	DC 6 V; 0.7 W

Table 1: Technical Specifications of Game Boy [4]

3 Milestones

3.1 Milestone 1 (April 5)

Complete the CPU module, DMA module, and input controller.

3.2 Milestone 2 (April 19)

Complete the GPU module and video interface.

3.3 Milestone 3 (May 3)

Complete the audio interface.

References

- [1] zephray, <https://github.com/zephray/VerilogBoy>, Github.
- [2] nightslide7, <https://github.com/nightslide7/Gameboy>, Github.
- [3] trun, <https://github.com/trun/fpgaboy>, Github.
- [4] Game Boy CPU Manual, <http://marc.rawer.de/Gameboy/Docs/GBCPUman.pdf>.