Final Project Proposal

Max Thrun — Samir Silbak

October 26, 2012

Project Title

Sega Game Gear on a Chip (SGGoC)

Problem Statement

As computer systems age it is often impossible to keep physically maintaining them. For many old systems you cannot buy replacement parts and finding people who have the skill to repair the original hardware is difficult. Recently, with the advent of Field Programmable Gate Arrays (FPGAs), it is now possible to completely recreate all the original hardware and reimplement everything in a hardware description language (HDL). The advantages of doing this is that you can replace a huge multi chip solution with a single chip implementation. Doing so also helps future-proof the system as the HDL is portable and standardized. Our project is a case study in the process of reimplementing the Sega Game Gear gaming console, which can be viewed as a specialized computer system, in HDL on a FPGA. From our project we hope to educate and provide people with a case study on the process and implementation strategies that go into recreating these old computer systems.

Project Requirements

The Game Gear hardware requirements can be easily broken down into submodules. Major components include the Zilog Z80 CPU, the Video Display Processor (VDP) which is a modified Texas Instruments TMS9918, the Sega IO controller, and the game cartridge memory mappers. All of these components are considered archaic and are extremely hard to source which makes the Game Gear an ideal system for this project. The reimplementation of the Zilog Z80 is outside the scope of this project and as such we will be using the popular open source TV80 CPU. The other components will be reimplemented from scratch based off both official and third party specifications and descriptions of their operation. A memory management unit will need to be developed to coordinate the addressing of system RAM and the cartridge ROM. The cartridge ROM will need to be initially preloaded on the flash memory chip on our development board. If time allows a proper bootloader may be developed to allow game ROMs to be selected off a SD card. We plan on implementing the submodules in the following order of priority: TV80 CPU, MMU, Sega Cartridge Memory Mapper, VDP, Sega IO Controller, and Audio (YM2413). The metric used to determine if our design satisfies these requirements will simply be the accuracy at which each component reimplements its original functionality. via VGA

Functional Description

Our final implementation will be a fully functioning Sega Game Gear running on an Altera DE-1 FPGA development board. Video output will be to a computer monitor via VGA and input will be through some type of retro gaming controller, such as the Sega Genesis controllers. Any Sega Game Gear ROM which uses the Sega mapper (we do not plan on implementing less common mappers) will be playable. Functional diagrams showing the interaction of the submodules as well the high level interaction with the user is shown on the following pages.

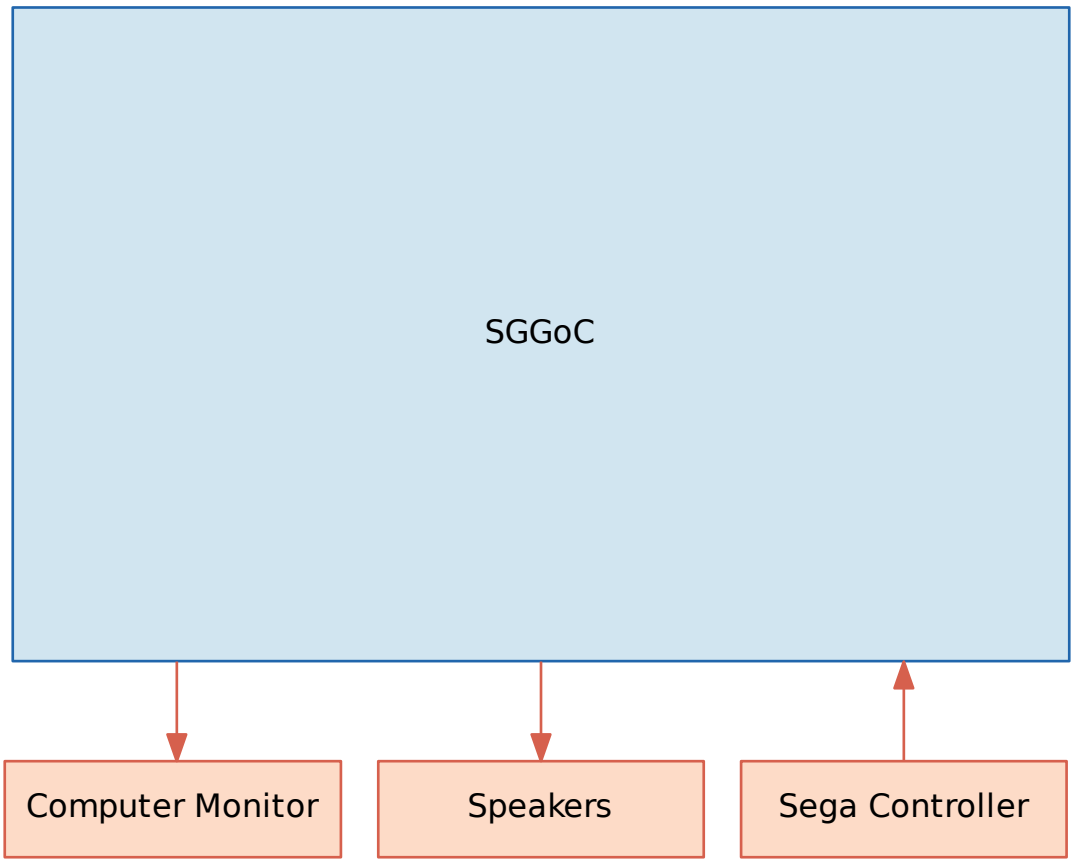
Team Participants

Max Thrun - FPGAs / computer architecture / programming
Samir Silbak - Linux / embedded systems / software development

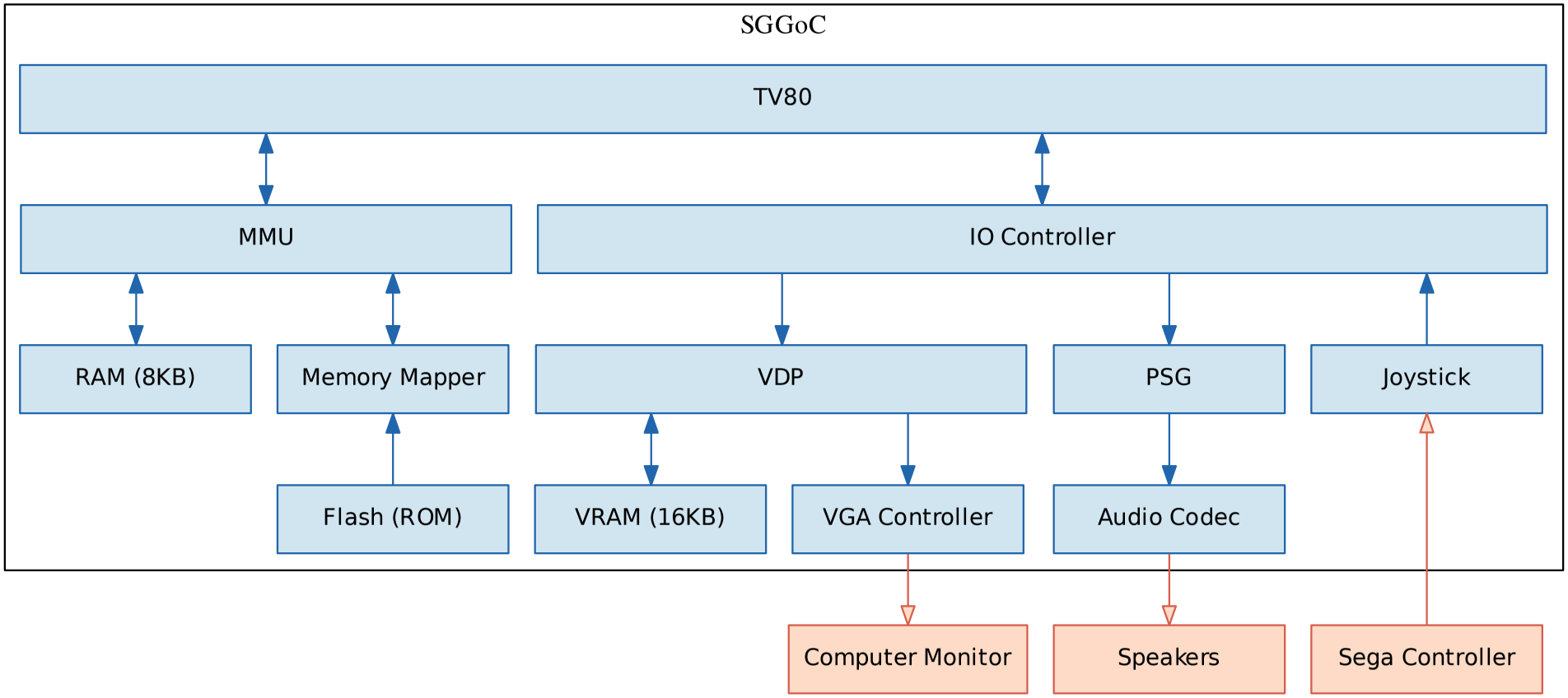
Advisor

Carla Purdy (carla.purdy@uc.edu)

SGGoC External Block Diagram



SGGoC Internal Block Diagram



Today's Date: 10/23/2012 Tuesday

(vertical red line)

Project Lead: Max Thrun, Samir Silbak

Start Date: 10/1/2012 Monday

First Day of Week (Mon=2): 2

WBS	Tasks	Task Lead	Start	End	Duration (Days)	% Complete	Working Days	Days Complete	Days Remaining
1	Research		10/1/12	10/6/12	6	99%	5	5	1
1.1	Find and gather technical information on the Game Gear Hardware	Max, Samir	10/1/12	10/1/12	1	95%	1	0	1
1.2	Determine how to interface with Flash memory	Max	10/2/12	10/3/12	2	100%	2	2	0
1.3	Determine how to interface with VGA	Samir	10/4/12	10/5/12	2	100%	2	2	0
1.4	Start GitHub Project	Max, Samir	10/6/12	10/6/12	1	100%	0	1	0
2	Implementation		10/6/12	11/13/12	39	11%	27	4	35
2.1	UART ROM flasher	Max	10/6/12	10/8/12	3	100%	1	3	0
2.2	VGA timing module	Samir	10/9/12	10/10/12	2	50%	2	1	1
2.3	Sega Memory Mapper		10/11/12	10/13/12	3	5%	2	0	3
2.4	Video Display Processor		10/15/12	11/13/12	30	0%	22	0	30