EEL 4930 - System-on-Chip Design

Spring 2023

Homework 1

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Date: April 1, 2023

Introduction:

This project implements the pong game where the game logic is calculated in a C program that runs on a Microblaze processor. The processor and the display driver for the VGA are implemented in an FPGA Board.

Overview:

Fig 2 shows the high-level working of the project. The flow direction indicates the transfer of information among different blocks of the project. The Game C code is run on the Processor, calculating the values of different game variables (Ball and paddle coordinates, player scores) and sends to the Display Driver. The Display Driver encapsulates two modules. The VGA Controller controls the vertical and horizontal sync and provides the current coordinate to the Pixel Gen. Pixel Gen computes the RGB value of the current coordinate and sends it to the VGA Port.

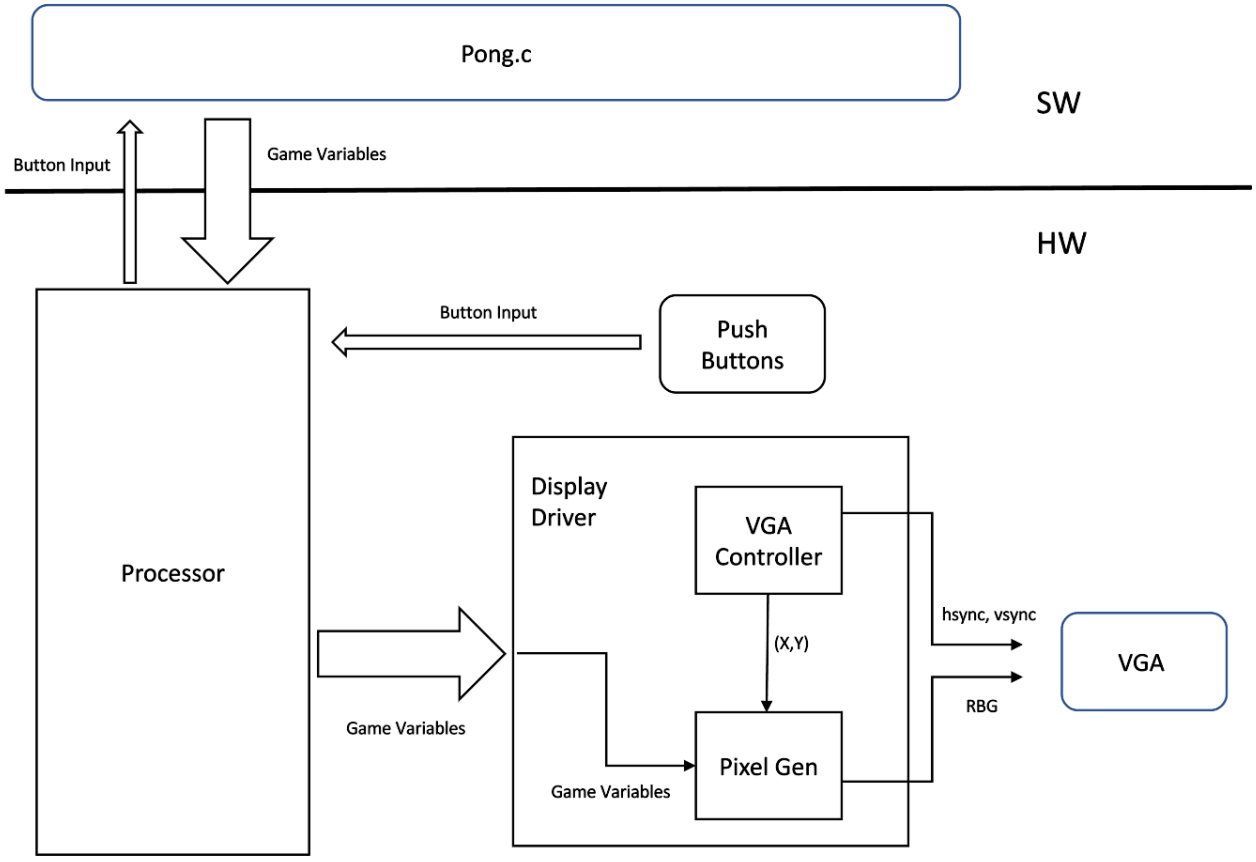

Fig 1: Working Flow

Implementation:

The project was designed using the Microblaze processor. The processor and the Display Driver IP were implemented in BaSys3 FPGA. The Display Driver IP contains the pixel gen and vga controller modules which control the monitor through the VGA port of the FPGA board. The push buttons on the board were used to play the game. The push buttons and the connection between the IP and VGA port have been configured in the constraint files. Fig 2 shows the implementation in Vivado.

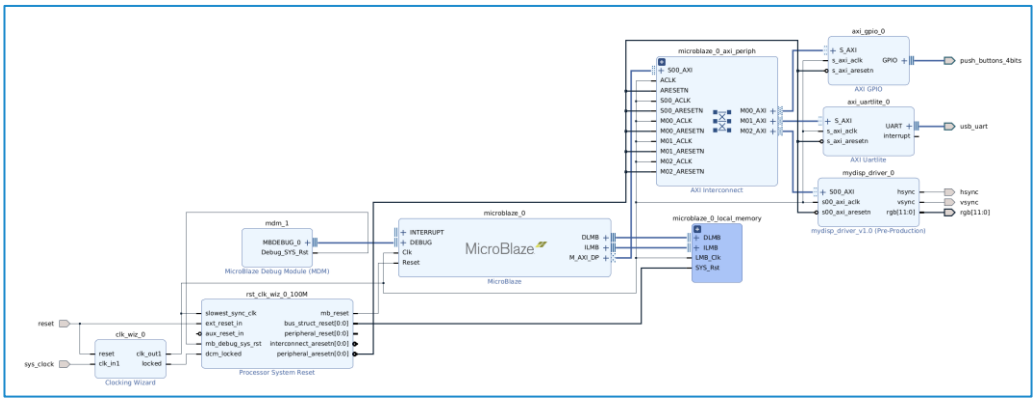

Figure 2: Implementation Diagram

Challenges :

The pixel gen and the vga controller were initially attempted to implement in the C code but later were shifted in the hardware. And the hardware implementation took a lot of effort and trial errors. It was also very hard to debug the codes as whenever the printf function was put in the C code to show values in the terminal, the execution was very slow.

Submissions:

Vivado Project Files, IP repository and Vitis Files. C codes.
A video demonstration of the project

Contribution of members:

Shuvagata Saha – Pong C Code, Display Driver IP
Mohammad Bin Monjil – Report, Pixel Gen Module
Hasan Al Shaikh – Game Logic, Integration of VGA Controller and Pixel Gen.

Conclusion:

Overall, this project was a valuable hands-on experience of building an embedded system and running applications on it.