![Maseeh College of Engineering and Computer Science — Portland State University]

ECE540 System-on-Chip Design with FPGAs

Final Project Proposal

Prepared By

Robert Wilcox (wilcox6@pdx.edu)

Ibrahim Binmahfood (ibrah5@pdx.edu)

Mohamed Gnedi (gnedi@pdx.edu)

Professor

Roy Kravitz

roy.kravitz@pdx.edu

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Project Description

Introduction:

In this project, our team aims to create an interactive basketball game, leveraging the capabilities of the RealDigital BooleanBoard. The essence of the game is straightforward yet engaging: players are tasked with shooting a ball into a hoop. The hoop can be positioned at various locations within the play area, introducing variability and challenge to the game.

Key Features and Implementation:

- Control Mechanism: Players will use a joystick to control the x-y aim of the ball-launching mechanism. This user-friendly interface allows for intuitive and precise control, essential for aiming at the hoop placed in different locations.
- Power Adjustment: The power of each shot, determining the ball's trajectory and speed, will be adjustable through buttons on the BooleanBoard. This feature introduces a strategic element to the game, as players must judge the appropriate power level for each shot.
- Power Display: The current power level will be displayed on the BooleanBoard's 7-segment display.
- Scoring System: The hoop will be equipped with a sensor to detect when a ball passes through it. The BooleanBoard will keep track of each individual player's score
- Display Output: A monitor connected via HDMI to the BooleanBoard will display the players' score.

Objective and Learning Outcomes:

Our project not only aims to deliver an enjoyable and challenging game but also serves as a practical application of FPGA technology. Through this endeavor, we anticipate honing our skills in system integration, electronic design, and real-time control - essential competencies in the field of electrical and computer engineering.

By the end of this project, we expect to have a fully functional and engaging basketball game that demonstrates the versatility and capability of FPGAs in real-world applications. This project will serve as a testament to our technical skills and creativity in system-on-chip design.

Block Diagram
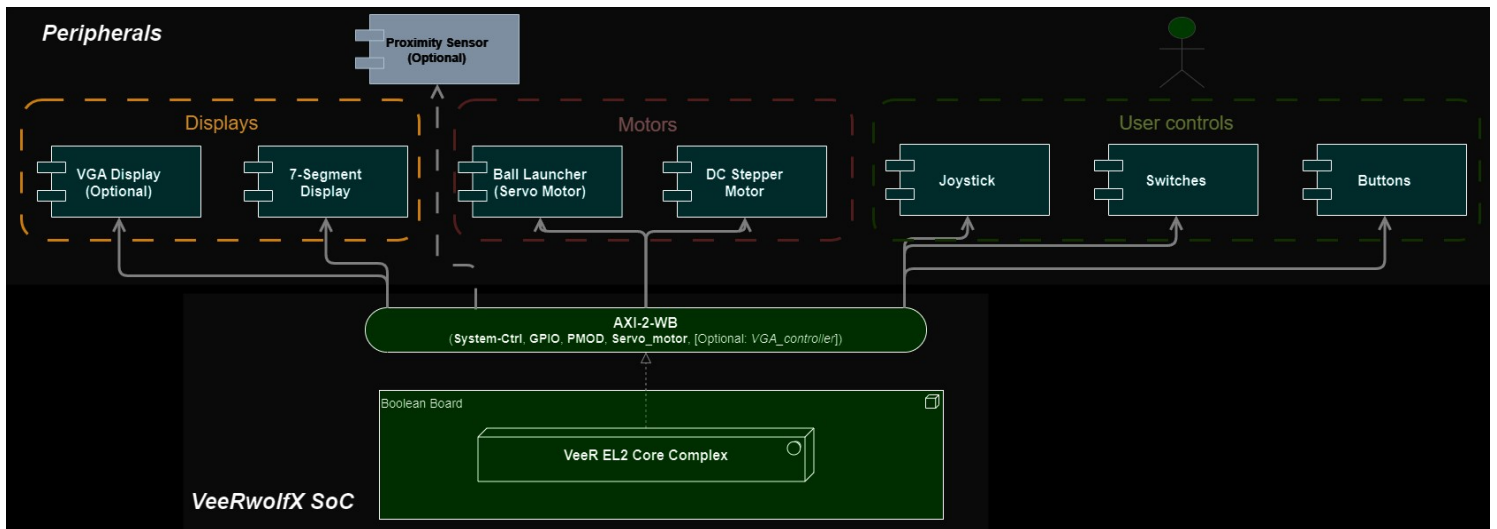
Bill of Material

Item	Component name	Component link	Quantity	Vendor	Price	total/part
1	Analog 2-axis Thumb Joystick with Select Button + Breakout Board	Joystick	2	adafruit	$5.95	$11.90
2	Projectile Motion - Ball Launcher	Ball Launcher	2	xplorably	$6.00	$12.00
3	Small Reduction Stepper Motor - 5VDC 32-Step 1/16 Gearing	Stepper Motor	3	adafruit	$4.95	$14.85
4	ULTRASONIC SENSOR SONAR DISTANCE	ULTRASONIC SENSOR	2	digikey	$3.95	$7.90
5	Boolean Board	N/A	N/A	N/A		
	Total					$46.65

Hierarchy

The components and connections in relation to the hierarchy:
- Servo Motor Peripheral:
    - Ball Launcher DC motor will connect up through the Servo Motor connections
    - Stepper DC motor will connect up to one of the servo motor connections.
- GPIO Peripheral:
    - Up and Down Buttons to increase/decrease the speed of the Ball Launcher DC motor. Another button to use to activate the Ball Launcher.
    - 1 Switch to enable/disable the buttons on the FPGA board.
- PMOD Peripheral:
    - The Joystick module will provide a way to control the 'Stepper DC motor' in turning a platform that the 'Ball Launcher' will be placed on. This module will connect up to one of the four PMOD expansion connectors.
    - The **Proximity Sensor** module will provide the ability to know when an object (ball) is in front of it at some distance. This sensor will connect up to one of the four PMOD expansion connectors.
- VGA Controller Peripheral:
    - The **VGA Display** will provide a way to keep score of how many times you launch the ball into the basket. This display is reliant on the VGA controller previously from Project 2.
- System Controller Peripheral:
    - The 7 Segment Displays will provide a way to let the user know if the game is ON/OFF and show the speed set from the Up/Down buttons.

Note:
- The bolded terms are considered as optional to the project.

Deliverables

This project has several key features that will be extending the VeeRwolfX SoC of RVfpga. The following deliverables of our project below include some optional features that may or may not be completed.

- **Control Mechanism**: The user will use the joystick to control the x-y aim of the ball-launching mechanism.
- **Power Adjustment**: The power of each shot, determining the ball's trajectory and speed, will be adjustable through 2 buttons on the BooleanBoard.
- **Power Display**: The power/speed percentage is adjusted from buttons displayed on the BooleanBoard's 7-segment display. Also displaying if the game is active with an ON/OFF message.
- *Scoring System (extra credit)*: The hoop will be equipped with a sensor to detect when a ball passes through it. The BooleanBoard will keep track of each individual player's score
- *Display Output (extra credit)*: A monitor connected via HDMI to the BooleanBoard will display the players' score.