

# Design of Embedded Systems - Advanced Course Project Proposal

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## 1 Introduction

In this project, we implement the Snake videogame on a Diligent Nexys 4 FPGA board. This implementation will include Microblaze processor. Figure below (fig. 1) shows proposed screenshot of the game. The main idea behind this game is that snake represented in white squares eats apples represented in red. Control of the snake would be implemented by using onboard buttons and it will be shown on display via VGA controller.

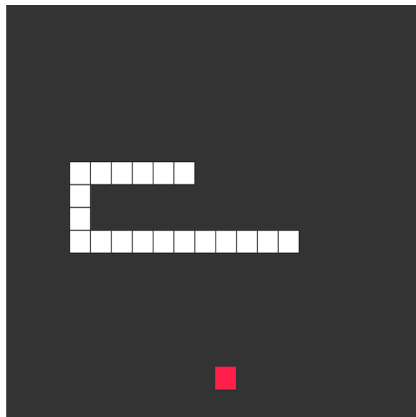


Figure 1: Screenshot of the game

In case if a snake hits its own body or crosses the border, game over screen appears.

## 2 Implementation

### 2.1 Hardware

Figure 2 represents the implementation divided into several blocks.

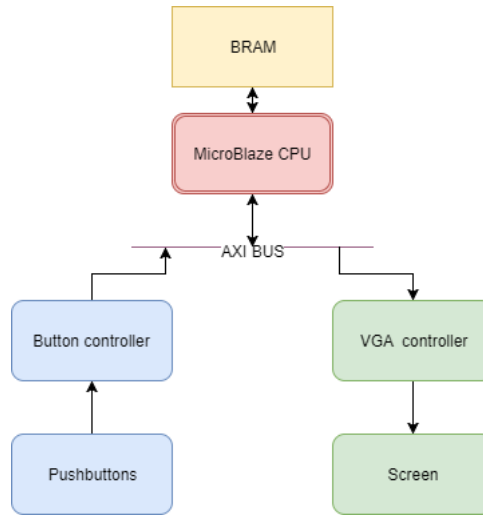


Figure 2: Block diagram of the implementation

Input would be handled by on-board pushbuttons and button controller. There will be five main buttons used, which would be denoted as UP, DOWN, LEFT, RIGHT and RESET to reset the game. As for an output, VGA controller would handle video output to the screen. Thanks to the overall simplicity of the game, no special GPU is required, because there would be only three graphical elements: border, snake squares, apple, black background and Game Over background. Input and output data would be feed through AXI BUS and processed by MicroBlaze CPU. For the storage BRAM with 32KB would be quite sufficient.

## 2.2 Software

VGA controller module will activate pixels starting from the top left corner of the screen, until it reaches down-right corner of the screen. After it reaches the end of the screen, process starts over again. Black pixels of screen doesn't require RGB specification, but snake's body, apple and borders will use RGB specification. Since apples needs to be placed on screen in random order, we need to implement pseudo-random coordinate generator. The overall size of the snake (without head) would be 127 pixels, and in order to speed up the game, each time snake eats an apple it would grow bigger by 4 squares. If an impact of snakes head with its body or with a border would be detected, Game Over screen shall appear. For the movement of the snake, tail part would disappear and new square appears with each move.

## 3 Improvements and optimizations

Introduction of keyboard and keyboard controller module would significantly change the gameplay. To show the score, onboard LED's could be used. Most of the computational power would be concentrated around pixel generation.

## 4 Task schedule

Tasks	Weeks							
	1	2	3	4	5	6	7	8
Project planning	■							
VGA controller		■	■	■				
Software Design				■	■	■	■	
Debugging					■	■	■	■
Report								■