

Project proposal,
Design of Embedded Systems Advanced Course,
EDA385

Michail Isaakidis, mi3105is-s@student.lu.se

Nishant Gupta, ni4086gu-s@student.lu.se

Yahia Ashrafieh, ya3311as-s@student.lu.se

September 4, 2017

1. Introduction

The main goal of this project is the implementation of a video game which we will be called "Crazy Car", using a Nexys 4 FPGA board. During the implementation both software and hardware must be designed.

Figure 1 illustrates a possible representation of the project. Although there might be changes and additions at the final design.

The user will be able to control a car with the use of the keyboard and the main purpose of the game will be to avoid obstacles and reach the end point. Each time you avoid obstacles your score will be raising. If the player hits an obstacle then he loses.

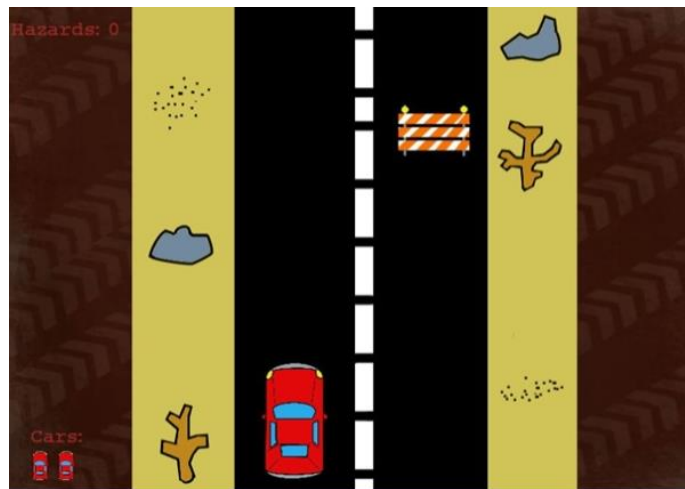


Figure 1: A possible graphical representation of the final design.

2. Implementation

Figure 2 shows the implementation of the project, divided in to different modules.

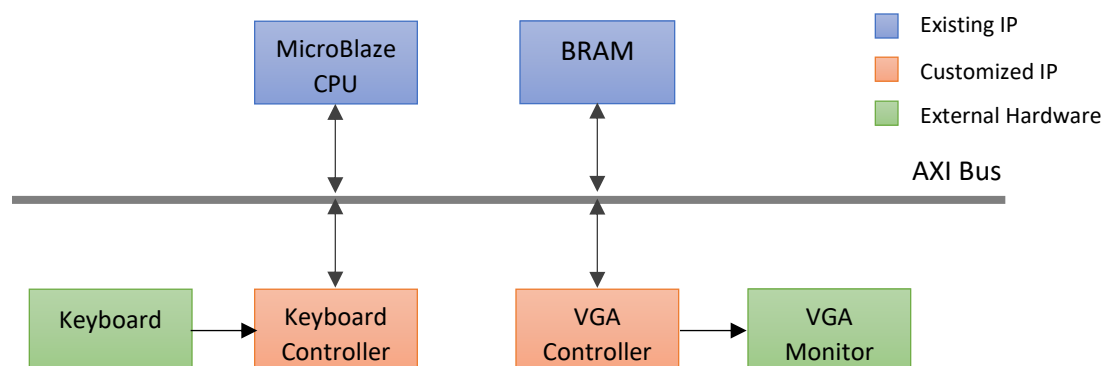


Figure 2: Block diagram.

2.1 Software



The software will be implemented on a MicroBlaze CPU on Nexys 4 CPU board. It will be responsible for controlling all the game states – the main game loop, involving all actions and movements by receiving inputs from keyboard and then sending data to the VGA controller for further processing in order to display it on VGA screen.

2.2 VGA Controller and BRAM



This module will be a customized IP which will be responsible for displaying the processed image. It will also make tell the VGA monitor to display which object where exactly on screen. The GPU will only send information about what color the pixels should have. The controller will iterate through the pixels horizontally and will send control signals back to the GPU to request the following pixels. Both vertical and horizontal synchronization signals will be used. The goal is to have an output of 640x480 at 60 Hz.

The BRAM will be helpful to buffer the graphical images, video data. For this project, we are considering that a 32KB ram should be enough.

2.3 Keyboard controller

The keyboard controller will receive input commands from the player. Those inputs will trigger hardware interrupts and will be passed to the MicroBlaze via the AXI bus to make the necessary relocation in the monitor. The possible inputs are “Left”, “Right” arrow keys for moving the car left and right, respectively. “ESC” key will be used for pausing the game.

2.4 I/O

2.4.1 Input



The input of the system will be the keyboard. This input will be connected through the existing USB port on Nexys board. The keyboard will send the inputs to the keyboard controller which will translate and transmit the to the CPU.

2.4.2 Output

The output in this game case will be a graphic picture displayed on a VGA monitor. We will use a monitor available in the lab to achieve this.

3. Improvements

There are many possible improvements from graphics perspective in this project, for example increasing the resolution or add more graphics and obstacles.

One possible improvement would be the addition of sound to the game which would make it look more realistic.

Another extra improvement would be the use of gyroscope of the FPGA as an input controller instead of the keyboard.

At last, an interesting addition would be the use of acceleration and break during the driving.

4. Schedule

The table below represents the split of work between the different stages required in order to complete this project.



Week	Work
1	Proposal
2	Overall design
3	Implementation and Verification
4	Implementation and Verification
5	Implementation and Verification
6	Verification
7	Final design and improvements
8	Report

Table 1: Schedule.