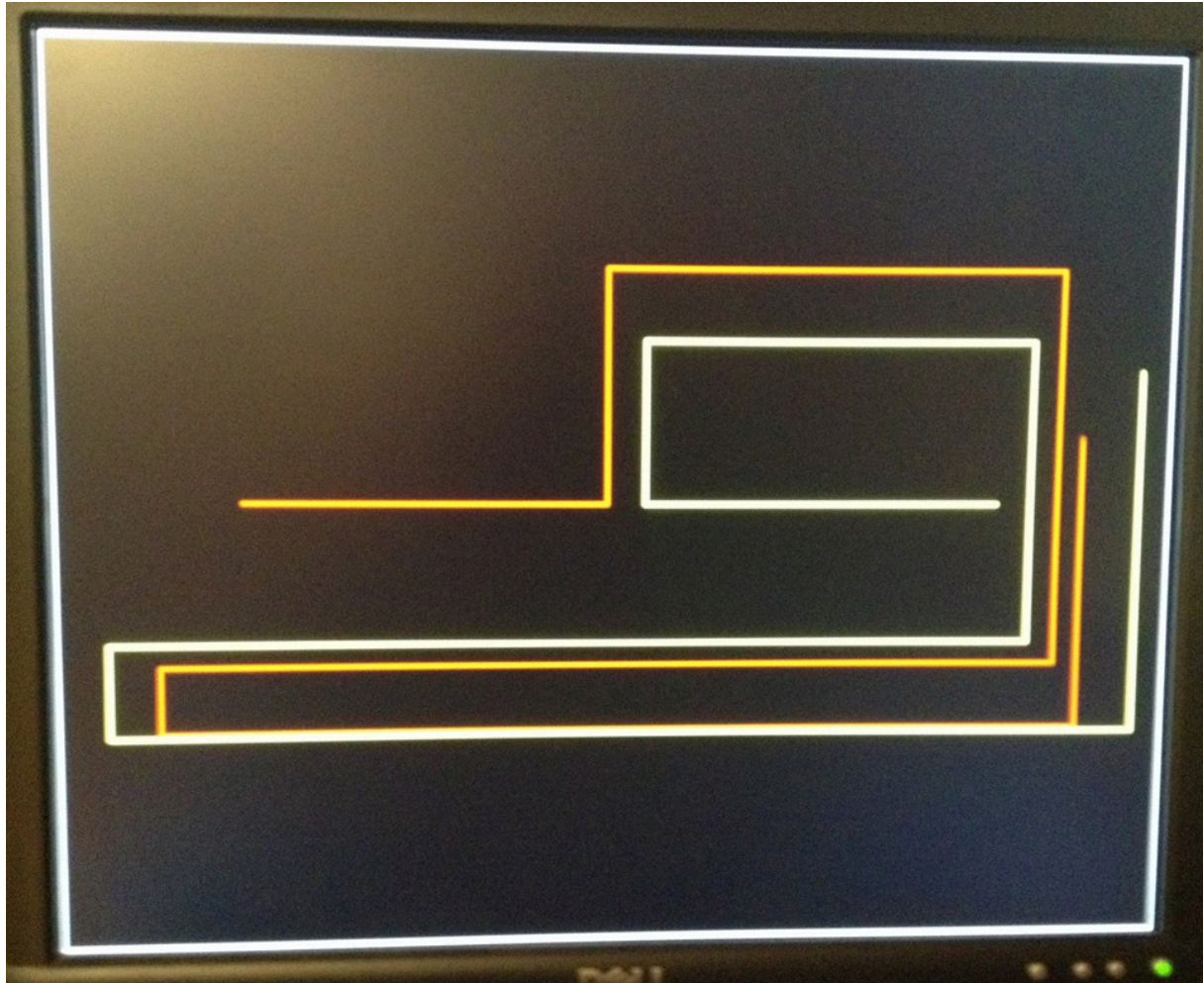


Tron Light Cycle Race like game on Xilinx Spartan 3 boards

a project by Sandro Meier and Pirmin Schmid, May 2014



game play

- the left 2 touch buttons (BTN3 and BTN2) are for player 1 (red), the right 2 buttons (BTN1 and BTN0) for player 2 (yellow)
- pressing a button turns the direction of your racing bike by 90 degrees to either left or right matching the button. Note: if you press too long, you will make a full U turn and hit your own wall. You will get a feeling for it while playing (the buttons are currently sampled at 6 Hz).
- the scores are shown in binary code on the status LEDs above the buttons (four for each player), thus allowing scores from 0 to 15.
- the game starts with quite a slow speed to get used to the steering. Speed increases after each round from initially 1 to currently maximum 3.

Welcome to the grid!

The game is implemented using the MIPS processor from lab8, a 104 instructions assembly program, 15 words of static data, and some additional verilog code to handle graphics, input and output. Graphics are rendered to 640 x 480 pixels at 60 Hz.

Since RAM on the Spartan 3 boards is quite limited, a „video card“ was implemented that offers a 320x240 2 bit bitmap that is upscaled to 640x480 3 bit RGB in the video output circuits. The card has an interface towards MIPS that allows access to x, y and bitmap value in reading and writing using lw and sw instructions. Reading the bitmap value (for collision detection) needs a delay nop operation between setting x, y values and then reading out due to video ram delay.

The input device is built with an interface towards MIPS to directly provide delta x and delta y values for the players based on buttons pressed by the player. This simplifies the assembly program a lot.

The score is shown as binary value on the status LEDs, which was simple to do (just sw to defined I/O addresses) and mapping of the least significant 4 bits to the LEDs.

Future options might be:

- adding an input driver that handles keyboard inputs from a PS/2 keyboard.
- score output on the digit segment LEDs.

Acknowledgments

- Tron, the grid and the light cycle race are (c) / TM from Walt Disney Productions. The present game was designed for educational in-class use without commercial interest.
- VGA output is based on Xilinx library code and based on ideas seen in a project bitvga-s3 by E. Gallimore and N. Smith on embedded.olin.edu.
- MIPS code including ALU, control unit, registry file, instruction memory are based on the files provided in lab8 of our class. They were written by Frank K. Gürkaynak. We introduced only a few modifications like optional 1 Hz debug clock frequency (which allows tracking of the assembly program from the outside with some internal wires put on the status LEDs), wider instruction memory bus and memory size for 128 instructions. Additional output pin isIO from MIPS to the motherboard top.v, which simplified the outside homebrew I/O controller.

SHA-256 for the tron.bit file:

2174b05f10675037dabcce89aa54176fb580a930531b91067a56ab1f7b50a0da