

VGA Brownian motion

B2M34NSV – Semester project

Martin Šimák

26th January, 2024



- 1 Task introduction
- 2 Modules
- 3 Conclusion



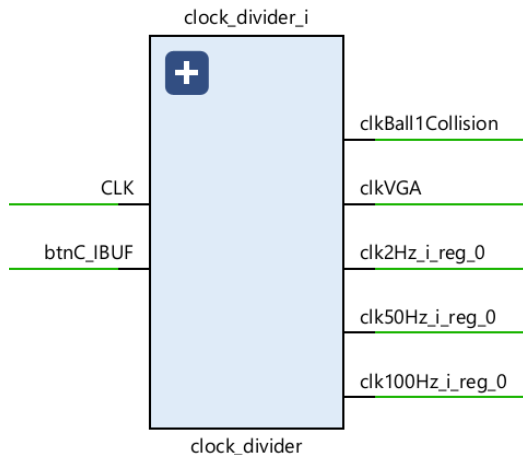
- *Task:* Brownian motion of molecules displayed using a VGA interface.
- *Development board:* Digilent Basys 3 featuring the Xilinx Artix-7 FPGA.



Clock divider

Division of system clock (100 MHz) into multiple clock signals:

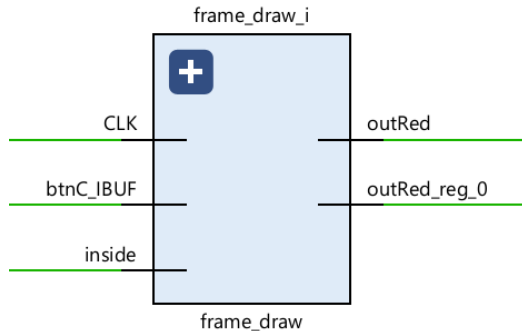
- 50 MHz clock for VGA controls,
- 100 Hz clock for Ball1 movement,
- 50 Hz clock for Ball2 movement,
- 4 Hz clock for Ball1 collision generation,
- 4 Hz clock for Ball2 collision generation.



Frame graphical component

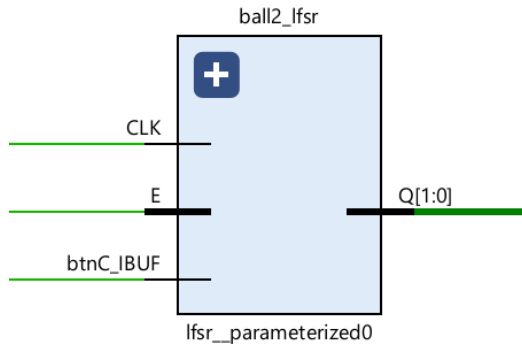
Bounding frame drawing component

- *In*: Clock signal (50 MHz), asynchronous reset, current drawing position coordinates.
- *Out*: RGB colour signals.



Pseudorandom generator of virtual collisions

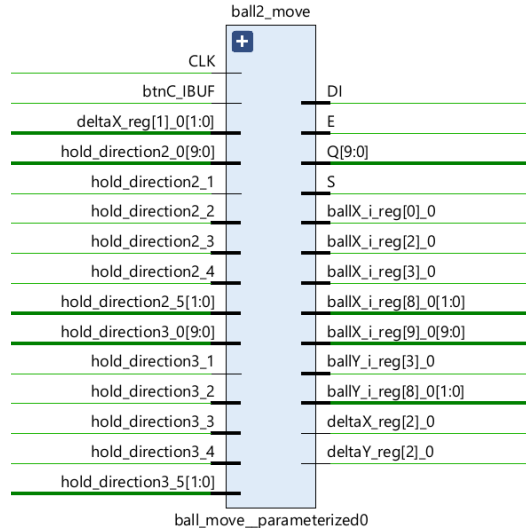
- *In*: Clock signal (4 Hz or 2 Hz), asynchronous reset, enable bit.
- *Out*: MSB, LSB.



Ball movement control

Ball movement controller responsible for collision detection

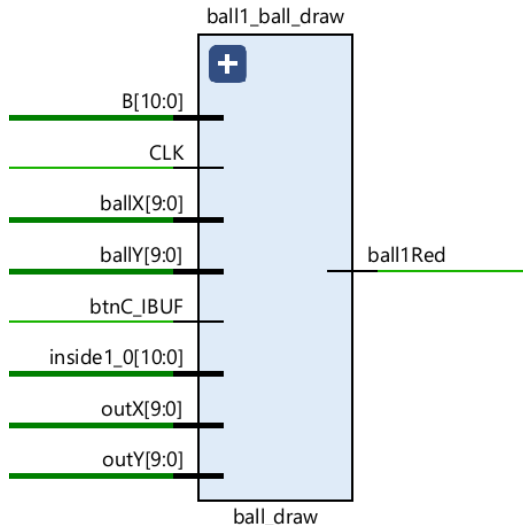
- *In*: Clock signal (100 Hz or 50 Hz), asynchronous reset, virtual collision bits, current other ball coordinates.
- *Out*: Current position coordinates of the drawn ball.



Ball graphical component

Ball drawing component

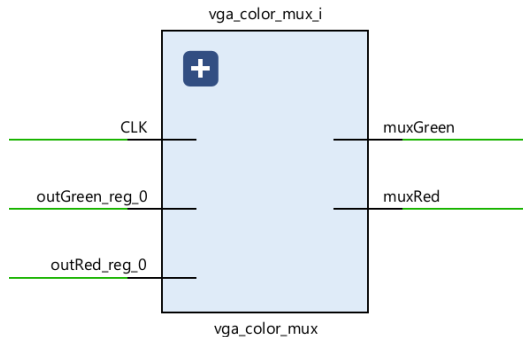
- *In*: Clock signal (50 MHz), asynchronous reset, current ball and drawing coordinates.
- *Out*: RGB colour signals.



Colour multiplexer

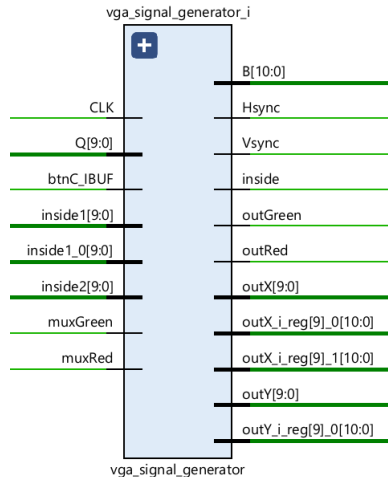
Combiner of RGB colour signals from all present objects

- *In*: Clock signal (50 MHz), asynchronous reset, RGB colour signals from all present objects.
- *Out*: Combined RGB colour signals.



VGA signal generator

- *In*: Clock signal (50 MHz), asynchronous reset, RGB colour signals.
- *Out*: Vertical and horizontal synchronization signals, VGA colour signals, current drawing coordinates.



What has been implemented:

- two molecules moving in a pseudorandom pattern,
- collision detection.

Possible improvements:

- better collision detection resolution.

