Interfacing a VGA monitor with an FPGA

P&S Course iCEBreaker FPGA for IoT Sensing Systems

Stefan Gloor

ETH Zürich

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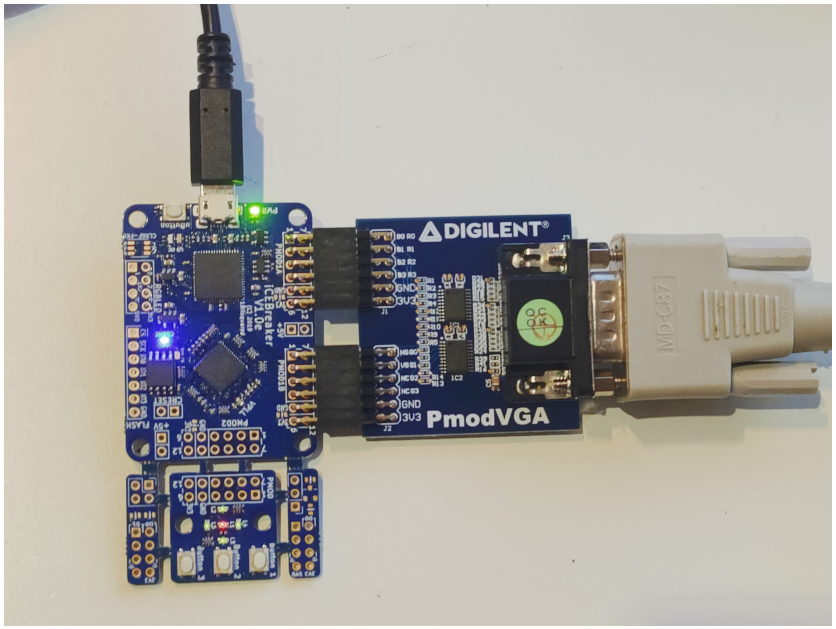
Goal of the project

- Implementation of the VGA protocol
- Ability to display arbitrary images in color
- Interactive animation for demo (e.g. game)

Necessary hardware



- iCEBreaker FPGA Board
- VGA Pmod
- Standard VGA cable and monitor

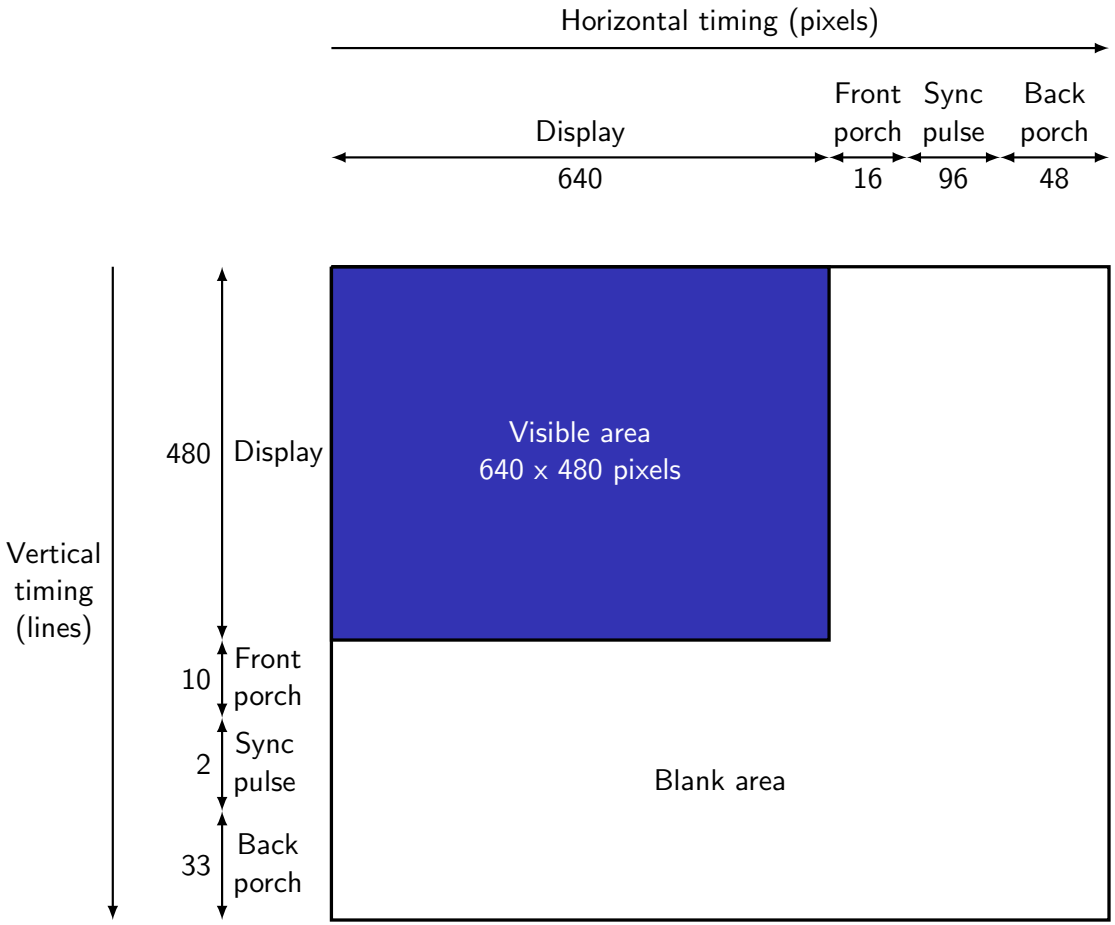
VGA interface

- The VGA protocol uses purely analog RGB signals.
  $\Longrightarrow$ this means we need to convert digital to analog signals.
- Pixel data is transmitted by "scanning" across the screen.
- Frame and line synchronisation is done by digital sync signals on dedicated lines.

Pin #	**Signal**	**Description**
1	R	Analog red color
2	G	Analog green color
3	B	Analog blue color
13	HSYNC	Horizontal synchronisation (line)
14	VSYNC	Vertical synchronisation (frame)

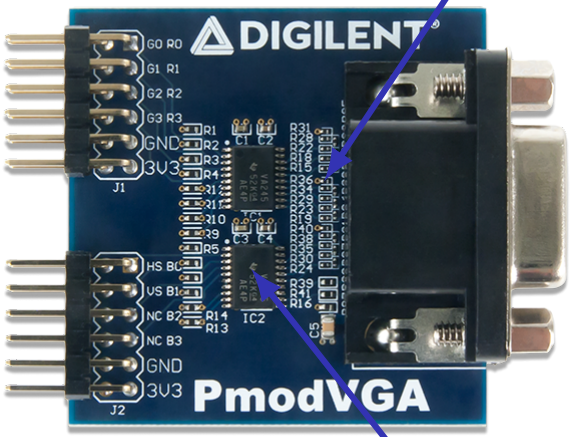
Figure: Most essential VGA pins

VGA interface



- Pixel frequency of 25.175 MHz
- Horizontal and vertical pixel counters
- Create sync pulses depending on counters

Pmod VGA



"R2R" Network

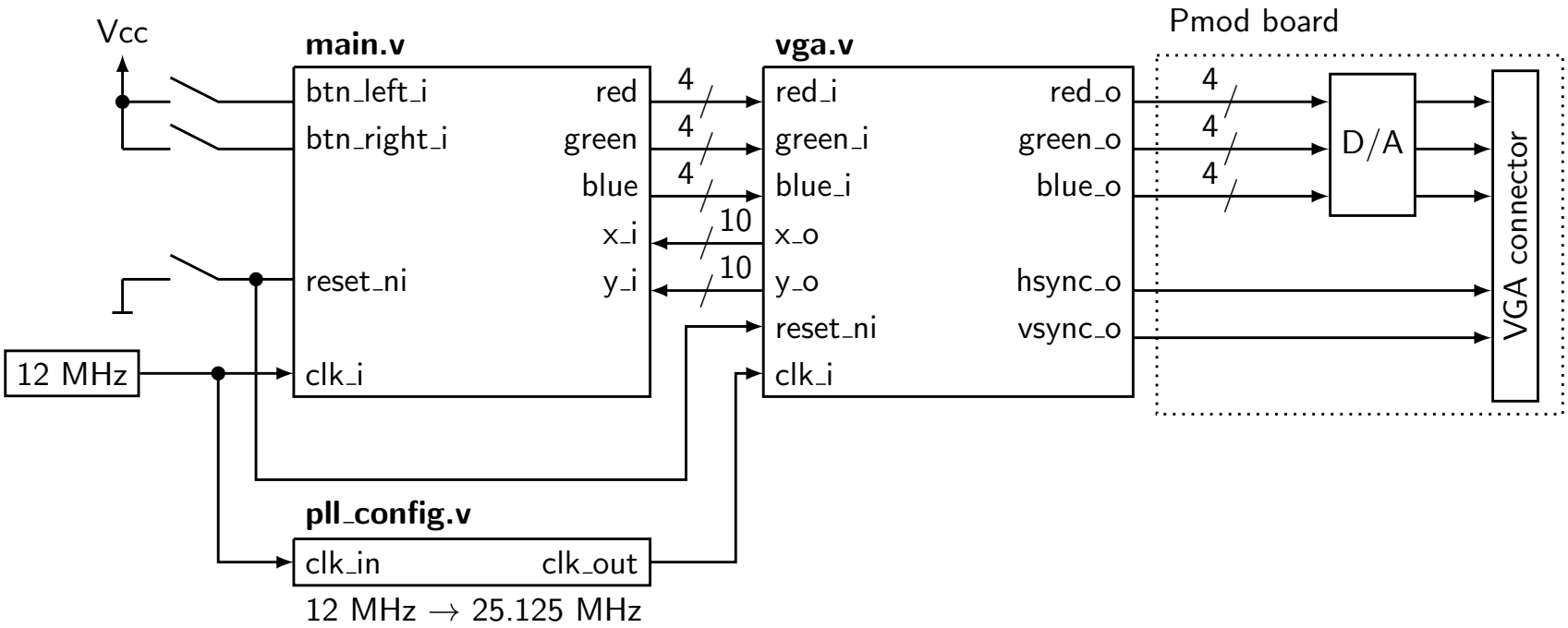
Voltage buffers

- Bus transceivers ensure stable voltage
- 4-Bit D/A conversion by simple resistor network

[1]

[1] Image based on Digilent reference: https://digilent.com/reference/_media/reference/pmod/pmodvga/pmodvga-1.png

My Implementation



Pong game demo

Questions?

The project is on Github!

Thank you for your attention.