

An open hardware interactive VJ station

Technical overview

Sébastien Bourdeauducq

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What we are speaking about

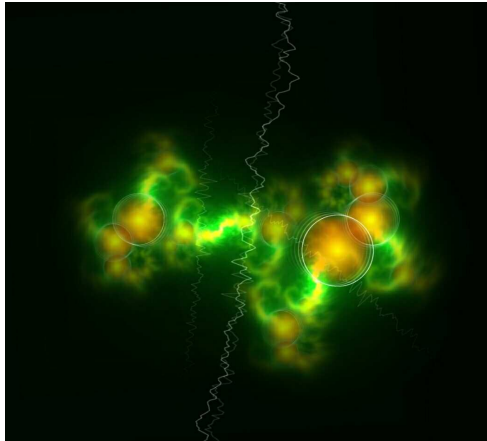
A device for video performance artists (VJs)...

- ▶ inspired by the popular MilkDrop program for PCs
- ▶ with many interfaces: MIDI, DMX, can also do video mixing
- ▶ highly integrated

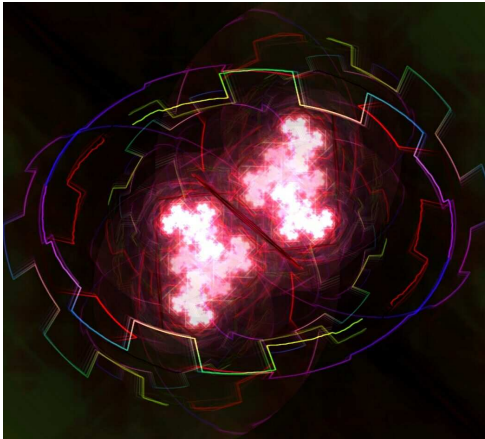
At the frontier between...

- ▶ big computers with software to render visual effects
- ▶ and small, handy microcontroller boards you connect to anything
(“Arduino” is today’s buzzword for those)

What is that MilkDrop thing?



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What is that MilkDrop thing?



Open Hardware, for real

- ▶ Arduino = AVR + power supply + connectors.
- ▶ The AVR chip does all the magic! And it's a black box in every sense.
- ▶ Here, all the logic of the chip is described (in Verilog HDL)...
- ▶ ...and open source!
- ▶ Ask Atmel for the same!

The design flow

“System-on-a-Programmable-Chip” (SoPC):

- ▶ A microcontroller is implemented using the FPGA fabric
- ▶ The software is written and compiled (GCC)
- ▶ The compiled firmware is flashed/loaded on the board
- ▶ The microprocessor made from the FPGA fabric executes it
- ▶ Acceleration units and specialty peripherals are added to the system and driven by the software

SoC interconnect

Three different buses are used:

- ▶ WISHBONE as general purpose bus (Openocores standard)
- ▶ Simplified bus for CSRs (custom)
- ▶ Fast Memory Link bus tailored for high speed DRAM access (custom)

Base system

- ▶ 32-bit RISC CPU, WISHBONE bus, supported by GCC:
 - ▶ Mico32 (from Lattice Semiconductors)
 - ▶ AEMB (from Shawn Tan, instruction set compatible with Xilinx's Microblaze)
- ▶ Off-chip Flash
- ▶ On-chip SRAM
- ▶ UART (debug), GPIO, ...
- ▶ Can run ucLinux or be programmed like a microcontroller, without OS.

Memory interface

- ▶ Off-chip DDR SDRAM
- ▶ Custom controller
- ▶ Flexible and high quality
 - ▶ reused by the NASA in the development of a software-defined radio prototype for the ISS
- ▶ Custom high-performance bus interface (FML)
- ▶ Bridged to WISHBONE
 - ▶ the base system can transparently access DRAM

VGA output

- ▶ The FPGA directly drives a video DAC for VGA
- ▶ Framebuffer-based (in DDR SDRAM)
- ▶ Supports multiple buffering
- ▶ Automatic buffer switch during blanking intervals

Graphics acceleration

- ▶ Texture mapping unit
 - ▶ implements any kind of image “distortion”
- ▶ Programmable floating point unit
 - ▶ similar to a vertex shader
- ▶ Flexible, can be used to implement MilkDrop or others...

Video inputs

- ▶ Still in development
- ▶ Dual PAL/NTSC inputs
- ▶ Off-chip ADC and decoder
- ▶ For live video mixing applications

Control peripherals

- ▶ Also in development
- ▶ Support planned for:
 - ▶ MIDI (electronic instruments)
 - ▶ DMX512 (stage lighting)
 - ▶ Ethernet – OpenSoundControl
- ▶ Artistic installations, performances, ...

Thank you for your attention

- ▶ Web: <http://www.milkymist.org>
 - ▶ documented source code (GPLv3 licensing)
 - ▶ binary kits (to get started fast)
 - ▶ mailing list
 - ▶ wiki (with suggested contributions)
 - ▶ blog
 - ▶ these slides are online (GNU FDL licensing)
- ▶ Mail: [sebastien.bourdeauducq \[AT\] lekernel DOT net](mailto:sebastien.bourdeauducq@lekernel.net)

Questions?