Milkymist One

A video synthesizer at the forefront of open source hardware

S. Bourdeauducq

Milkymist project

August 2011

・ロト ・ 日 ト ・ ヨ ト ・

What is open source hardware?

・ロト ・四ト ・ヨト ・ヨト

Openly licensed development kits from chip makers?

・ロト ・ 日 ト ・ ヨ ト ・ ヨ ト

Beagleboard (TI) 19 ALA BAR N

<ロ> <四> <四> <四> <三< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< =< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< => <=< =< =< =< =< =< =< =< =< =<

mbed (ARM)



◆□▶ ◆□▶ ◆臣▶ ◆臣▶ ─ 臣

In fact nothing really new...

- They sell (proprietary) chips.
- They always have been happy to see you copy their "reference designs".

(日) (同) (三) (三)

Community-developed devices for hobbyists?

・ロト ・四ト ・ヨト ・ヨト

Arduino



<ロ> (日) (日) (日) (日) (日)



- Grassroots movement
- More potential for open innovation

But...

- Niche markets
- Small volumes
- Hackers are cheap
- Low price implies low technology

< A > < > > <

Open source practice for developing "industry-grade" hardware?

・ロト ・ 日 ト ・ ヨ ト ・ ヨ ト



Milkymist One



(日) (四) (三) (三) (三)



・ロト・(局)・(目)・(目)・(日)・(の)



< □ > < □ > < □ > < □ > < □ > < □ > < □ > < □ > < □ > ○ < ○

A video synthesizer for...

- VJs who want low latency, cutting edge interactive effects.
- Clubs and concert venues who can use it like a nice "lighting effect".
- Small music bands who want plug and play VJing.
- (Hackers who want to play with advanced digital technology.)

- 4 同 ト 4 ヨ ト 4 ヨ

Those are niche markets and "small" volumes too, but...

- Milkymist One is better and cheaper than existing devices.
 - which sold in the order of 40000 units
 - publicity is of utmost importance (We sold 40 so far)
- Competitive even in small volumes.
- We can afford cutting edge technology.
 - Milkymist One is one of the first commercially available embedded devices with open source CPU

- **(())) (())) ())**

Milkymist One in more detail

- **Milkymist One** is a product containing a FPGA as central component.
- The FPGA implements the **Milkymist System-on-Chip (SoC)** comprised of a CPU, I/O interfaces and accelerators.
- The Flickernoise video synthesis software runs on the SoC.

< ロ > < 同 > < 三 > < 三

Milkymist One: everything on board for interactive installations

- Video input
- VGA output (1280×1024)
- DMX512
- MIDI
- Line audio and built-in microphone
- Ethernet (OSC, Twitter wall, updates, TODO: streaming...)
- Infrared
- USB

< ロ > < 同 > < 三 > < 三

Milkymist SoC: an advanced open source system-on-chip

- LatticeMico32 32-bit RISC CPU core
- High performance DDR SDRAM controller
- All I/O peripherals for Milkymist One
- 2D texturing acceleration
- Floating point vertex shader
- Wishbone, FML and CSR interconnect
- Extensive use of on-chip DMA

Flickernoise VJ software: flexibility and ease of use

- Effects (called "patches") are fully programmable
- Using the Flickernoise Patching (FNP) language
- Graphical user interface on Milkymist One
- Automatically share patches between Milkymist devices online













Why open source hardware?

(日) (四) (三) (三) (三)

JTAG/Serial debugger for Milkymist One (Yanjun Luo, Michael Walle)



Linux port to the Milkymist platform (Takeshi Matsuya, Lars-Peter Clausen, Michael Walle)



◆□▶ ◆□▶ ◆ □▶ ◆ □▶ ● □ ● ● ● ●

OpenWrt port (Lars-Peter Clausen)



< ロ > < 同 > < 三 > < 三

LLVM back-end (JP Bonn)



・ロト ・ 日 ト ・ ヨ ト ・ ヨ ト

Parts of the RTEMS port to the Milkymist platform (Yann Sionneau)

- RTEMS is a light POSIX real-time operating system
- Ported during Google Summer of Code 2010
- Now flashed on production devices

On-chip GDB server (Michael Walle)

- Debug embedded software on Milkymist One with GDB
- As if it were running on your local PC
 - stack trace
 - breakpoints
 - single stepping
 - evaluations
 - etc.

< ロ > < 同 > < 三 > < 三

QEMU emulation support for Milkymist hardware (Michael Walle)

QEMU			_
Control panel			
Keyboard IR remote Audio			Ħ
MIDI OSC DMX51	2 Video in		
RSS wall We	eb update		
Patches Patch editor Variat Performanc Flicker		AI	bout
		rnoise 0.4 (bu	ilt on May 25 2011)
		GUI toolkit: MTK 1.1	
First sets		OS: RTEMS 4.10.99.0	
First pate	Pli	atform: Milkyn	hist SoC 1.0RC1
Start! Sin	CPU: LatticeMico32		
Tools -		Board: M1 (PCB rev. 0)	
File manag System Eth		ernet MAC: 00:00:00:00:00:00	
Settings	ettings Flickernoise is free software, released under GNU GPL version 3.		
About Sł	Copyright (C) 2010, 2011 Flickernoise developers. Milkymist is a trademark of Sebastien Bourdeauducq. Web: www.milkymist.org		
		lash	Close

・ロト ・ 日 ・ ・ 目 ト ・

Distribution maintainers, please make our life easier:

PACKAGE QEMU-SYSTEM-LM32!

It's part of the recently released QEMU 0.15. If you are very nice, also package qemu-user-Im32.

THANKS!

▲ 伺 ▶ ▲ 国 ▶ ▲ 国

Collaborative hardware debugging (Michael Walle, Werner Almesberger)



< ロ > < 同 > < 三 > < 三

Case design (Joachim Steiger / Raumfahrtagentur)



◆□▶ ◆□▶ ◆臣▶ ◆臣▶ ─ 臣

Manufacturing (Sharism at Work Ltd: Wolfgang Spraul, Xiangfu Liu, Adam Wang, Yi Zhang)



< □ > < 同 > < 回 > < Ξ > < Ξ

Re-uses of Milkymist technology for scientific research

- NASA CoNNeCT experiment
 - Software defined radio
 - Milkymist SoC's SDRAM controller
 - Scheduled for launch in January 2012
 - Will be put on board the ISS
- GSI/CERN particle accelerator control systems
 - On-chip GDB server
 - In development
 - www.ohwr.org

- **(1))) (1)))))**

[your awesome hack here]

- IRC: #milkymist on Freenode
- Mailing list: devel@lists.milkymist.org
- Web: http://www.milkymist.org
- Twitter: @milkymistvj Github: milkymist

