

Milkymist One

A video synthesizer at the forefront of open source hardware

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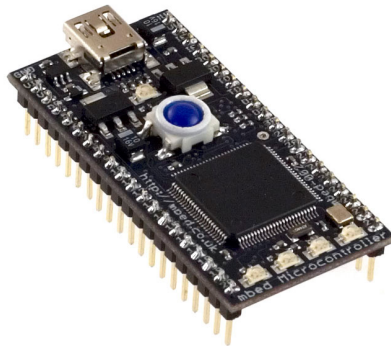
Milkymist project

May 2011

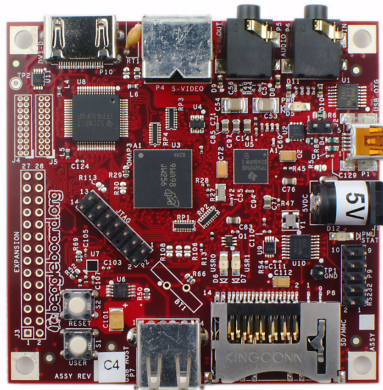
What is open source hardware?

Openly licensed development kits from chip makers?

mbed (ARM)



Beagleboard (TI)

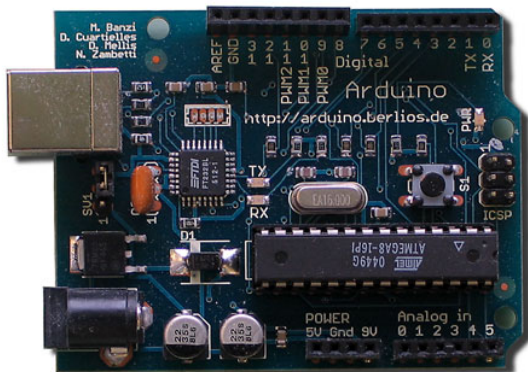


In fact nothing really new...

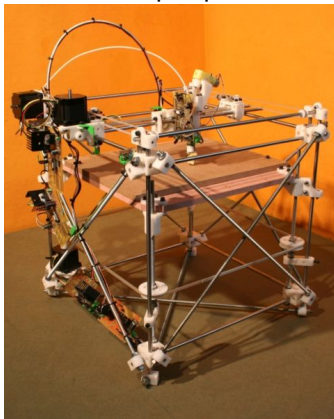
- They sell (proprietary) chips.
- They always have been happy to see you copy their “reference designs”.

Community-developed devices for hobbyists?

Arduino



RepRap



- Grassroots movement
- More potential for open innovation

But...

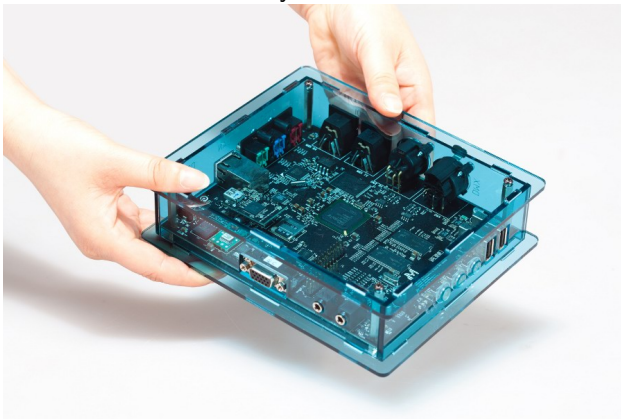
- Niche markets
- Small volumes
- Hackers are cheap
- Low price implies low technology

Open source practice for developing “industry-grade” hardware?

Openmoko



Milkymist One



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.)

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.

Milkymist One: everything on board for interactive installations

- Video input
- VGA output (1280x1024)
- DMX512
- MIDI
- Line audio and built-in microphone
- Ethernet (OSC, Twitter wall, updates, TODO: streaming...)
- Infrared
- USB

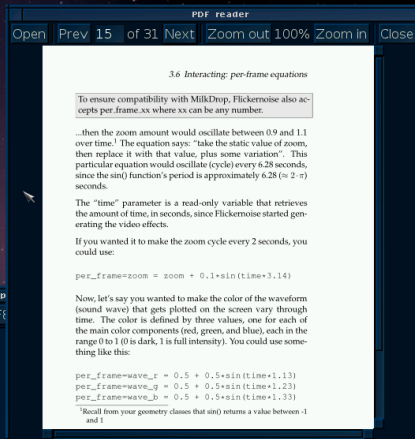
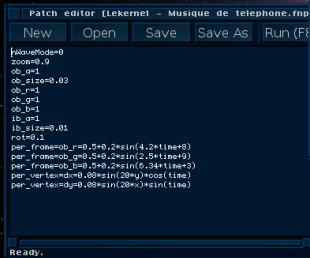
Milkymist SoC: the most advanced open source system-on-chip

- 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

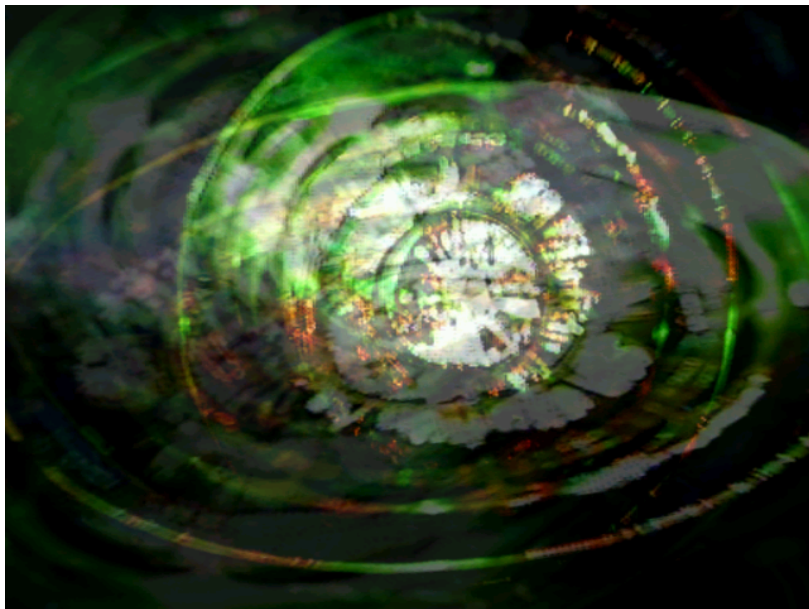
Flickernoise VJ software: flexibility and ease of use

- 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

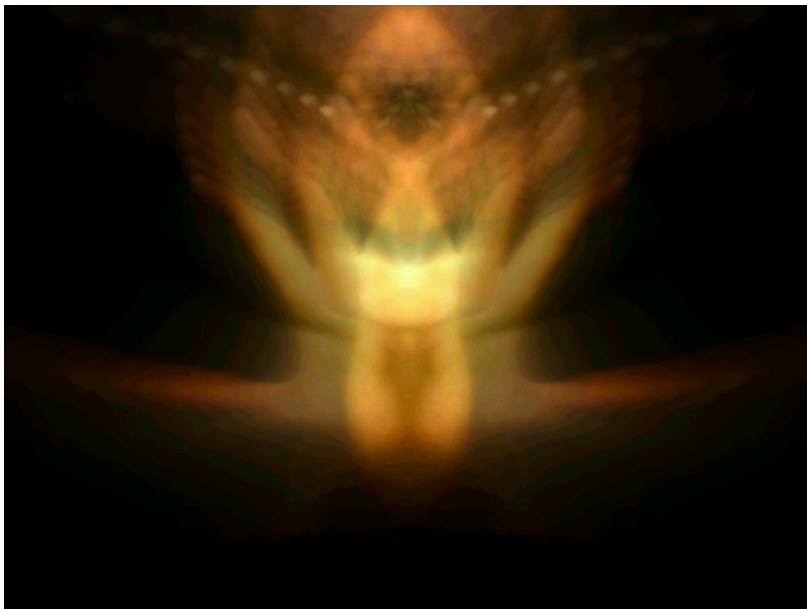






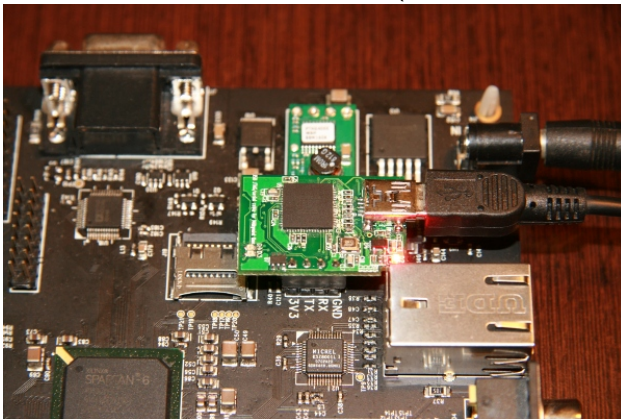






Why open source hardware?

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



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



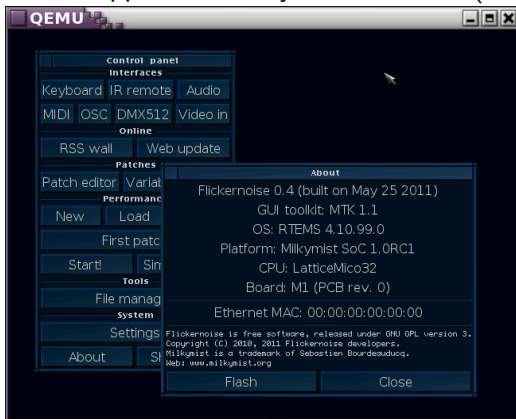
Parts of the RTEMS port to the Milkymist platform (Yann Sionneau)

- 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.

QEMU emulation support for Milkymist hardware (Michael Walle)



Case design (Joachim Steiger)



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



High profile 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

[your stuff here]

- IRC: #milkymist on Freenode
- Mailing list: devel@lists.milkymist.org
 - moderated for non-members only, open membership
- Web: <http://www.milkymist.org>

