Open Source
Embedded Vision Sensors

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Embedded Vision Sensors
Part 1: Why are opening up our hardware

Part 2: Reconciling chip design and open source
My Obsession (since 1996)

Major Goal:

Use optical flow and other vision techniques to allow a small robotic aircraft to fly through an environment without crashing into obstacles.
http://www.youtube.com/watch?v=EkFh_2UX-Jw

16 pixels, PIC18C252, 2MIPS
http://www.youtube.com/watch?v=Ah-eESVigd4

3 X (88 pixels, PIC18F, 10MIPS)
“If we knew what we were doing, it wouldn’t be research!”

-Albert Einstein

http://www.youtube.com/watch?v=dDbazL5IplI
Vertically Integrated Approach

- Split processing between optics, circuitry, and algorithms as appropriate
- Optimize to figures of merit that really matter as opposed to arbitrary metrics
- Control the interface - optimize them instead of being constrained by some industrial standard
- Include useful features
- Eliminate unnecessary features
- Eliminate unnecessary pixels!!
And so why open source?

We have experience with the vertically integrated approach … and others do not.

Therefore:
• It is very difficult to convey exactly what our technology “is”
• Things that are obvious to us are not to others
  (We are not smarter than others- we just have experience…)

Why open source hardware?
• We need to make it easy for others to tinker and experiment
• Transparency and openness is the only way to encourage this
• Our technology is both software and hardware
Basic Chip Design
You draw both the connections and the components!

The problem: Design rule files and library files for chip design are generally NOT open!
Is “Partially Open” a Possibility?
Well, it is possible, but would the community accept it?

1. Designer creates abstract layout

2. “Middleman” or foundry generates native level layout

3. Fabricate!
Batch Fabrication of Chips is Pretty Common
The Numbers: Hypothetical Batch Chip Fab

Cost for a fab on a 0.6um process: $35,000
• $20,000 for the mask set
• $10,000 for a batch of 10 x 6” wafers
  • Note: About 30+ reticles per wafer or 300+ reticles total
• $5,000 for dicing

Scenario: Get 100 customers to contribute 100 different designs
• Reticle = 21mm x 21mm → 2mm x 2mm for each design
• Total fab cost per customer for chips = $350 (for 300 chips!)
• Add $100 per customer for packaging (5 chips in DIP packages)
• Total cost per customer: About $450
• If we multiply by 2.6, we bill the customer $1170
Thank You!!!

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