The Small Potato Collider
or how to solve a multidisciplinary problem
using a modular camera

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CELOX XT-P Potato Grader
Why Potatoes?

368M tons per year [1].

Price per kg: 0.104 € [2].

Kg per capita [3]:

Europe: 88

World: 31

[1] FAOSTAT 2013
[2] Potato Weekly (yes this exists…) 19/01/2015
[3] International Year of the potato 2008 (I do not make up the names)
Why Grade them?

[Images of different types of fries]
Why Grade them?

- Delirium
- Diarrhea
- Dilated pupils
- Fever
- Hallucinations
- Headache
- Loss of sensation

- Hypothermia
- Paralysis
- Shock
- Slow pulse
- Slowed breathing
- Abdominal pain
- Vision changes
- Vomiting

Conclusion: Eat chocolate, not potatoes.
Why Grade Them?

Green Spot  Black Spot  Scurf  Golf Ball
Grey Damage  Rot  Fresh Cut  Potato Fruit
How it is done?

1 mm² resolution
Dimensions equivalent to old-school caliper

13 categories
Data Specs

8x12x40 = 3840 MBytes/sec
112.78 PBytes/year

Max Latency: 1 sec

Jitter: Close to zero

28 tons per hour

Web services enable
30 Pbytes/year
CELOX XT-P Potato Grader
Potato Grader: Celox v2002
Celox V1
Celox V2
The first CCD

INVENTORS

W. S. BOYLE
G. E. SMITH

1969
SRI Vision Module
Custom-designed computer vision systems are being applied to specific manufacturing tasks. Current development may lead to general-purpose systems for a broad range of industrial applications.

Gerald J. Agin, 1980

Stanford Research Institute

Bio-Sensor

Image Credit: Wikipedia CC BY-SA 3.0
Sensor

Image Credit: Wikipedia CC BY-SA 3.0
Other sensors

Image Credit: Wikipedia CC BY-SA 3.0
Processing
Vision Software
Modular Open Source Camera
Hardware Modules

HEAD

Sensor

LVDS

FPGA

PCIe

BODY

AMD APU

PCIe

GPU

SOFTWARE

User Application

Open Source API

OpenCL

Video4Linux2

Linux

Yocto Project Distro
HOW STANDARDS PROLIFERATE:
(SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC)

**Situation:** There are 14 competing standards.

**14?! Ridiculous! We need to develop one universal standard that covers everyone's use cases.**

**Yeah!**

**Soon:**

**Situation:** There are 15 competing standards.
Generic Operations

Buffer → Interpolation → Remap → Gain
Software Stack

User Application

OpenCV

Python

Gstreamer

Third Party libs

libv4l2

Video4Linux2

Kernel
Why Open Source?
Yocto Project
Our Upstream Contributions

- **Linux Kernel**: 200+ patches. Including a 9+ year old bugfix.
- **Yocto project**: 38 patches. Supporting organization of the project.
- **v4l-utils/libv4l2**: 7 patches.
- **Gstreamer**: 3 patches on core and Maintainers of gst-instruments
- **Flashrom**: Support for the first board with EEprom memory.
- **Gerbil**: 2 patches.
- **Clpeak**: 2 patches.
- **Video Lan Client**: 1 patch.
Effort for upstream

Remember you need to make this trivial to review in order to get it accepted.

You have to do extra work because of this: our limited resource is reviewers and maintainers, not developers.

Greg Kroah-Hartman
Why Upstream?

- Support [1]
- Training experience
- Code Review
- Distro Independent!

[1] Kernel Newbies Autoresponder:

What changes are you making to the kernel that you are sticking with such an old version (X.Y is Z years old now, and over KKK thousand changes have happened to the kernel since then)?
War Story: USB Gadget 3380

- Upstream driver
- Access to engineers from:
  - Samsung
  - Texas Instruments
  - Intel
War Story: HSV
Results:

Batch analyzer

Checkweigher

Spectral Camera
Conclusions

- Open Source is the new Standard
- Be part of the standard by:
  - Be up to date
  - Sharing your code
  - Upstreaming your code
- You will get the best support and magically meet your deadlines
Questions?
More Information

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