

The Small Potato Collider

or how to solve a multidisciplinary problem
using a modular camera

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@ribalda





Norway

Estonia

Latvia

Lithuania

Belarus

Ukraine

Georgia

Black Sea

Ireland

United
Kingdom

North Sea

Denmark

Netherlands

Belgium

Germany

Poland

Czech Rep

Slovakia

Austria

Hungary

Romania

France

Croatia

Italy

Tyrrhenian Sea

Serbia

Bulgaria

Turkey

Portugal

Spain

Greece

Syria

Iraq

Lebanon

Israel Jordan

Morocco

Tunisia

Mediterranean Sea

Egypt

Saudi A.

Kaza



France

Strasbourg

Augsburg • Munich

Salzburg

Austria

Vienna

B

Rennes

Nantes

Tours

La Rochelle

Limoges

Clermont-Ferrand

Lyon

Geneva

Grenoble

Bordeaux

Toulouse

Montpellier

Marseille

Andorra

Zaragoza

Girona

Barcelona

Tarragona

Zürich

Liechtenstein

Switzerland

Milan

Turin

Genoa

Bologna

Pisa

San Marino

Italy

Naples

Graz

Slovenia

Zagreb

Trieste

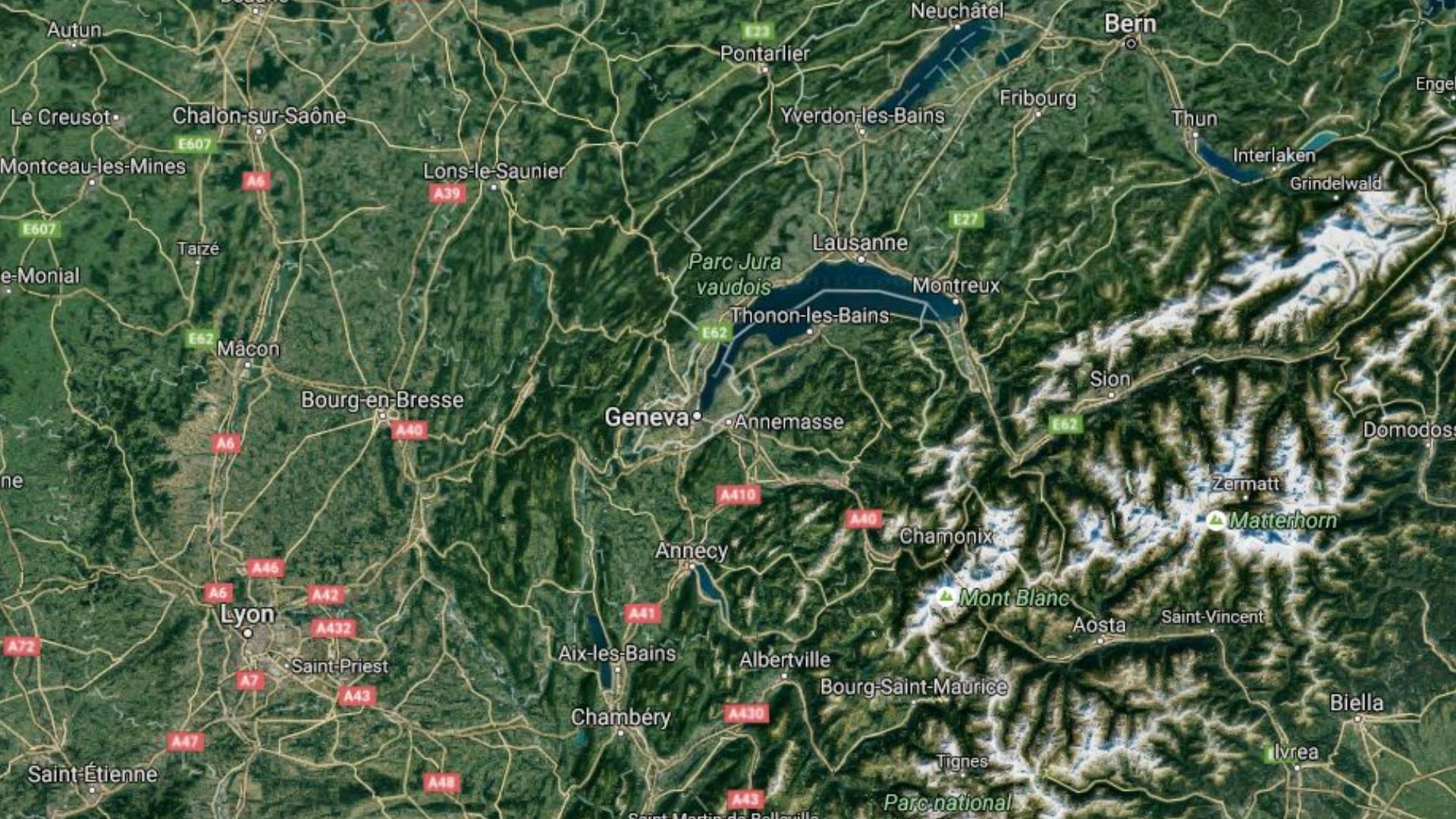
Croatia

Zadar

Adriatic

Corsica

Rome





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?



Why Grade them?

Delirium	Hypothermia
Diarrhea	Paralysis
Dilated pupils	Shock
Fever	Slow pulse
Hallucinations	Slowed breathing
Headache	Abdominal pain
Loss of sensation	Vision changes
	Vomiting

Solanine



Conclusion: Eat chocolate, not potatoes

Why Grade them?



Green Spot



Black Spot



Scurf



Golf Ball



Grey Damage



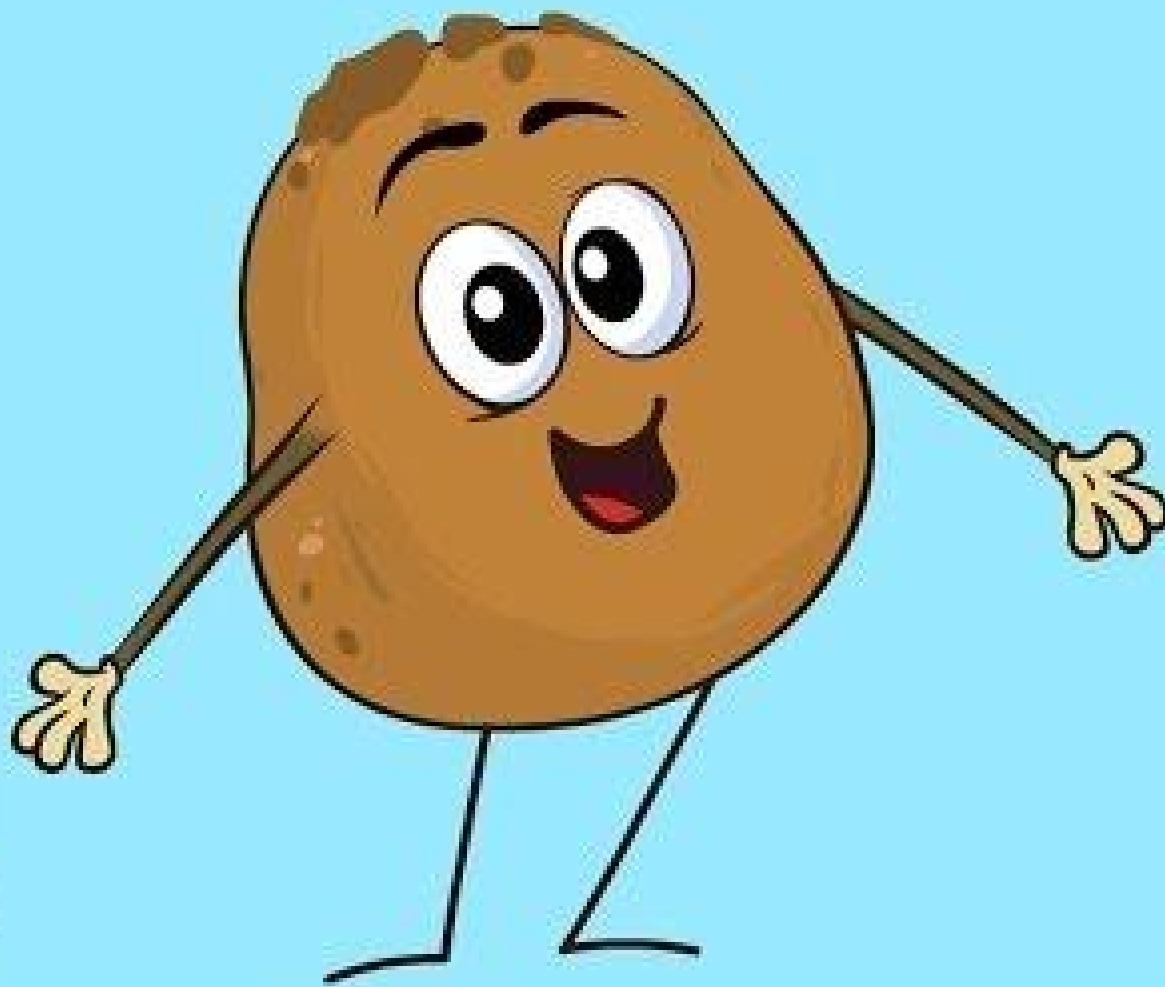
Rot



Fresh Cut



Potato Fruit



Super
Simple
Learning

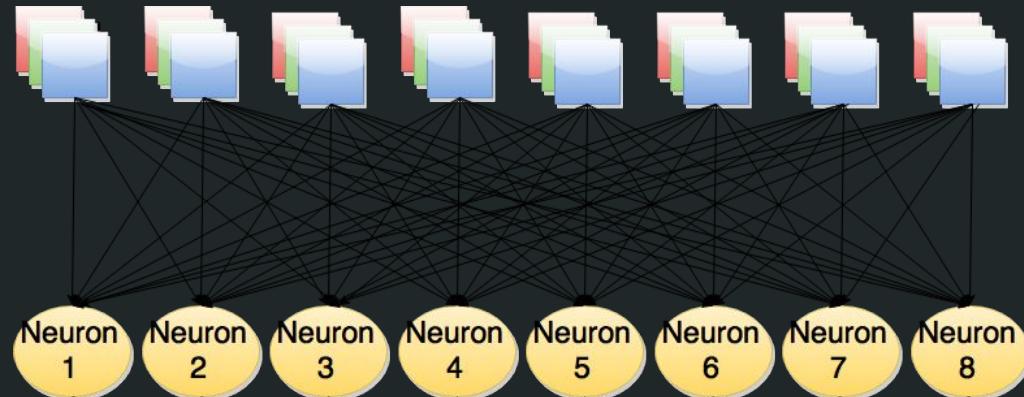
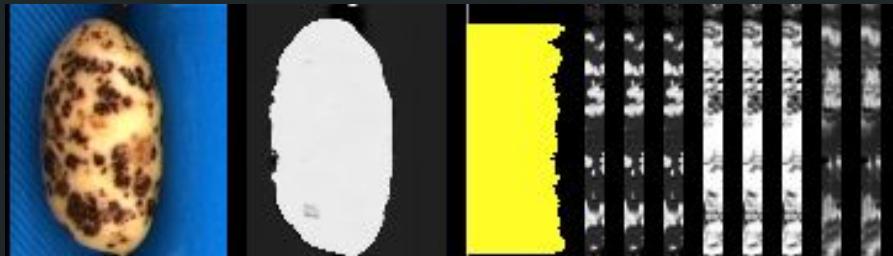


How it is done?

1 mm² resolution

Dimensions equivalent to
old-school caliper

13 categories





6 7 8 9 10

1 2 3 4 5

11
12
13
14
15
16
17

Landjuweel

Data Specs

$8 \times 12 \times 40 = 3840$ MBytes/sec

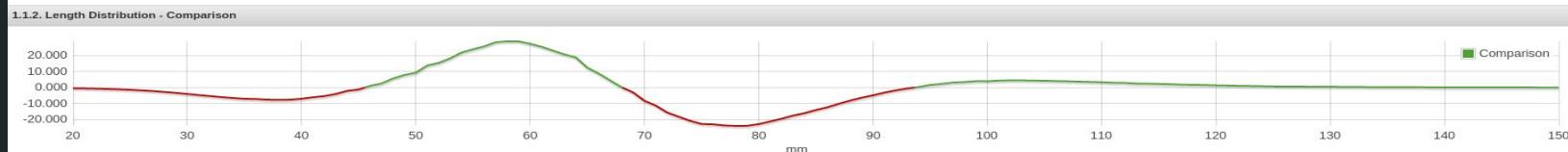
112.78 PBytes/year

Max Latency: 1 sec

Jitter: Close to zero

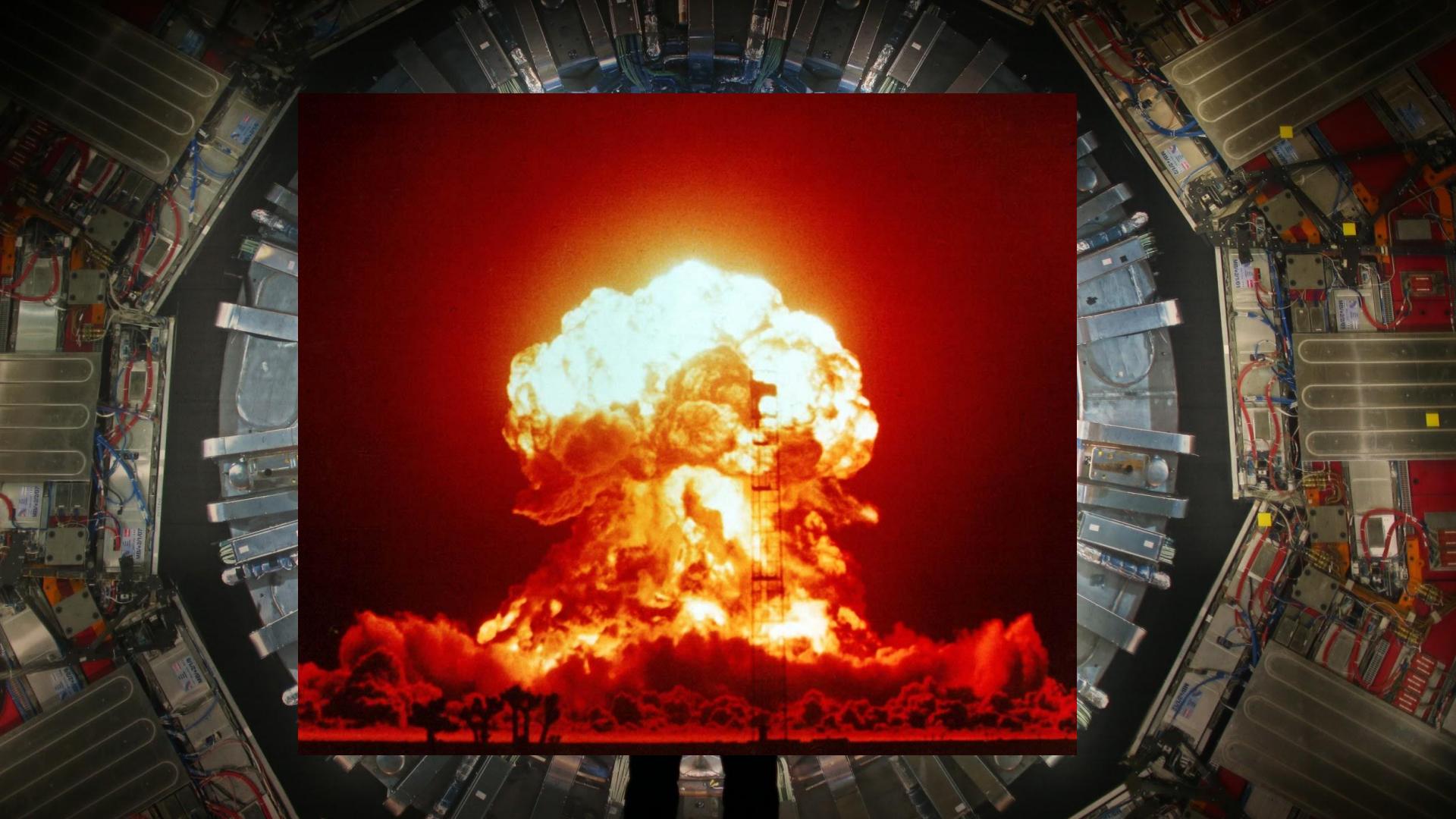
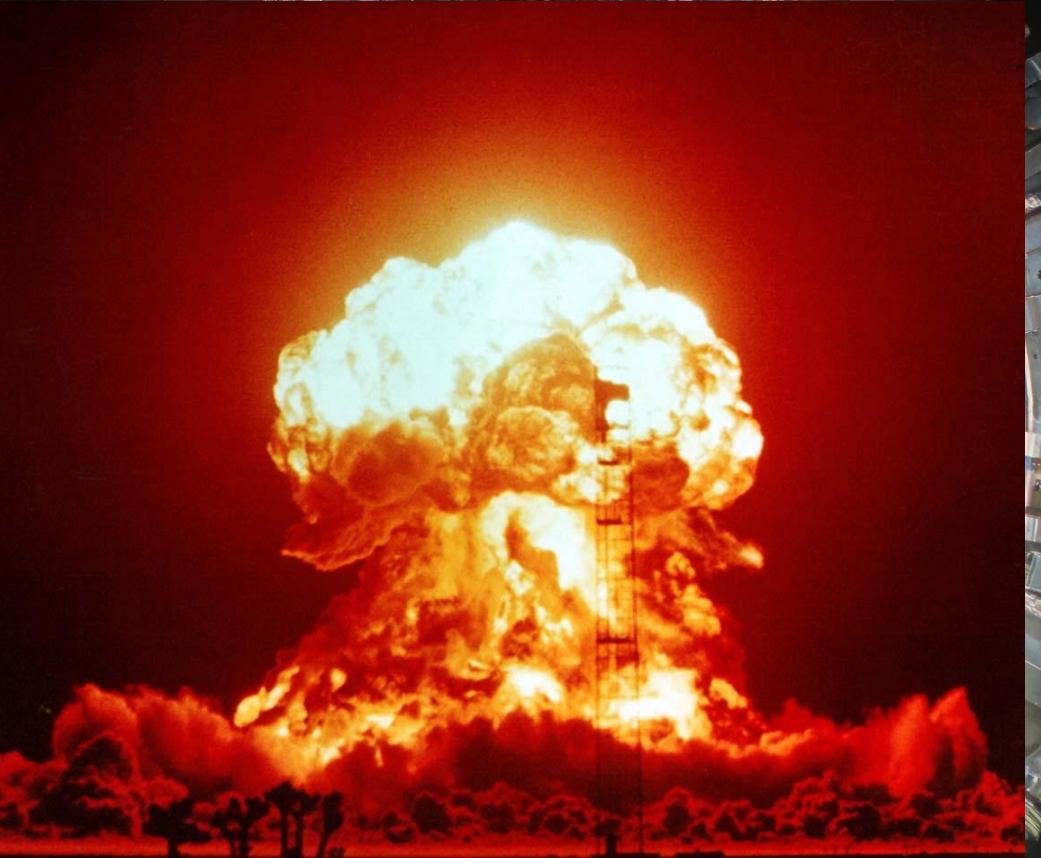
28 tons per hour

Web services enable

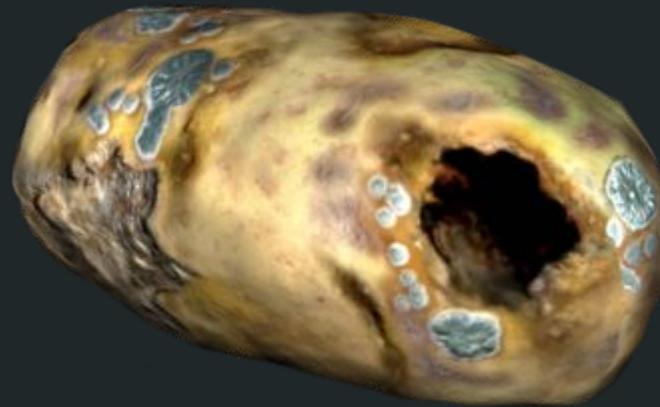


30 Pbytes/year





CELOX XT-P Potato Grader



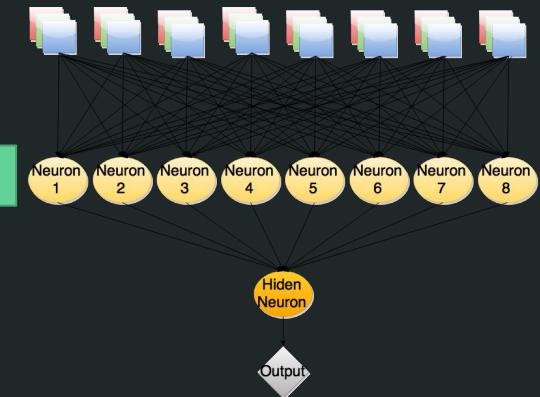
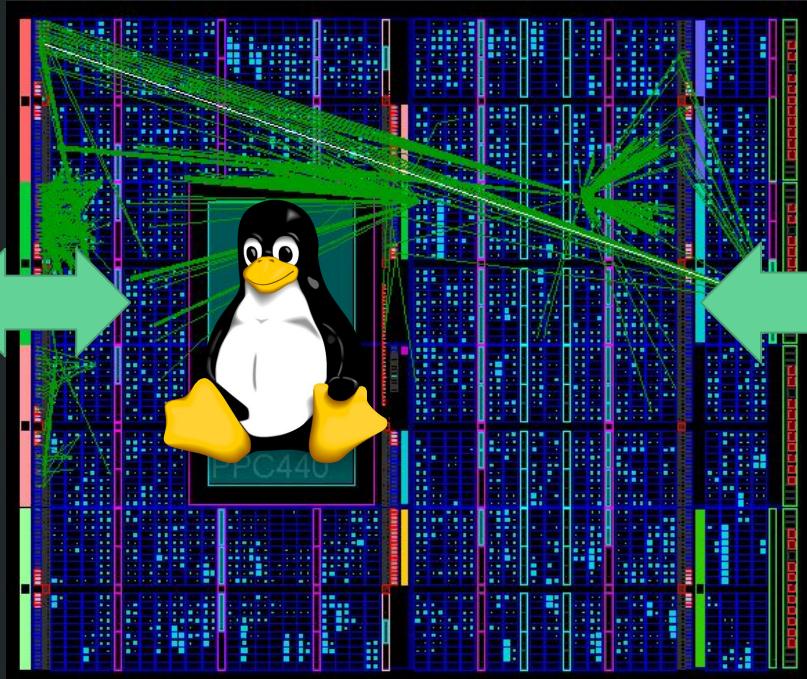
Potato Grader: Celox v2002



Celox V1



Celox V2



Celox V3

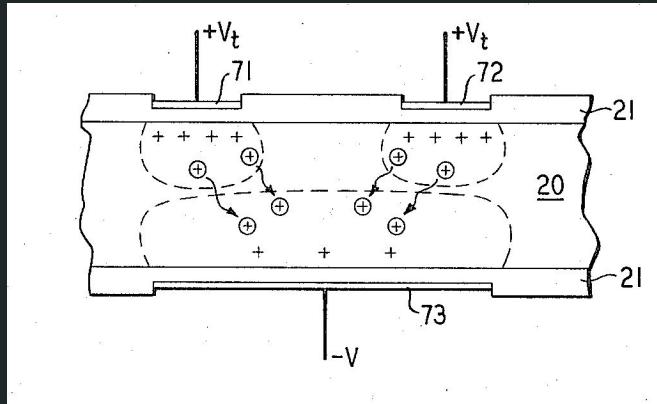






SPECIAL
OFFER

The first CCD

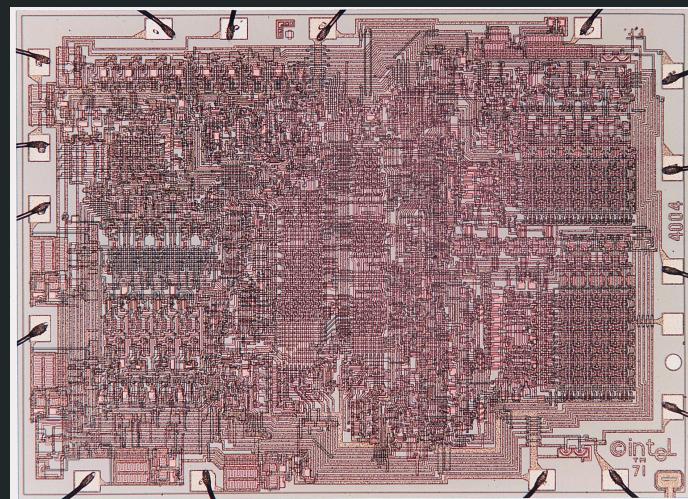
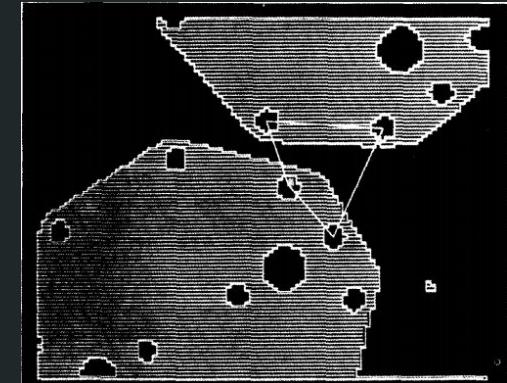
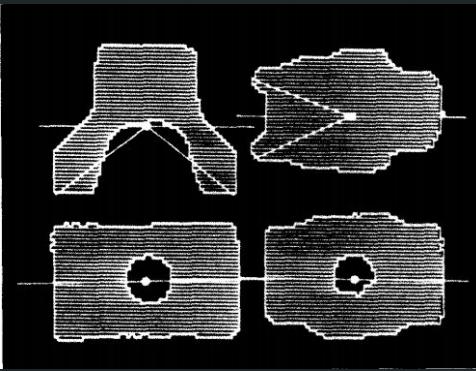


INVENTORS **W. S. BOYLE**
G. E. SMITH
BY
[Signature]

1969



SRI Vision Module



1972

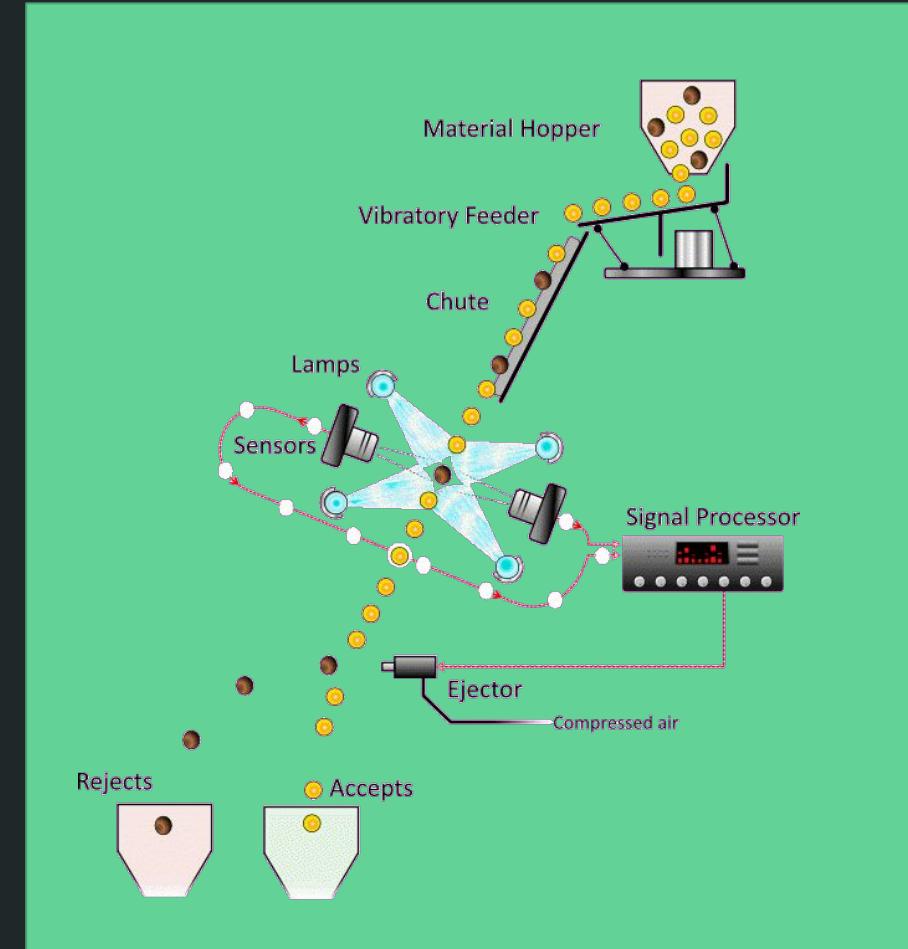
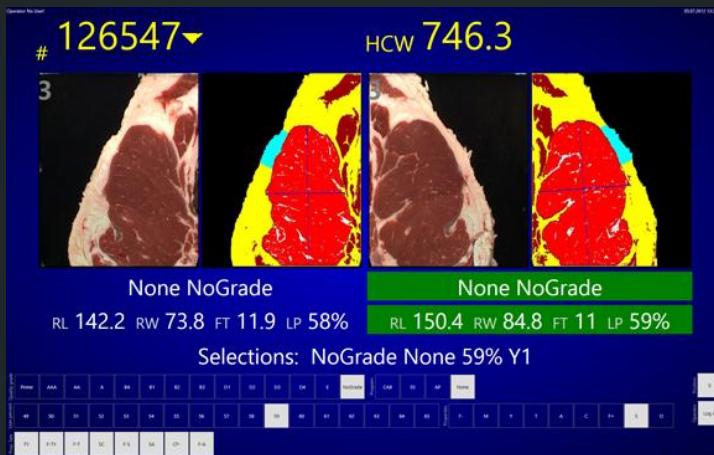


Custom-designed computer vision systems are being applied to specific manufacturing tasks. Current development may lead to general-purpose systems for a broad range of industrial applications.

Gerald J. Agin, 1980

Stanford Research Institute

Agin, Gerald J. "Computer vision systems for industrial inspection and assembly." *Computer* 5 (1980): 11-20.



Bio-Sensor

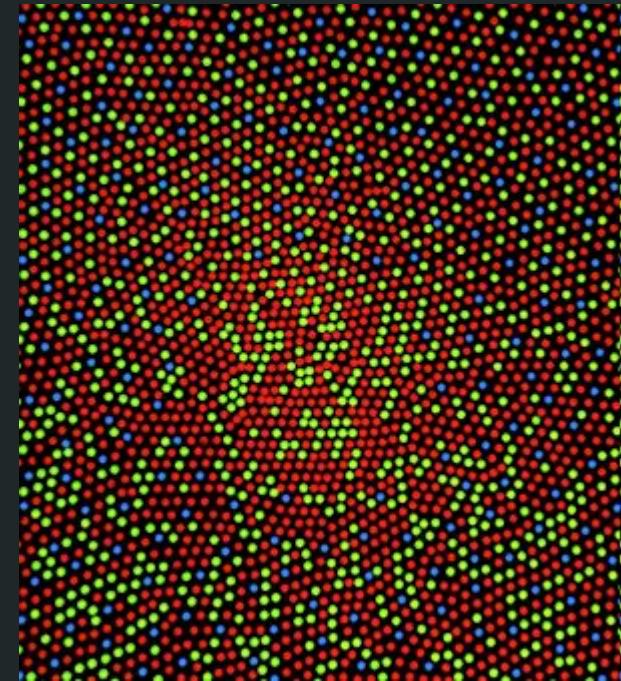
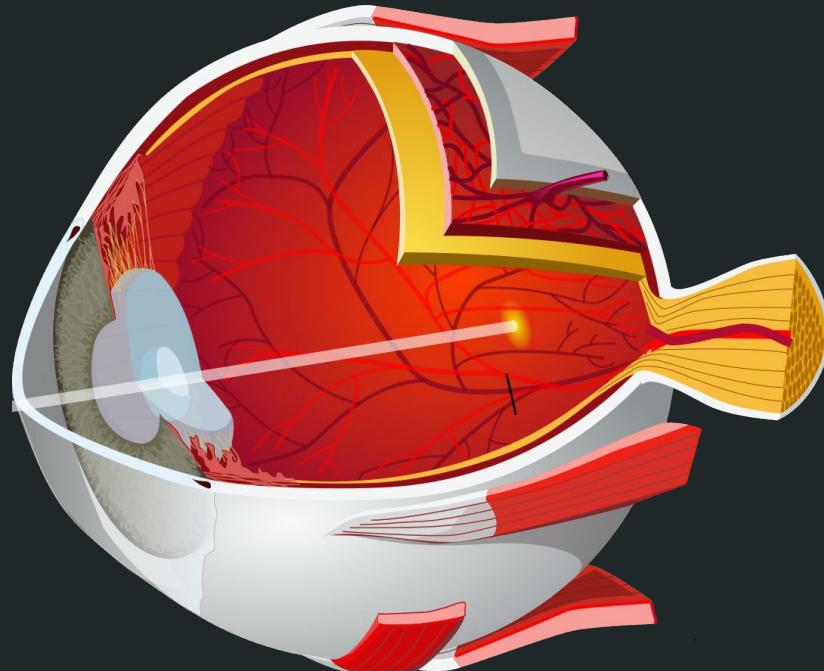


Image Credit: Wikipedia CC BY-SA 3.0

Sensor

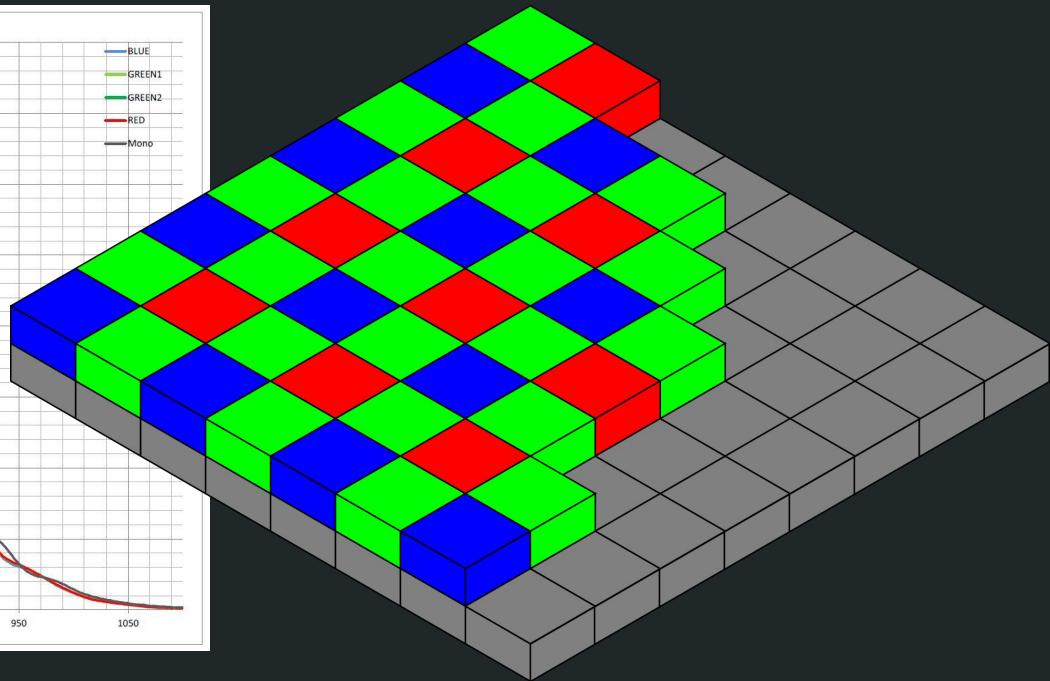
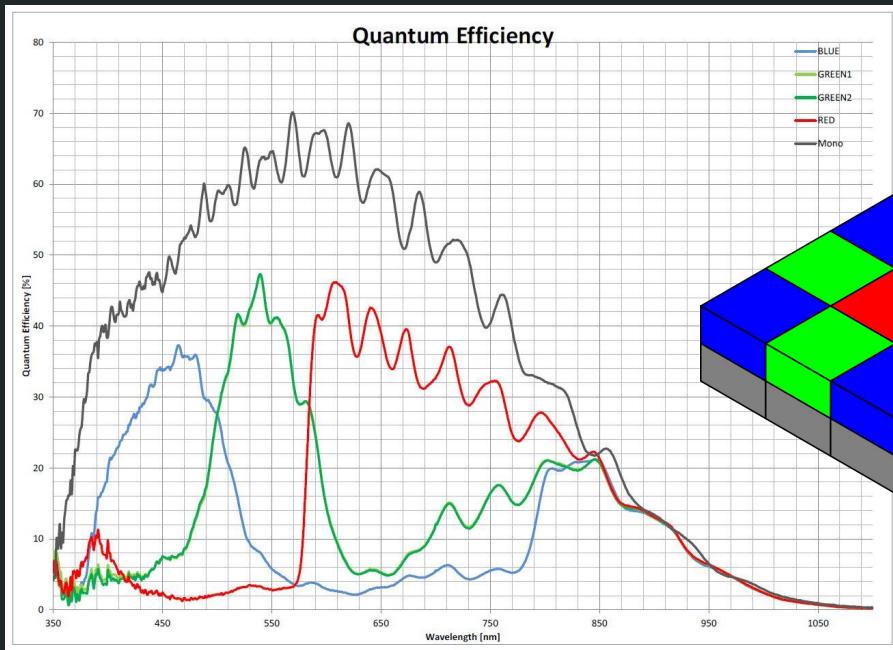
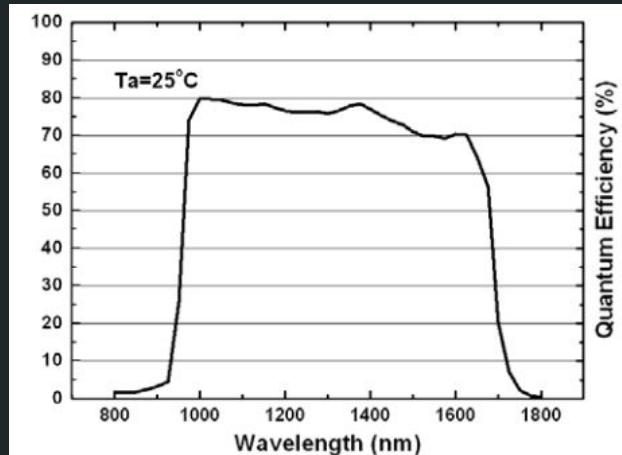
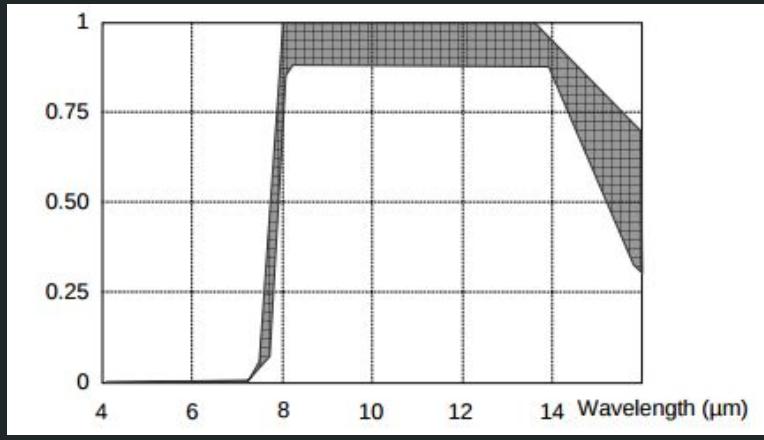


Image Credit: Wikipedia CC BY-SA 3.0

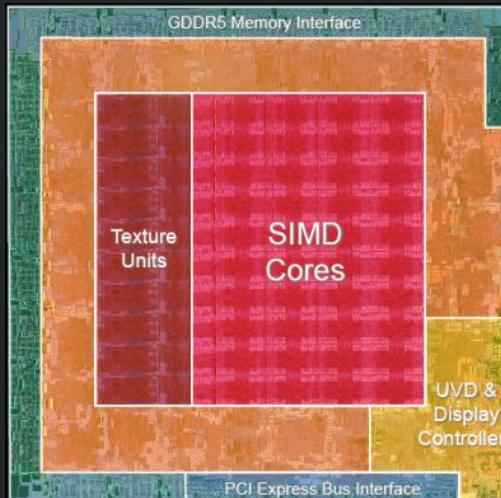
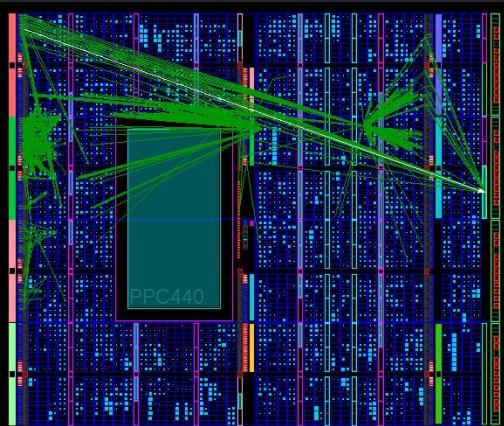
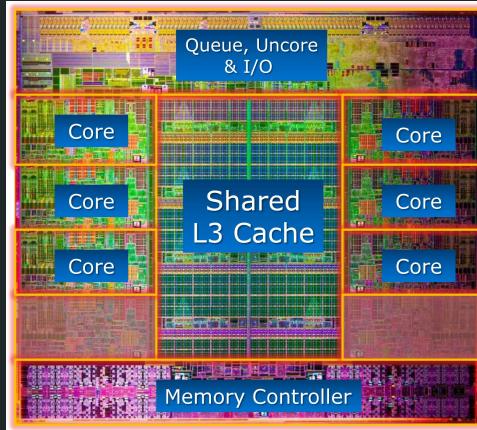
Other sensors



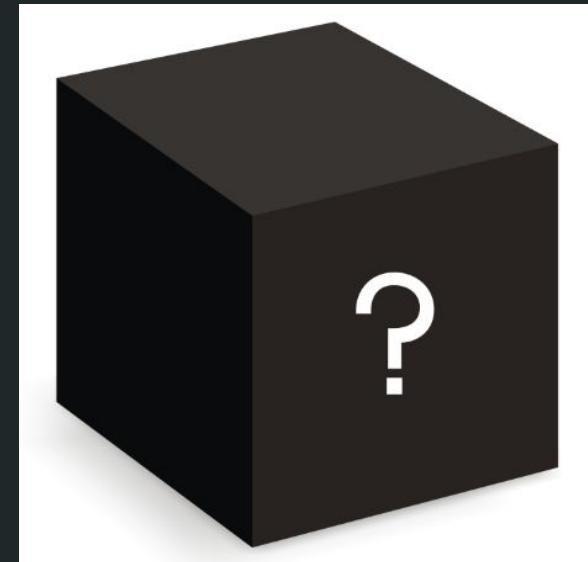
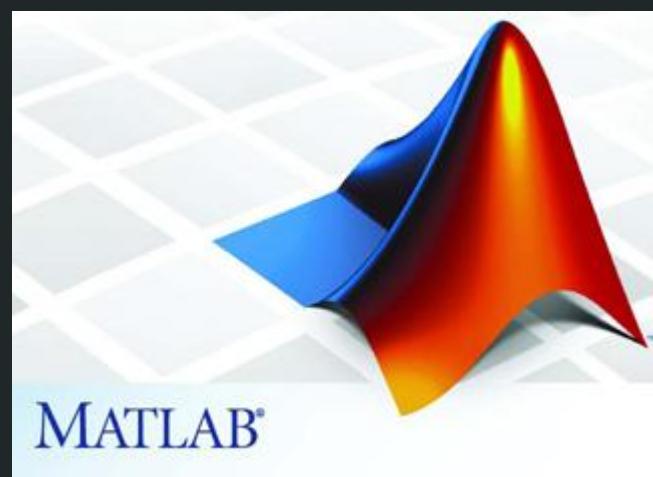
Image Credit: Wikipedia CC BY-SA 3.0



Processing



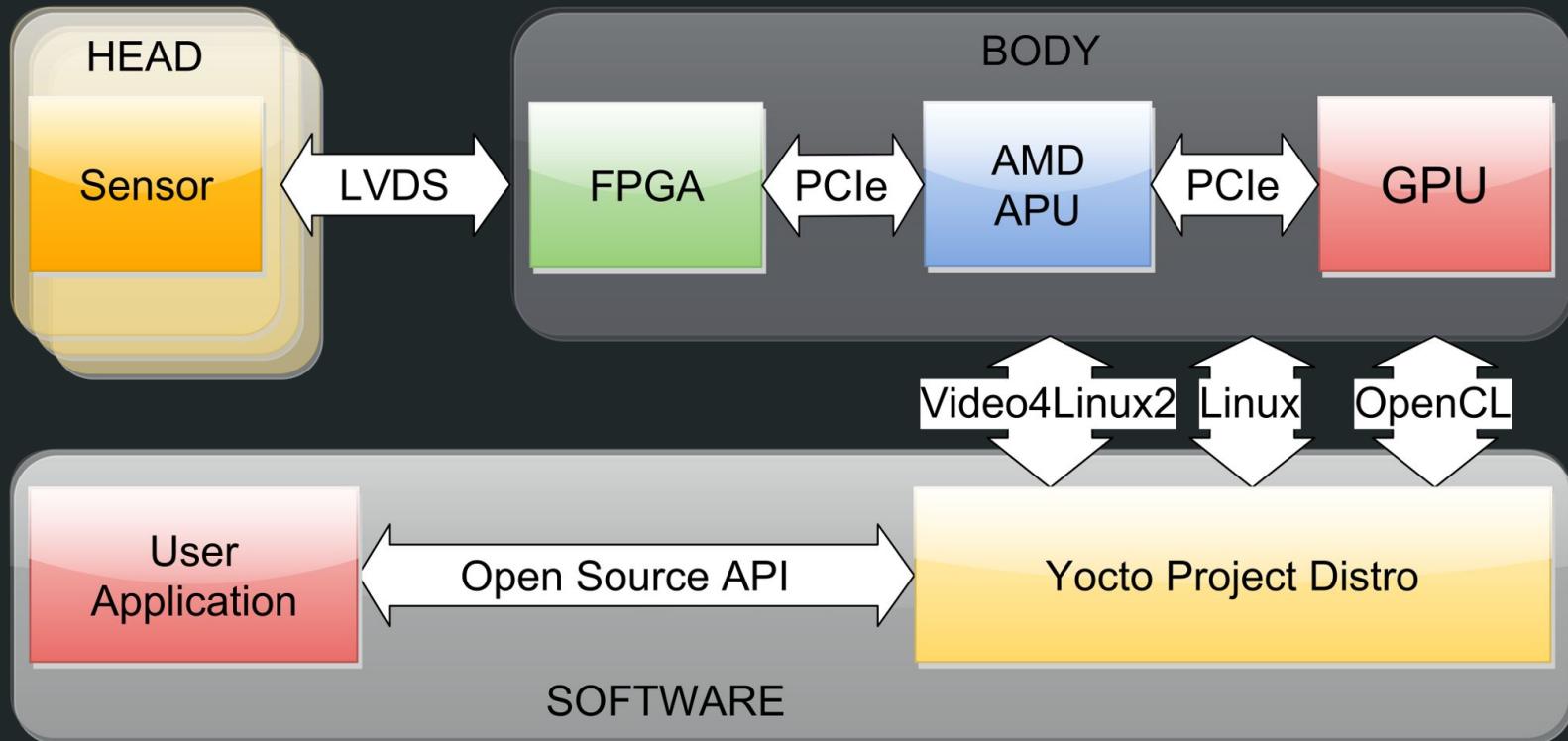
Vision Software



Modular Open Source Camera



Hardware Modules



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.

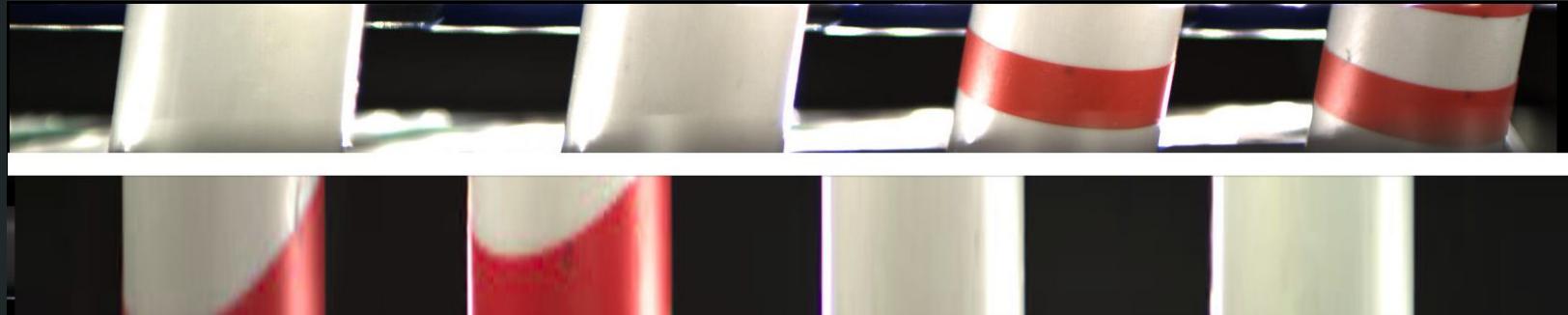
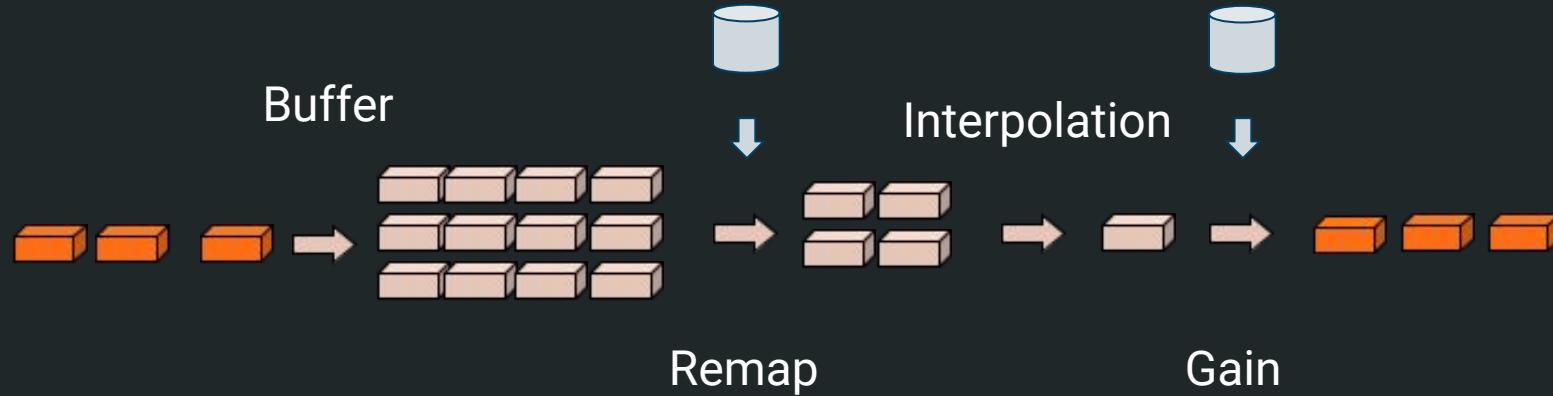
YEAH!



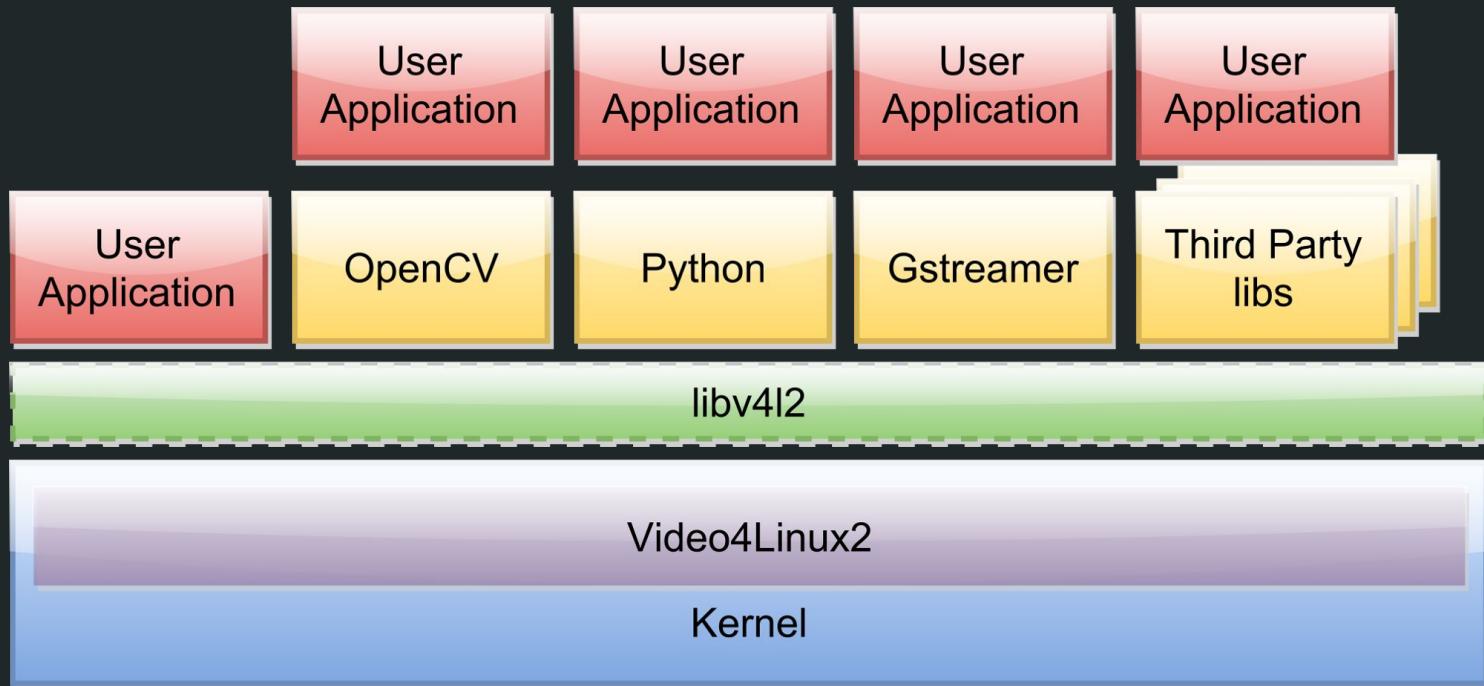
SOON:

SITUATION:
THERE ARE
15 COMPETING
STANDARDS.

Generic Operations



Software Stack

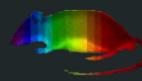
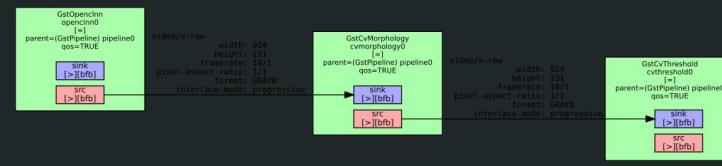


Why Open Source ?

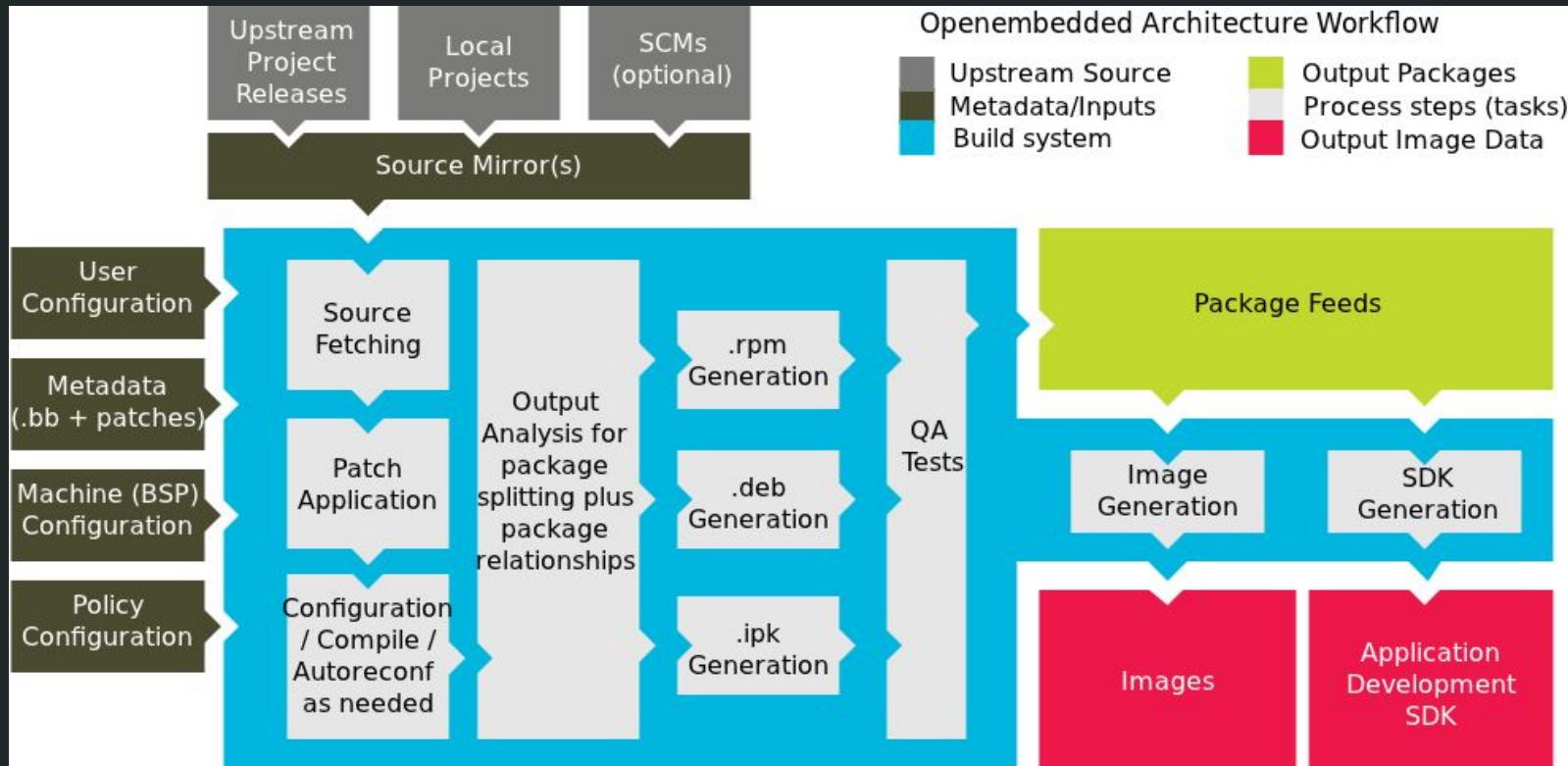
Jupyter Milk_clasification Last Checkpoint: 13 hours ago (autosaved)

File Edit View Insert Cell Kernel Help Cell Toolbar: None Python 2 O

```
In [1]: from __future__ import division, print_function  
%matplotlib inline  
from matplotlib import pyplot as plt  
import matplotlib.cm as cm  
import numpy as np  
import v4l2, utils  
  
In [2]: plt.rcParams['image.cmap'] = 'spectral'  
cmap = plt.get_cmap('jet')  
from skimage import io, segmentation as seg, color  
  
In [3]: url = 'images/montage.pgm'  
image = (utils.read_pgm(url) / 257).astype(np.int32)  
rgba_img = cmap(image)  
rgb_img = np.delete(rgba_img, 3, 2)  
labels = seg.slic(rgb_img, n_segments=15, compactness=20, sigma=2)  
utils.imshow_all(rgb_img, labels.astype(float)/ labels.max())  
  
In [4]: rgb_img = utils.read_rgb_from_pgm('images/montage/739.pgm', 'images/montage/833.pgm', 'images/montage/874.pgm')  
labels = seg.slic(rgb_img, n_segments=10, compactness=10, sigma=2)  
utils.imshow_all(rgb_img, labels.astype(float)/ labels.max())
```



Yocto Project



Our Upstream Contributions

- **Linux Kernel:** 200+ patches. Including a 9+ year old bugfix.
- **U-boot:** 25 patches. Maintainers of Virtex PowerPC boards.
- **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.
- **Cipeak:** 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!

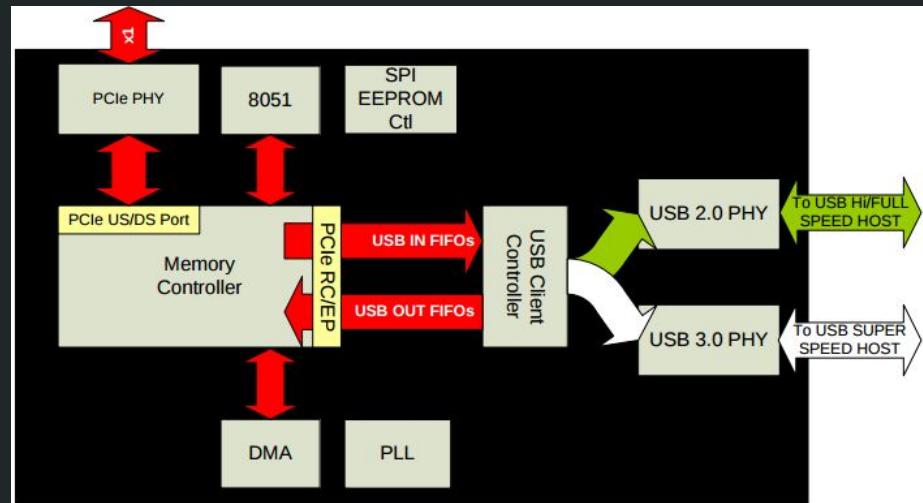
[1] Kernel Newbies Autoresponder:

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)?

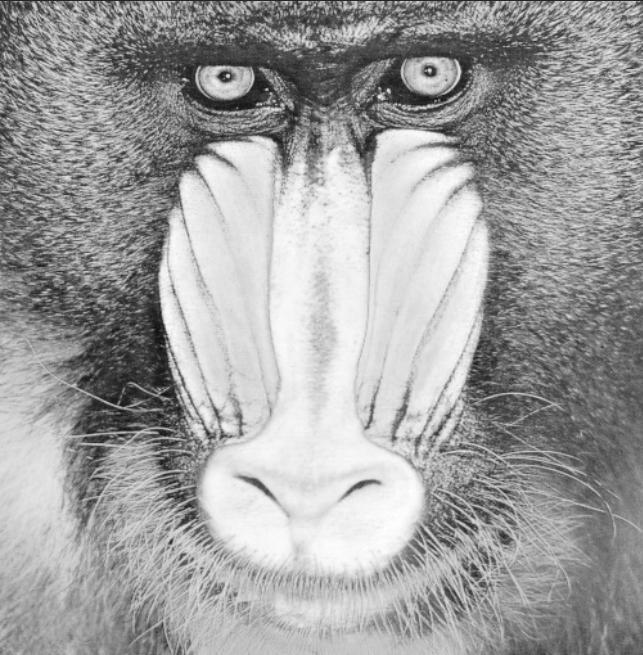


War Story: USB Gadget 3380

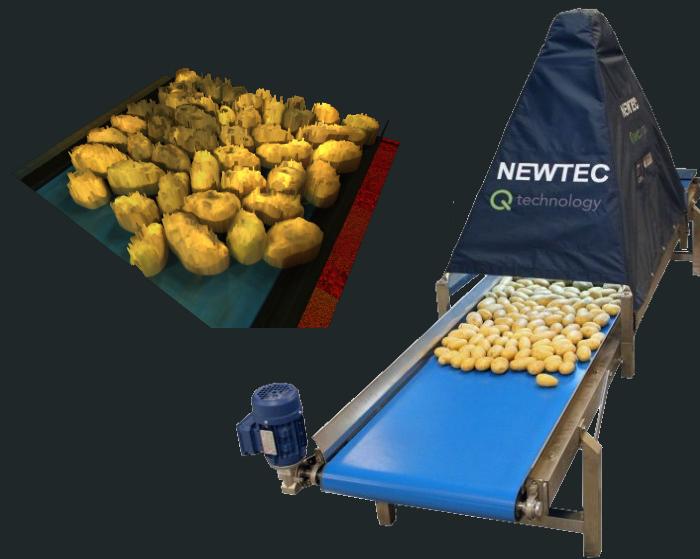
- Upstream driver
- Access to engineers from:
 - Samsung
 - Texas Instruments
 - Intel



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

<http://qtec.com>

info@qtec.com

@ribalda