

PharoVX

Accelerated computer vision in Pharo

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About

Me:

- A C++ programmer
- Playing with Smalltalk since 2009
- **Itseez** employee since 2013

PharoVX:

- An interface to OpenVX from Pharo

Cool, but... What is OpenVX?

OpenVX

- A standard for accelerated computer vision
- Released by Khronos group
- Specifies a set of optimized functions
- Hardware vendors will implement it for various platforms

<https://www.khronos.org/openvx/>



Companies behind OpenVX



Itseez is the OpenVX working group chair

OpenVX Concepts

1. **Express** your computer vision task as a graph
 - a. Operate with nodes and kernels
 - b. Each node (kernel) represents a single accelerated operation
2. Ask hardware to **perform** the task
3. That's it!

OpenVX Example



Convert to
YUV

Extract "Y"

Gaussian
blur

Canny
edge
detector



OpenVX Example

Source and destination images are available in the host (application memory)



Convert to YUV

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OpenVX Example

Source and destination images are available in the host (application memory)



Convert to YUV

Intermediate data is somewhere in the hardware memory (inaccessible)

Gaussian blur

Canny edge detector



OpenVX Example

Source and destination images are available in the host (application memory)



Canny edge detector

How it is executed - God (vendor) only knows!

Gaussian blur

Intermediate data is somewhere in the hardware memory (inaccessible)

Convert to YUV

Extract "Y"



OpenVX

1. Reference implementation is available on the Khronos website
2. More optimized vendor implementations to come...
3. But we can play with it right now!

PharoVXBasicExample>>#runChannelExtractFile

VX

- Last Modified Classes
- Most Viewed Classes
- Work
- PharoVX
 - PharoVX
 - Constants
 - Core
 - Examples
 - Tests

PharoVXBasicExample -- all -- as yet unclassified

- runAccumulateWeighted
- runAnd
- runBox3x3
- runCannyFile
- runChannelCombine
- runChannelExtract
- runChannelExtractFile
- runDilate3x3
- runEqHist
- runErode3x3

Groups Hierarchy Class side Comments History Navigator

```
runChannelExtractFile
| ctx in tmp out g|
ctx := VXContext new.
g := VXGraph new: ctx.
in := (Form fromFileName: '/tmp/lena.jpg') asVXImage: ctx.
tmp := VXImage virtual: g format: VX_DF_IMAGE_YUV4.
out := VXImage new: ctx width: in width height: in height format: VX_DF_IMAGE_U8.
g
  colorConvert: in to: tmp;|
  channelExtract: tmp channel: VX_CHANNEL_Y to: out.
g verify; process.
out asForm inspect
```


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PharoVX

Inspector on a Form (Form(512x512x32))

a Form (Form(512x512x32))

Raw Morph Meta



PharoVX

- Binding to core OpenVX functions
- Built with NativeBoost
- Provides interface to standard nodes (VX 1.0)
- Works with Khronos implementation
- ...Highly experimental: **written in a week!**

<http://smalltalkhub.com/#!/~DmitryMatveev/PharoVX>

Demo

Sample code: running Canny

runCanny

```
| ctx g in yuv y blr t out |
ctx := VXContext new.
g   := VXGraph new: ctx.
t   := VXThreshold new: ctx thresholdType: VX_THRESHOLD_TYPE_RANGE dataType: VX_TYPE_UINT8.
t lower: 64; upper: 200.
in  := (Form fromFileName: '/tmp/lena.jpg') asVXImage: ctx.
yuv := VXImage virtual: g format: VX_DF_IMAGE_YUV4.
y   := VXImage virtual: g.
blr := VXImage virtual: g.
out := VXImage new: ctx width: in width height: in height format: VX_DF_IMAGE_U8.
g   colorConvert: in to: yuv;
    channelExtract: yuv channel: VX_CHANNEL_Y to: y;
    gaussian3x3: y to: blr;
    canny: blr threshold: t gradSize: 3 normType: VX_NORM_L2 to: out.
g verify; process.
^out asForm
```

Status: OpenVX 1.0

AbsDiff	Channel extr.	Gaussian pyr.	Multiply	Table lookup
Accumulate	Color convert	HalfScale Gauss.	Not	Threshold
AccumulateW	Convert depth	Harris corners	OptFlowPyrLK	Warp affine
AccumulateSqr	Convolve	Histogram	Or	Warp perspective
Add	Dilate3x3	Integral	Phase	
And	EqualizeHist	Magnitude	Remap	
Box3x3	Erode3x3	MeanStdDev	Scale	
Canny	FAST corners	Median3x3	Sobel3x3	
Channel comb.	Gaussian 3x3	MinMaxLoc	Subtract	

Status: PharoVX 16/Jul/2015

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Summary

- PharoVX is currently a prototype:
 - Provides core objects and almost all standard kernels
 - Fragile, buggy, and so on - yes!
 - Pretty close to plain C API - probably needs to be “Smalltalkized”
- Computer vision in Smalltalk is fun!
- Feel free to join :-)

Questions

Contacts and resources

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PharoVX/OpenVX

- <http://dmitrymatveev.co.uk/pharovx/>
- <http://smalltalkhub.com/#!/~DmitryMatveev/PharoVX>
- <http://khronos.org/openvx/>
- <http://itseez.com/>

Thanks!