



OpenCV China



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深圳市人工智能与机器人研究院

OpenCV 4.x & 5.0 New Features

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OpenCV is ...

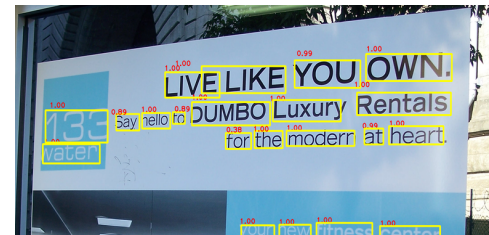
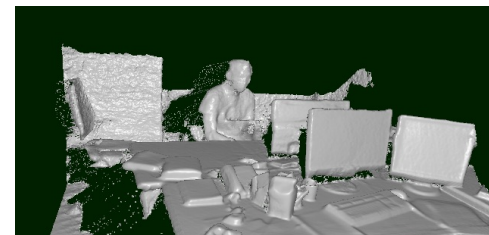
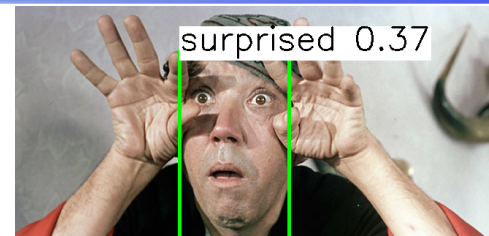
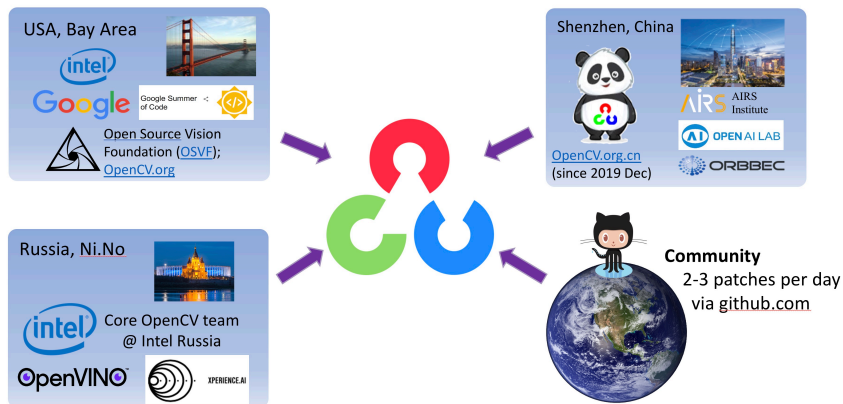


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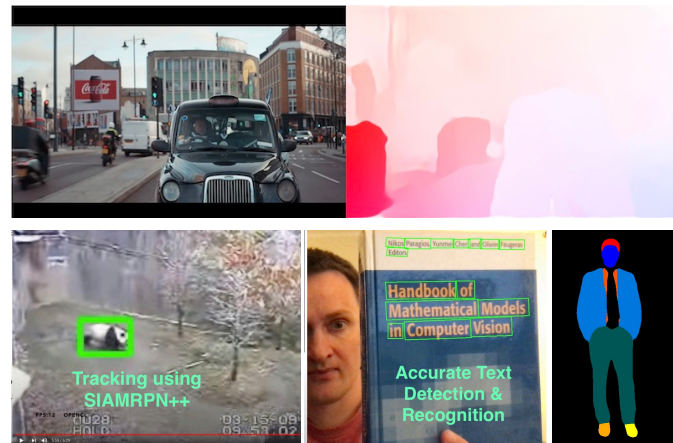
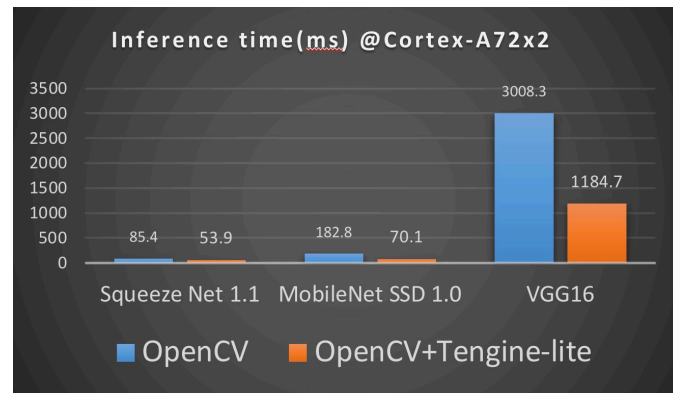
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- One of the most popular Computer Vision Libraries: <http://opencv.org>
- Free for research and commercial use
- Implemented in **C/C++** with automatically generated bindings for **Python, Java, JavaScript**
- Big, but modular: **>1M** lines of code; **70+** modules (**opencv** + **opencv_contrib**)
- Very popular: downloaded **21M** times from Source Forge; **10K** times/week from <http://github.com/opencv> ; $\approx 52K$ ★ on GitHub.
- Actively developed: **>5 patches per day** since 2012 & well-tested
- Developed by the international team:



OpenCV 4.5, 5.0 (2020'Q4-2021'Q1)

- **20-th** year anniversary:
<http://opencv.org/anniversary>
- Revised API using C++ 14 & Python 3.x.
- Better performance on the edge (**~2.5x** faster DL inference on **ARM**, added **RISC-V** port)
- **Support for more DL topologies** (body part segmentation, person reID, facial features detection, tracking & optflow, OCR ...)
- Better support for **3D**



OpenCV Deep Learning Module



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- Easy-to-use API
- Supports pre-trained networks in different formats
- Extendible architecture with several backends already available

Unit tests (1000+) + Examples (20+)



Simple C++ & Python Interface

DNN Graph Engine + Layers (~50)

Backend API

Default cross-
platform
backend

`parallel_for()`

Univ. intrin

OpenCL

OpenVINO™

High-speed
inference on
Intel CPUs,
GPUs, VPUs



For GPUs,
including
mobile



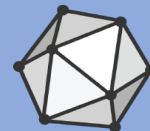
High-speed
inference on
ARM



High-speed
inference on
Nvidia GPUs

Custom
backends
are possible

Caffe



ONNX



The Body Parsing Example



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```
1  #!/usr/bin/env python
2  import sys, numpy as np, cv2 as cv
3
4  def postprocess(out, input_shape):
5      head_out, tail_out = np.split(out, indices_or_sections=[1], axis=0)
6      head_out = head_out.squeeze(0)
7      tail_out = tail_out.squeeze(0)
8
9      nparts = head_out.shape[0] # 20
10     head_out = [cv.resize(head_out[i, ...], dsize=input_shape) for i in range(nparts)]
11     tail_out = [cv.resize(tail_out[i, ...], dsize=input_shape) for i in \
12                 [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 14, 17, 16, 19, 18]]
13     labels = np.zeros(head_out[0].shape, dtype='uint8')
14     maxprob = np.zeros(head_out[0].shape, dtype=head_out[0].dtype)
15
16     for i in range(nparts):
17         avg = (head_out[i] + np.flip(tail_out[i], axis=1))*0.5
18         labels[avg > maxprob] = i
19         maxprob = np.maximum(maxprob, avg)
20
21     height, width = labels.shape
22     colors = [(0, 0, 0), (0, 0, 128), (0, 0, 255), (0, 85, 0), (51, 0, 170), (0, 85, 255),
23              (85, 0, 0), (221, 119, 0), (0, 85, 85), (85, 85, 0), (0, 51, 85), (128, 86, 52),
24              (0, 128, 0), (255, 0, 0), (221, 170, 51), (255, 255, 0), (170, 255, 85),
25              (85, 255, 170), (0, 255, 255), (0, 170, 255)]
26     segm = np.stack([colors[idx] for idx in labels.flatten()])
27     segm = segm.reshape(height, width, 3).astype(np.uint8)
28     return segm
29
30 def parse_human(net, image):
31     image_rev = np.flip(image, axis=1)
32     input = cv.dnn.blobFromImages([image, image_rev], mean=(104.00698793, 116.66876762, 122.67891434))
33     input_h, input_w = input.shape[2:]
34     net.setInput(input)
35     output = net.forward()
36     return postprocess(output, (input_w, input_h))
37
38 net = cv.dnn.readNet("lip_jppnet_384.pb")
39 image = cv.imread(sys.argv[1])
40 output = parse_human(net, image)
41 cv.imshow("parsed body", output)
42 cv.waitKey()
```



LIP-JPPNet



See

https://github.com/opencv/opencv/blob/master/samples/dnn/human_parsing.py

for more advanced version of the example

Selected DNN Examples & Tutorials



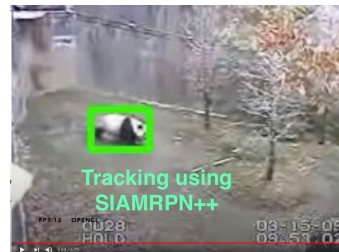
• OpenCV Examples

(<https://github.com/opencv/opencv/tree/master/samples/dnn>):

- person_reid.py — person reidentification model (using 768-element descriptors)
- object_detection.py — object detection (now includes YOLO4 support)
- action_recognition.py — recognition of one of 400 actions using 3D Resnet trained on Kinetics dataset
- dasiamrpn_tracker.py, siamrpnpp.py — trackers using “Distractor aware SiamRPN” and “SiamRPN++” networks, respectively.
- text_detection.cpp, scene_text_detection.cpp & scene_text_recognition.cpp, scene_text_spotting.cpp — a family of text detection & recognition examples. See the tutorials https://docs.opencv.org/master/d4/d43/tutorial_dnn_text_spotting.html and https://docs.opencv.org/master/d9/d1e/tutorial_dnn_OCR.html

• OpenCV Contrib Examples

- dnn_superres/samples/dnn_superres_*.cpp — a family of image superresolution algorithms using various topologies.
- wechat_qrcode/samples/qrcode.py — state-of-art Qrcode detector by Tencent.



OpenCV 5.x plans



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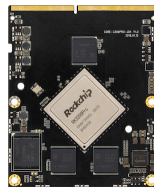
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- **Better performance on edge devices (ARM, RISC-V)**

- Faster traditional vision
- Faster DL inference

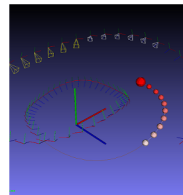
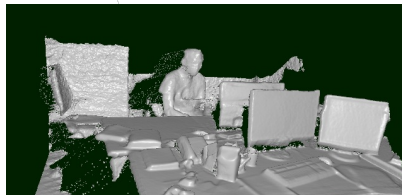
- **Greatly improved OpenCV DNN**

- Support for ML accelerators (by Rockchip, Mediatek, HiSilicon etc.)
- FP16/INT8 inference paths
- More sophisticated ONNX importer
- Native Intel's IR format support ("opens" Open Model Zoo for all OpenCV users)
- Extendible architecture to enable external DNN backends
- Many more topologies and examples (including 1D case (e.g. for audio/speech processing)!)



- **First-class 3D vision functionality**

- 3D module
- SLAM module
- Advanced camera/sensor calibration functionality
- Support for various 3D sensors



Thank You!

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