OpenCV with Python for Visual Analytics

Faculty Development Programme on
“Data Analytics using Python/R Programming”

Department of Computer Science and Engineering,
National Institute of Technology Puducherry, Karaikal
Sponsored by: AICTE Training and Learning Academy (ATAL)

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About me

1. PhD student (ESR-7 for MORE-ITN Project)
2. Did work for 2 years as a research engineer for Clear Image AI. lead and contributed to several projects on data pipelines, neural networks and edge AI.

Outline

- Introduction to Computer Vision and Vision Analytics
- Applications and Methods of Computer Vision
- Python for Vision Analytics
- OpenCV
- Hands-on Examples
- Question and Discussion

Introduction

- What is computer vision?

  It’s all about the ways computer extracts information from images and videos.

What We See

What Computers See

Applications of Computer Vision

- Robotics
- Document Analysis
- Medical Imaging
- Sports Analytics
- Retail
- Warehouse
- Autonomous driving
- Surveillance
- Environmental Monitoring
- Structural Inspection
- …. etc

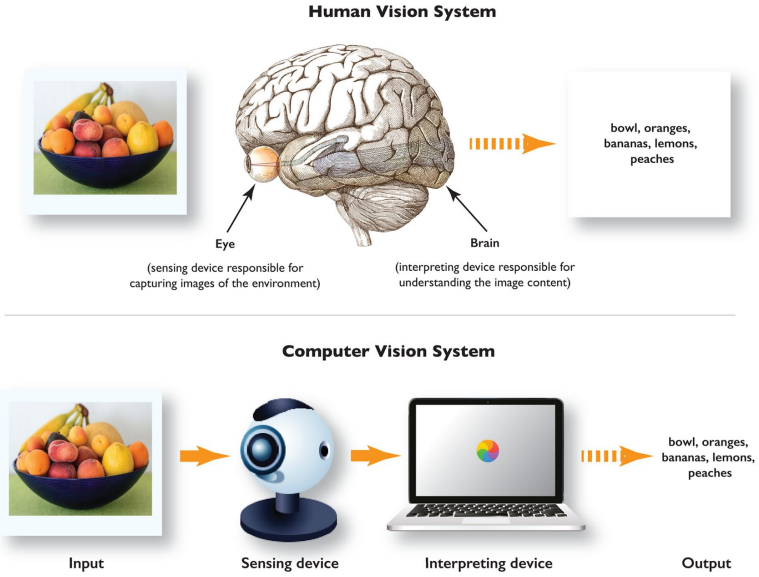
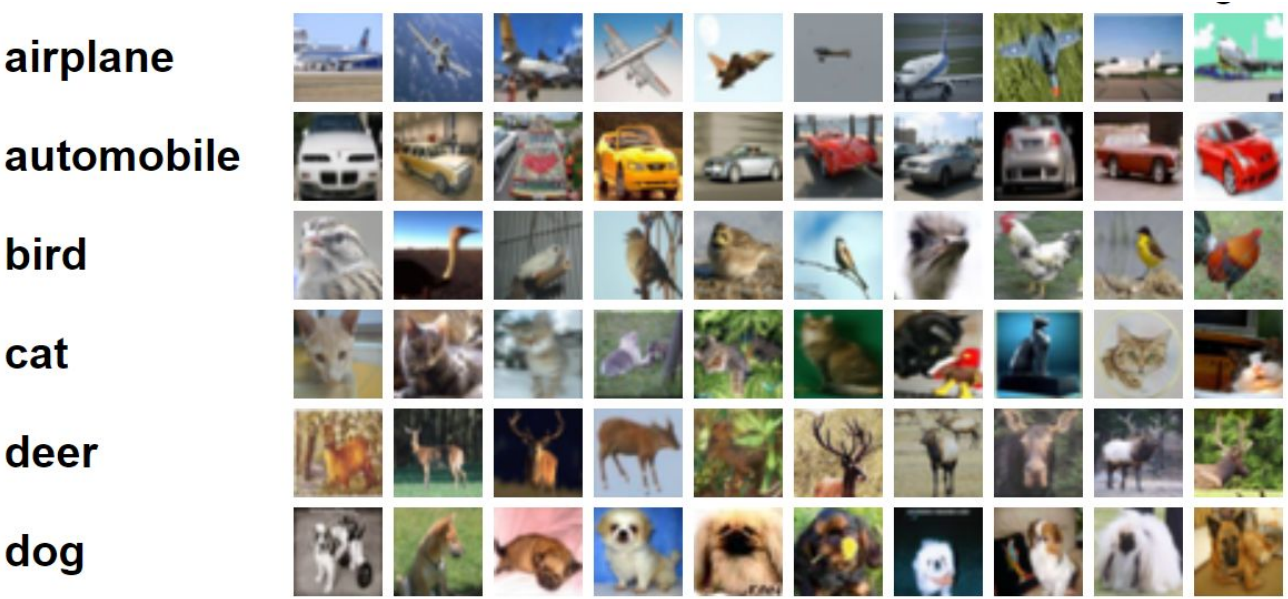


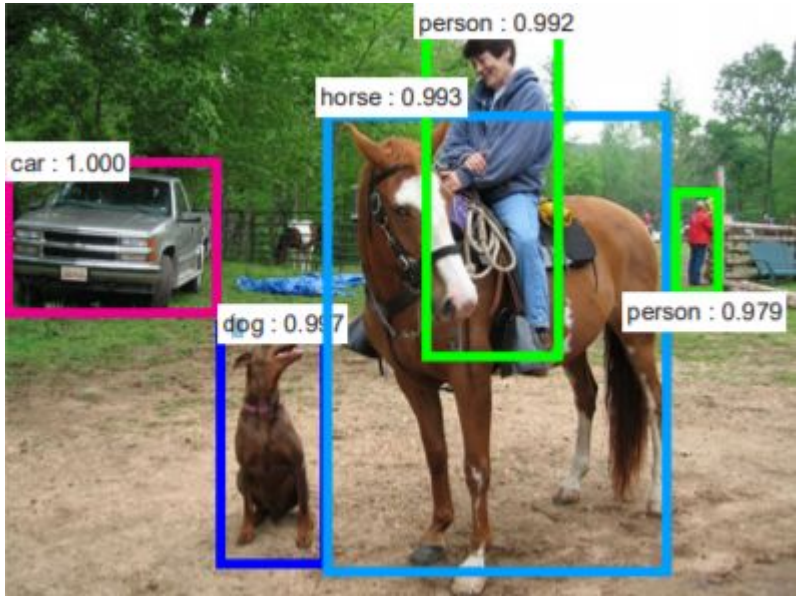
Image Classification



CIFAR10 dataset

Object Detection

Classification(Semantic Attribute) +
Localization(position in image)

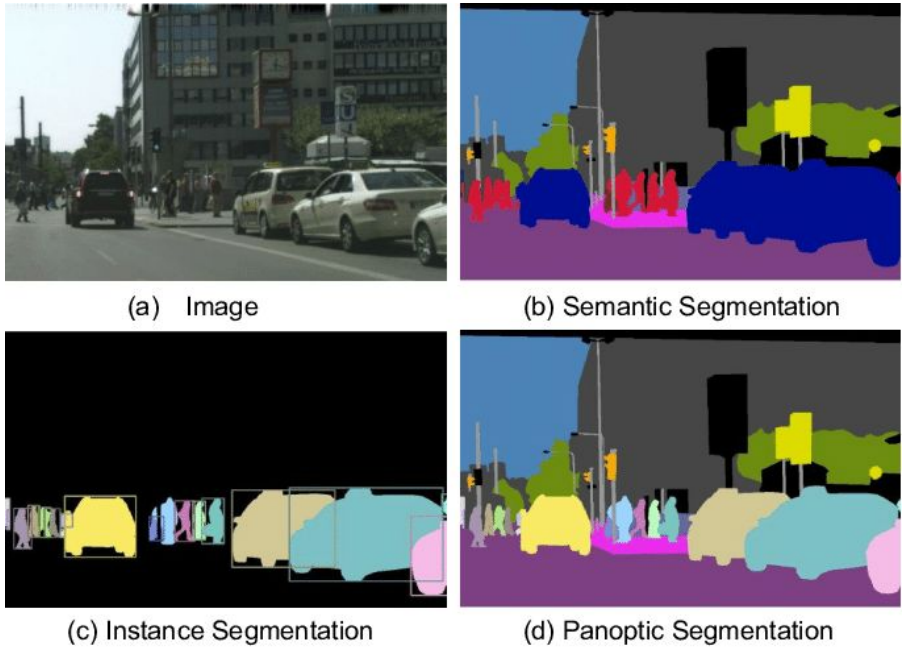


Img. FasterRCNN, Ren et al.

Segmentation

Classifies on the pixel-level.

- Semantic
- Instance
- Panoptic



Img. Deep Learning for Localization and Mapping, Wang et al.

Tracking

To detect/segment an object, assign an id and localize in consecutive frames of video.

FastMOT: High-Performance Multiple Object Tracking Based on Deep SORT and KLT

Pose Estimation

To Locate the keypoint in human body and use them to get the pose and recognize the action.

OpenPose CMU

Tools and Libraries

heavy math(processing)+lower level(speed)+higher level(interface)...

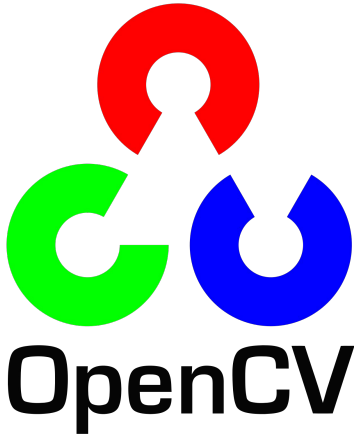
To perform video and image processing, there are libraries in Python

- OpenCV
- Sci-Kit image
- Pillow
- Kornea

OpenCV

Open source computer vision and machine learning library

OpenCV was started at Intel in 1999 by **Gary Bradsky.**



OpenCV-Python

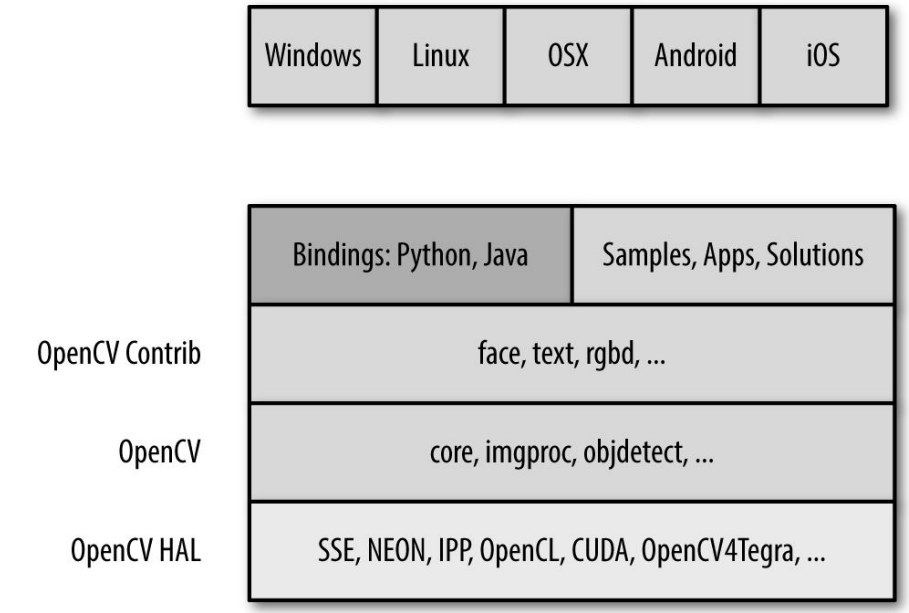
Contains implementations of a large number of vision algorithms(more than 2500)

- Written natively in C++, also has C, Python, Java, and MATLAB interfaces
- Supports Windows, Linux, Mac OS X, Android, and iOS

OpenCV-Python is a library of Python bindings designed to solve computer vision problems.

Installation

1. Ubuntu
   a. sudo apt-get install python3-opencv
   b. pip install opencv_python
   c. conda install -c conda-forge opencv
   d. build from source
2. Windows
   a. pip install opencv_python
   b. conda install -c conda-forge opencv
3. Mac
   a.



Learning Opencv3

Modules of OpenCV

- core
- imgproc
- highgui
- video
- calib3d
- features2d
- objectdetect
- ml
- flann
- cuda
- dnn
- photo
- stitching
- contrib
- nonfree

ImageTypes

Images are read as numpy array.

cv2.imread(path, flag)

Flag:

- **cv2.IMREAD_COLOR:** It specifies to load a color image. Any transparency of image will be neglected. It is the default flag. Alternatively, we can pass integer value **1** for this flag.
- **cv2.IMREAD_GRAYSCALE:** It specifies to load an image in grayscale mode. Alternatively, we can pass integer value **0** for this flag.
- **cv2.IMREAD_UNCHANGED:** It specifies to load an image as such including alpha channel. Alternatively, we can pass integer value **-1** for this flag.

PixelTypes

PixelTypes shows how the image is represented in data

- BGR - The default color of imread(). Normal 3 channel color
- HSV - Hue is color, Saturation is amount, Value is lightness. 3 channels
- GRAYSCALE - Gray values, Single channel
- OpenCV requires that images be in BGR or Grayscale in order to be shown or saved. Otherwise, undesirable effects may appear.

Basic Operations

- Access pixel values and modify them (image[x,y] =)
- Access image properties
- Set a Region of Interest (ROI)
- Split and merge images

References

1. LearnOpenCV – OpenCV, PyTorch, Keras, Tensorflow examples and tutorials
2. OpenCV: OpenCV-Python Tutorials
3. CS131 Computer Vision: Foundations and Applications
4. Pillow — Pillow (PIL Fork) 8.3.1 documentation
5. scikit-image: Image processing in Python — scikit-image
6. PyImageSearch - You can master Computer Vision, Deep Learning, and OpenCV.
7. https://www.freecodecamp.org/learn/scientific-computing-with-python/#scientific-computing-with-python-projects
8. OpenCV: Home
9. Thanks to Sagar Kumar for use case code.

Thank You!