# Introduction to OpenCV

What is OpenCV library?

- OpenCV is a cross-platform library using which we can develop real-time **computer vision applications**. It mainly focuses on image processing, video capture and analysis including features like face detection and object detection.

- When it integrated with various libraries, such as NumPy, python is capable of processing the OpenCV array structure for analysis. To Identify image pattern and its various features we use vector space and perform mathematical operations on these features.

- The first OpenCV version was 1.0. OpenCV is released under a BSD license and hence it's free for both **academic** and **commercial** use. It has C++, C, Python and Java interfaces and supports Windows, Linux, Mac OS, iOS and Android. When OpenCV was designed the main focus was real-time applications for computational efficiency. All things are written in optimized C/C++ to take advantage of multi-core processing.
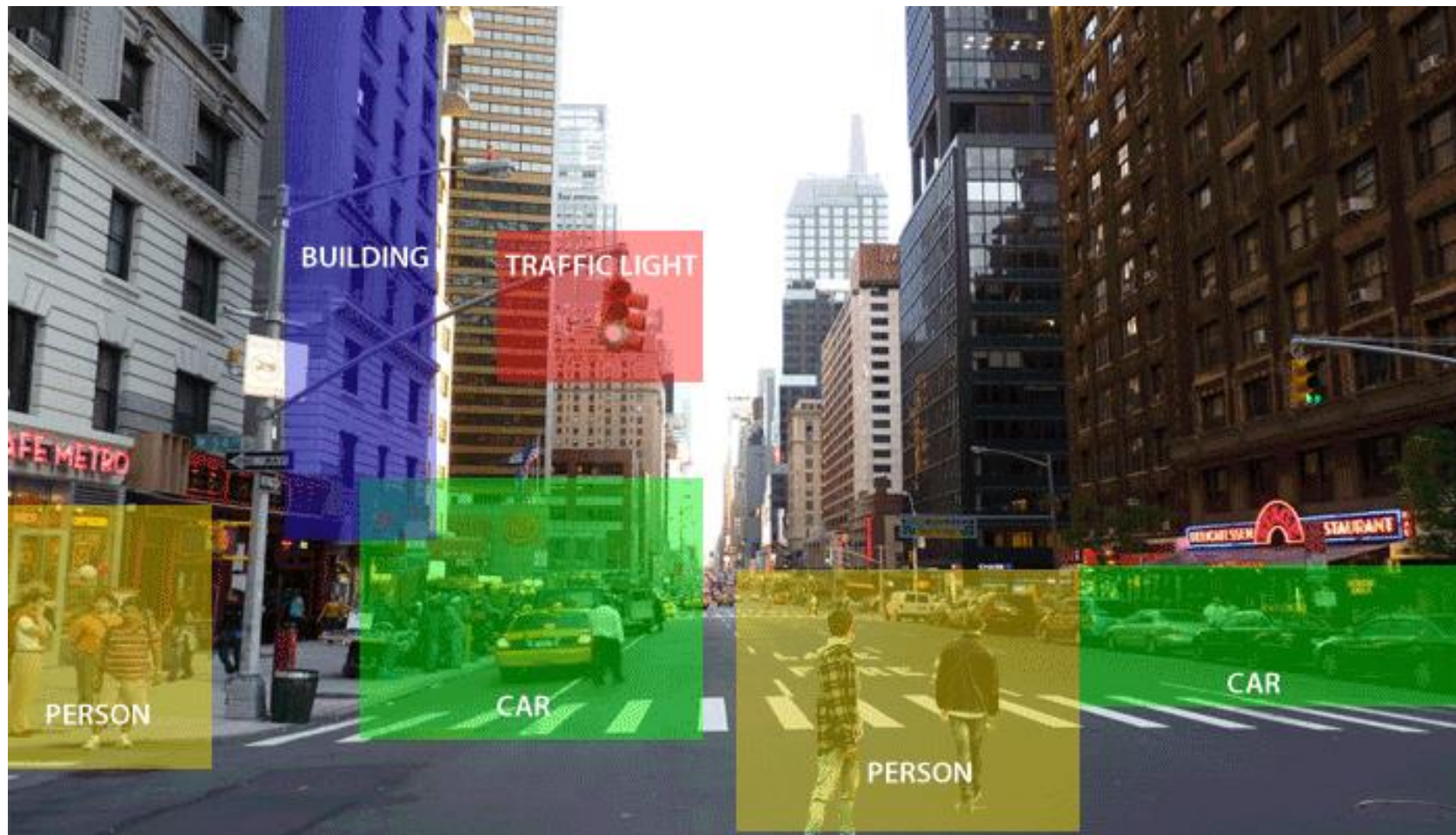
Computer Vision

▶ Computer Vision can be defined as a discipline that explains how to reconstruct, interrupt, and understand a 3D scene from its 2D images, in terms of the properties of the structure present in the scene. It deals with modeling and replicating human vision using computer software and hardware.

▶ Computer Vision overlaps significantly with the following fields −

• **Image Processing** − It focuses on image manipulation.

• **Pattern Recognition** − It explains various techniques to classify patterns.

• **Photogrammetry** − It is concerned with obtaining accurate measurements from images.

▶ **Image processing** deals with image-to-image transformation. The input and output of image processing are both images.

▶ **Computer vision** is the construction of explicit, meaningful descriptions of physical objects from their image. The output of computer vision is a description or an interpretation of structures in 3D scene.

How OpenCV works

► **How does computer recognize the image?**

► Human eyes provide lots of information based on what they see. Machines are facilitated with seeing everything, convert the vision into numbers and store in the memory. Here the question arises how computer convert images into numbers. So the answer is that the pixel value is used to convert images into numbers. A pixel is the smallest unit of a digital image or graphics that can be displayed and represented on a digital display device.

► The picture intensity at the particular location is represented by the numbers. In the above image, we have shown the pixel values for a grayscale image consist of only one value, the intensity of the black color at that location.

► There are two common ways to identify the images:

- ▶ **1. Grayscale**

- ▶ Grayscale images are those images which contain only two colors black and white. The contrast measurement of intensity is black treated as the weakest intensity, and white as the strongest intensity. When we use the grayscale image, the computer assigns each pixel value based on its level of darkness.

- ▶ **2. RGB**

- ▶ An RGB is a combination of the red, green, blue color which together makes a new color. The computer retrieves that value from each pixel and puts the results in an array to be interpreted.

Why OpenCV is used for Computer Vision?

- OpenCV is available for free of cost.

- Since the OpenCV library is written in C/C++, so it is quit fast. Now it can be used with Python.

- It require less RAM to usage, it maybe of 60-70 MB.

- Computer Vision is portable as OpenCV and can run on any device that can run on C.
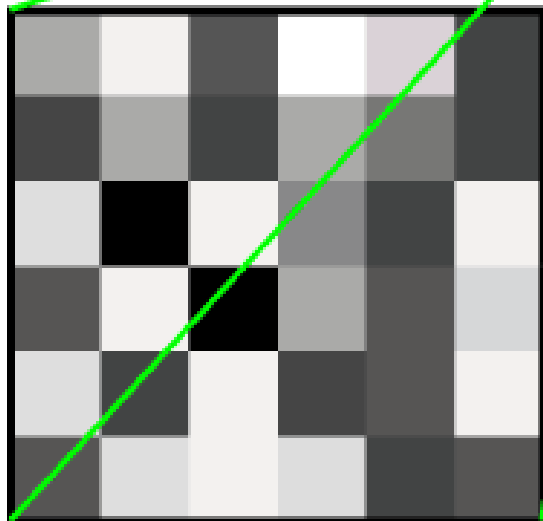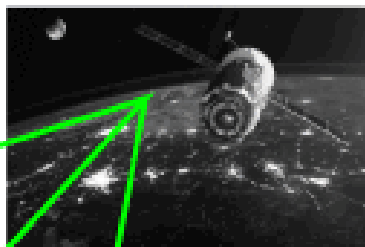
170	283	85	255	221	0
68	138	17	170	119	68
221	0	238	136	0	255
119	255	85	170	136	238
238	17	221	68	119	255
85	170	119	221	17	136

OpenCV Functionality

- Image/video I/O, processing, display (core, imgproc, highgui)

- Object/feature detection (objdetect, features2d, nonfree)

- Geometry-based monocular or stereo computer vision (calib3d, stitching, videostab)

- Computational photography (photo, video, superres)

- Machine learning & clustering (ml, flann)

- CUDA acceleration (gpu)

Applications of OpenCV

▶ There are lots of applications which are solved using OpenCV, some of them are listed below

- face recognition

- Automated inspection and surveillance

- number of people – count (foot traffic in a mall, etc)

- Vehicle counting on highways along with their speeds

- Interactive art installations

- Anamoly (defect) detection in the manufacturing process (the odd defective products)

- Street view image stitching

- Video/image search and retrieval

- Robot and driver-less car navigation and control

- object recognition

- Medical image analysis

- Movies – 3D structure from motion

- TV Channels advertisement recognition

Installation and Simple tasks like reading image and Extracting the RGB values of pixels is mentioned in the README.md file

Resources

- [Introduction to OpenCV – GeeksforGeeks](#)

- [OpenCV Tutorial | OpenCV using Python – javatpoint](#)

- [OpenCV - Overview (tutorialspoint.com)](#)

- [OpenCV - Overview – GeeksforGeeks](#)

- [OpenCV Installation - javatpoint](#)