A Brief Introduction to OpenCV

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Overview

- Open-source library that implements common computer vision algorithms
- Segmentation, face recognition, 3D reconstruction and many more
- Written in C++ (Python, Java, Matlab C#, Perl interfaces available)

Installation

- Download (recommended version 2.4.10) http://opencv.org/downloads.html

- Install
  http://docs.opencv.org/doc/tutorials/introduction/table_of_content_introduction/table_of_content_introduction.html

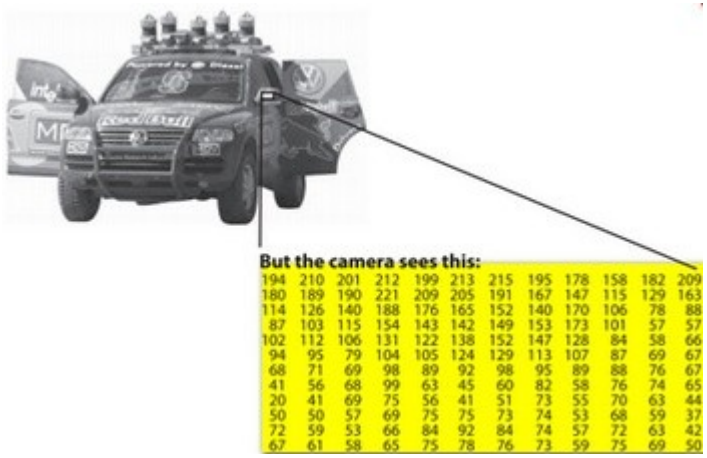
- Cheatsheet
  http://docs.opencv.org/opencv_cheatsheet.pdf

Modules

- **core** – basic data structures, common functions
- **imgproc –** general image processing (filtering, geometrical transformations)
- **features2d** – feature detectors, descriptors, matching algorithms
- **objdetect** – detection of objects and instances (faces, people etc.)
- **highgui** – simple UI functions

Core

- Basic n-dimensional array (**Mat**)



- Short numerical vectors (**Vec**, **Scalar**)

- Simple drawing functions (**line**, **circle**, **ellipse**)

Highgui

- I/O functionality for images/videos (**imread**, **imwrite**)
- Simple windows to display content (**namedWindow**, **imshow, waitkey**)
- Trackbars for quick debugging (**createTrackbar**)

Imgproc

- Change image color space (**cvtColor**)
- Filters to reduce image noise and remove fine details (**blur**, **GaussianBlur**)
- Basic geometry extraction (**cornerHarris**, **Canny**, **HoughLines**)

Example 1: Gaussian smoothing

- *Smoothing* is often used for noise removal
- Input image F
- Output image G
- For each pixel (i, j) and kernel h

$\frac{1}{273}$

1	4	7	4	1
4	16	26	16	4
7	26	41	26	7
4	16	26	16	4
1	4	7	4	1

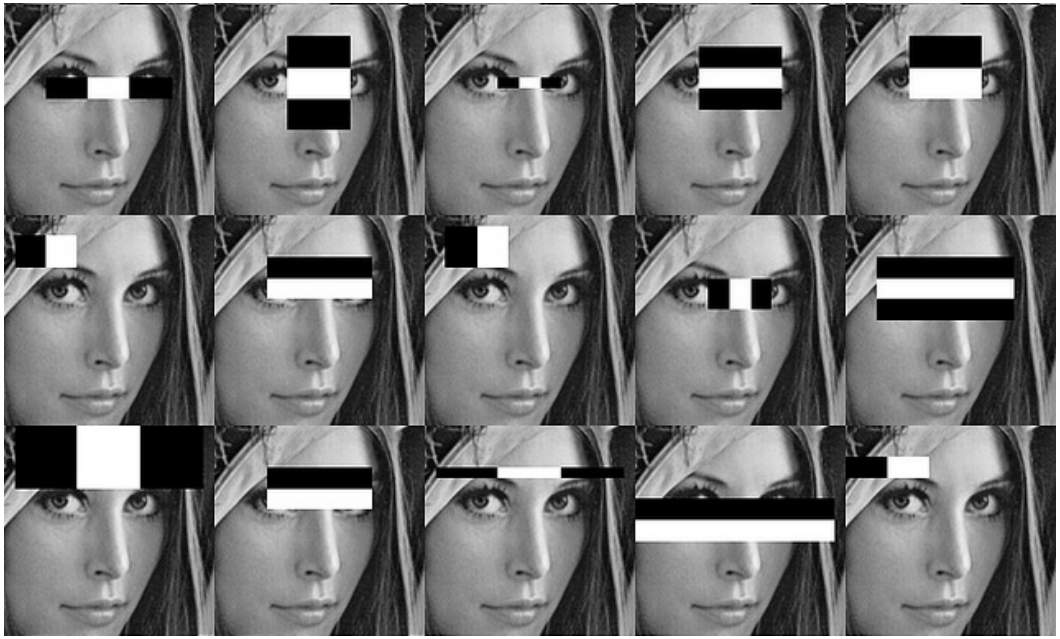
$$G(i,j) = \sum_{k,l} F(i+k, j+l)h(k,l)$$

- Gaussian kernel

$$h(k,l) = \frac{1}{2\pi\sigma^2} \exp\left(\frac{-k^2}{2\sigma^2} + \frac{-l^2}{2\sigma^2}\right)$$

Example 2: Face detection

- Scan input image at different scales with a sliding window of a fixed size
- Classify each window with a pre-trained classifier



Hints

- Detect basic geometric features in images
- **Canny** edge detector
- **Hough transform**