Digital Image Processing Basics

Lab 01

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01. Basics of OpenCV

OpenCV: Open Source Computer Vision library to implement image processing

In openCV we use arrays to store an image and Numpy library is used to handle arrays, image always store in 2D array

Images types

Gray scale Image: Single channel

True Color Image: RGB, BGR in Python, 3 channel

Binary Image: 1 bit, 0 or 1 black or white

Functions for Images in Python

In [2]:

```
import cv2    # OpenCV used as cv2 in python
import matplotlib.pyplot as plt # to plot inside
print(cv2.__version__)
```

```
4.6.0
```

Read an image and display

In [3]:

```
path = "C:\\Users\\hp\\Google Drive\\Fiverr Work\\2022\\33. Computer Vision Course\\pictures"
```

In [4]:

```
img = cv2.imread(path+"\\coloredChips.png")  # took path and name of image as an argument
```

In [5]:

```
print(img)
```

```
[[[157 182 197]
  [157 180 195]
  [155 178 192]
  ...
  [207 230 230]
  [204 228 229]
  [209 232 234]]

 [[150 171 192]
  [149 171 189]
```

```
  [149 173 187]
  ...
  [208 232 228]
  [204 229 229]
  [206 231 232]]

 [[146 165 185]
  [148 168 186]
  [149 172 187]
  ...
  [202 229 228]
  [201 226 227]
  [201 226 226]]

 ...

 [[143 163 174]
  [139 161 174]
  [135 159 171]
  ...
  [193 219 226]
  [197 224 231]
  [201 228 235]]

 [[141 161 169]
  [141 162 171]
  [137 159 169]
  ...
  [201 224 232]
  [200 222 230]
  [201 224 232]]

 [[144 162 169]
  [138 157 165]
  [142 160 170]
  ...
  [198 219 227]
  [196 217 225]
  [202 224 232]]]
```

In [6]:

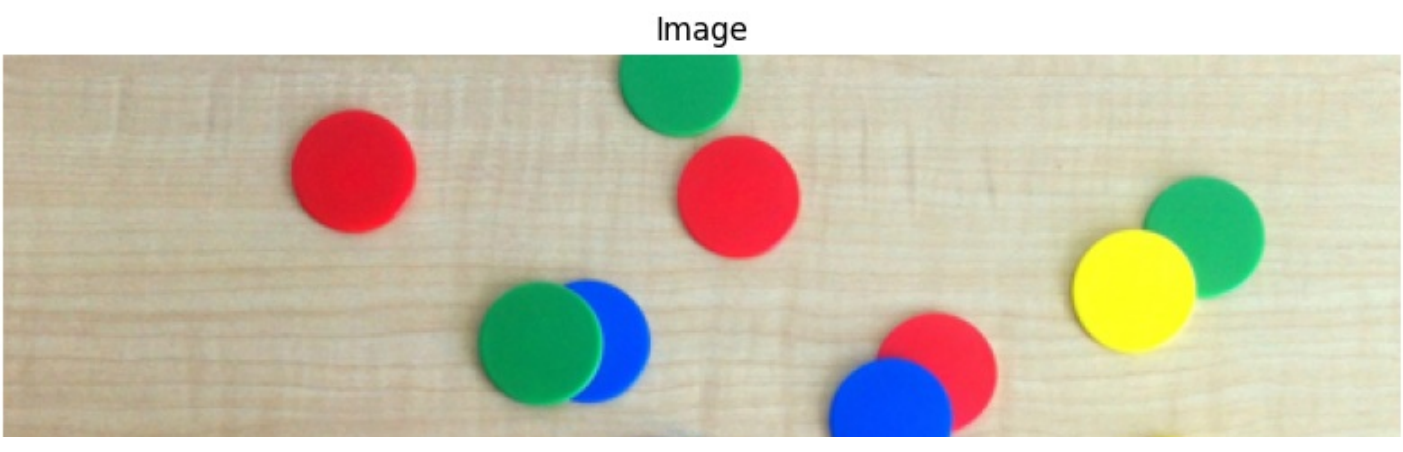
```
cv2.imshow("Image", img)
cv2.waitKey(0)
cv2.destroyAllWindows()
```

In [10]:

```
# Display image using matplotlib
plt.figure(figsize=[10,10])
plt.imshow(cv2.cvtColor(img, cv2.COLOR_BGR2RGB))
plt.title("Image")
plt.axis("off")
```

Out[10]:

```
(-0.5, 517.5, 390.5, -0.5)
```



Resize image

In [7]:

```
img_new = cv2.resize(img, (200, 200))
```

In [ ]:

```
plt.figure(1)
plt.imshow(img_new)
plt.title("Resized Image")
plt.axis("off")
```

In [8]:

```
cv2.imshow("Image", img)
cv2.imshow("NewImage", img_new)
cv2.waitKey(0)
cv2.destroyAllWindows()
```

Read image in grayscale

In [9]:

```
img1 = cv2.imread(path +"\\coloredChips.png", 0)   # 0 means in grayscale
```

In [10]:

```
cv2.imshow("Image1", img1)
cv2.waitKey(0)
cv2.destroyAllWindows()
```

Flip the image

In [12]:

```
img = cv2.imread(path+"\\football.jpg")
cv2.imshow("fliped image", cv2.flip(img, -1))   # it take parameters 0,-1,1
cv2.waitKey(0)
cv2.destroyAllWindows()
```

Convert image to grayscale and save in current directory

In [13]:

```
import os

img2 = cv2.imread(path+"\\football.jpg", 0)   # 0 means in grayscale
cv2.imshow("Image2", img2)

k = cv2.waitKey()   # waits untill key press or wait for particular miliseocds time
if k == ord('s'):
    os.chdir("C:/Users/hp/Google Drive/Fiverr Work/2022/33. Computer Vision Course/pictur
es")
    cv2.imwrite('output.png', img2)
    cv2.destroyAllWindows()
else:
    cv2.destroyAllWindows()
```

Import video

In [14]:

```
cap = cv2.VideoCapture(path+"\\traffic.avi")

print(cap)
```

```
< cv2.VideoCapture 00000294AD3310D0>
```

In [15]:

```
while True:
    success, frame = cap.read()

    cv2.imshow('video', frame)
    key = cv2.waitKey(100)

    if key == ord('q'):
        break

cap.release()
cv2.destroyAllWindows()
```

In [ ]:

```
cv2.destroyAllWindows()
```

How to use webcam

In [16]:

```
import cv2
```

```
# 1. read video
cap = cv2.VideoCapture(0)

# now what is in cap, let's see
print('cap:', cap)  # so basically cap is an object of video capture

# as video is collection of frames
while True:

    status, frame = cap.read()    # status return boolean value True for read frame succ
essfully, false for not

    # 2. resize the frame
    frame = cv2.resize(frame, (700, 500))

    # 3. convert frames into grayscale
    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)

    cv2.imshow("frames", frame)

    # showing gray frames
    cv2.imshow("gray frames", gray)

    # waits untill q pressed
    k = cv2.waitKey(100)
    if k == ord('q'):   # if not work the write k == ord('q') & 0xFF: this is mask
        break

cap.release() # relase the cap which capture the video
cv2.destroyAllWindows()
```

```
cap: < cv2.VideoCapture 00000294AD2EDF10>
```

Separate B G R from webcam frame

In [19]:

```
import cv2

# 1. read video
cap = cv2.VideoCapture(0)

# now what is in cap, let's see
print('cap:', cap)  # so basically cap is an object of video capture

# as video is collection of frames
while True:

    status, frame = cap.read()    # status return boolean value True for read frame succ
essfully, false for not

    # make the copy of orignal frame
    blueFrame = frame.copy()
    greenFrame = frame.copy()
    redFrame = frame.copy()

    # 2. resize the frame
    frame = cv2.resize(frame, (700, 500))

    # 3. convert frames into grayscale
    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)

    # for blue make 1, and 2, green, and red 0
    blueFrame[:,:,1] = 0
    blueFrame[:,:,2] = 0
```

```
    # for green make 0, and 2, blue, and red 0
    greenFrame[:,:,0] = 0
    greenFrame[:,:,2] = 0

    # for blue make 0, and 1, blue, and green 0
    redFrame[:,:,0] = 0
    redFrame[:,:,1] = 0

    cv2.imshow("Blue frames", blueFrame)
    cv2.imshow("Green frames", greenFrame)
    cv2.imshow("Red frames", redFrame)

    cv2.imshow("frames", frame)

    # showing gray frames
    cv2.imshow("gray frames", gray)

    # waits untill q pressed
    k = cv2.waitKey(100)
    if k == ord('q'):    # if not work the write k == ord('q') & 0xFF: this is mask
        break

cap.release() # relase the cap which capture the video
cv2.destroyAllWindows()
```

```
cap: < cv2.VideoCapture 00000294AD28FDD0>
```

How to draw shapes and lines on images

In [18]:

```
import cv2
import numpy as np

# How to draw shapes and lines on images
# we have to crate a matrix filled with zeros

# img = np.zeros((512,512)) # this is gray scale image
# print(img.shape)

img = np.zeros((512,512,3),np.uint8) # defining three colors
print(img.shape)

# obtaining color
img[:] = 255,0,0 # print blue
cv2.imshow("blue",img)

img[:] = 0,255,0 # print green
cv2.imshow("green",img)

img[:] = 0,0,255 # print red
cv2.imshow("red",img)

img[200:300,10:500] = 0,255,0 # print green
cv2.imshow("center red",img)

img[10:500,200:300] = 0,255,0 # print green
cv2.imshow("center red",img)

img[250:260,10:500] = 255,255,255 # print green
cv2.imshow("center red",img)

img[10:500,250:260] = 255,255,255 # print green
cv2.imshow("center red",img)

cv2.line(img,(0,0),(512,512),(0,0,0),3)
cv2.line(img,(0,512),(512,0),(0,0,0),3)
```

```
cv2.imshow("new",img)

cv2.waitKey(0)
cv2.destroyAllWindows()
```

```
(512, 512, 3)
```

Get Pixel value Using Cursor

In [ ]:

```
import cv2
import numpy as np

path = "C:\\Users\\hp\\Google Drive\\Fiverr Work\\2022\\33. Computer Vision Course\\pictures"

def draw(event, x,y,flag,param): # x,y for event call
    if event == cv2.EVENT_LBUTTONDBLCLK:
        font = cv2.FONT_HERSHEY_PLAIN
        text = str(x) + "," + str(y)

        cv2.putText(image, text, (x,y), font, 2, (255,0,255), 2)

# load image
image = cv2.imread(path+"\\car.png")

# create window and set mouse callback
cv2.namedWindow('image')
cv2.setMouseCallback('image', draw)
while True:
# show image
    cv2.imshow('image', image)
    key = cv2.waitKey(1)
    if key == ord("q"):
        break
cv2.destroyAllWindows()
```

Gaussian FIlter (Blur an Image)

A Gaussian Filter is a low pass filter used for reducing noise (high frequency components) and blurring regions of an image. The filter is implemented as an Odd sized Symmetric Kernel (DIP version of a Matrix) which is passed through each pixel of the Region of Interest to get the desired effect.

3x3

1/16

1	2	1
2	4	2
1	2	1

5x5

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

7x7

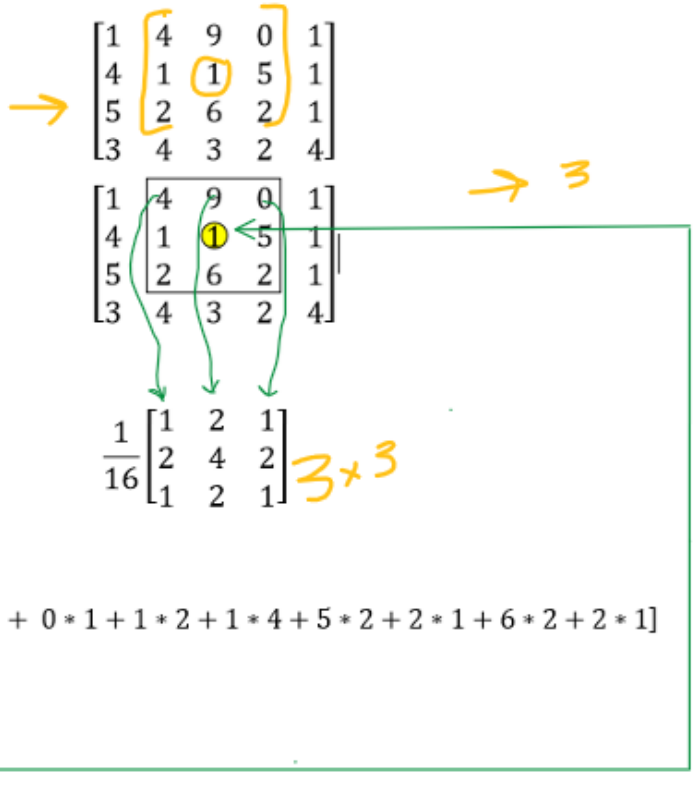
1/1003

0	0	1	2	1	0	0
0	3	13	22	13	3	0
1	13	59	97	59	13	1
2	22	97	159	97	22	2
1	13	59	97	59	13	1
0	3	13	22	13	3	0
0	0	1	2	1	0	0

Kernel

```
dst = cv2.GaussianBlur(src, ksize, 0)
```

Src: input image
Ksize: Gaussian Kernel Size. [height width]. height and width should be odd and can have different values. If ksize is set to [0 0], then ksize is computed from sigma values.
0: boarder type



$$= \frac{1}{16}[4*1+9*2+0*1+1*2+1*4+5*2+2*1+6*2+2*1]$$

$$= \frac{1}{16}[54]$$

$$= 3.3 = 3$$

Gaussian, Canny, Dilation, Erosion

In [ ]:

```
import cv2
import numpy as np

img = cv2.imread('onion.PNG')
cv2.imshow("original Image", img)

kernel = np.ones((5,5),np.uint8)

# convert to gray
img_gray = cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)

cv2.imshow('Gray Image',img_gray)


# convert to blur
img_blur = cv2.GaussianBlur(img_gray,(7,7),0)
cv2.imshow('Blur Image', img_blur)


# finding edges using canny functions
img_canny = cv2.Canny(img,200,200)
cv2.imshow('Canny Image', img_canny)
```

```
# Image dilation:  increase the thickness of edges
img_dilation = cv2.dilate(img_canny,kernel,iterations=1)
cv2.imshow('Dilation Image',img_dilation)


# Image Errosion
img_eroded = cv2.erode(img_dilation,kernel,iterations=1)
cv2.imshow('Eroded Image',img_eroded)
cv2.waitKey(0)
cv2.destroyAllWindows()
```

Find Types of an Image Using PIL Library

```
PIL.Image.open(fp, mode='r', formats=None)

    Opens and identifies the given image file.
    This is a lazy operation; this function identifies the file, but the file rema
ins open and the actual image data is not read from the file.

PARAMETERS:

    fp – A filename (string), pathlib.Path object or a file object. The file objec
t must implement file.read, file.seek, and file.tell methods, and be opened in bina
ry mode.

    mode – The mode. If given, this argument must be "r".
```

Link: https://pillow.readthedocs.io/en/stable/handbook/tutorial.

- **Modes**

The mode of an image is a string which defines the type and depth of a pixel in the image. Each pixel uses the full range of the bit depth. So a 1-bit pixel has a range of 0-1, an 8-bit pixel has a range of 0-255 and so on. The current release supports the following standard modes:

- 1 (1-bit pixels, black and white, stored with one pixel per byte)
- L (8-bit pixels, black and white)
- P (8-bit pixels, mapped to any other mode using a color palette)
- RGB (3x8-bit pixels, true color)
- RGBA (4x8-bit pixels, true color with transparency mask)
- CMYK (4x8-bit pixels, color separation)
- YCbCr (3x8-bit pixels, color video format)
    - Note that this refers to the JPEG, and not the ITU-R BT.2020, standard
- LAB (3x8-bit pixels, the L*a*b color space)
- HSV (3x8-bit pixels, Hue, Saturation, Value color space)
- I (32-bit signed integer pixels)
- F (32-bit floating point pixels)

In [ ]:

```
from PIL import Image
import cv2 as cv

def findTypeOfImage(image):

    if image.mode == "1":
        imageType = "1-bit pixels, black and white, stored with one pixel per byte"
```

```
    elif image.mode == "L":
        imageType = "8-bit pixels, black and white"
    elif image.mode == "P":
        imageType = "8-bit pixels, mapped to any other mode using a color palette"
    elif image.mode == "RGB":
        imageType = "3x8-bit pixels, true color"
    elif image.mode == "CMYK":
        imageType = "4x8-bit pixels, color separation"
    elif image.mode == "YCbCr":
        imageType = "3x8-bit pixels, color video format"
    elif image.mode == "LAB":
        imageType = "3x8-bit pixels, the L*a*b color space"
    elif image.mode == "HSV":
        imageType ="3x8-bit pixels, Hue, Saturation, Value color space"
    elif image.mode == "I":
        imageType = "32-bit signed integer pixels"
    elif image.mode == "F":
        imageType = "32-bit floating point pixels"

    return imageType
```

In [ ]:

```
path ="C:\\Users\\hp\\Google Drive\\Fiverr Work\\2022\\15. Teaching OpenCV to Client\\Pi
cs+scripts\\Pictures"

### Part 01 open the images icons01.png .....#####

img1 = Image.open(path + "\\icons01.png")
img2 = Image.open(path + "\\icons02.png")

img1Type = findTypeOfImage(img1)
img2Type = findTypeOfImage(img2)

print(f"The Type of icons01.png is "+img1Type)
print(f"The Type of icons02.png is " +img2Type)
```

Find RGB Values

In [ ]:

```
def findRGBValuesByPIL(image, x, y):
    img = Image.open(image).convert("RGB")
    r, g, b = img.getpixel((x, y))

    value = (r, g, b)

    return value
```

In [ ]:

```
def findRGBValuesByOpenCV(image):
    blue = image[:,:,0]
    green = image[:,:,1]
    red = image[:,:,2]

    print(f"Blue color values: {blue} \nGreen Color Values: {green}\nRed Color Values: {
red}")
```

In [ ]:

```
img3 = cv.imread(path + "\\rgb01.png")
img03 = path + "\\rgb01.png"

img4 = cv.imread(path + "\\rgb02.png")
img04 = path + "\\rgb02.png"

findRGBValuesByOpenCV(img3)
findRGBValuesByOpenCV(img4)
```

```
rgbValue = findRGBValuesByPIL(img03, 10, 10)
print(rgbValue)

cv.imshow("imgae3", img3)
cv.imshow("image4", img4)
cv.waitKey()
cv.destroyAllWindows()
```

Find Resolution, dimension, class(data type), Number of channel, Image Type

In [ ]:

```
import tkinter as tk
from PIL import Image
import numpy as np
import cv2 as cv
import os

root = tk.Tk()

def findResolutionOfImage(image):

    # Image resolution is typically described in PPI, which refers to
    # how many pixels are displayed per inch of an image

    # Screen Dimensions from Monitor (or Display) Control Panel = 1024x768 pixels
    # Viewable Width of Monitor Screen Resolution = 12.5 inches
    # Screen Resolution = 1024/12.5 = 82 ppi

    # find the width of your monitor or laptop
    # it is in mm
    width_mm = root.winfo_screenmmwidth()
    # convert it to inches, To convert mm to inches, you must multiply the unit by 0.0393
7
    # because 1 mm = 0.03937 inches
    width_in = width_mm * 0.03937

    height = image.shape[0]
    width = image.shape[1]

    if height > width:
        resolution = round(height / width_in)
    else:
        resolution = round(width / width_in)

    return str(resolution) + " ppi"
```

In [ ]:

```
def completeInformation(image, img, name):

    resolution_img = findResolutionOfImage(image)
    dimension_img = image.shape

    height_img = dimension_img[0]
    width_img = dimension_img[1]

    channels_img = dimension_img[2]

    Type_img = findTypeOfImage(img)
    dataType_img = image.dtype


    print(f"\nThe resoltuion of {name} is " + resolution_img)
    print(f"The dimension {name} is {dimension_img}, height: {height_img}, width: {width
_img}")
    print(f"Channels: {channels_img}\nData Type: {dataType_img}\nType: {Type_img}\n")
```

In [ ]:

```
path ="C:\\Users\\hp\\Google Drive\\Fiverr Work\\2022\\15. Teaching OpenCV to Client\\Pi
cs+scripts\\Pictures"

img_1 = cv.imread(path + "\\flower.png")
img1 = Image.open(path + "\\flower.png")
image_1_name = os.path.basename(path + "\\flower.png")

img_2 = cv.imread(path + "\\eagle.png")
img2 = Image.open(path + "\\eagle.png")
image_2_name = os.path.basename(path + "\\eagle.png")

completeInformation(img_1, img1, image_1_name)

completeInformation(img_2, img2, image_2_name)
```

In [ ]:

```

```