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Hand Tracking Module

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Abstract: *This paper is written to introduce and make the people familiar with Open CV library. Throughout this paper we will be covering the basic aspects of list specifically.*

Keywords: Hand Tracking

I. Introduction

OpenCV is an open-source library for computer vision, image processing and machine learning and in today's world we can use it for real time operation.by using it we can process image and videos to identify objects, faces or even hand tracking of human. The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state- of-the-art computer vision and machine learning algorithms. In OpenCV, the CV is an abbreviation form of a computer vision, which is defined as a field of study that helps computers to understand the content of the digital images such as photographs and videos.

How does computer recognize the image?

When we see through our eyes. Our eye provides lots of information. Machines are capable of seeing and process the vision into numbers and store in the memory. So, the happen is we use pixel value to convert images into numbers. The pixel is the basic unit of programmable colour on a computer display or in a computer image. Think of it as a logical rather than a physical unit.

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 colour at that location.

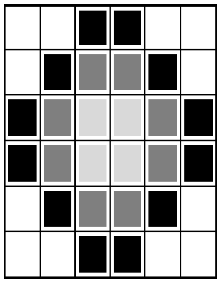
There are two common ways to identify the images:

A. Grayscale

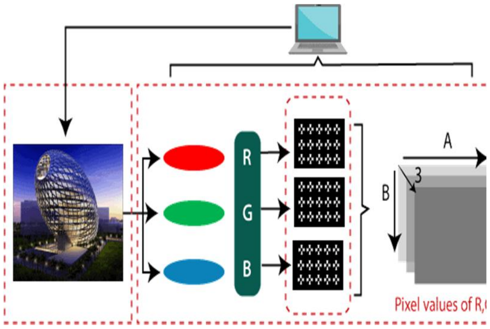
Grayscale images are those images which contain only two colours black and white. The contrast measurement of intensity is black treated as the weakest intensity, and white as the strongest intensity. When we use the grayscale image, the computer assigns each pixel value based on its level of darkness.

B. RGB

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



```
11 11 00 00 11 11
11 00 01 01 00 11
00 01 10 10 01 00
00 01 10 10 01 00
11 00 01 01 00 11
11 11 00 00 11 11
```



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 quite fast. Now it can be used with Python.
- It requires 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.

OpenCV Read and Save Image

OpenCV allows us to perform multiple operations on the image, but to do that it is necessary to read an image file as input, and then we can perform the various

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operations on it. OpenCV provides following functions which are used to read and write the images.

OpenCV imread function

The imread() function loads image from the specified file and returns it. The syntax is:

```
cv2.imread(filename[,flag])
```

Parameters:

filename: Name of the file to be loaded
flag: The flag specifies the color type of a loaded image:

- CV_LOAD_IMAGE_ANYDEPTH - If we set it as flag, it will return 16-bits/32- bits image when the input has the corresponding depth, otherwise convert it to 8-BIT.
- CV_LOAD_IMAGE_COLOR - If we set it as flag, it always returns the converted image to the colour one.
- C V_LOAD_IMAGE_GRAYSCALE - If we set it as flag, it always converts image into the grayscale.

OpenCV Save Images

OpenCV imwrite() function is used to save an image to a specified file. The file extension defines the image format. The syntax is the following:
cv2.imwrite(filename, img[,params])

Parameters:

filename- Name of the file to be loaded image- Image to be saved.
params- The following parameters are currently supported:

- For JPEG, quality can be from 0 to 100. The default value is 95.
- For PNG, quality can be the compress level from 0 to 9. The default value is 1.
- For PPM, PGM, or PBM, it can be a binary format flag 0 or 1. The default value is 1

OpenCV Basic Operation on Images

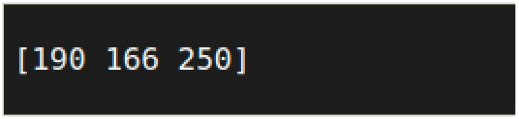
In this tutorial, we will learn the essential operations that are related to the images. We are going to discuss the following topics.

- Access pixel values and modify them
- Access Image Properties
- Setting Region of Image
- Splitting and merging images
- Change the image color

Accessing and Modifying Pixel Values

We can retrieve a pixel value by its row and column coordinates. It returns an array of blue, green, red values of the BGR image. It returns the corresponding intensity for the grayscale image. First, we need to load the BGR image.

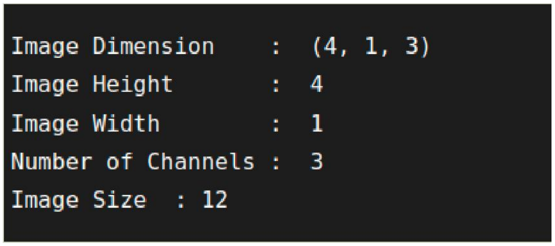
```
1.Import numpy as np
2.import cv2
3.img=cv2.imread("C:\Users\username",1)
4.pixel=img[100,100]
5.print(pixel)
```



```
[190 166 250]
```

Consider the following example: import cv2

```
# read image
img = cv2.imread(r'C:\Users\username',1)
# height, width, number of channels in image
height = img.shape[0]
width = img.shape[1]
channels = img.shape[2]
size1 = img.size
print('Image Dimension : ',dimensions)
print('Image Height : ',height)
print('Image Width : ',width)
```



```
Image Dimension    :  (4, 1, 3)
Image Height       :  4
Image Width        :  1
Number of Channels :  3
Image Size  : 12
```

```
print('Number of Channels : ',channels)
print('Image Size :', size1)
```

OpenCV Image Filters

Image filtering is the process of modifying an image by changing its shades or color of the pixel. It is also used to increase brightness and contrast. In this tutorial, we will learn about several types of filters.

Bilateral Filter

OpenCV provides the bilateralFilter() function to apply the bilateral filter on the image. The bilateral filter can reduce unwanted noise very well while keeping edges sharp. The syntax of the function is given below:

Original Image

Bilateral Filter

Applications of OpenCV

- Face recognition
- Count number of people
- Object recognition
- Robot and driverless car navigation
- Vehicle counting on highway

Hand Tracking Module using Python, OpenCV, and MediaPipe

To create the program that will perform hand tracking, we will need two Python libraries. These are OpenCV and MediaPipe.

We will use openCV to perform operations associated with computer vision. We will use MediaPipe to perform the actual hand detection and tracking on our input image. We will finally need an IDE. For this tutorial, we will use the Pycharm IDE.

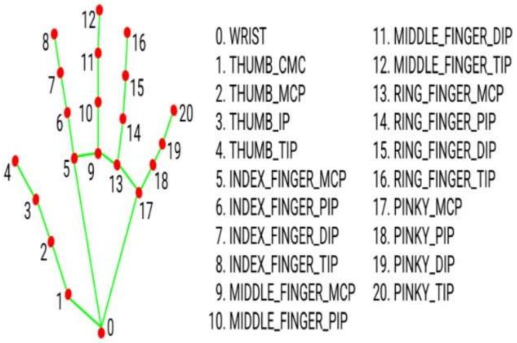
This tutorial will be divided into two parts. The first part will focus on how to create a program that does hand tacking. The second part will focus on how to turn the program into a module. A person using Windows, Linux, or macOS can follow through.

Creating a Hand Tracking Program

Before we jump into coding, let us discuss how MediaPipe performs hand tracking. Hand tracking using MediaPipe involves two stages:

- **Palm Detection:** MediaPipe works on the complete input image and provides a cropped image of the hand.
- **Hand Landmarks Identification:** MediaPipe finds the 21 hand landmarks on the cropped image of the hand.

The 21 hand pointsthat MediaPipe identifies are shown in the image below:



Advantages:

- First and foremost, OpenCV is available free of cost
- Since OpenCV library is written in C/C++ it is quite fast
- Low RAM usage
- It is portable as OpenCV can run on any device that can run C

Disadvantages:

- OpenCV does not provide the same ease of use when compared to MATLAB
- OpenCV has a Flann library of its own. This causes conflict issues when you try to use OpenCV library with the PCL library.

Drawbacks and Possible Solution

- This kind of input also raises issues that are not relevant with traditional input.
- These problems are to learn, to remember and to accurately execute gestures.
- The developer not only has to ensure that gestures are quickly and correctly recognized,

but also has to provide a guide that allows a rapid and easy learning of these gestures.

CONCLUSION

OpenCV is the future of computer vision, image processing. Which has lots of application in daily life and OpenCV is optimising their library so that we can use Artificial intelligence more efficiently.

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