

Image Processing with Python Libraries

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ABSTRACT

Today, computer vision is considered one of the most important sub-fields of artificial intelligence, due to the variety of its applications and capabilities to transfer the human ability to understand and describe a scene or image to the computer, so that it becomes able to recognize objects, shapes, colors, behavior and other capabilities of understanding the image. Image processing is one of the branches of computer science, and it is a way to perform some operations on an image in order to obtain an improved model for this image or extract some useful information from it. Often the data that is collected is primary data, meaning that it is not suitable for direct use in applications, so its need to analyze or pre-process it and then use it. For example: to build a data set that has been used in a model that classifies images as to whether they contain a house or not, depending on an image as input for this program. Our first step will be to collect hundreds of house images, but the problem is that these images will not be of the same dimensions, for example, so it's to Change its dimensions, i.e., processing it in advance before submitting it to the model. The above is just one of the many reasons why image processing is important for any computer vision application

Keywords: Python, OpenCV, Computer Vision, Image Processing.

1. Introduction

An open-source library developed by Intel and based on the C++ programming language. This library is the most widely used in image processing and computer vision. This library is rich in methods and functions that facilitate the operations of dealing with and processing images, where it can read images and perform many operations on them, such as converting color images to gray scale images, cropped images, changing image dimensions resizing, and image analysis such as obtaining histograms and many other operations will reviewing some of them in this article.

Image classification is a branch of computer science that studies how to build algorithms that automatically label images. For example, you can use image processing to automatically label your company's logo as a car logo, flower logo, etc. In this post, we'll explore 15 Python Packages for Image Processing [1].

A huge amount of the data collected today is made up of images and videos. That is why effective image

processing for translating and obtaining information is crucial for businesses. Data scientists usually preprocess the images before feeding it to machine learning models to achieve desired results. Consequently, it is paramount to understand the capabilities of various image processing libraries to streamline their workflows.

Python is a widely-used programming language for machine learning, deep learning, and many other fields. Suppose you want to make an image recognition and prediction model. Then it's obvious that you have to do many things before making a model, like converting to grayscale, preprocessing of image etc. Thus, you have to know which python image modules fit for you. In this entire tutorial, you will know the best image processing library in python [2].

2. Computer Vision

It can be abbreviated as the process that takes place in our brains to understand images. It is based on classification, identification, or other algorithms, so that

the output is a description of what the images contain. Therefore, it is used in wide fields such as recognizing faces, classifying images, or analyzing them to contribute to driving, and many others. In this article, it will focus on the image processing process.

Since in programming and algorithms, the best programming languages that are widely used in the field of artificial intelligence in general and in computer vision in particular are Python. Because of the libraries it contains to shorten the work and reach satisfactory results, it will present the most important libraries in the Python language, which you will need to enter the field of image processing and computer vision [3].

3. Image processing

Image processing focuses on applying one or several types of transformations to the image, for example: removing or adding noise, contrast, rotating or changing color, which are operations that take place at the pixel level (the smallest part of the image), and are usually a stage for processing and preparing images To be inputs to other stages, such as the input of a neural network, for example, that eventually gives a specific output [1].

4. Image Processing Libraries

Image processing is the phenomenon of manipulating an image to extract features from it.

In today's world of computer vision and deep learning, different algorithms for image processing are heavily used to carry out edge detection, recognition, classification from a dataset of images.

Sometimes these algorithms are also applied to videos frame by frame to extract features from them [1].

4.1 Numpy

Before starting any treatment in the field of computer vision, you must know this library well, as images or video clips are represented programmatically as matrices, and here lies the mission of this library, as the Numpy library provides a multidimensional matrix object and a variety of procedures for quick operations on matrices, including shape manipulation and sorting, basic statistical operations, Fourier transforms and many more [2].

4.2 matplotlib

One of the most widely used Python libraries for creating analytic diagrams on data (which are essentially arrays); That is, what is known as the Data Visualization process. By using the Matplot library, it can display images and charts that help in mathematical analysis to know some details that appear graphically more clearly [3].

OpenCV

One of the largest and most famous open-source libraries used in computer vision operations, such as: image processing, object detection, image segmentation, face recognition and much more.

It is the best library in terms of execution speed. It is written in C++ and produced by Intel. The difference is that it reads color images as BGR images instead of RGB. This library is used a lot in image processing operations such as color conversion, image rotation, filtering, edge detection and chopping [4].

Performing the color conversion process from RGB to Gray using the OpenCV library known as cv2 as follows:

- 1_ Include the OpenC library in OpenCV.
- 2_ Read the image and assign it to a variable (it must put the path and name of the image, or its name suffices if it is in the project file).
- 3_ Show the image.
- 4_ Convert the color image to gray using the conversion method `cvtColor()` which takes the color image and the conversion process as its variables.
- 5_ Show the image.

The result as it appears in the figure (1)



Figure 1: OpenCV Lib

4.3 Scipy

An open-source scientific library that relies entirely on matrices of the Numpy type. It is useful in applying mathematical algorithms such as integration, differentiation, and Fourier transforms, in addition to algorithms such as clustering. As for image processing, it contains functions that add filters to the image, such as noising, smoothing, and basic operations such as color conversion. And cutting and rotating.

- 1_ Include partial packages from the Cybay library, misc containing pre-saved images for the experimentation process, `ndimage` image containing editing functions and filters ready for images [5].
- 2_ Include a Matplot library for the process of showing images.
- 3_ Include the nambay library to deal with arrays.

4_ Assigning an image to deal with it as a variable (array).

5_ Modifying the image using the diving filter “glass effect”. The function takes the image and the degree of noise as its variables, and assigns them to a new variable.

10<<6_View the image before and after modification.

The result is as shown in Figure (2):

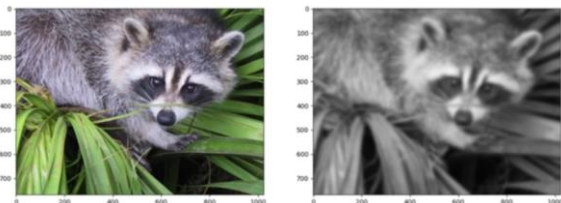


Figure 2: Scipy

4.4 PIL (Python Image Library)

Currently known as PILLOW, this library provides comprehensive support for all image file formats and basic operations on them, such as resizing, rotating, creating thumbnails, and converting between file formats, but support has been discontinued since 2011 and it still maintains its popularity due to its simplicity and ease of dealing with its dependencies. Fairly powerful on image processing [6].

1_Include the partial package from the Python image library.

2_ Continue to fetch the image and assign it to a variable (it must put the path and name of the image, or its name suffices if it is in the project file).

3_ Rotating the image using a function that takes the degree of rotation and the expansion process (either false= specifying the dimensions of the image “not to show parts that deviate from the dimensions of the original image” or true= expanding the dimensions so as not to cut anything from the image) as its variables and assigning them to a new variable.

4_ Show the image.

The result as shown in Figure (3):



Figure 3: PIL

4.5 SimpleITK

It is a layer of ITK(Insight segmentation and registration ToolKit), which is one of the most widely used libraries in medical image processing. It is used indirectly through 3D slicer or ITK_SNAP programs. The reason for its medical use is its high ability to purify images without Great removal of impurities that may mean a lot in the medical field, such as a blood clot, which helps in the correct medical reading. It supports operations on two-, three- and four-dimensional images (three with time) [7].

1_Include the SimpleITK library.

2_ Include the Matplotlib drawing library.

3_ A variable to specify the slide number (since it is a medical image, some images consist of several consecutive snapshots as if they were a short video, so the third dimension is for the slide number “the snapshot”)

4_ Bringing the image and assigning it to a transformer.

5_ Show the image with slide number 26 (you can try another number).

6_ Use a follower to apply an image smoothing process that takes the image and the time step (the smaller the time step, the more accurate the process becomes, but this requires an increase in the number of iterations) and the number of iterations of the process as its variables and assigning them to a variable.

7_ Show the filtered image.

The result is as shown in Figure (4):

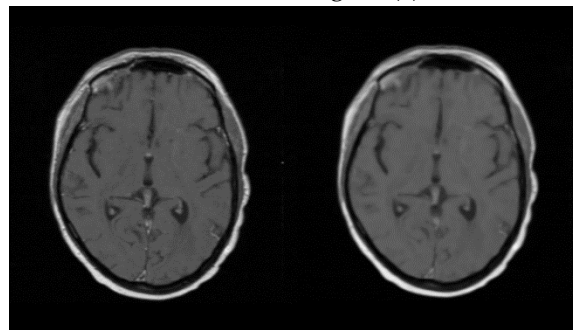


Figure 4: SimpleITK

4.6 Mahotas

It is also one of the libraries used in image processing, and in addition to its fast performance and the ability to add effects with simple code, the Mahotas library can dispense with the Nambay library as a helper library for reading images as arrays, as it reads them directly as an array, which simplifies the code and conversions even more [8].

- 1_ Include Mahotas library.
 - 2_ Include the matplotlib graphing library.
 - 3_ Read the image and assign it to a variable (it must put the path and name of the image, or its name suffices if it is in the project file).
 - 4_ Preparing to show the picture
 - 5_ Show the image within the previous step.
 - 6_ Finding the number of pixels that belong to each color gradient in the form of a graphic representation, and this is what is known as a histogram, using the function () fullhistogram and assigning it to a variable (matrix).
 - 7_ Preparing window to show the histogram.
 - 8_ Histogram drawing within the window.
 - 9_ Show an interface containing images.
- The result, as shown in Figure (5):

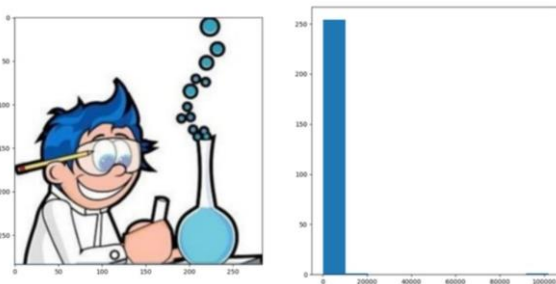


Figure 5: Mahotas

The diagram in Figure (5) shows that most of the colors within the image are white or close to white, and this is what its seeing in the image that “contains many white areas.”

4.7 Scikit_image

Also called skimage, it is an open source package designed for image processing. If you have previously dealt with the sklearn library, using skimage is a piece of cake for its ease of handling. Even if you are new to Python, sk Skimage is easy to learn and use [9]. The SK library is built on the libraries Numpy, Matplotlib and scipy and must be present when using the skimage image.[10]

It supports a large number of image processing algorithms that include segmentation, geometry, filtering, features detection, and others [9].

- 1_ Include Nambay library.
- 2_ Include the matplotlib graphing library.
- 3_ Include the data package (which contains some images for testing) from the SK image library.
- 4_ Embed the submersible filter from the filters package from the SK image library.
- 5_ Include an edge selection function from the slicing package from the SK image library.

- 6_ Multiple attributions to two converts for the same image (Raed al-Qada’s image).
 - 7_ Determine the size of the circle (it has defined the face within the circle)
 - 8_ The size of the window lines (starting from any line has specify).
 - 9_ The size of the window columns (starting from any column has specify).
 - 10_ Prepare a matrix with the dimensions of the rows and columns of the specified window.
 - 11_ Using a function to determine the edges that takes the image, the size of the window within which the processing will take place, the step length when defining the edge, the smoothing rate when defining the edge, and the time of the learning step (mathematically, these coefficients are the differential equation coefficients that work to detect edges).
 - 12_ Preparing an interface to show the images and placing two windows for the original image and the modified image.
 - 13_ Putting the modified image in the second window.
 - 14_ Show the circle (window) in red.
 - 15_ Show the detected edges in blue.
 - 16_ Show coordinate axes.
 - 17_ Show numbering on the coordinate axes.
 - 18_ Putting the original photo in the first window.
 - 19_ Display the interface with pictures.
- The result is as shown in Figure (6):



Figure 6: Scikit_image

4.8 TensorFlow

TensorFlow is a fast, flexible, and comprehensive system for building machine learning systems. It is intended for use with problems that have a clear conceptual structure, in particular, problems that can be expressed as a linear transformation of inputs (e.g., matrix factorization, structured prediction, reinforcement learning, image recognition, and many others). For image classification, you can use an already pre-trained model that is available in TensorFlow for ease of use [11].



Figure 7: TensorFlow

4.9 Keras

Keras is a high-level neural networks API, written in Python and capable of running on top of TensorFlow, CNTK, or Theano. It was developed with a focus on enabling fast experimentation. Being able to go from idea to result with the least possible delay is key to doing good research. Using Keras you can train your network model from scratch at configuring it how you want.[12]

5. Discussion

In this article, its explored what are the different types of Python Packages for Image Processing. It's reviewed some Python Packages for Image Processing that help automate much of the process behind images. These Python Packages for Image Processing range from low-level implementations of popular algorithms to high-level frameworks that make image classification and processing much easier. Some packages related to this topic are fairly new or underdeveloped, but there's no shortage of packages that can be used in this field. It's better to use more mature and well-known libraries anyhow. I hope this blog will help you decide on which tool is best for your work.

6. Conclusion

Computer vision is one of the branches of artificial intelligence that focuses on developing technologies that help computers see and understand visual content in the same way as humans, so the Python programming language has been supported by libraries that are based on processing images and video clips and using machine learning and deep learning, so that it becomes able to identify and classify things as they are. In previously, and each library has an angle in which it is used for all image processing operations, such as the famous OpenC library in OpenCV, which is characterized by its speed. Although OpenCV is the major image-processing library that has been using in the future, having a little bit of knowledge about other image-processing libraries will definitely be a good idea. All these libraries can make your workflow easier with their simpler implementation for specific functions. As for disease diagnosis, there have SimpleITK, which is characterized by its accuracy, and other simple libraries such as Mahotas and the

Python Image Library PIL, which will be the focus of your launch to enter the field of computer vision.

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