Research and Practice of Image Processing Based on Python

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Abstract. Image is an important means to acquire, express and transmit information. Digital image processing means computer processing of images. In this paper, firstly mainly analyse the application characteristics of Python, focus on the typical functions of image processing PIL library, and then consult the relevant application cases of image processing. Finally, the image processing functions of PIL library are put into practice, which has certain reference and guiding significance for the image processing functions of Python and other platforms. Image processing and graphics processing have always been important fields in the development of computer technology.

1. Introduction
Python is an interpretive scripting language, which can be used in the following fields: Web and Internet development, scientific computing and statistics, education, desktop interface development, software development, back-end development, etc. It has been widely used in system management task processing and Web programming. Python's design philosophy is "elegance", "clarity", "simplicity". Python developers try to avoid immature or unimportant optimization. Python is a fully object-oriented language with functions, modules, numbers and strings as objects. Python itself is designed to be extensible. Python provides a wealth of APIs and tools so that programmers can easily use C, C++, Cython to write extension modules. The Python compiler itself can also be integrated into other programs that require scripting languages. Therefore, many people also use Python as a "glue language". Python is used to integrate and encapsulate programs written in other languages.

2. Application Characteristics of Python
Because of the simplicity, readability and extensibility of Python language, many open source scientific computing software packages provide Python calling interfaces, such as computer vision library OpenCV, three-dimensional visualization library VTK, medical image processing library ITK. Python has more specialized scientific computing extension libraries, so the development environment of Python language and its many extension libraries is very suitable. With the help of engineering technology and scientific researchers, we can process experimental data, make charts, and even develop scientific computing applications.
Python applications [7] have system programming: Application Programming Interface is provided. Graphics processing: PIL, Tkinter and other graphics library support, can facilitate graphic processing. Mathematical processing: NumPy extensions provide a large number of interfaces with many standard mathematical libraries. Text processing: re module can support regular expressions, but also provides SGML, XML analysis module. Database programming: communicate with Microsoft SQL Server, Oracle, Sybase, DB2, MySQL, SQLite and other databases. Network Programming: Provide rich modules to support sockets programming, which can facilitate the rapid development of distributed applications. Web programming: Application development language, supporting the latest XML technology. Multimedia applications: PyOpenGL module encapsulates the OpenGL application programming interface, which can process two-dimensional and three-dimensional image. Pymo engine: It is an AVG game engine running on Symbian S60V3, Symbian 3, S60V5, Symbian 3, Android system. Hacker programming: Python has a hack library.

When Python executes, it first compiles the source code in the .pyfile into Python's byte code, and then executes the compiled byte code by Python Virtual Machine. The basic idea of this mechanism is consistent with that of Java.NET. However, unlike Java or .NET Virtual Machines, Python Virtual Machines are a more advanced Virtual Machine. The advanced level here is not the usual advanced level, not that Python's Virtual Machine is more powerful than Java or .NET, but that Python's Virtual Machine is farther away from the real machine than Java or .NET. Or it can be said that Python's Virtual Machine is a higher level of abstraction Virtual Machine. Bytecode files compiled based on Cython are usually in .PyC format.

In addition, Python can also run in interactive mode, such as the mainstream operating systems Unix/Linux, Mac, Windows can run Python interactive environment directly in command mode. The interactive operation can be realized by directly issuing operation instructions.

3. Image Processing Library PIL
The Python standard library is really huge. It can help deal with a variety of tasks, including regular expressions, document generation, unit testing, threads, databases, web browsers, CGI, FTP, e-mail, XML, XML-RPC, HTML, WAV files, cryptosystem, GUI, Tk and other system-related operations. In addition to standard libraries, there are many other high-quality libraries, such as wxPython, Twisted and Python image libraries.

The most commonly used image processing library in Python is PIL [6] (Python Image Library), which is a powerful tool for Python users to process images. The library can convert, print and display graphics formats. Some graphics effects can also be processed, such as enlargement, reduction and rotation of graphics.

The basic concepts involved in PIL are as follows: bands, modes, sizes, coordinate systems, palette, info and filters.

PIL has the following modules: Image module, ImageChops module, ImageCrackCode module, ImageDraw module, ImageEnhance module, ImageFileIO module, ImageFilter module, ImageFont module, ImageGrab module, ImageOps module, ImagePath module, ImageSequence module, ImageStat module, ImageTk module, ImageWin module, PSDraw module.

Image module is the most important module in PIL. It provides many functions of image manipulation, such as creating, opening, displaying and saving images, synthesis, clipping, filtering and other functions, and acquiring image attributes, such as image histogram, channel number, etc. The Image module provides a class with the same name, image class, to represent PIL images. This module also provides some functions, including loading images from files and creating new images. The ImageChops module contains arithmetic graphics operations called channel operations ("chops"). These operations can be used for many purposes, such as image effects, image combination, algorithm drawing and so on. The ImageDraw module provides basic graphics processing functions for image objects. It can create new images, annotate or polish existing images, and generate various graphics for web applications in real time. The Image Enhance module includes some classes for image enhancement, such as Color class, Brightness class, Control class and Sharpness class. The ImageFile module provides
related support functions for image opening and saving. In addition, it provides a Parser class, which can decode an image piece by piece. The ImageFileIO module is used to read an image from a socket or other streaming device. The ImageFilter module includes predefined sets of various filters, which are used in conjunction with the filter method of the Image class. The ImageGrab module is used to copy the content on the screen into a PIL image memory. The ImageOps module includes some ready-made image processing operations. It can accomplish histogram equalization, clipping, quantization, mirroring and other operations. TheImagePath module is used to store and manipulate two-dimensional vector data. The ImageSequence module includes a wrapper class that provides an iterator for each frame in the image sequence. The ImageStat module calculates the global statistics of an image or an area of an image. The ImageTk module is used to create and modify Tkinters in BitmapImage and PhotoImage objects.

4. Application Analysis of Python Image Processing

Ming Xu [1] pointed out in the article "Application of Python in Function Drawing" that drawing function image is the basic content of mathematical experiment. Grasping basic drawing commands provided by Python and drawing related function graphics are the important basis of other mathematical experiments with Python. Two-dimensional and three-dimensional function graphs are drawn with the classical experimental tool of matplolib drawing module in Python. Guojun Li [2] in "A New Method of Digital Image Processing" uses Python to call OpenCV for free to complete the corresponding image processing functions, realizing image histogram, spatial filtering, frequency domain filtering, edge detection, morphological image processing. Jun Li [3] et al. used PIL library and NumPy library to draw implicit function image in the article "Fast Drawing Method of Functional Image in Python"; and compared the calculation speed under different schemes. Jun Liu [4] pointed out that Python has a large number of standard libraries and extended libraries with abundant functions in the teaching reform of digital image processing combined with artificial intelligence. In a sense, for a task, such as image processing, Python can be used to write fewer lines of code. In addition, for image processing, machine learning and in-depth learning, there are many libraries available for Python, such as OpenCV, Dlib, etc., and some more specific libraries, such as the example OpenFace for face detection and recognition, which only applies to Python and torch based on deep neural network. Some libraries, such as Tensorflow, Keras, Caffe, Theano, which are suitable for machine learning and deep learning, can be invoked in Python, and because of the simplicity of Python language, they are easier to use in Python. In the article "Application of Python in Image Processing", Xiao dong Han[5] and others elaborated the application of Python in digital image processing, through its methods and techniques in gray level transformation, histogram equalization, image averaging and Gauss blurring.

5. Exploration of Python's Image Processing Practice

Based on the research and analysis of PIL library, this paper completes image filtering technology, outline image contour, relief style, image edge enhancement and other image processing in Python platform. As shown in Figure 1, several different image effects are compared and analysed.

![Figure 1. Comparison of several different images](image)

By using PIL library and Open and Save functions, the conversion between PNG, BMP and JPG image formats is realized. Image Enhance module is used to realize the change of image contrast. Through Split and Merge channel separation and merge technology to change the color of the current image, add filters to the image. Filter image filtering technology is used to achieve the effects of outlining image contour, relief style and image boundary enhancement. Resize, Rotate and Transpose are used for geometric transformation such as image zooming and rotation.
From several aspects of Python's application in digital image processing, we can see that Python can improve the quality of digital image processing greatly by using fast, convenient and without losing the verification of basic theory. In addition, C++, Java, MATHLAB and Python can call libraries for free to complete corresponding image processing functions. C++ has the longest writing code and the highest execution efficiency; Java has the longest writing code. The execution efficiency is second; the code of MATHLAB and Python is the same, but the execution efficiency of Python is slightly higher than that of MATHLAB.

6. Conclusion
At present, with the background of the development of artificial intelligence, the corresponding experimental programming language should be expanded in the practice of digital image processing. Python should be used as the experimental language. It is easier to master the language itself, so that most of the energy and time can be spent on conceiving solutions to problems, so as to stimulate students' interest in learning and improve students' practical ability. In recent years, Python has been widely used in the field of digital image processing. The application of language in mathematical modeling and various big data contests has attracted much attention. Although the research and practice of image processing based on Python are carried out in this paper, there is room for further thinking in image and graphics contrast processing, graphics image storage, graphics image rendering process and so on.

Based on the research and analysis of PIL library, this paper completes image filtering technology, outline image contour, relief style, image edge etc.

Acknowledgments
I thank the reviewers for their comments and suggestions, which helped me improve the quality of this paper. This paper is devoted to the application of the Science and Technology Research Program of Hubei Education Department for the key project of youth in 2019. The project name: "PIL digital image processing research based on Python", and the project No. is D20192902. And thank other scholars for their research and Discussion on Python image processing. Thank you for the support of the teaching and research platform of Huang gang Normal University and the virtual simulation experiment centre platform of the department of computer.

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