ANNASAHEB DANGE COLLEGE OF ENGINEERING AND TECHNOLOGY, ASHTA

Artificial Intelligence and Data Science

COMPUTER VISION

Subject Code: 1ADPC312
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Course Coordinator

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ANNASAHEB DANGE COLLEGE OF ENGINEERING AND TECHNOLOGY, ASHTA

(An Autonomous Institute affiliated to Shivaji University, Kolhapur)

Artificial Intelligence and Data Science Department

Vision

To produce exclusive software professionals who shall effectively contribute to the leveraging field of Artificial Intelligence and Data Science.

Mission

We will achieve our Vision by:

- Providing Excellent Infrastructure facilitating the students and faculty members with recent trends and technologies.
- Imparting High-Quality Education to the students also instigating them with ethical and moral values.
- Enabling students to enhance their research abilities to address various society-oriented issues through Innovative projects
- Collaborating with various Industries to make students industry ready

PO Programme Outcomes

Learners / Students of Artificial Intelligence and Data Science Engineering Programme Graduates are expected to have attained & will be able to:

01. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

02. Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

03. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

04. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

05. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

06. The engineer and society: Demonstrate understanding of contemporary knowledge of engineering to assess societal, health, safety, legal and cultural issues and the consequent responsibilities.

07. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

08. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

09. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities, write effective reports, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the ability to engage in independent and life-long learning in the broadest context of technological change.

Sant Dnyaneshwer Shikshan Sanstha's

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PEO Program Educational Objectives

PEO 1: Ability to understand, apply, analyse, design models and applications for all the real-world scenarios related to Artificial Intelligence and Data Science. (PO 1,2,3)
PEO 2: Practice engineering in a broader aspect and exhibit professional leadership qualities in their field. (PO 4,5,6)
PEO 3: Enhancing technological competence to withstand the challenges in the volatile IT industry. (PO 7,8,9)
PEO 4: To be committed in Life-long research and Learning activities that supports societal development. (PO 10,11,12)

PSO Program Specific Outcomes:

PSO 1: - Practically Applying the skills & knowledge acquired to various Inter/Multi/Trans disciplinary problem areas. (PEO 1,2)

PSO 2: - Enrich Leading abilities in the field of Artificial Intelligence and Data Science to qualify for employability. (PEO 3,4)

General Lab Instructions

Do

1. Join the lab session few minutes before the start time.
2. Maintain proper environment of the lab.
3. Go through the theory behind the experiments before attending each lab.
4. Complete your assignment within the given period of time.

Don'ts

1. Don't use internet for solving assignment problems.
2. Don't share your codes with other students. You will get zero marks if your codes are found copied from any online resource.
3. Don't use electronic gadgets (e.g., Mobile phone, Tab, etc.) during the lab hours. You should only use one system for solving assignment problems.

Lab Equipment

Following hardware and software are necessary to perform the experiments in data science lab.

Programming Languages:

1. Python

Programming Editor:

1. Visual Studio Code
2. Jupyter
3. Google Colab

Hardware:

1. A computer that can execute Python and ML Programs.

Operating system:

1. Windows

Content

EXPERIMENT NO. 1

Title:

To implement basic image processing operations: reading images, writing images, converting images to different formats, and complementing an image.

Objective:

To understand the basics of image processing and OpenCV library functions, to perform operations like image reading, writing, format conversion, and complementing and to develop skills for handling image data programmatically.

Brief Theory:

Introduction: Image processing refers to the manipulation or analysis of images to enhance their quality or extract useful information. Basic operations form the foundation of complex image processing tasks.

1. **Reading an Image**:

   Reading an image means loading it from storage into memory. OpenCV uses the `cv2.imread()` function to read images in different formats.

2. **Writing an Image**:

   Writing an image involves saving the processed or modified image back to storage using `cv2.imwrite()`.

3. **Image Conversion**:

   Conversion involves changing the format or type of the image, such as converting a color image to grayscale using `cv2.cvtColor()`.

4. **Complementing an Image**:

   Image complement involves inverting the pixel values. For grayscale images, this is done by subtracting the pixel values from 255.

Steps: -

Step 1: Import Necessary Libraries

First, we need to import the libraries required for Image Processing Essentials on Google Colab.

Code: -

```
import cv2
from google.colab.patches import cv2_imshow
from google.colab import files
```

Step 2: Read the Image

We will read the sample image from the local directory.

Code: -

```
image = cv2.imread('sample.jpg')
```

imread() reads the image from source.

Step 3: Show the Image

```
cv2_imshow(image)
```

```
import cv2
from google.colab.patches import cv2_imshow

# Read the image
image = cv2.imread('sample.jpg')

# Display the image using cv2_imshow (compatible with Google Colab)
cv2_imshow(image)
```

Step 4: Write/Save the Image

We will save the image to local directory.

Code: -

```
cv2.imwrite('output_image.jpg', image)
print("Image saved successfully as 'output_image.jpg'")
```

Output -

output_image.jpg has been saved successfully in the local directory. It means that we saved the image/written the image successfully.

Step 5: Conversion of Image (Grayscale Conversion)

Colored Image will be converted into the Grayscale Image.

Code: -

```
gray_image = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
cv2_imshow(gray_image)
```

Output -

```
gray_image = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
cv2_imshow(gray_image)
```

Step 6: Complimenting an Image

Image complement involves inverting the pixel values. For grayscale images, this is done by subtracting the pixel values from 255.

Code: -

```
complement_image = 255 - gray_image  # Complement of the grayscale image
cv2_imshow(complement_image)  # Display the complemented image
```

Output –

```
complement_image = 255 - gray_image  # Complement of the grayscale image
cv2_imshow(complement_image)  # Display the complemented image
cv2.imwrite('complement_image.jpg', complement_image)  # Save the complemented image
```

```
True
```

Conclusion:

- The experiment successfully demonstrated basic image processing operations like reading, writing, converting, and complementing an image.
- These operations are essential for understanding how image data is manipulated and processed in OpenCV.
- The practical application of these operations forms the building blocks for more advanced image processing tasks.

Practice Questions:

1. Write code to read and display a PNG image.
2. Convert a color image to HSV (Hue, Saturation, Value) format using OpenCV.
3. Implement code to resize an image to half its original size.
4. Write a program to rotate an image by 90 degrees.
5. Modify the code to save the complemented image as a PNG file instead of JPG.
6. Implement a function to overlay text on an image using OpenCV.

Expected Oral Questions

1. Explain the steps involved in reading and writing an image in OpenCV.
2. What is the purpose of the `cv2.cvtColor()` function?
3. How do you complement an image in OpenCV?
4. What is the difference between color and grayscale images in terms of data representation?
5. Why do we subtract pixel values from 255 for complementing an image?
6. Mention some real-world applications of image processing.

FAQs in Interviews

1. **What is OpenCV, and why is it used?**
   OpenCV (Open Source Computer Vision Library) is a library for real-time computer vision applications. It provides functions for image and video processing.
2. **What are the common image formats OpenCV supports?**
   OpenCV supports formats like JPG, PNG, BMP, and TIFF.
3. **What is the significance of grayscale conversion?**
   Grayscale conversion reduces computational complexity by converting a 3-channel color image to a single-channel image.

4. **What does the `255 - gray_image` operation do?**

   It inverts the pixel values, creating a negative or complement of the grayscale image.

5. **Why do we use `cv2_imshow` in Google Colab instead of `cv2.imshow`?**

   Google Colab does not support GUI windows, so `cv2_imshow` is used for displaying images.

6. **What does the `cv2.imwrite()` function do?**

   It saves the modified image to a file.