COMPUTER VISION LAB

(COURSE CODE: 23UPCSC4L04)

A laboratory record submitted to Periyar University, Salem. In partial fullfilment of the requirements for the Degree of

MASTER OF SCIENCE INDATA SCIENCE

BY

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CERTIFICATE

This is to certify that the programming laboratory entitled "**COMPUTER VISION LAB**" (23UPCSC4L04) is a bonafide record work done by **ARCHANA M** Register No. **U23PG507DTS005** as partial fulfilment of the requirement degree of **MASTER OF SCIENCE IN DATA SCIENCE** in the department of computer science, Periyar University, Salem, during the year 2023 – 2025.

Faculty In-Charge Head of the Department

Submitted for the practical examination held on …../…../……

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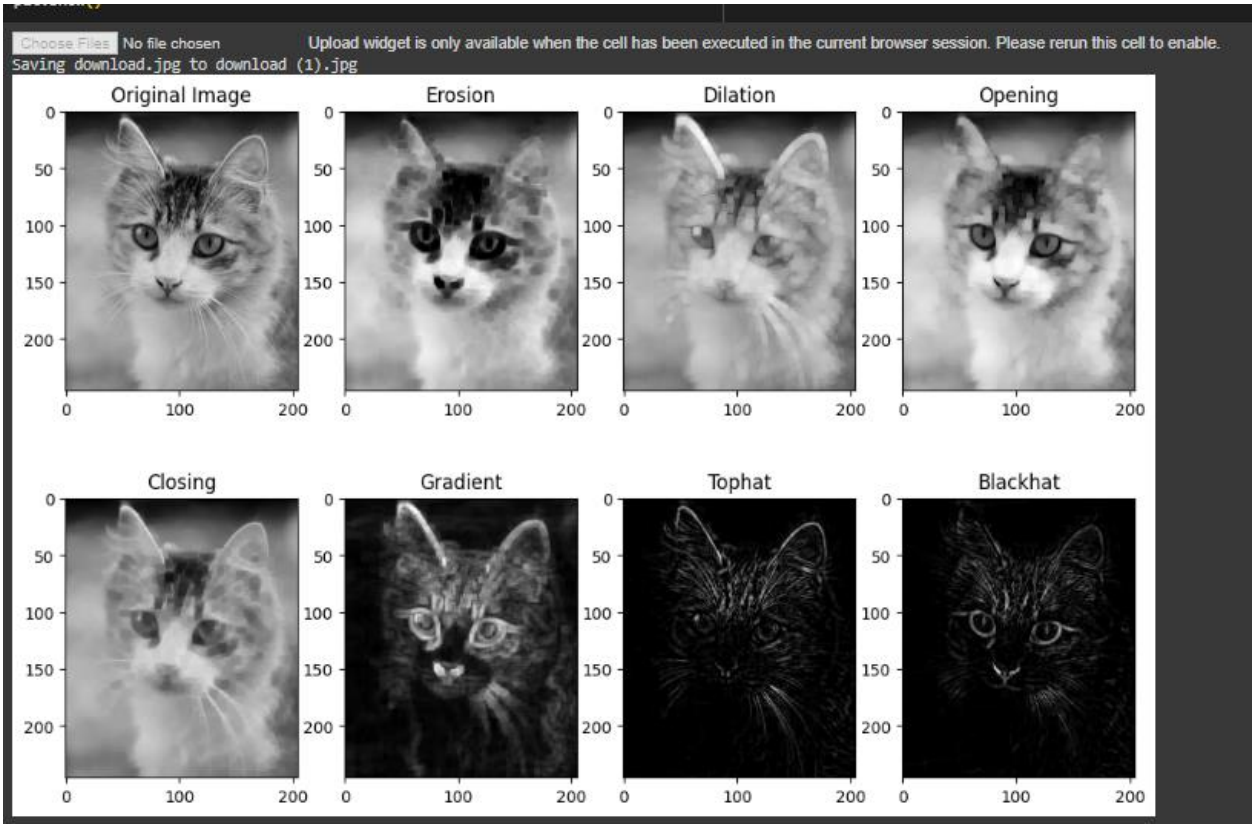
PROGRAM

```
#MORPHOLOGICAL
# Import necessary libraries
import cv2
import numpy as np
from matplotlib import pyplot as plt
from google.colab import files
# Upload the image
uploaded = files.upload()
# Get the file name
file_name = list(uploaded.keys())[0]
# Load the image in grayscale
image = cv2.imread(file_name, cv2.IMREAD_GRAYSCALE)
# Check if the image was loaded successfully
if image is None:
print("Error: Could not load image.")
exit()
# Apply a binary threshold to the image
_, binary_image = cv2.threshold(image, 127, 255, cv2.THRESH_BINARY)
# Define a kernel for the morphological operations
kernel = np.ones((5, 5), np.uint8)
# Apply morphological operations
dilated = cv2.dilate(binary_image, kernel, iterations=1)
eroded = cv2.erode(binary_image, kernel, iterations=1)
opened = cv2.morphologyEx(binary_image, cv2.MORPH_OPEN, kernel)
closed = cv2.morphologyEx(binary_image, cv2.MORPH_CLOSE, kernel)
gradient = cv2.morphologyEx(binary_image, cv2.MORPH_GRADIENT, kernel)
tophat = cv2.morphologyEx(binary_image, cv2.MORPH_TOPHAT, kernel)
blackhat = cv2.morphologyEx(binary_image, cv2.MORPH_BLACKHAT, kernel)
# Plot the results
plt.figure(figsize=(18, 12))
plt.subplot(3, 3, 1)
plt.title('Original Image')
```

```
plt.imshow(image, cmap='gray')
plt.axis('off')
plt.subplot(3, 3, 2)
plt.title('Binary Image')
plt.imshow(binary_image, cmap='gray')
plt.axis('off')
plt.subplot(3, 3, 3)
plt.title('Dilated Image')
plt.imshow(dilated, cmap='gray')
plt.axis('off')
plt.subplot(3, 3, 4)
plt.title('Eroded Image')
plt.imshow(eroded, cmap='gray')
plt.axis('off')
plt.subplot(3, 3, 5)
plt.title('Opened Image')
plt.imshow(opened, cmap='gray')
plt.axis('off')
plt.subplot(3, 3, 6)
plt.title('Closed Image')
plt.imshow(closed, cmap='gray')
plt.axis('off')
plt.subplot(3, 3, 7)
plt.title('Gradient Image')
plt.imshow(gradient, cmap='gray')
plt.axis('off')
plt.subplot(3, 3, 8)
plt.title('Top Hat Image')
plt.imshow(tophat, cmap='gray')
plt.axis('off')
plt.subplot(3, 3, 9)
plt.title('Black Hat Image')
```

```
plt.imshow(blackhat, cmap='gray')
plt.axis('off')
plt.tight_layout()
plt.show()
```

OUTPUT

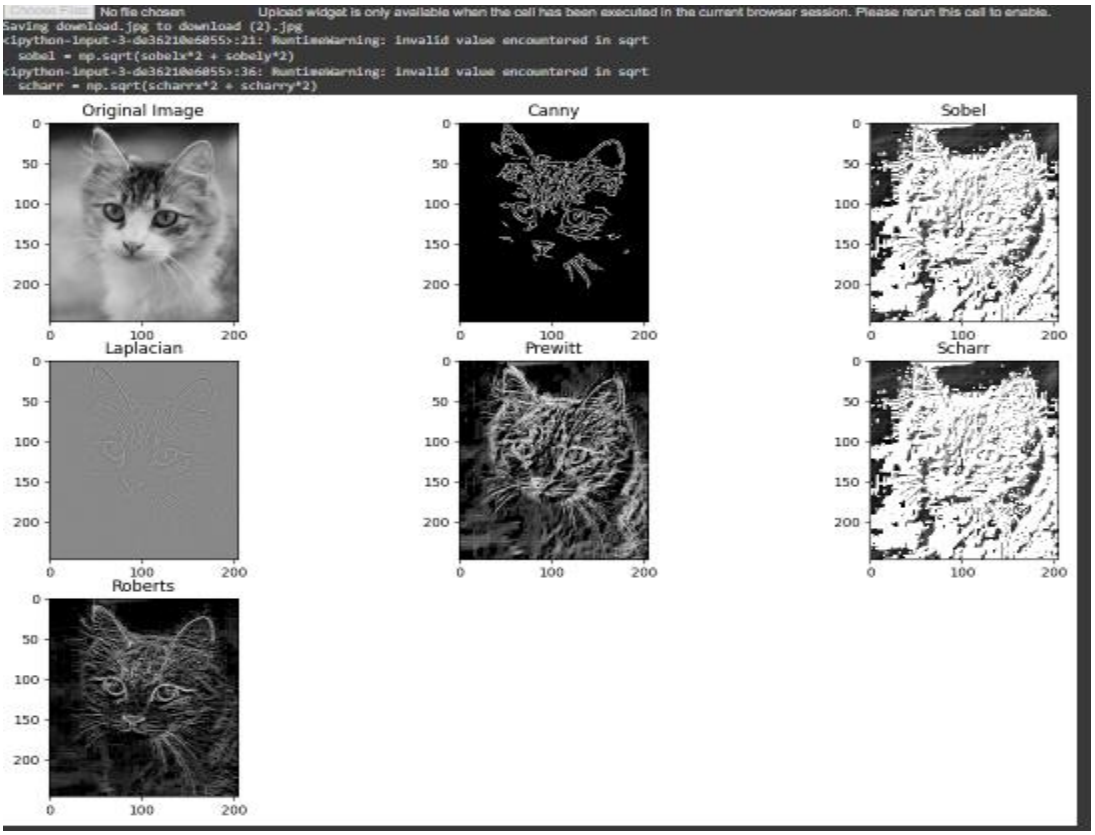


```
#EDGE DETECTION
# Import necessary libraries
import cv2
import numpy as np
from matplotlib import pyplot as plt
from google.colab import files
# Upload the image
uploaded = files.upload()
# Get the file name
file_name = list(uploaded.keys())[0]
# Load the image in grayscale
image = cv2.imread(file_name, cv2.IMREAD_GRAYSCALE)
# Check if the image was loaded successfully
if image is None:
    print("Error: Could not load image.")
    exit()
# Apply Canny edge detection
edges_canny = cv2.Canny(image, 100, 200)
# Apply Sobel edge detection
sobelx = cv2.Sobel(image, cv2.CV_64F, 1, 0, ksize=3)
sobely = cv2.Sobel(image, cv2.CV_64F, 0, 1, ksize=3)
edges_sobel = np.sqrt(sobelx**2 + sobely**2)
edges_sobel = np.uint8(edges_sobel / np.max(edges_sobel) * 255)
# Apply Prewitt edge detection
kernelx = np.array([[1, 0, -1], [1, 0, -1], [1, 0, -1]], dtype=int)
kernely = np.array([[1, 1, 1], [0, 0, 0], [-1, -1, -1]], dtype=int)
edges_prewittx = cv2.filter2D(image, cv2.CV_64F, kernelx)
edges_prewitty = cv2.filter2D(image, cv2.CV_64F, kernely)
edges_prewitt = np.sqrt(edges_prewittx**2 + edges_prewitty**2)
edges_prewitt = np.uint8(edges_prewitt / np.max(edges_prewitt) * 255)
# Apply Roberts edge detection
kernelx = np.array([[1, 0], [0, -1]], dtype=int)
kernely = np.array([[0, 1], [-1, 0]], dtype=int)
```

```
edges_robertsx = cv2.filter2D(image, cv2.CV_64F, kernelx)
edges_robertsy = cv2.filter2D(image, cv2.CV_64F, kernely)
edges_roberts = np.sqrt(edges_robertsx**2 + edges_robertsy**2)
edges_roberts = np.uint8(edges_roberts / np.max(edges_roberts) * 255)
# Apply Laplacian of Gaussian (LoG) edge detection
blurred = cv2.GaussianBlur(image, (3, 3), 0)
edges_log = cv2.Laplacian(blurred, cv2.CV_64F)
edges_log = np.uint8(np.absolute(edges_log) / np.max(np.absolute(edges_log)) * 255)
# Apply Zero-cross edge detection (approximated with Laplacian of Gaussian)
edges_zerocross = cv2.Laplacian(blurred, cv2.CV_64F)
edges_zerocross = np.uint8(np.absolute(edges_zerocross) /
np.max(np.absolute(edges_zerocross)) * 255)
# Plot the results
plt.figure(figsize=(15, 10))
plt.subplot(2, 4, 1)
plt.title('Original Image')
plt.imshow(image, cmap='gray')
plt.axis('off')
plt.subplot(2, 4, 2)
plt.title('Canny Edge Detection')
plt.imshow(edges_canny, cmap='gray')
plt.axis('off')
plt.subplot(2, 4, 3)
plt.title('Sobel Edge Detection')
plt.imshow(edges_sobel, cmap='gray')
plt.axis('off')
plt.subplot(2, 4, 4)
plt.title('Prewitt Edge Detection')
plt.imshow(edges_prewitt, cmap='gray')
plt.axis('off')
plt.subplot(2, 4, 5)
plt.title('Roberts Edge Detection')
```

```
plt.imshow(edges_roberts, cmap='gray')
plt.axis('off')
plt.subplot(2, 4, 6)
plt.title('LoG Edge Detection')
plt.imshow(edges_log, cmap='gray')
plt.axis('off')
plt.subplot(2, 4, 7)
plt.title('Zero-cross Edge Detection')
plt.imshow(edges_zerocross, cmap='gray')
plt.axis('off')
plt.tight_layout()
plt.show()
```

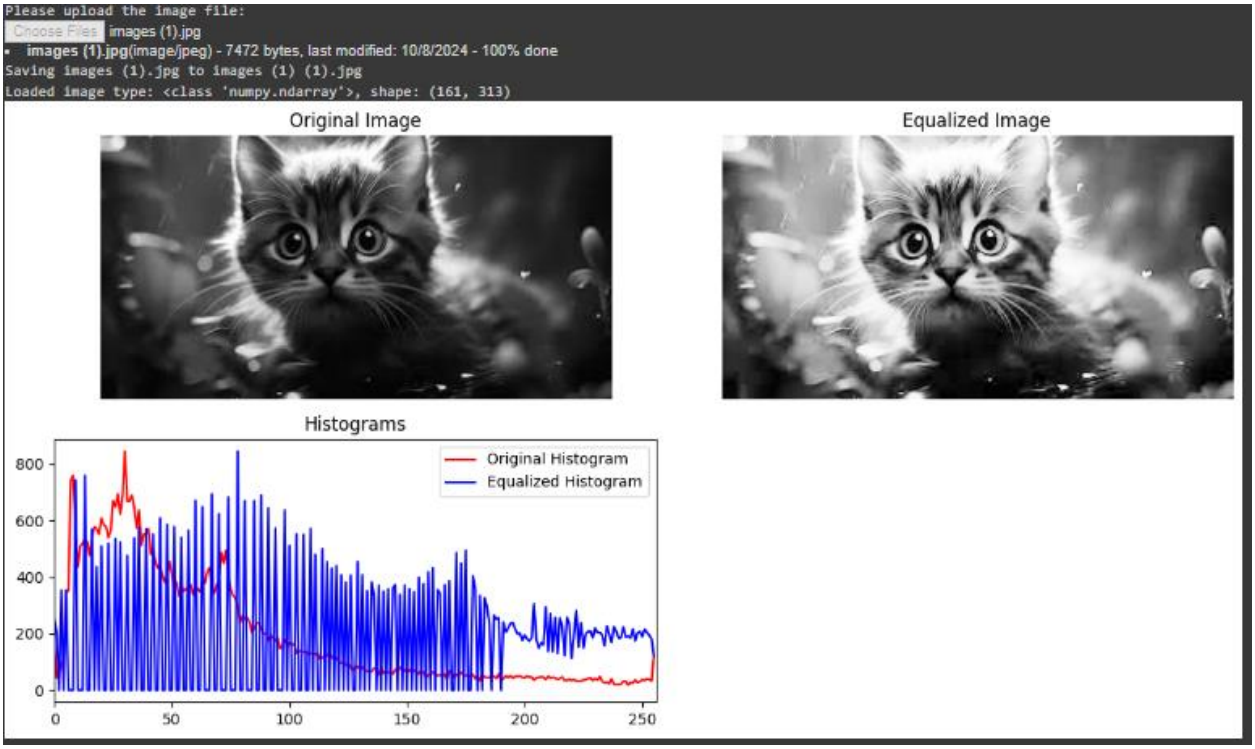
OUTPUT



```
# HISTOGRAM EQUALIZATION
# Step 1: Import necessary libraries
import cv2
import numpy as np
from matplotlib import pyplot as plt
from google.colab import files
# Step 2: Upload the image file
print("Please upload the image file:")
uploaded = files.upload()
# Extract the filename from the uploaded file
for filename in uploaded.keys():
    image_path = filename
# Step 3: Load the image in grayscale
image = cv2.imread(image_path, cv2.IMREAD_GRAYSCALE)
# Check if the image was loaded successfully
if image is None:
    print(f"Error: Could not load image at path {image_path}.")
else:
    # Print the type and shape of the loaded image
    print(f"Loaded image type: {type(image)}, shape: {image.shape}")
    # Step 4: Apply histogram equalization
    equalized_image = cv2.equalizeHist(image)
    # Step 5: Calculate histograms
    original_hist = cv2.calcHist([image], [0], None, [256], [0, 256])
    equalized_hist = cv2.calcHist([equalized_image], [0], None, [256], [0, 256])
    # Step 6: Plot the images and their histograms
    plt.figure(figsize=(12, 6))
    plt.subplot(2, 2, 1)
    plt.title('Original Image')
    plt.imshow(image, cmap='gray')
    plt.axis('off')
    plt.subplot(2, 2, 2)
```

```
plt.title('Equalized Image')
plt.imshow(equalized_image, cmap='gray')
plt.axis('off')
plt.subplot(2, 2, 3)
plt.title('Histograms')
plt.plot(original_hist, color='red', label='Original Histogram')
plt.plot(equalized_hist, color='blue', label='Equalized Histogram')
plt.xlim([0, 256])
plt.legend()
plt.tight_layout()
plt.show()
```

OUTPUT



#WATERSHED ALGORITHM

```
# Import necessary libraries
import cv2
import numpy as np
from scipy.ndimage import distance_transform_edt
from skimage import color, segmentation, filters, morphology
import matplotlib.pyplot as plt
from google.colab import files
# Step 1: Upload the image to Google Colab
uploaded = files.upload()
# Step 2: Load the uploaded image
image_path = list(uploaded.keys())[0]
I = cv2.imread(image_path)
I = cv2.cvtColor(I, cv2.COLOR_BGR2RGB)
# Step 3: Convert to Grayscale (if necessary)
if len(I.shape) == 3:
    I_gray = cv2.cvtColor(I, cv2.COLOR_RGB2GRAY)
# Step 4: Noise Reduction
I_filtered = cv2.GaussianBlur(I_gray, (5, 5), 2)
# Step 5: Compute the Gradient Magnitude
Ix = filters.sobel_h(I_filtered)
Iy = filters.sobel_v(I_filtered)
gradmag = np.sqrt(Ix**2 + Iy**2)
# Step 6: Marker-Based Segmentation
# Compute the distance transform
ret, binary_image = cv2.threshold(I_filtered, 0, 255, cv2.THRESH_BINARY_INV +
cv2.THRESH_OTSU)
D = distance_transform_edt(binary_image)
# Identify regional maxima and create markers
local_maxi = morphology.local_maxima(D)
markers = np.zeros_like(I_filtered, dtype=int)
markers[local_maxi] = np.arange(1, np.sum(local_maxi) + 1)
# Step 7: Apply the Watershed Transform
```

```
markers = segmentation.watershed(-D, markers, mask=binary_image)
# Define 7 distinct colors for visualization
colors = [
    [255, 0, 0],    # Red
    [0, 255, 0],    # Green
    [0, 0, 255],    # Blue
    [255, 255, 0],  # Yellow
    [0, 255, 255],  # Cyan
    [255, 0, 255],  # Magenta
    [192, 192, 192] # Gray]
# Map each label to one of the 7 colors
Lrgb = np.zeros((*markers.shape, 3), dtype=np.uint8)
unique_labels = np.unique(markers)
for k, label in enumerate(unique_labels):
    if label == 0:
        continue # Skip the background
    mask = markers == label
    color_idx = k % 7
    for c in range(3):
        Lrgb[:, :, c] += (mask * colors[color_idx][c]).astype(np.uint8)
# Step 8: Visualize the Results
fig, axes = plt.subplots(1, 3, figsize=(18, 6))
axes[0].imshow(I)
axes[0].set_title('Original Image')
axes[0].axis('off')
axes[1].imshow(gradmag, cmap='gray')
axes[1].set_title('Gradient Magnitude')
axes[1].axis('off')
axes[2].imshow(Lrgb)
axes[2].set_title('Watershed Transform')
axes[2].axis('off')
plt.show()
```

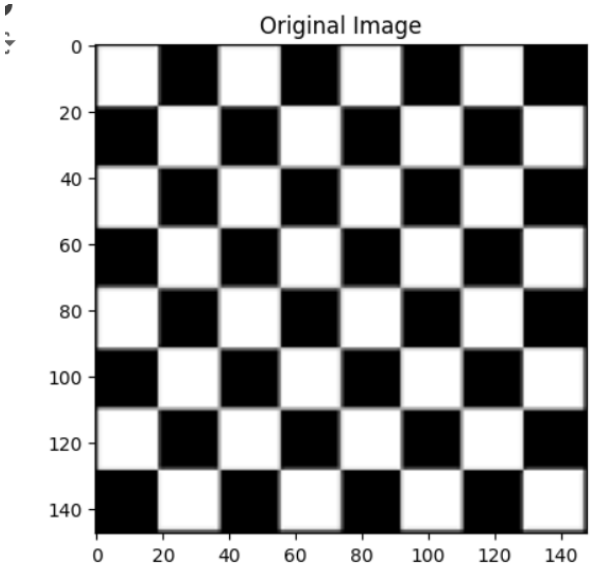
OUTPUT:

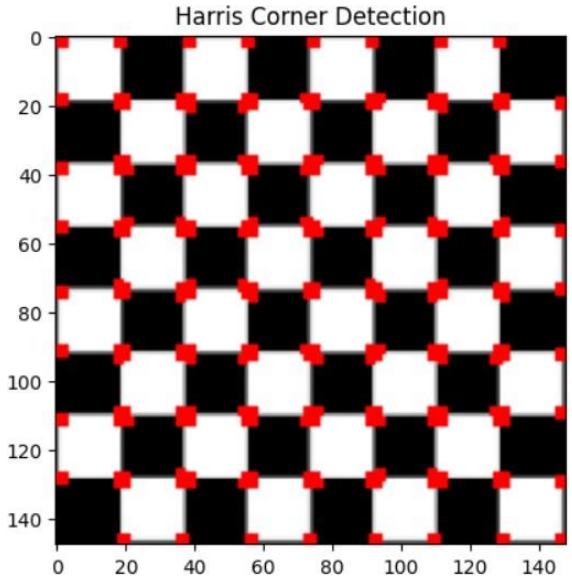

images (1).jpg
images (1).jpg(image/jpeg) - 7472 bytes, last modified: 10/8/2024 - 100% done
Saving images (1).jpg to images (1) (8).jpg
Original Image
Gradient Magnitude
Watershed Transform

#HARRIS CORNER

```
import cv2
import numpy as np
from google.colab import files
import matplotlib.pyplot as plt
# Upload the image
uploaded = files.upload()
# Assuming the uploaded file is the image you want to process
filename = list(uploaded.keys())[0]
# Read the image
img = cv2.imread(filename)
img_rgb = cv2.cvtColor(img, cv2.COLOR_BGR2RGB) # Convert BGR to RGB for
matplotlib
# Display the original image
plt.imshow(img_rgb)
plt.title('Original Image')
plt.show()
# Convert to grayscale
gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
# Convert to float32
gray = np.float32(gray)
# Apply the Harris corner detector
dst = cv2.cornerHarris(gray, 2, 3, 0.04)
# Result is dilated for marking the corners, not important
dst = cv2.dilate(dst, None)
# Threshold for an optimal value, it may vary depending on the image
img[dst > 0.01 * dst.max()] = [0, 0, 255]
# Convert the result to RGB for displaying
img_rgb = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
# Display the Harris Corner Detection result
plt.imshow(img_rgb)
plt.title('Harris Corner Detection')
plt.show()
```

OUTPUT


Original Image
0
20
40
60
80
100
120
140
0
20
40
60
80
100
120
140

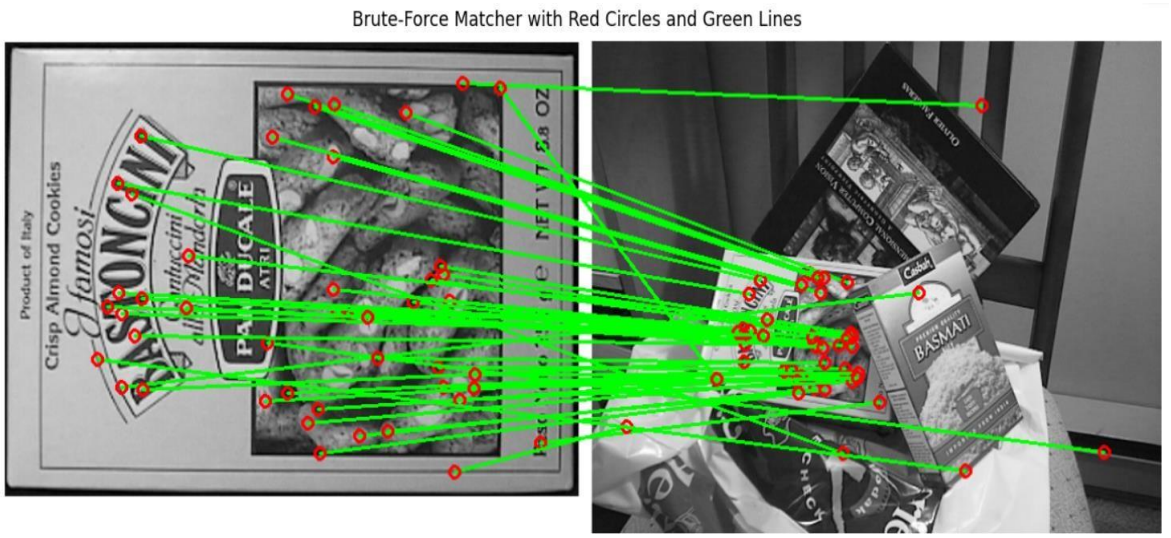

Harris Corner Detection
0
20
40
60
80
100
120
140
0
20
40
60
80
100
120
140

#**BROUTE FORCE**

```
# Install required libraries
!pip install opencv-python-headless matplotlib
import cv2 as cv
import numpy as np
import matplotlib.pyplot as plt
from google.colab import files
# Function to upload an image from local drive
def upload_image(title):
    uploaded = files.upload()
    for filename in uploaded.keys():
        print(f'User uploaded file "{filename}"')
        return cv.imread(filename)
# Load the images
print("Upload the first image:")
img1 = upload_image("Select first image")
if img1 is None:
    print("Could not open or find the first image.")
    exit()
print("Upload the second image:")
img2 = upload_image("Select second image")
if img2 is None:
    print("Could not open or find the second image.")
    exit()
# Convert images to grayscale
gray1 = cv.cvtColor(img1, cv.COLOR_BGR2GRAY)
gray2 = cv.cvtColor(img2, cv.COLOR_BGR2GRAY)
# Create SIFT detector object
sift = cv.SIFT_create()
# Detect keypoints and compute descriptors
keypoints1, descriptors1 = sift.detectAndCompute(gray1, None)
keypoints2, descriptors2 = sift.detectAndCompute(gray2, None)
```

```
# Create Brute-Force Matcher
bf = cv.BFMatcher(cv.NORM_L2, crossCheck=True)
# Match descriptors
matches = bf.match(descriptors1, descriptors2)
matches = sorted(matches, key=lambda x: x.distance)
# Draw matches with red circles and green lines
def draw_matches_red_circles_green_lines(img1, kp1, img2, kp2, matches,
num_matches=50):
    # Create an output image that stacks both input images side by side
    output_image = np.hstack((img1, img2))
    offset = img1.shape[1]  # Offset for the second image (since they are stacked side by
side)
    # Iterate through the matches and draw circles and lines
    for i, match in enumerate(matches[:num_matches]):
        pt1 = tuple(np.round(kp1[match.queryIdx].pt).astype(int)) # Keypoint in the first image
        pt2 = tuple(np.round(kp2[match.trainIdx].pt).astype(int) + np.array([offset, 0]))  #
Keypoint in the second image (with offset)
        # Draw green line between keypoints
        cv.line(output_image, pt1, pt2, (0, 255, 0), 2)
        # Draw red circles around keypoints
        cv.circle(output_image, pt1, 5, (0, 0, 255), 2)
        cv.circle(output_image, pt2, 5, (0, 0, 255), 2)
    return output_image
# Draw the matches with red circles and green lines
output_image = draw_matches_red_circles_green_lines(img1, keypoints1, img2, keypoints2,
matches, num_matches=50)
# Display the output image using matplotlib
plt.figure(figsize=(15, 10))
plt.imshow(cv.cvtColor(output_image, cv.COLOR_BGR2RGB))
plt.title('Brute-Force Matcher with Red Circles and Green Lines')
plt.axis('off')
plt.show()
```

OUTPUT

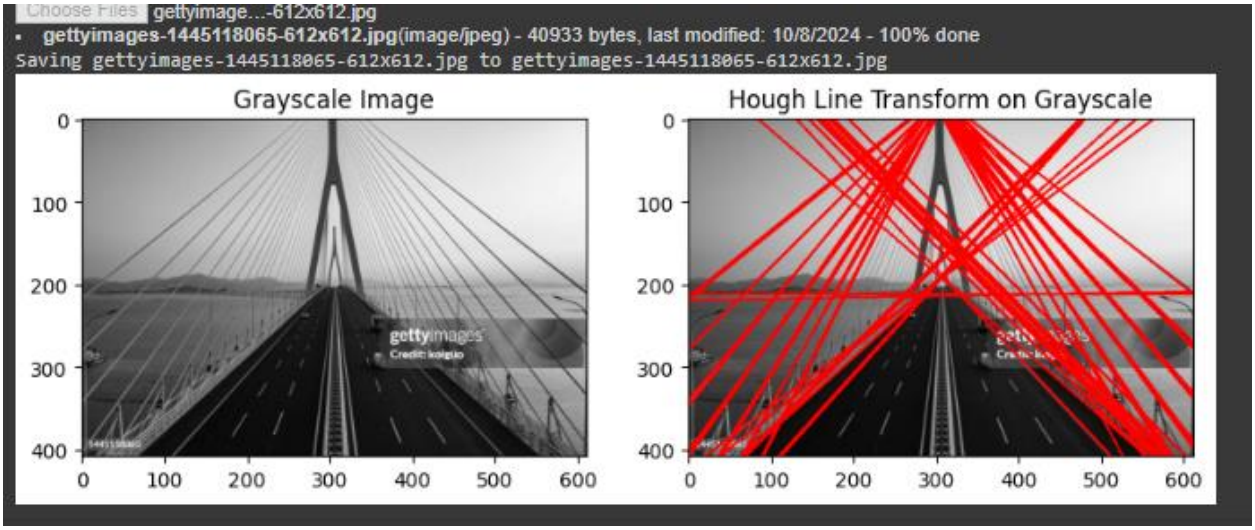

Brute-Force Matcher with Red Circles and Green Lines
Product of Italy
Crisp Almond Cookies
BASMATI

```
#HOUGH LINE
import cv2
import numpy as np
from matplotlib import pyplot as plt
from google.colab import files
# Upload the image from your local machine
uploaded = files.upload()
# Load the uploaded image
image_path = list(uploaded.keys())[0] # Get the uploaded file name
image = cv2.imread(image_path)
# Convert the image to grayscale
gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
# Apply Canny edge detection
edges = cv2.Canny(gray, 50, 150, apertureSize=3)
# Apply Hough Line Transform
lines = cv2.HoughLines(edges, 1, np.pi/180, 200)
# Create an output image to draw the lines
output_image = cv2.cvtColor(gray, cv2.COLOR_GRAY2BGR)
# Draw the lines on the image
if lines is not None:
    for rho, theta in lines[:, 0]:
        a = np.cos(theta)
        b = np.sin(theta)
        x0 = a * rho
        y0 = b * rho
        x1 = int(x0 + 1000 * (-b))
        y1 = int(y0 + 1000 * (a))
        x2 = int(x0 - 1000 * (-b))
        y2 = int(y0 - 1000 * (a))
        cv2.line(output_image, (x1, y1), (x2, y2), (0, 0, 255), 2)
# Display the original grayscale image and the image with detected lines
plt.figure(figsize=(10,8))
plt.subplot(121), plt.imshow(gray, cmap='gray'), plt.title('Grayscale Image')
```

plt.subplot(122), plt.imshow(cv2.cvtColor(output_image, cv2.COLOR_BGR2RGB)),
plt.title('Hough Line Transform on Grayscale')

plt.show()

OUTPUT



```
#K-MEANS CLUSTER
 # Import necessary libraries
 import cv2 as cv
 import numpy as np
 from google.colab.patches import cv2_imshow
 from IPython.display import display, Javascript
 from google.colab.output import eval_js
 from base64 import b64decode
 import io
 from PIL import Image
 # JavaScript to capture an image from the webcam
 def capture_image():
    js = Javascript('''
    async function capture() {
       const video = document.createElement('video');
       const stream = await navigator.mediaDevices.getUserMedia({video: true});
       document.body.appendChild(video);
       video.srcObject = stream;
       await video.play();
       // Resize the output canvas to match the video feed.
       const canvas = document.createElement('canvas');
       canvas.width = video.videoWidth;
       canvas.height = video.videoHeight;
       canvas.getContext('2d').drawImage(video, 0, 0);
       stream.getVideoTracks()[0].stop();
       video.remove();
       return canvas.toDataURL('image/png');
    }
    capture();
    ''')
    display(js)
    data = eval_js('capture()')
    binary = b64decode(data.split(',')[1])
```

```
    image = Image.open(io.BytesIO(binary))
    return cv.cvtColor(np.array(image), cv.COLOR_BGR2RGB)
# Apply K-means clustering to the captured image
def apply_kmeans(image, K=6):
    # Reshape the image to a 2D array of pixels
    pixel_values = image.reshape((-1, 3))
    pixel_values = np.float32(pixel_values)
    # Define criteria and apply K-means
    criteria = (cv.TERM_CRITERIA_EPS + cv.TERM_CRITERIA_MAX_ITER, 100, 0.2)
    _, labels, centers = cv.kmeans(pixel_values, K, None, criteria, 10,
cv.KMEANS_RANDOM_CENTERS)
    # Convert centers back to uint8
    centers = np.uint8(centers)
    # Map labels to colors
    segmented_image = centers[labels.flatten()]
    segmented_image = segmented_image.reshape(image.shape)
    # Create a color palette for the clusters
    colors = np.random.randint(0, 255, size=(K, 3))
    # Reshape labels to match the original image shape
    labels_reshaped = labels.reshape(image.shape[0], image.shape[1])
    # Color each cluster distinctly
    color_image = np.zeros_like(image)
    for i in range(K):
        color_image[labels_reshaped == i] = colors[i]
    return color_image
# Capture and display images from the webcam
def main():
    try:
        # Prompt the user to enter the number of clusters
        K = int(input("Enter the number of clusters (K): "))
        if K < 1:
            raise ValueError("The number of clusters (K) must be greater than 0.")
```

```
    except ValueError as e:
        print(f"Invalid input: {e}. Please enter a valid integer.")
        return
    image = capture_image() # Capture image from the webcam
    if image is not None:
        clustered_image = apply_kmeans(image, K=K) # Apply K-means clustering
        cv2_imshow(clustered_image)  # Display the clustered image
    else:
        print("Failed to capture image from webcam.")
main()
```

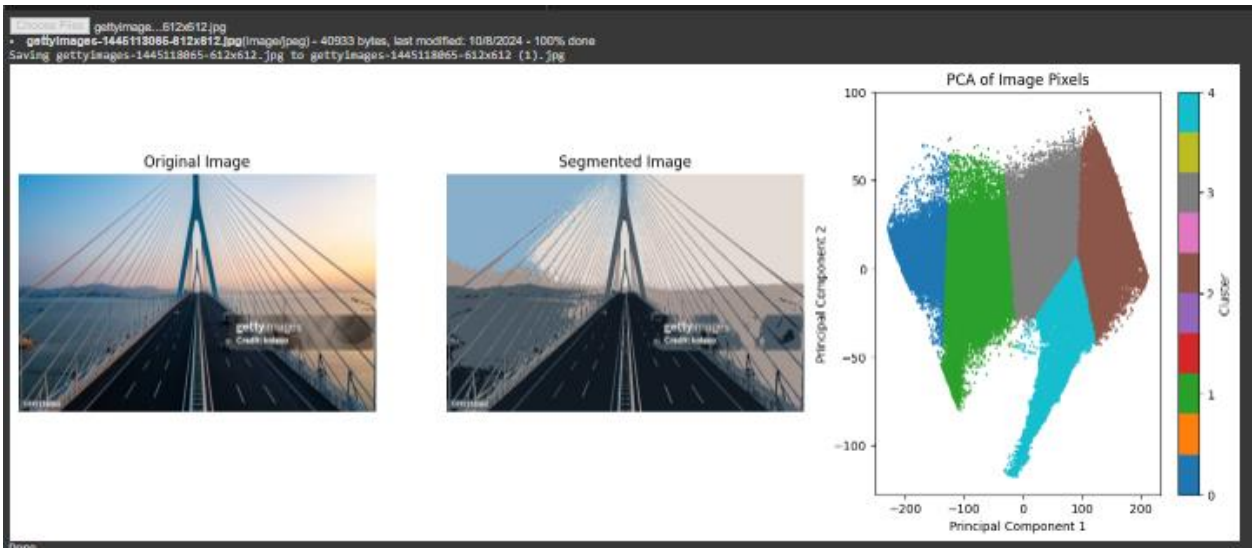
OUTPUT

#PCA

```
# Import necessary libraries
import numpy as np
import cv2 as cv
import matplotlib.pyplot as plt
from sklearn.decomposition import PCA
from google.colab import files
# Upload the image
uploaded = files.upload()
# Extract the filename from the uploaded files
image_path = list(uploaded.keys())[0]
# Function to perform K-means clustering on image pixels and plot PCA
def kmeans_on_image(image_path, cluster_n):
    # Load the image
    img = cv.imread(image_path)
    if img is None:
        raise ValueError("Image not found or unable to load.")
    # Convert the image to RGB
    img_rgb = cv.cvtColor(img, cv.COLOR_BGR2RGB)
    # Reshape the image to a 2D array of pixels
    pixel_values = img_rgb.reshape((-1, 3))
    pixel_values = np.float32(pixel_values)
    # Perform K-means clustering
    term_crit = (cv.TERM_CRITERIA_EPS, 30, 0.1)
    _, labels, centers = cv.kmeans(pixel_values, cluster_n, None, term_crit, 10,
cv.KMEANS_RANDOM_CENTERS)
    # Convert centers to uint8
    centers = np.uint8(centers)
    # Map the labels to center colors
    segmented_img = centers[labels.flatten()]
    # Reshape segmented image to original dimensions
    segmented_img = segmented_img.reshape(img_rgb.shape)
```

```
    # Apply PCA for 2D visualization
    pca = PCA(n_components=2)
    pixel_values_pca = pca.fit_transform(pixel_values)
    # Create a scatter plot for PCA
    plt.figure(figsize=(18, 6))
    # Plot the original and segmented images
    plt.subplot(1, 3, 1)
    plt.imshow(img_rgb)
    plt.title('Original Image')
    plt.axis('off')
    plt.subplot(1, 3, 2)
    plt.imshow(segmented_img)
    plt.title('Segmented Image')
    plt.axis('off')
    # Plot PCA results
    plt.subplot(1, 3, 3)
    scatter = plt.scatter(pixel_values_pca[:, 0], pixel_values_pca[:, 1], c=labels.flatten(), cmap='tab10', s=1)
    plt.colorbar(scatter, ticks=range(cluster_n), label='Cluster')
    plt.title('PCA of Image Pixels')
    plt.xlabel('Principal Component 1')
    plt.ylabel('Principal Component 2')
    plt.show()
    print('Done')
# Number of clusters
cluster_n = 5
kmeans_on_image(image_path, cluster_n)
```

OUTPUT


Choose Files
gettyimage...612x612.jpg
gettyimages-1445113086-812x812.jpg(image/jpeg) - 40933 bytes, last modified: 10/8/2024 - 100% done
Saving gettyimages-1445118065-612x612.jpg to gettyimages-1445118065-612x612 (1).jpg
Original Image
Segmented Image
PCA of Image Pixels
Principal Component 2
Principal Component 1
Cluster
100
50
0
−50
−100
−200
−100
0
100
200
4
3
2
1
0

```
#OBJECT DETECTION

# Step 2: Import Libraries
import cv2
import numpy as np
import torch
from torchvision import models
import torchvision.transforms as T
import matplotlib.pyplot as plt
from google.colab import files
# Step 3: Upload Image File
uploaded = files.upload()
# Step 4: Get the Uploaded File Name
image_path = list(uploaded.keys())[0] # Get the name of the uploaded file
# Verify if the image was uploaded successfully
if image_path:
    print(f"Image '{image_path}' uploaded successfully.")
else:
    print("Error: No image was uploaded. Please try again.")
# Step 5: Load the Pre-trained Mask R-CNN Model
model = models.detection.maskrcnn_resnet50_fpn(pretrained=True)
model.eval()
# Step 6: Define Function to Perform Object Detection
def detect_objects(image_path):
    # Read the input image
    image = cv2.imread(image_path)
    # Check if the image is loaded properly
    if image is None:
        print("Error: Image not loaded. Check the file path or ensure the file exists.")
        return
    # Convert BGR image to RGB
    image_rgb = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
    # Transform image to match the model's input requirements
    transform = T.Compose([T.ToTensor()])
```

```
image_tensor = transform(image_rgb)
# Perform object detection
with torch.no_grad():
    output = model([image_tensor])
# Get the detected boxes, labels, and scores
boxes = output[0]['boxes'].numpy()
labels = output[0]['labels'].numpy()
scores = output[0]['scores'].numpy()
# Define labels for COCO dataset
coco_labels = [
    '_background_', 'person', 'bicycle', 'car', 'motorcycle', 'airplane', 'bus', 'train', 'truck', 'boat',
    'traffic light', 'fire hydrant', 'N/A', 'stop sign', 'parking meter', 'bench', 'bird', 'cat', 'dog',
'horse',
    'sheep', 'cow', 'elephant', 'bear', 'zebra', 'giraffe', 'N/A', 'backpack', 'umbrella', 'N/A', 'N/A',
    'handbag', 'tie', 'suitcase', 'frisbee', 'skis', 'snowboard', 'sports ball', 'kite', 'baseball bat',
    'baseball glove', 'skateboard', 'surfboard', 'tennis racket', 'bottle', 'N/A', 'wine glass', 'cup',
'fork',
    'knife', 'spoon', 'bowl', 'banana', 'apple', 'sandwich', 'orange', 'broccoli', 'carrot', 'hot dog',
'pizza',
    'donut', 'cake', 'chair', 'couch', 'potted plant', 'bed', 'N/A', 'dining table', 'N/A', 'N/A',
'toilet',
    'N/A', 'tv', 'laptop', 'mouse', 'remote', 'keyboard', 'cell phone', 'microwave', 'oven',
'toaster', 'sink',
    'refrigerator', 'N/A', 'book', 'clock', 'vase', 'scissors', 'teddy bear', 'hair drier', 'toothbrush'
]
# Set detection threshold
detection_threshold = 0.7
# Plot the detections on the image
for i in range(len(boxes)):
    if scores[i] > detection_threshold:
        # Draw the bounding box
        (x1, y1, x2, y2) = boxes[i].astype(int)
        cv2.rectangle(image_rgb, (x1, y1), (x2, y2), (0, 255, 0), 2)
```

 # Add label

label = coco_labels[labels[i]]

cv2.putText(image_rgb, label, (x1, y1 - 10), cv2.FONT_HERSHEY_SIMPLEX, 0.9,(36, 255, 12), 2)

 # Display the image

plt.figure(figsize=(12,

8))

plt.imshow(image_rgb)

plt.axis('off')

plt.show()

 # Step 7: Run Detection on Your Image

if image_path:

detect_objects(image_pat

h)

OUTPUT