Tugas OpenCV Thresholding

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1. Install Libraries yang Dibutuhkan

```
!pip install opencv-python
!pip install requests
!pip install numpy
!pip install matplotlib
```

```
Requirement already satisfied: opencv-python in
/usr/local/lib/python3.11/dist-packages (4.11.0.86)
Requirement already satisfied: numpy>=1.21.2 in
/usr/local/lib/python3.11/dist-packages (from opencv-python) (1.26.4)
Requirement already satisfied: requests in
/usr/local/lib/python3.11/dist-packages (2.32.3)
Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.11/dist-packages (from requests) (3.4.1)
Requirement already satisfied: idna<4,>=2.5 in
/usr/local/lib/python3.11/dist-packages (from requests) (3.10)
Requirement already satisfied: urllib3<3,>=1.21.1 in
/usr/local/lib/python3.11/dist-packages (from requests) (2.3.0)
Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.11/dist-packages (from requests) (2025.1.31)
Requirement already satisfied: numpy in
/usr/local/lib/python3.11/dist-packages (1.26.4)
Requirement already satisfied: matplotlib in
/usr/local/lib/python3.11/dist-packages (3.10.0)
Requirement already satisfied: contourpy>=1.0.1 in
/usr/local/lib/python3.11/dist-packages (from matplotlib) (1.3.1)
Requirement already satisfied: cycler>=0.10 in
/usr/local/lib/python3.11/dist-packages (from matplotlib) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in
/usr/local/lib/python3.11/dist-packages (from matplotlib) (4.56.0)
Requirement already satisfied: kiwisolver>=1.3.1 in
/usr/local/lib/python3.11/dist-packages (from matplotlib) (1.4.8)
Requirement already satisfied: numpy>=1.23 in
/usr/local/lib/python3.11/dist-packages (from matplotlib) (1.26.4)
Requirement already satisfied: packaging>=20.0 in
/usr/local/lib/python3.11/dist-packages (from matplotlib) (24.2)
Requirement already satisfied: pillow>=8 in
/usr/local/lib/python3.11/dist-packages (from matplotlib) (11.1.0)
Requirement already satisfied: pyparsing>=2.3.1 in
/usr/local/lib/python3.11/dist-packages (from matplotlib) (3.2.1)
Requirement already satisfied: python-dateutil>=2.7 in
```

```
/usr/local/lib/python3.11/dist-packages (from matplotlib) (2.8.2)
Requirement already satisfied: six>=1.5 in
/usr/local/lib/python3.11/dist-packages (from python-dateutil>=2.7-
>matplotlib) (1.17.0)
```

2. Import Libraries yang Dibutuhkan

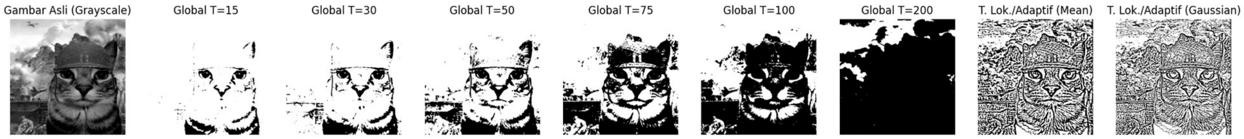
```python
from google.colab.patches import cv2_imshow
import requests
import numpy as np
import cv2
import matplotlib.pyplot as plt
```

3. Unduh Gambar dan Simpan

```python
url = 'https://mfazrinizar.com/assets/img/akmal-war.jpg'
response = requests.get(url, stream=True)
response.raise_for_status()

with open('object.jpg', 'wb') as file:
    for chunk in response.iter_content(chunk_size=8192):
        file.write(chunk)

image = cv2.imread("object.jpg")
cv2_imshow(image)
```

4. Jalankan Operasi Thresholding

```python
# Read grayscale image
img = cv2.imread('object.jpg', cv2.IMREAD_GRAYSCALE)

# Multiple global threshold values
threshold_values = [15, 30, 50, 75, 100, 200]

# Apply each global threshold
global_thresh_results = []
for val in threshold_values:
    _, th = cv2.threshold(img, val, 255, cv2.THRESH_BINARY)
    global_thresh_results.append((val, th))

# Local/adaptive threshold (mean)
thresh_local = cv2.adaptiveThreshold(img, 255,
cv2.ADAPTIVE_THRESH_MEAN_C,
                                     cv2.THRESH_BINARY, 11, 2)

# Local/adaptive threshold (Gaussian)
thresh_adaptive = cv2.adaptiveThreshold(img, 255,
cv2.ADAPTIVE_THRESH_GAUSSIAN_C,
                                        cv2.THRESH_BINARY, 11, 2)

# Show results: original, multiple globals, mean, gaussian
fig, axs = plt.subplots(1, len(global_thresh_results) + 3,
figsize=(25, 5))

# Original
axs[0].imshow(img, cmap='gray')
axs[0].set_title('Gambar Asli (Grayscale)')
axs[0].axis('off')

# Global threshold variations
for i, (val, res) in enumerate(global_thresh_results, start=1):
    axs[i].imshow(res, cmap='gray')
    axs[i].set_title(f'Global T={val}')
    axs[i].axis('off')

# Mean adaptive
axs[-2].imshow(thresh_local, cmap='gray')
axs[-2].set_title('T. Lok./Adaptif (Mean)')
axs[-2].axis('off')

# Gaussian adaptive
axs[-1].imshow(thresh_adaptive, cmap='gray')
axs[-1].set_title('T. Lok./Adaptif (Gaussian)')
axs[-1].axis('off')

plt.show()
```



5. Analisis

Beberapa metode thresholding yang diterapkan dalam notebook ini, yaitu:

1. Global Thresholding dengan berbagai nilai threshold (15, 30, 50, 75, 100, 200).

- Metode ini membagi piksel menjadi dua kelompok berdasarkan nilai ambang batas (T = threshold).
- Hasilnya menunjukkan bagaimana perubahan nilai threshold memengaruhi segmentasi objek dalam gambar. Nilai threshold yang lebih tinggi menghasilkan citra biner yang lebih putih (latar belakang yang lebih dominan), sementara nilai rendah akan membuat foreground lebih menonjol.

2. Local/Adaptive Thresholding (Mean):

- Metode ini menghitung threshold secara lokal, yang lebih baik untuk gambar dengan variasi pencahayaan yang tidak merata.
- Nilai threshold dihitung berdasarkan rata-rata intensitas piksel di sekitar setiap piksel.

3. Local/Adaptive Thresholding (Gaussian):

- Mirip dengan adaptive mean, tetapi threshold dihitung dengan menggunakan weighted average (gaussian) dari intensitas piksel di sekitar setiap piksel.
- Cara ini umumnya lebih robust terhadap noise.
- Apabila dibandingkan, adaptive gaussian dengan adaptive mean dan global threshold, terdapat perbedaan segmentasi, terutama pada area dengan variasi pencahayaan.

Kesimpulan:

- Pemilihan metode thresholding bergantung pada karakteristik gambar dan tujuan segmentasi.
- Jika pencahayaan merata, global threshold mungkin cukup.
- Untuk gambar dengan variasi pencahayaan, adaptive thresholding biasanya lebih baik, dan Gaussian cenderung lebih robust terhadap noise. Terlihat pada gambar perbandingan.