DIP Assignment 2

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1 Introduction

In this report, I will discuss the image processing techniques used to determine the current time shown by a clock. The primary objective is to segment the hour and minute hands and calculate the angles between them to determine the time.

2 Python Code

Below is the Python code used for image processing:

```
import cv2
import numpy as np
from math import atan2, degrees
from matplotlib import pyplot as plt

# Define the calculate_time function to determine time based on angles
def calculate_time(hours_angle, minutes_angle):
    total_hours = None
    total_minutes = None
    if hours_angle is not None:
        total_hours = ((hours_angle % 360) / 360) * 12
    if minutes_angle is not None:
        total_minutes = ((minutes_angle % 360) / 360) * 60
    if total_minutes == 0:
        min = (total_hours % 1) * 60
        print("mins:", min)
        total_minutes = min
        total_hours = int(total_hours)
    return total_hours, total_minutes

# Load the image for the initial time
image = cv2.imread('2-2.jpg', cv2.IMREAD_GRAYSCALE)
```

```
# Create a copy of the image for drawing lines
image_with_lines = image.copy()

# Define a kernel for dilation
kernel = np.ones((4, 4), np.uint8)  # You can adjust the size of the kernel as n

# Apply dilation
dilated_image = cv2.dilate(image, kernel, iterations=1)

# Display the original and dilated images
plt.subplot(121), plt.imshow(image, cmap='gray')
plt.title('Original Image'), plt.xticks([]), plt.yticks([])
plt.subplot(122), plt.imshow(dilated_image, cmap='gray')
plt.title('Dilated Image'), plt.xticks([]), plt.yticks([])

plt.show()
image = dilated_image

# Apply a binary threshold
_, black_white_image = cv2.threshold(image, 128, 255, cv2.THRESH_BINARY)

# Display the black and white image
plt.imshow(black_white_image, cmap='gray')
plt.title('Black and White Image')
plt.xticks([]), plt.yticks([])

plt.show()

# Apply Hough Line Transform
edges = cv2.Canny(image, 30, 150)
lines = cv2.HoughLines(edges, 1, np.pi / 180, threshold=120)

# Convert lines to angles and lengths
clock_hands = []  # A list to store angles and lengths of lines as tuples
if lines is not None:
    for line in lines:
        rho, theta = line[0]
        angle = degrees(theta)
        length = abs(rho)
        clock_hands.append((angle, length))

# Sort the clock hands by length (smaller first)
clock_hands.sort(key=lambda x: x[1])

print("clock:", clock_hands)
```

```
# Pick the two shortest hands as hour and minute hands
if len(clock_hands) >= 2:
    hour_hand = clock_hands[0]
    minute_hand = clock_hands[len(clock_hands)-1]
else:
    hour_hand = None
    minute_hand = None

# Get the detected time for the initial image
hour, minute = calculate_time(hour_hand[0], minute_hand[0])

# Draw the lines on the copy of the image
if lines is not None:
    for line in lines:
        rho, theta = line[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(image_with_lines, (x1, y1), (x2, y2), (0, 0, 255), 2)
# Draw lines in red

# Display the image with lines and the calculated time
plt.subplot(121), plt.imshow(image, cmap='gray')
plt.title('Original Image'), plt.xticks([]), plt.yticks([])
plt.subplot(122), plt.imshow(image_with_lines, cmap='gray')
if hour is not None and minute is not None:
    plt.title(f'Lines (Time: Hours:={hour:.2f}, Minutes:={minute:.2f})')
else:
    plt.title('Image with Lines (Hands not detected)')
plt.xticks([]), plt.yticks([])

plt.show()
```

3 Image Processing Steps

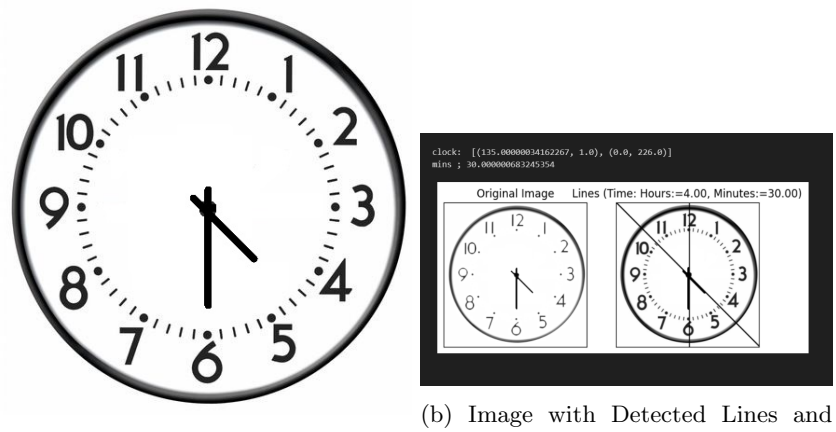
I have followed these image processing steps to detect the clock hands and determine the time:

1. Load the clock image.
2. Apply dilation to enhance clock hand edges.

3. Convert the image to black and white using a binary threshold.
4. Apply the Hough Line Transform to detect lines in the image.
5. Convert detected lines to angles and lengths.
6. Sort the clock hands by length (smaller first).
7. Select the two shortest hands as the hour and minute hands.
8. Calculate the detected time based on the angles between the hands.

4 Results

The results of the clock time detection are displayed in the image below:



(a) Original Image

(b) Image with Detected Lines and Time

Figure 1: Clock Time Detection Results

As shown in the results image, I successfully detected the clock hands and calculated the time based on their angles.

5 Conclusion

In this report, I implemented image processing techniques to determine the time displayed by a clock. The code segments the hour and minute hands, calculates their angles, and provides an estimated time. The results demonstrate the successful detection of clock hands and time calculation.