Lane Marking Detection Using OpenCV

Introduction

Lane detection is a crucial component in autonomous driving and computer vision applications. This project aims to extract lane markings from an image using color thresholding in the HSV color space. The approach focuses on detecting white and yellow lane markings, which are commonly used on roads.

Approach

1. Image Processing Workflow

The lane detection process follows these key steps:

1. **Load the Image**: Read the input image using OpenCV.
2. **Convert to HSV Color Space**: HSV (Hue, Saturation, Value) is more robust for color-based segmentation than RGB.
3. **Define Color Thresholds**: Define lower and upper HSV bounds to detect white and yellow lane markings.
4. **Create Binary Masks**: Use cv2.inRange() to extract pixels within the defined color ranges.
5. **Highlight Detected Markings**: Apply the masks to the original image to highlight lane markings.
6. **Save the Output Images**: The binary masks and highlighted image are saved for further analysis.

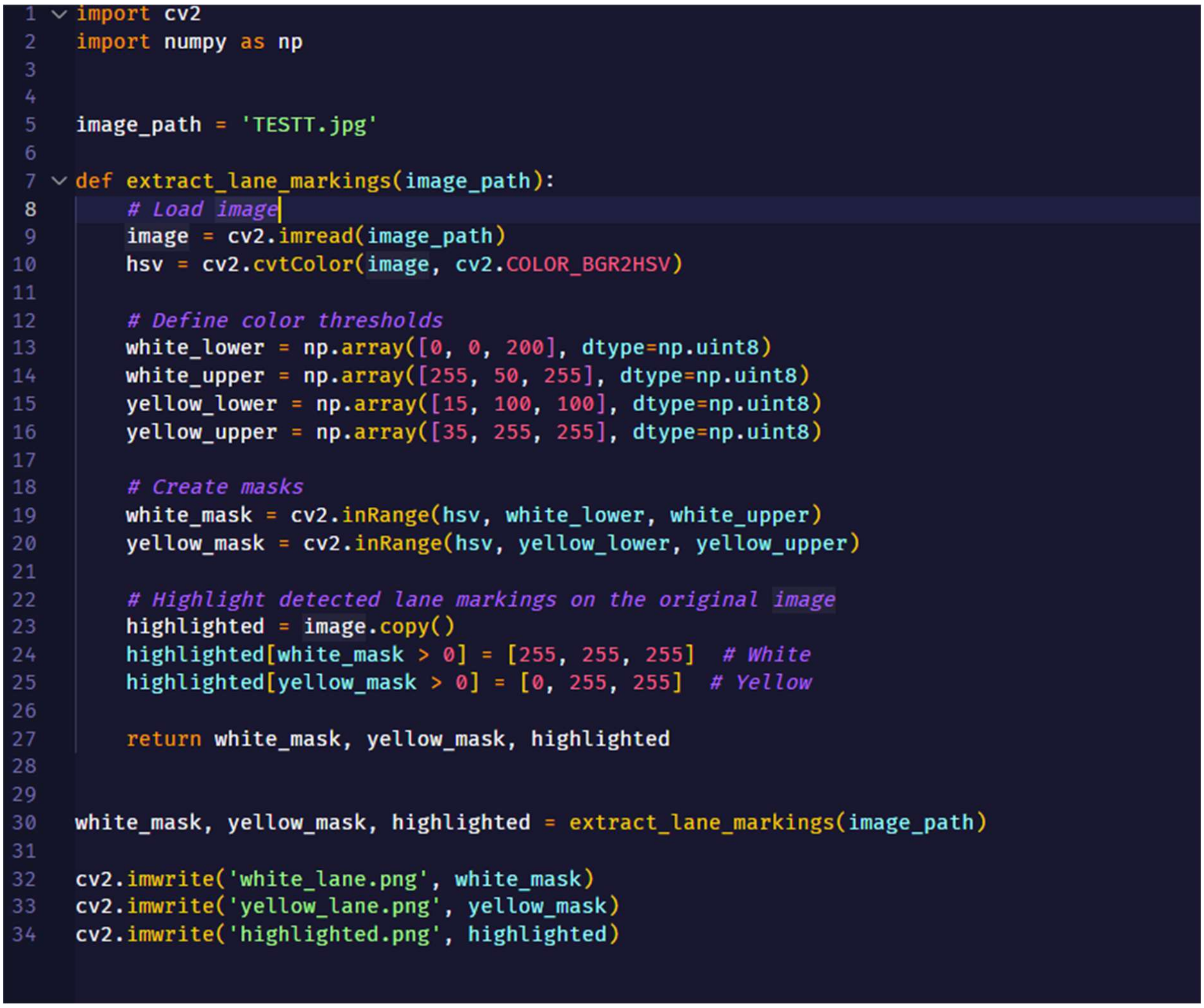
2. Why Use HSV Color Space?

- The Hue channel helps isolate specific colors (yellow and white) more effectively.
- Saturation and Value adjustments make detection more robust under varying lighting conditions.

3. Image Segmentation Using Thresholding

- White lanes typically have high brightness and low saturation.
- Yellow lanes have a distinct hue range that can be isolated.
- Applying cv2.inRange() generates binary masks for easier processing.

Code Implementation



```python
import cv2
import numpy as np


image_path = 'TESTT.jpg'

def extract_lane_markings(image_path):
    # Load image
    image = cv2.imread(image_path)
    hsv = cv2.cvtColor(image, cv2.COLOR_BGR2HSV)

    # Define color thresholds
    white_lower = np.array([0, 0, 200], dtype=np.uint8)
    white_upper = np.array([255, 50, 255], dtype=np.uint8)
    yellow_lower = np.array([15, 100, 100], dtype=np.uint8)
    yellow_upper = np.array([35, 255, 255], dtype=np.uint8)

    # Create masks
    white_mask = cv2.inRange(hsv, white_lower, white_upper)
    yellow_mask = cv2.inRange(hsv, yellow_lower, yellow_upper)

    # Highlight detected lane markings on the original image
    highlighted = image.copy()
    highlighted[white_mask > 0] = [255, 255, 255]  # White
    highlighted[yellow_mask > 0] = [0, 255, 255]  # Yellow

    return white_mask, yellow_mask, highlighted


white_mask, yellow_mask, highlighted = extract_lane_markings(image_path)

cv2.imwrite('white_lane.png', white_mask)
cv2.imwrite('yellow_lane.png', yellow_mask)
cv2.imwrite('highlighted.png', highlighted)
```

Output Explanation

1. white_lane.png - Binary mask of detected white lane markings.
2. yellow_lane.png - Binary mask of detected yellow lane markings.
3. highlighted.png - Original image with detected lanes highlighted in white and yellow.