IPMV Continuous Assessment

Find number of straws/pipes in given image using atleast 2 methods

Group Number : B8

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Problem Statement

In many industrial and engineering scenarios, it's crucial to accurately detect and count pipes or straws in images for various purposes such as quality control, inventory management, and maintenance scheduling. This project aims to develop a system that automatically detects and counts pipes/straws in given images using at least two different methods: preprocessing techniques with thresholding and the Hough Circle Transform.

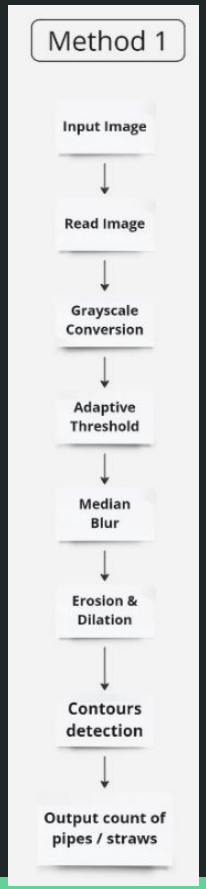
Solution

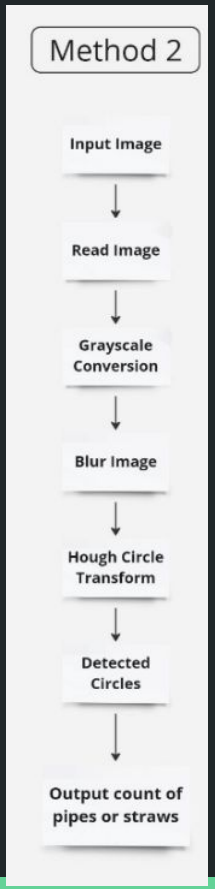
To solve this problem, first, apply the erosion and dilation operations to the image to enhance the edges and eliminate noise. Then, use contour detection and thresholding techniques to identify individual straw-like shapes and count them. This method relies on the assumption that straws/pipes have specific geometric features that can be captured through these operations. Next, utilize the Hough Circle Transformation, specifically the Houghcircle transformation, to detect circular shapes within the image, which could represent the pipes. By setting appropriate parameters for circle detection, count the detected circles to estimate the number of pipes. Finally, compare the results obtained from both methods to assess their accuracy and robustness in counting the straws/pipes, taking into consideration the image's complexity and the diversity of pipe shapes present.

Literature Survey

Sr. No	Title of Technical paper	Name of Author	Year of publication	Name of Journal	Methodology	Results/ conclusions	Drawbacks/ Limitations
[1]	Approach to Accurate Circle Detection: Circular Hough Transform and Local Maxima Concept	Virendra Kumar Yadav, Saumya Batham, Anuja Kumar Acharya, Rahul Paul	2014	ICECS	This paper describes a circle detection algorithm based on a technique called Circular Hough Transform. The algorithm finds the most likely circles by searching for high points in a data map, and then maps those points back to the original image to locate the circles. The article shows that this method works well for real industrial images.	This research improves circle detection in images by refining the way the algorithm finds likely circles. It reduces false circles compared to traditional methods, but some may still appear due to image features or imperfect circles. The goal of balancing accuracy and simplicity remains a challenge.	While the proposed algorithm reduces false circles compared to traditional methods, its effectiveness with non-perfect circles, a common occurrence in real-world images, remains unclear.
[2]	Implementation of Size-Based Recognition on Automatic Liquid Filling Machine Using Canny-Edge Detection Method	Muhammad Nabawi Ramadani,Nur Rokhman ,Kurnia Sandi	2023	IEEE	This paper proposes an image processing method using edge detection to automate soap liquid filling in small industries. The system differentiates between 10ml and 20ml bottles based on size. Edge detection and image processing techniques improve detection accuracy.	This study proposes an image processing method for automating liquid filling in small industries. By analyzing edges to detect object size, the system differentiates between 10ml and 20ml bottles for soap filling. The results validate the approach for specific sizes.	While the method achieves automation for these bottle sizes, its reliance solely on object size presents a limitation. Further research is needed to explore its effectiveness with various shapes and a wider range of dimensions.

Flow Diagram





Method 1

```python
import cv2
import numpy as np
im = cv2.imread('/content/th.jpeg')

out = im.copy()
gry = cv2.cvtColor(im, cv2.COLOR_BGR2GRAY)

bw = cv2.adaptiveThreshold(
    gry, 255, cv2.ADAPTIVE_THRESH_GAUSSIAN_C, cv2.THRESH_BINARY, 11, 12)

bw = cv2.medianBlur(bw, 3)
bw = cv2.erode(bw, np.ones((5, 5)))
bw = cv2.medianBlur(bw, 9)
bw = cv2.dilate(bw, np.ones((5, 5)))

cnts, _ = cv2.findContours(bw, cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)

for c in cnts:
    (x, y, w, h) = cv2.boundingRect(c)
    cv2.circle(out, (x + w // 2, y + h // 2), max(w, h) // 2, (0, 255, 0), 2)

num_pipes = len(cnts)
print("Number of pipes:", num_pipes)
cv2.imwrite('output_image.jpg', out)
```

Results

```
Number of pipes: 19
True
```

Method 2

```python
import numpy as np
import cv2
from matplotlib import pyplot as plt

image_url = '/content/th.jpeg'
img = cv2.imread(image_url, cv2.IMREAD_COLOR)

def show(img):
    plt.figure(figsize=(10, 16))
    plt.imshow(cv2.cvtColor(img, cv2.COLOR_BGR2RGB
    plt.axis('off')
    plt.show()

show(img)

gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

gray_blurred = cv2.blur(gray, (3, 3))

show(gray_blurred)

detected_circles = cv2.HoughCircles(
    gray_blurred,
    cv2.HOUGH_GRADIENT,
    dp=1,
    minDist=15,
    param1=100,
    param2=20,
    minRadius=0,
    maxRadius=20
)
```

```python
pipes_count = 0

if detected_circles is not None:

    detected_circles = np.uint16(np.around(detected_circles))

    for points in detected_circles[0, :]:
        a, b, r = points[0], points[1], points[2]

        cv2.circle(img, (a, b), 1, (0, 0, 255), 3)
        pipes_count += 1

show(img)
print("Number of pipes:", pipes_count)
```

Results

```
Number of pipes: 20
```

Google Collab File Link

https://colab.research.google.com/drive/1-0Ow7YV-o2R5LM0_Cr8if6hg1KFo2MO6?usp=sharing

References

1) Virendra Kumar Yadav, Saumya Batham , Anuja Kumar Acharya, Rahul Paul, " Approach to Accurate Circle Detection : Circular Hough Transform and Local Maxima Concept," 2014 I International Conference on Electronics and Communication Systems (ICECS -2014), Feb.13 -14, 2014, Coimbatore, INDIA, pp. 1-6, doi: 10.1109/ICEngTechnol.2017.8308186.
2) Muhammad Nabawi Ramadani, Nur Rokhman, Kurnia Sandi,"Implementation of Size-Based Recognition on Automatic Liquid Filling Machine Using Canny-Edge Detection Method" 2023 9th International Conference on Wireless and Telematics (ICWT), Solo, Indonesia, 2023, pp. 1-4, doi: 10.1109/ICWT58823.2023.10335433.
3) N. M. Syahrian, P. Risma and T. Dewi, "Vision-Based Pipe Monitoring Robot for Crack Detection Using Canny Edge Detection Method as an Image Processing Technique", Kinet. Game Technol. Inf. Syst. Comput. Network Comput. Electron. Control, pp. 243-250, Sep. 2017.

THANK YOU !