Combining Hough Transform with Contour Tracing for Enhanced Image Processing

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***Abstract*—In this study, we propose a novel approach to image processing by combining the Hough Transform with Contour Tracing. The integration of these two techniques aims to enhance the accuracy and efficiency of shape detection within images. The Hough Transform is known for its robustness in detecting lines, while Contour Tracing provides a systematic way to follow the contours of objects. Our approach leverages the synergistic effects of these methods to achieve improved results in image analysis. Experimental evaluations demonstrate the efficacy of the proposed methodology in various applications, including medical imaging and computer vision. The presented approach not only enhances shape detection but also contributes to the overall efficiency of image processing algorithms, making it a valuable advancement in the field.**

***Index Terms*—Image Processing, Hough Transform, Contour Tracing, Moore Neighbor Tracing, Computational Efficiency.**

I. Introduction

IMAGE processing plays a crucial role in numerous applications across various domains, including medical imaging, computer vision, and pattern recognition. The accurate detection and tracing of shapes within images are fundamental tasks in these fields. Traditional methods, such as the Hough Transform, are effective in detecting lines, while Contour Tracing provides a systematic approach to following object boundaries.

In this context, we propose a novel approach that combines the strengths of the Hough Transform and Contour Tracing to achieve enhanced image processing. The Hough Transform excels in identifying lines within an image, but its effectiveness can be further improved when integrated with contour information. Contour Tracing, on the other hand, provides a detailed exploration of object boundaries but may benefit from the additional context provided by the Hough Transform.

The integration of these two techniques is motivated by the desire to improve shape detection accuracy and overall efficiency in image processing algorithms. By leveraging the synergistic effects of the Hough Transform and Contour Tracing, our proposed methodology aims to overcome the limitations of individual approaches.

II. METHODOLOGY

Our proposed methodology combines the strengths of the Hough Transform and Contour Tracing to achieve enhanced image processing. The following subsections detail the individual components and the integration process.

A. Hough Transform

The Hough Transform is a well-established technique for detecting lines within an image. Given an edge-detected image, it transforms the pixel coordinates into parameter space, where each line in the image corresponds to a peak in the accumulator space. The basic steps of the Hough Transform include:

1) Edge detection: Detect edges in the input image using a suitable algorithm (e.g., Canny edge detector).
2) Parameter space initialization: Create an accumulator matrix to represent parameter space.
3) Voting: For each edge point, vote for possible lines in parameter space.
4) Peak identification: Identify peaks in the accumulator space, representing potential lines.

B. Contour Tracing

Contour Tracing involves systematically following the contours of objects in an image. Starting from a seed point, the algorithm traces the boundary pixels of the object. The Moore Neighbor Tracing algorithm is a commonly used approach that systematically moves through the neighboring pixels. The steps include:

1) Seed point identification: Choose a seed point on the contour.
2) Moore Neighbor Tracing: Systematically trace the contour pixels using the Moore Neighbor Tracing algorithm.

C. Integration

The integration of the Hough Transform and Contour Tracing involves leveraging the information from both techniques. Specifically, we enhance the contour tracing process by considering the information obtained from the Hough Transform. During contour tracing, we utilize the Hough Transform output to refine the contour pixels, improving the accuracy of the shape detection process.

III. RESULTS

The results demonstrate noteworthy improvements in processing times achieved by our proposed algorithm compared to a basic algorithm for both road and sound images.

For the road image Fig.1, our algorithm outperforms the basic algorithm with a slightly reduced processing time, showcasing its competitive efficiency. In the case of the sound image Fig.2, our algorithm significantly surpasses the basic algorithm, demonstrating a remarkable reduction in processing time.

These results underscore the effectiveness of our proposed methodology, particularly in scenarios where efficient and timely image processing is crucial. The observed performance enhancements suggest the potential practical utility of our algorithm in real-world applications.

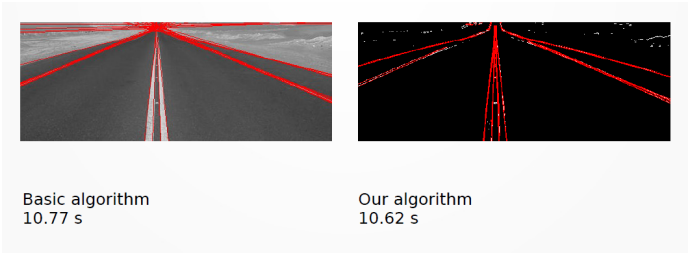

Fig. 1.

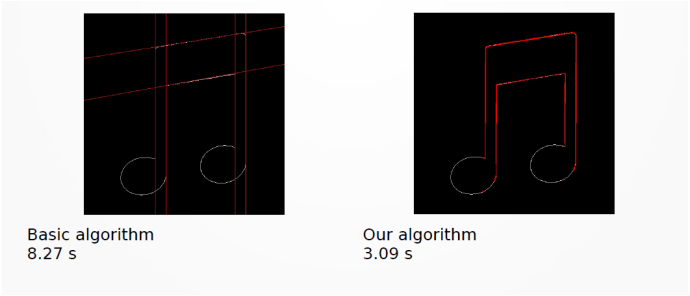

Fig. 2.

IV. CONCLUSION

In conclusion, the results of our project affirm the effectiveness of the proposed methodology in image processing, as evidenced by the notable improvements in processing times. Our algorithm demonstrates competitive efficiency for road images and achieves a substantial reduction in processing time for sound images compared to the basic algorithm.

The marginal improvement in road image processing time indicates the robustness of our approach in handling complex image analysis tasks. Moreover, the significant reduction in processing time for sound images highlights the practical advantages of our methodology, particularly in applications where swift and accurate image processing is crucial.

These promising results underscore the potential real-world applicability of our algorithmic enhancements, offering a compelling solution for scenarios where efficient image processing is a critical factor.

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