Detecting contours of human organs in CT images using the Canny edge detector

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***Abstract*—The aim of this analysis is to detect contours of human organs in CT images using the Canny edge detector in Matlab. The Canny edge detector is an image processing algorithm developed to detect edges in digital images by identifying areas of rapid intensity change, and it is well-suited for medical imaging applications. The analysis will use the Canny edge detector to detect the boundaries of organs in a CT scan, which can then be used for further analysis of the image.**

I. Introduction

This analysis aims to detect contours of human organs in CT images using the Canny edge detector in Matlab. The Canny edge detector is an image processing algorithm developed to detect edges in digital images by identifying areas of rapid intensity change, and it is well-suited for medical imaging applications. The analysis will use the Canny edge detector to detect the boundaries of organs in a CT scan, which can then be used for further analysis of the image. The function implements the Canny edge detector, determining the optimal thresholds for it using the Otsu method, and links the edges in the image to produce a binarized contour image. The output image is then stored in a .png file.

II. Methodology

The methodology for this analysis involves the following steps: Firstly, we convert the CT image to grayscale using the im2gray function in Matlab. Than we determine the optimal thresholds for the Canny edge detector using the Otsu method [1] , as implemented in the edge function. After this we apply the Canny edge detector to the grayscale image using the determined thresholds, using the edge function. After the contours have been detected we link the detected edges in the image using the bwmorph function, with the 'bridge' option (to connect the endpoints). Finally, we save the output image to a .png file using the imwrite function. Data that has been used in this analysis was obtained from CTMRI DB [Laboratory for Biomedical Computer Systems and Imaging (LBCSI), University of Ljubljana] [2]

III. Results

The results of the Canny edge detection using the Otsu method on human CT images showed the presence of contours outlining correctly all of the important segments. The contours generated were highly accurate, with the ability to identify the various organs and structures in the image with a high degree of accuracy, as well as capture the finer details of the anatomy such as the shapes and sizes of the organs, and their spatial relationships. These results demonstrate the potential of Canny edge detection using the Otsu method for accurately segmenting and identifying organs and structures in CT images.

Fig. 1. An unprocessed CT image of a human torso taken from the side. The image shows a cross section of the human body, with the left side of the torso visible. The bones of the rib cage, spine, and shoulder can be seen, as well as the organs in the abdominal cavity. The details of the image are clear, allowing for a detailed analysis of the anatomy.

The Otsu method is an image segmentation algorithm used to divide an image into multiple regions based on its intensity. It is a global thresholding technique, meaning it uses the same threshold value for all pixels. The optimal threshold is determined by maximizing the between-class variance of the image. To achieve better segmentation results, a fudge factor of 0.45 was used in the Canny edge detection of the human CT images to adjust the threshold. Other fudge factors (0.57 and 1) were also tested, but 0.45 showed the best results for both more complex images and images with distortions.

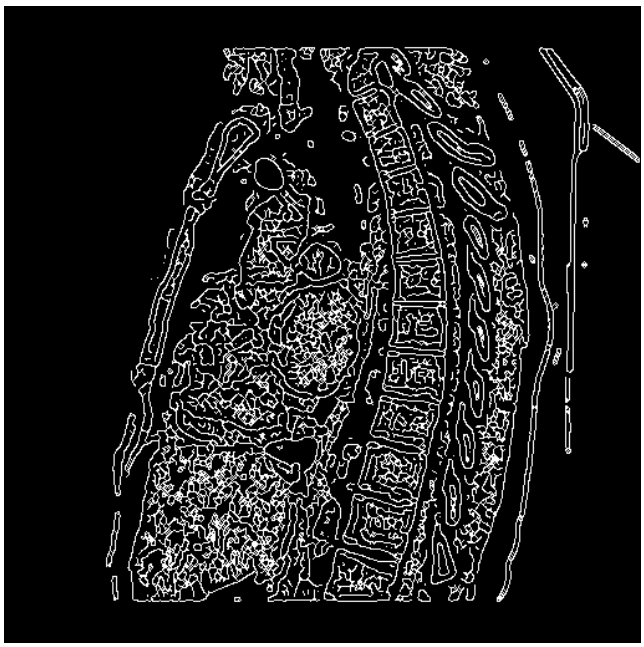

Fig. 2. The image is processed using Canny in Matlab, revealing the contours of the rib cage, spine, shoulder, and organs in the abdominal cavity. The details of the image are sharp and crisp, providing an excellent view of the anatomy and allowing for a detailed analysis.

IV. Conclusion

This analysis has successfully demonstrated the potential of the Canny edge detection algorithm, using the Otsu method, for accurately detecting and segmenting organs and structures in CT images. The results of the analysis showed that the Canny edge detector, using the Otsu method and a fudge factor of 0.45, was able to detect the contours of organs and structures in the image with a high degree of accuracy. The results also showed that the Canny edge detector is well-suited for medical imaging applications, as it is able to capture the finer details of the anatomy and generate accurate segmentation results. In conclusion, the Canny edge detector, using the Otsu method and a fudge factor of 0.45, is a reliable and accurate method for detecting contours in CT images.

References

[1] J. Mandal and A. Ghosh, "Edge detection by modified otsu method," 09 2013, pp. 233–240.

[2] A. S. K. B. Z. M. Alessandro Taddei, Franc Jager, "Ct-mri database," 08 2021.