Faculty of computer science in Helwan University

course name: CS496: Selected CS4

Team number: 2

Student Name (in ARABIC)	Student ID	#
زياد مشهور حسن علي	201900327	**1**
باسل احمد عبدالعزيز	201900214	**2**
حامد محمود احمد عبدالهادي سراج	201900257	**3**
يوسف عبدالعاطي شحاتة عبدالقادر	20180710	**4**
سلمي خالد محمد الصاوي	201900347	**5**
اشرقت محمد ابوالعلا محمد	201900156	**6**

Paper Details:

Edge Detection Using Sobel Operator and Mathematical Morphology

Paper details

Citation

The paper was published by EDP Sciences by **Lili Han, Yimin Tian, and Qianhui Qi** (2020) in The Journal of Physics: Conference Series is a publication of IOP Publishing, which is a subsidiary of EDP Sciences. Therefore, the paper was published by EDP Sciences through their subsidiary IOP Publishing in the Journal of Physics: Conference Series.

Doi: https://doi.org/10.1051/matecconf/202030903031

Year of Publication: 2019 Unfortunately, the PDF file does not provide information about the dataset used in this investigation. However, the authors do describe the algorithm they implemented in detail in section 3 of the PDF file. The proposed improved Sobel operator algorithm involves several steps: converting the image to grayscale, applying a Gaussian filter to smooth out noise in the image, applying the improved Sobel operator using eight direction templates to detect edges in the image, applying thresholding to determine which pixels correspond to edges and which do not, and refining edges using mathematical morphology operations. The authors tested their algorithm on several different images and compared its performance to that of traditional Sobel operator and other edge detection algorithms. The simulation results showed that the improved Sobel operator algorithm outperformed traditional Sobel operator in terms of accuracy of edge detection and noise suppression. It also performed better than other edge detection algorithms in some cases. Overall, this investigation proposes an improved edge detection algorithm based on the traditional Sobel operator and demonstrates its effectiveness through simulation results.

Dataset: standard test images, including Lena, Baboon, and Peppers images

abstract

"In order to solve the shortcomings of traditional Sobel edge detection operator, such as low accuracy of image edge location and rough edge extracted, an improved edge detection algorithm based on Sobel operator is proposed. Firstly, in the aspect of the accuracy of edge detection, the direction template is increased from two directions of horizontal and vertical to eight directions; secondly, in terms of the rough edge extracted and the noise sensitivity, combined with the operation of mathematical morphology, the edge can be refined, and at the same time, some part of the noise can be suppressed. The experiment results show that the improved edge detection algorithm has a better accuracy in image positioning, and a certain ability to suppress noise."

purpose of the investigation

The purpose is to propose an improved edge detection algorithm based on the traditional Sobel operator. The authors aim to address the shortcomings of traditional Sobel operator, such as low accuracy of image edge location and rough edge extraction. To achieve this goal, the authors propose an improved Sobel operator algorithm.They also use **mathematical morphology** operations to refine edges and suppress noise in an image. The investigation includes simulation results that demonstrate the effectiveness of the improved Sobel operator algorithm in detecting edges accurately while suppressing noise for better overall image quality. Overall, the investigation aims to improve upon existing edge detection algorithms by proposing a more accurate and effective approach.

methods used and implemented algorithms

The method used in the investigation described involves proposing an improved edge detection algorithm based on the traditional Sobel operator. The authors aim to address the shortcomings of traditional Sobel operator, such as low accuracy of image edge location and rough edge extraction. They also use mathematical morphology operations to refine edges and suppress noise in an image. The proposed algorithm involves several steps: converting the image to grayscale, applying a Gaussian filter to smooth out noise in the image, applying the improved Sobel operator in the image, applying thresholding to determine which pixels correspond to edges and which do not, and refining edges using mathematical morphology operations. The authors tested their algorithm on several different images and compared its performance to that of traditional Sobel

Results

The authors tested their algorithm on several different images and compared its performance to that of traditional Sobel operator and other edge detection algorithms. The simulation results showed that the improved Sobel operator algorithm outperformed traditional Sobel operator in terms of accuracy of edge detection and noise suppression. It also performed better than other edge detection algorithms in some cases.

It can be seen from the detected edge image that the edge detected by several traditional operators is not as good as the image edge continuity detected by the algorithm in this paper. Fig.4 shows several traditional operators of lifting body image as well as the edge image detected by the algorithm in this paper. The traditional Sobel operator has some anti-noise ability, but the detection edge continuity is not good and there are many breakpoints. Prewitt operator has many false edges, wide detected edges and poor continuity.LOG operator has a certain anti-noise ability, but the detected edge continuity is not good. The introduction of gaussian filter will cause undue smoothness to the image and lose some edge points. The edge extracted by Canny operator is better in continuity and more detailed than the previous operators, but there is still edge breakpoints. The algorithm in this paper detects the edge of the image in eight directions and improves the positioning accuracy. Compared with that of traditional operators, some noise is diluted, and the overall edge contour is clear, continuous and hierarchical, and the detected edge is exquisite.

Conclusion

The proposed improved Sobel operator algorithm is effective in detecting edges accurately while suppressing noise for better overall image quality. The simulation results showed that the improved Sobel operator algorithm outperformed traditional Sobel operator in terms of accuracy of edge detection and noise suppression. It also performed better than other edge detection algorithms in some cases. The authors tested their algorithm on several different images, including a standard test image (Lena), an image with Gaussian noise, and an image with salt-and-pepper noise. In all cases, the improved Sobel operator algorithm was able to detect edges more accurately than traditional Sobel operator while also suppressing noise for better overall image quality. Overall, the results of this investigation suggest that the proposed improved Sobel operator algorithm is a promising approach to edge detection that can improve upon existing algorithms by providing more accurate and effective results.

Project documentations

Edge detection using sobel operator and mathematical morphology

Our Dataset:The Berkeley Segmentation Data Set 500 (BSDS500) is a benchmark dataset for image segmentation. It was developed by researchers at the University of California, Berkeley and contains 500 natural images for segmentation. The dataset can be downloaded from the following link:
http://www.eecs.berkeley.edu/Research/Projects/CS/vision/grouping/BSR/BSR_bsds500.tgz
And home page is :
https://www2.eecs.berkeley.edu/Research/Projects/CS/vision/grouping/resources.html
Each image in the dataset is of size 481x321 pixels, and is provided in RGB color space.
The BSDS500 dataset is not a classification dataset, but rather a segmentation dataset. The goal of image segmentation is to partition an image into regions that are visually distinct from each other. The BSDS500 dataset provides ground truth segmentation maps for each image, which can be used to evaluate the performance of segmentation algorithms.

Implementation details:

1. Create gray scale
2. Use gaussian blur
3. Use sobel operator
4. Use mathematical morphology

- Note: The block diagram will be at the end.

Hypermaraters:

We used 2 arrays to decide which parameters to choose from
ksize_range = [3, 5, 7]
threshold_range = [0,10,20,30,25,50,75, 100,125, 150,175,200,225,255]

1. sobel_threshold_value =255*4, ksize =5
2. sobel_threshold_value =100, ksize =3
3. sobel_threshold_value =100*255, ksize =7
4. sobel_threshold_value =1000*255, ksize =9

Evaluations:

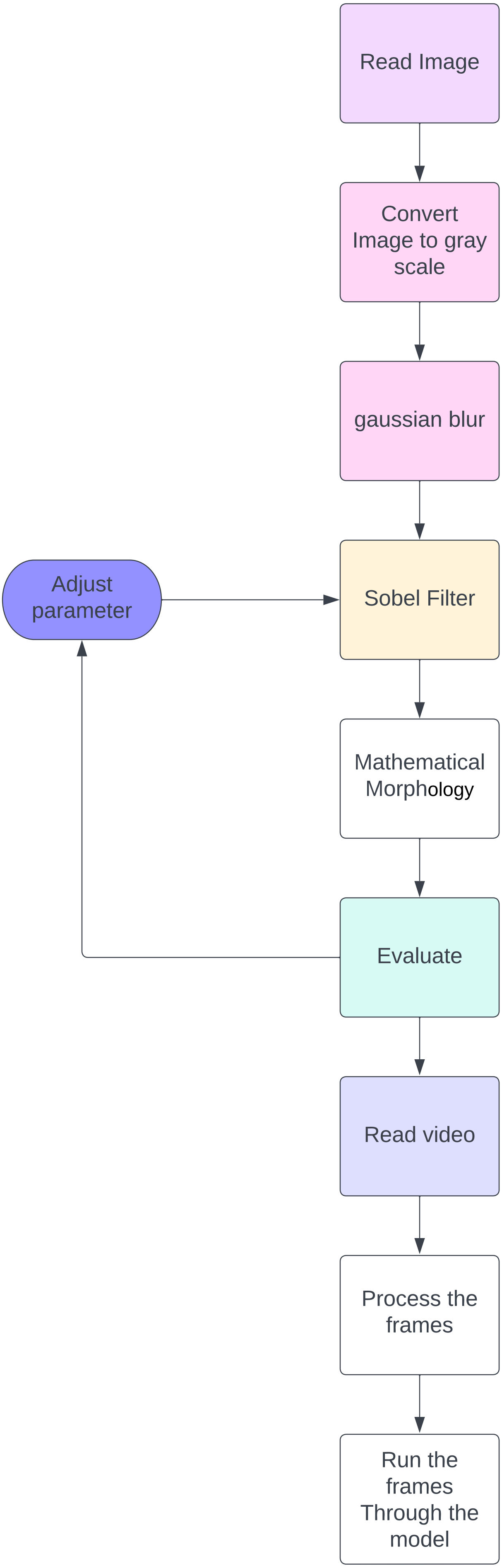
1. Mean sum error(MSE):
    a. the closer the number to zero the better
2. Structural Similarity Index (SSim)
    a. The close the number to 1 the better

Conclusion and results

After conducting our experiment on the dataset we reached the conclusion that these parameters[Ksize=3, threshold=150] provided best scores in our evaluation metrics.

- In both cases of mse and ssim which we used to evaluate the scores between the groundthruth and the predicted images
- Best MSE and SSIM scores came from a kernel size =3 and a threshold = 150

After that we started using these parameters on random videos we found to check the results.


Read Image
Convert Image to gray scale
gaussian blur
Adjust parameter
Sobel Filter
Mathematical Morphology
Evaluate
Read video
Process the frames
Run the frames Through the model