Eight Direction Sobel Edge’s Brain Tumor Detection

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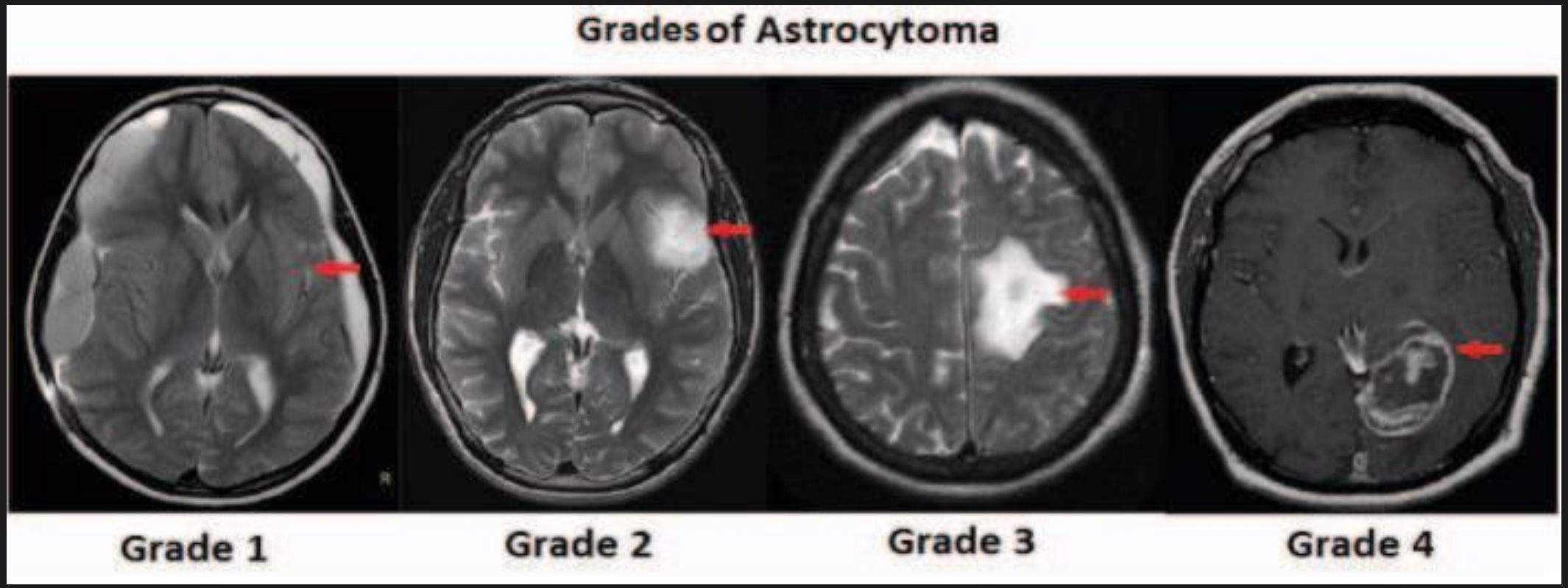
Addressed issue:

Developing a precise edge detector

Addressed issue

- Article done by Remya Ajai A Sa, Sundararaman Gopalana
- Tumor detection requires high precision to distinguish accurately different grades of tumors
- The article proposes a novel method that provides this accuracy
- How? Using a Sobel edge detector applied in eight different directions instead of the traditional two directions method

Addressed issue



State of the art:

What has been done until today?

State of the art

- Histogram Thresholding and Artificial Neural Network technique by Chithambaram et al (The region of interests(ROIs) within the tumor area are extracted using histogram thresholding)[1]
- Reddy et al discussed the levelset algorithm along with image thresholding to extract tumor cells The effective pre-processing of images helps to gain better accuracy for classification problems using machine learning approaches[2]
- Indumathi et al used Co-occurrence filtering for image filtering before segmentation to analyse breast cancer[3]
- Deep learning approaches Fuzzy based edge detection and U-Net classification algorithms are used by Masqood et al for brain tumor detection[4]
- An interval based edge detection algorithm using laplacian technique was suggested by Zhang et al in for skin cancer detection [5]

Comments on the different edge detectors

Gx

-1	0
0	+1

Gy

0	-1
+1	0

Roberts Edge Operator

Gx

-1	-1	-1
0	0	0
+1	+1	+1

Gy

-1	0	+1
-1	0	+1
-1	0	+1

Prewitt Edge Operator

1	2	1
0	0	0
-1	-2	-1

D_1

0	1	2
-1	0	1
-2	-1	0

D_2

-1	0	1
-2	0	2
-1	0	1

D_3

-2	-1	0
-1	0	1
0	1	2

D_4

Gx

0	-1	0
-1	4	-1
0	-1	0

Gy

-1	-1	-1
-1	8	-1
-1	-1	-1

Laplacian of Guassian(LoG) Edge Detection

Gx

-1	0	1
-2	0	2
-1	0	-1

Gy

-1	-2	-1
0	0	0
1	2	1

Sobel Edge Detection

-1	-2	-1
0	0	0
1	2	1

D_5

2	1	0
1	0	-1
0	-1	-2

D_6

1	0	-1
2	0	-2
1	0	-1

D_7

0	-1	-2
1	0	-1
2	1	0

D_8

8-Sobel Edge Detection

Critical analysis:

Developing a precise edge detector

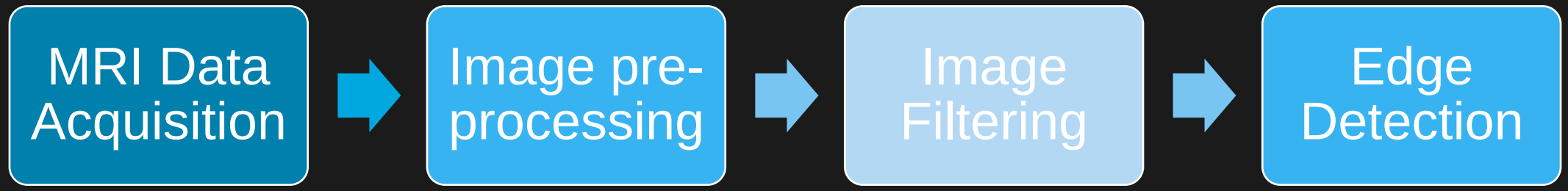
Critical Analysis

- Larger datasets for analysing medical images using transfer learning technology is really challenging (Data Quality and Annotation…)
- Canny algorithm can produce sharp edges, but it is computationally complex (Gaussian Smoothing + Gradient Calculation + Non-maximum Suppression + Double thresholding and edge tracking by hysteresis)
- Fractional order Sobel (Fractional derivatives capture more information about the behavior of a function, it helps see smaller details)

Article’s pipeline

Towards a precise edge detector

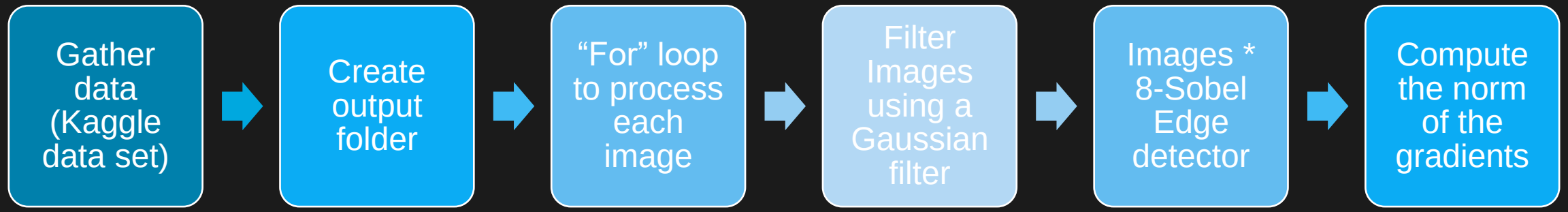
Article’s pipeline



Noise Removal:
Avoids redundant pixel information and helps in further analysis of images

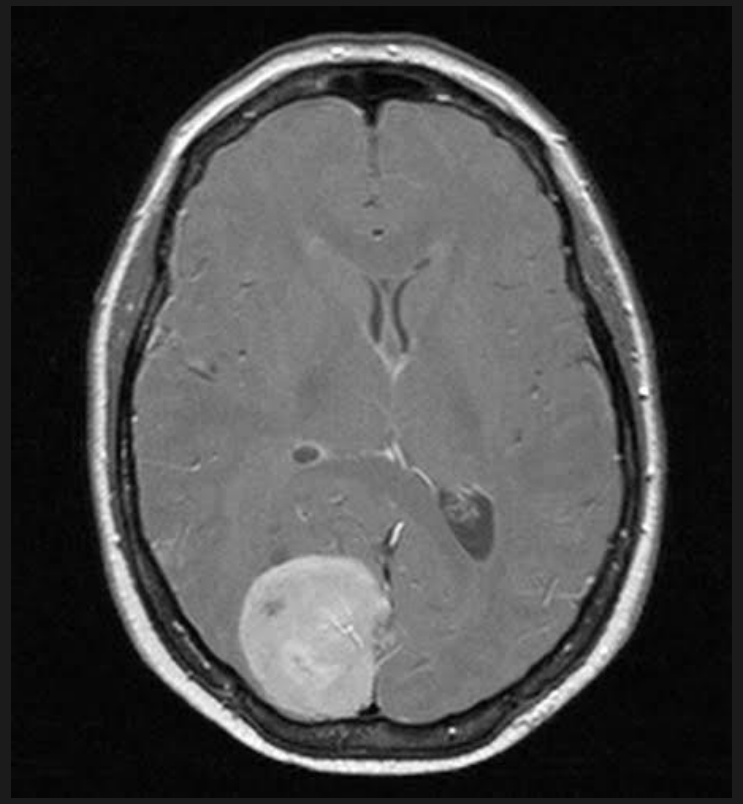
Suggested prototype

Suggested prototype



Prototype testing

Kaggle brain Tumor Dataset



Original Image

Eight directions
Sobel edge Detector

Output Image

Conclusions

Conclusion

- Need for a highly precise edge detector to distinguish several grades of tumors
- The 8-Sobel edge detector
- Article’s result : The RMSE (Root Mean Square Error) value is the lowest for 8 Sobel algorithm when tested with other edge detectors
- Precision at the cost of time

Perspectives

Perspectives

- Applicable in Deep Learning-based pipelines for MRI images processing which architectures accounts for the flaws of the method
- A less time-costing solution should also be considered
- In the future, combine the solution with appropriate hardware (FPGA) as suggested by the article at the end

Thank you for your attention

Questions ?

References

- [1] T. Chithambaram and K. Perumal, “Edge detection algorithms using brain tumor detection and segmentation using artificial neural network techniques,” International Research Journal of Advanced Engineering and Science, vol. 1, no. 3, pp. 135–140, 2016.
- [2] D. Reddy, Dheeraj, Kiran, V. Bhavana, and H. Krishnappa, “Brain tumor detection using image segmentation techniques,” in 2018 International Conference on Communication and Signal Processing (ICCSP), 2018, pp. 0018–0022.
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- [4] S. Kadry, D. Taniar, R. Damasevi ˇ cius, and V. Rajinikanth, “Automated detection of schizophrenia from brain mri slices using optimized ˇ deep-features,” in 2021 Seventh International conference on Bio Signals, Images, and Instrumentation (ICBSII). IEEE, 2021, pp. 1–5.
- [5] H. Zhang, Z. Wang, L. Liang, and F. R. Sheykhahmad, “A robust method for skin cancer diagnosis based on interval analysis,” Automatika, vol. 62, no. 1, pp. 43–53, 2021.

Used Figures

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- Figure 1 CT Scan vs MRI for Brain Tumor Diagnosis: What You Need to Know :: CTBTA. https://www.ctbta.org/news/blog/ct-scan-vs-mri-brain-tumor-diagnosis-what-you-need-know. Zugegriffen 16. April 2024.
- Figure 2 Devlin, Hannah, und Hannah Devlin Science correspondent. „Make Brain Scans Routine for New Psychosis Patients, Experts Say“. The Guardian, 12. Juli 2023. The Guardian, https://www.theguardian.com/science/2023/jul/12/make-brain-scans-routine-for-new-psychosis-patients-experts-say.
- Figure 3 Using Deep Learning to Classify Brain Tumors with a Single Scan, AUGUST 11, 2021 https://www.mir.wustl.edu/using-deep-learning-to-classify-brain-tumors-with-a-single-scan/
- Figure 4 Rodriguez, Arnaud. „L’IRM du futur en développement sur le campus bordelais“. Bordeaux Neurocampus, 29. September 2021, https://www.bordeaux-neurocampus.fr/lirm-du-futur-en-developpement-sur-le-campus-bordelais/.