2019 Second International Conference on
Advanced Computational and Communication Paradigms
(ICACCP)
25 – 28 February, 2019

Technical Session #V Paper ID #. 1570507765

Brain Tumor Classification Using ResNet-101 Based Squeeze and Excitation Deep Neural Network

Swati Kanchan*, Lokesh Nandanwar*, Palash Ghosal, Ashok Bhadra, Jayasree Chakraborty, Debashis Nandi
Affiliations: NIT Durgapur, Medical College Kolkata, Memorial Sloan Kettering Cancer Center New York
swatikanchan070@gmail.com, lokeshnandanwar32@gmail.com

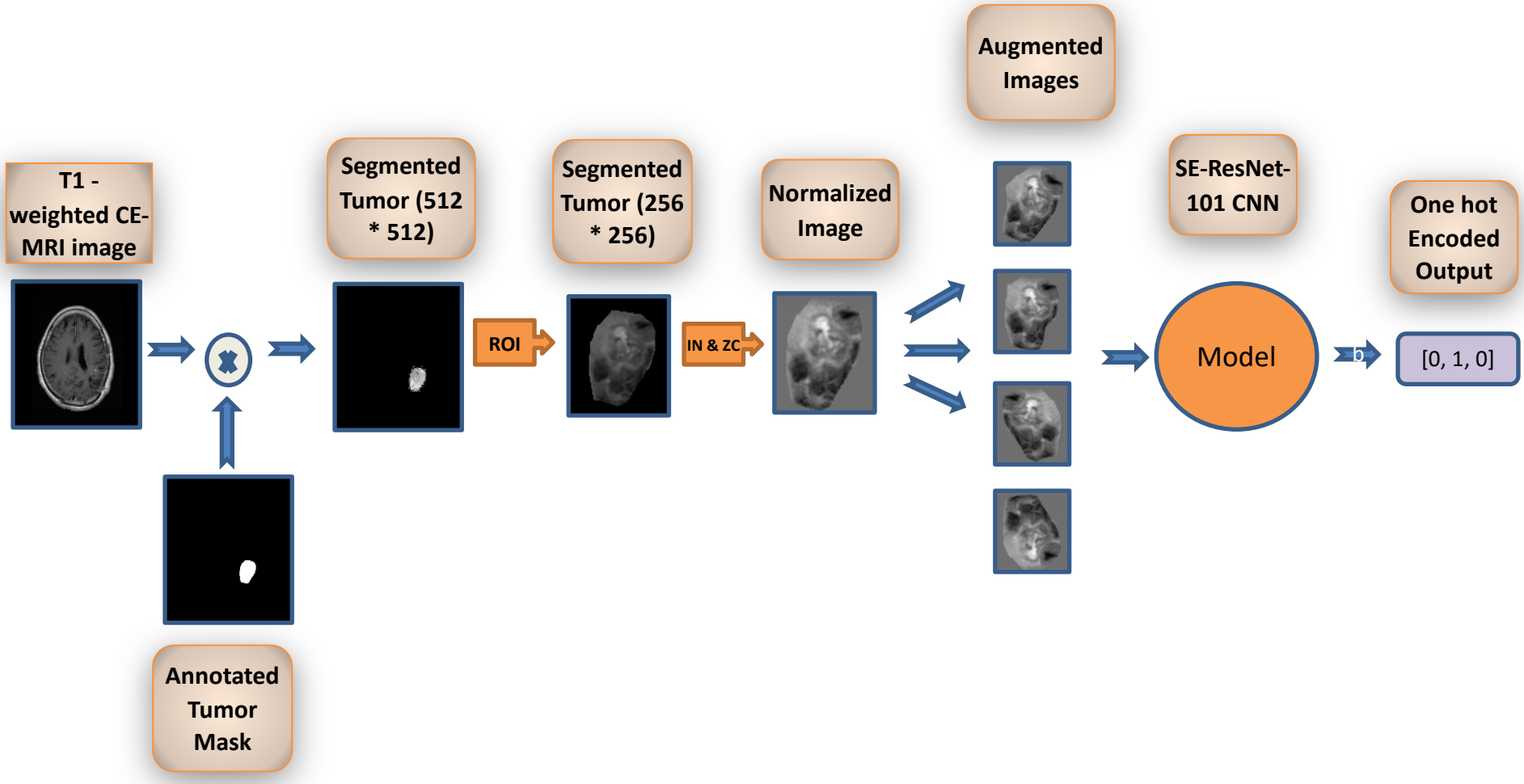
Paper Outline

- ✓ Introduction
- ✓ Block Diagram of Proposed Method
- ✓ Dataset Description & Data Pre-processing
- ✓ Proposed Methodology
- ✓ Experimental Results & Discussions
- ✓ Conclusion
- ✓ Future Scope
- ✓ References

Introduction

- Current Indian Scenario
- Lack of adequate doctors
- Conventional Vs. computerized diagnosis
- Our work

Block Diagram of Proposed Method

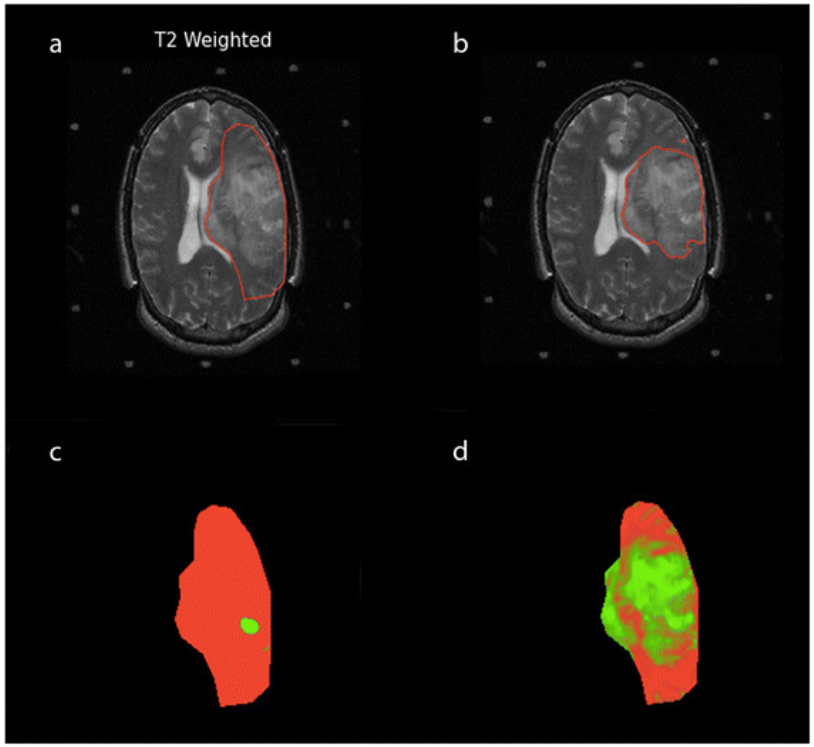


Dataset Description

- Source of Data
  - Nanfang Hospital, Guangzhou, China, and General Hospital, Tianjin Medical University, China(2005 to 2010)
- Full Description
  - It contained 3064 T1-weighted contrast-enhanced images from 233 patients:
    - ✓ meningioma (708 slices)
    - ✓ glioma (1426 slices)
    - ✓ pituitary tumor (930 slices).
    - ✓ The dimension of each MRI slices: 512 × 512 pixels

Data Pre-processing

- ROI segmentation

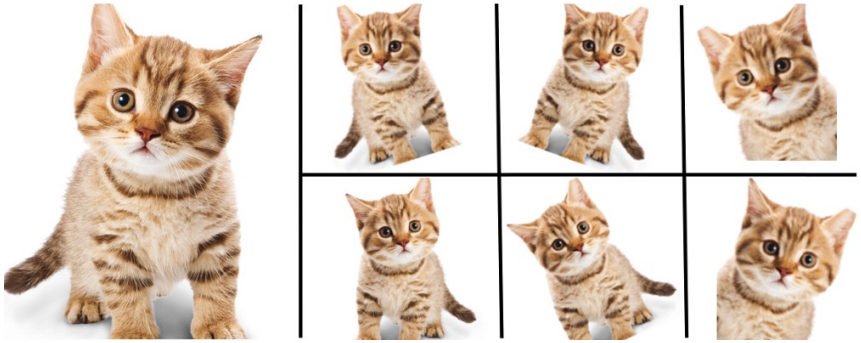


Data Pre-processing

- ROI segmentation
- Intensity Zero-centering and Normalization

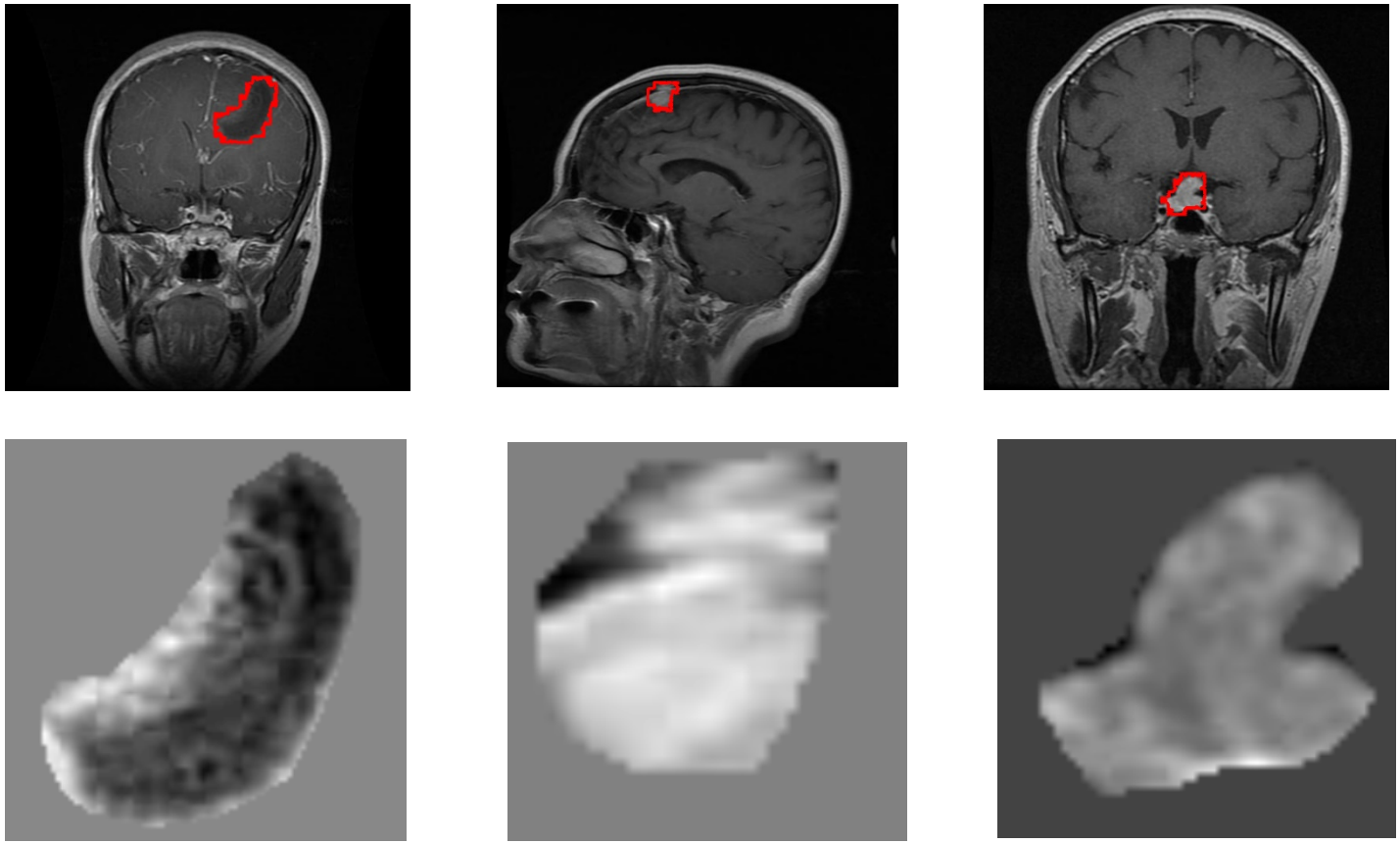
Data Pre-processing

- ROI segmentation
- Intensity Zero-centering and Normalization
- Data Augmentation



Enlarge your Dataset

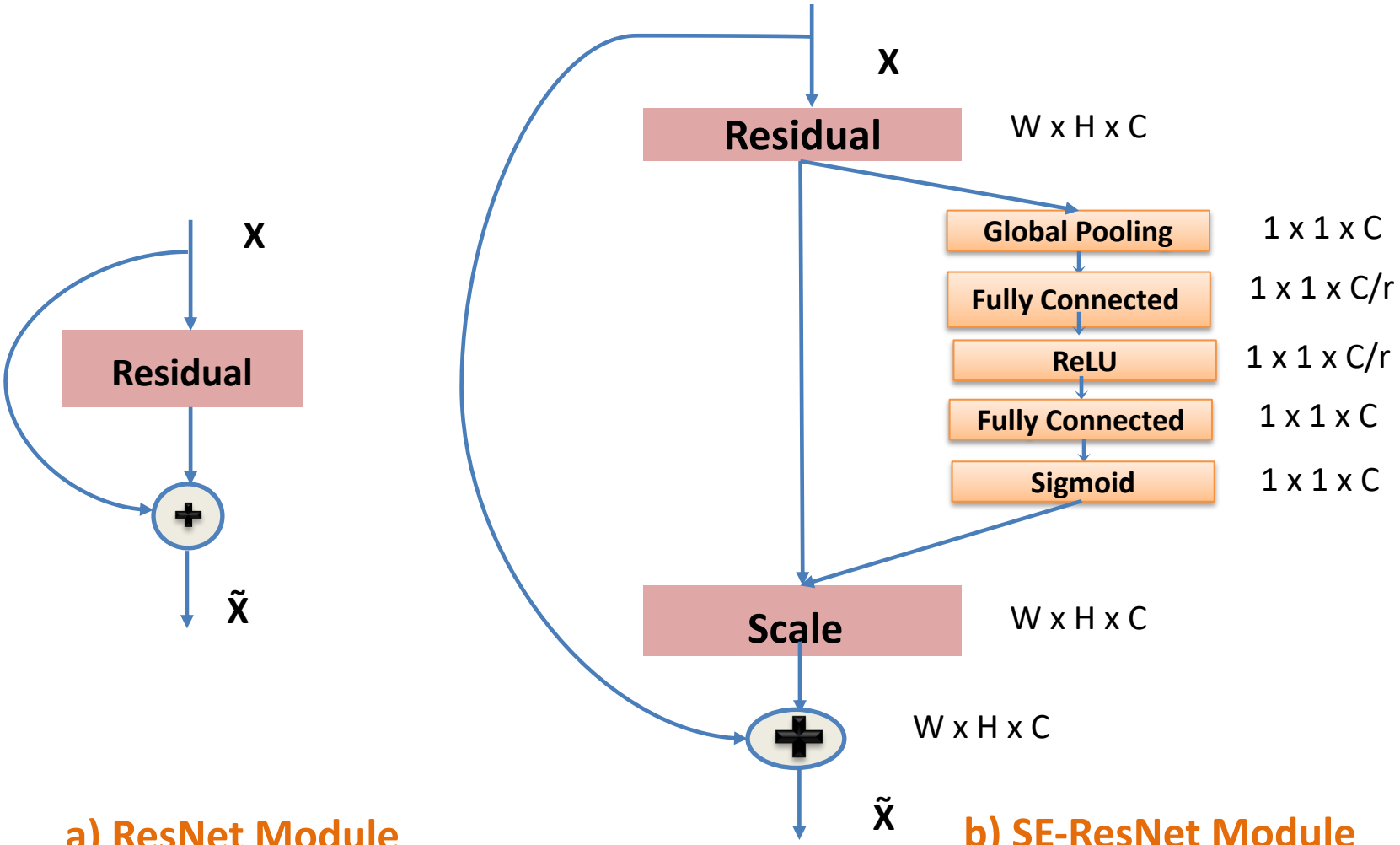
Preprocessed Images



Proposed Methodology

- **Deep Learning Model : ResNet-101**
  - Subtraction of input features.
  - Shortcut connections - directly connecting the input of kth layer to (k + x)th layer.
  - Resolves the problem of vanishing gradients.
  - Weights amplifies the layer next to the present one.
  - 101-layer Residual Network - modified version of the 50-layer ResNet.

Block Diagrams



a) ResNet Module

b) SE-ResNet Module

Squeeze and Excitation block with ResNet

- Max Pooling - used to average the feature maps in a spatial plane.
- Two fully connected layers:
  - with ReLU and Sigmoid activations are used for excitation operation.
- Stacking the SE blocks.
- SE-blocks combined with ResNet architecture, has performed outstandingly good in classifying the brain tumors.

Training of Model

- Trained from scratch and finely tuned to just fit.
- Total data size = 7771:
  - 3064 original samples
  - 4707 samples of augmented data

Training of Model

- Trained from scratch and finely tuned to just fit.
- Total data size = 7771:
  - 3064 original samples
  - 4707 samples of augmented data
- Training duration = 7 hours

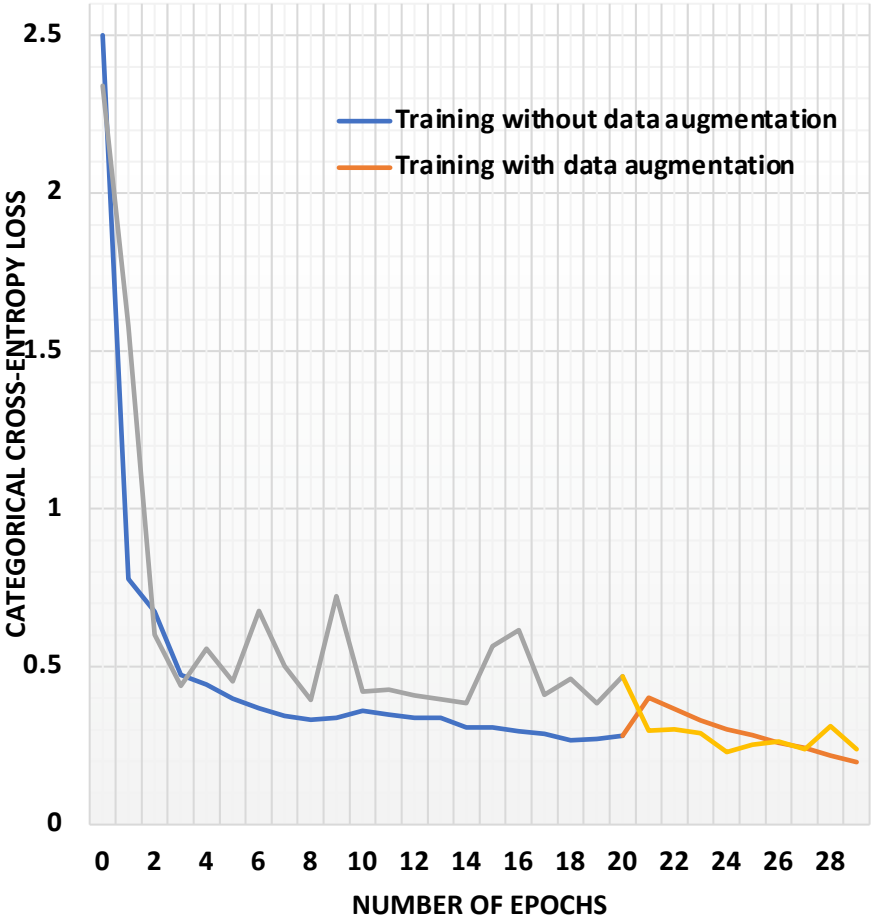
  (batch size = 5 for 26,094 iterations):
  - 12,196 iterations on original samples
  - 13,898 iterations on augmented samples

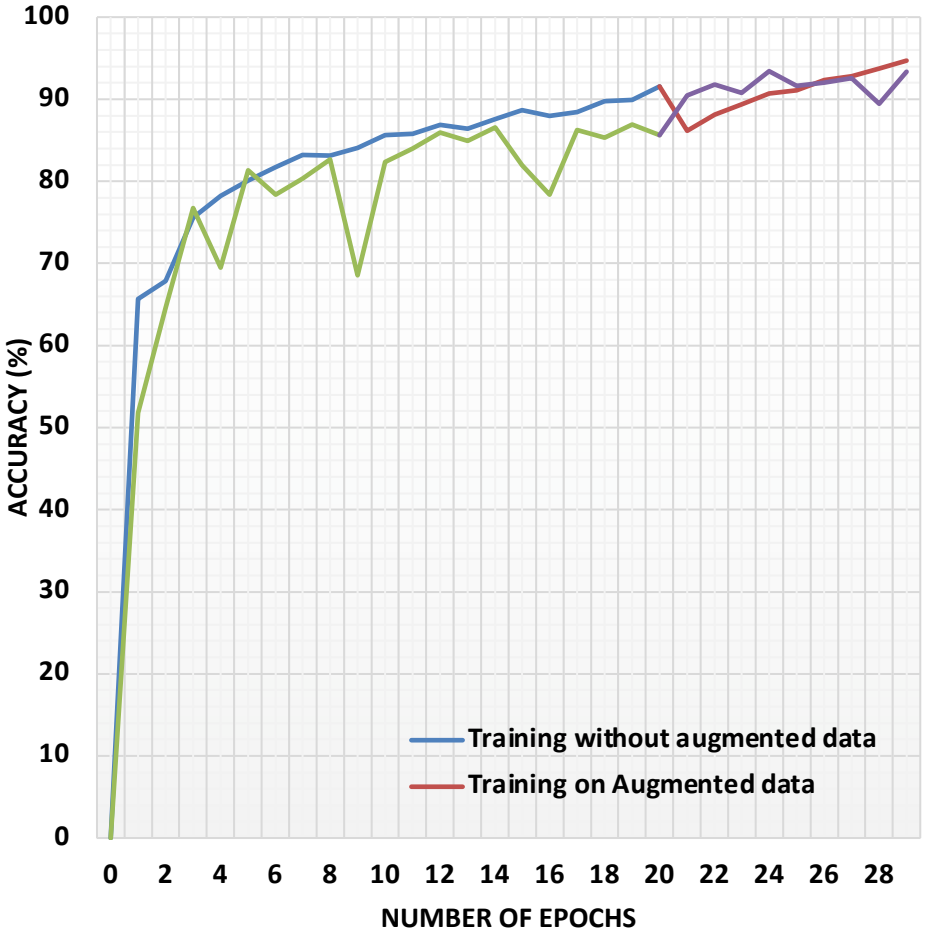
Experimental Results

- Performance Metrics used for Evaluations are:
  - **Categorical Accuracy i.e Accuracy**
  - **Specificity**
  - **Sensitivity**
  - **Cross-entropy loss**

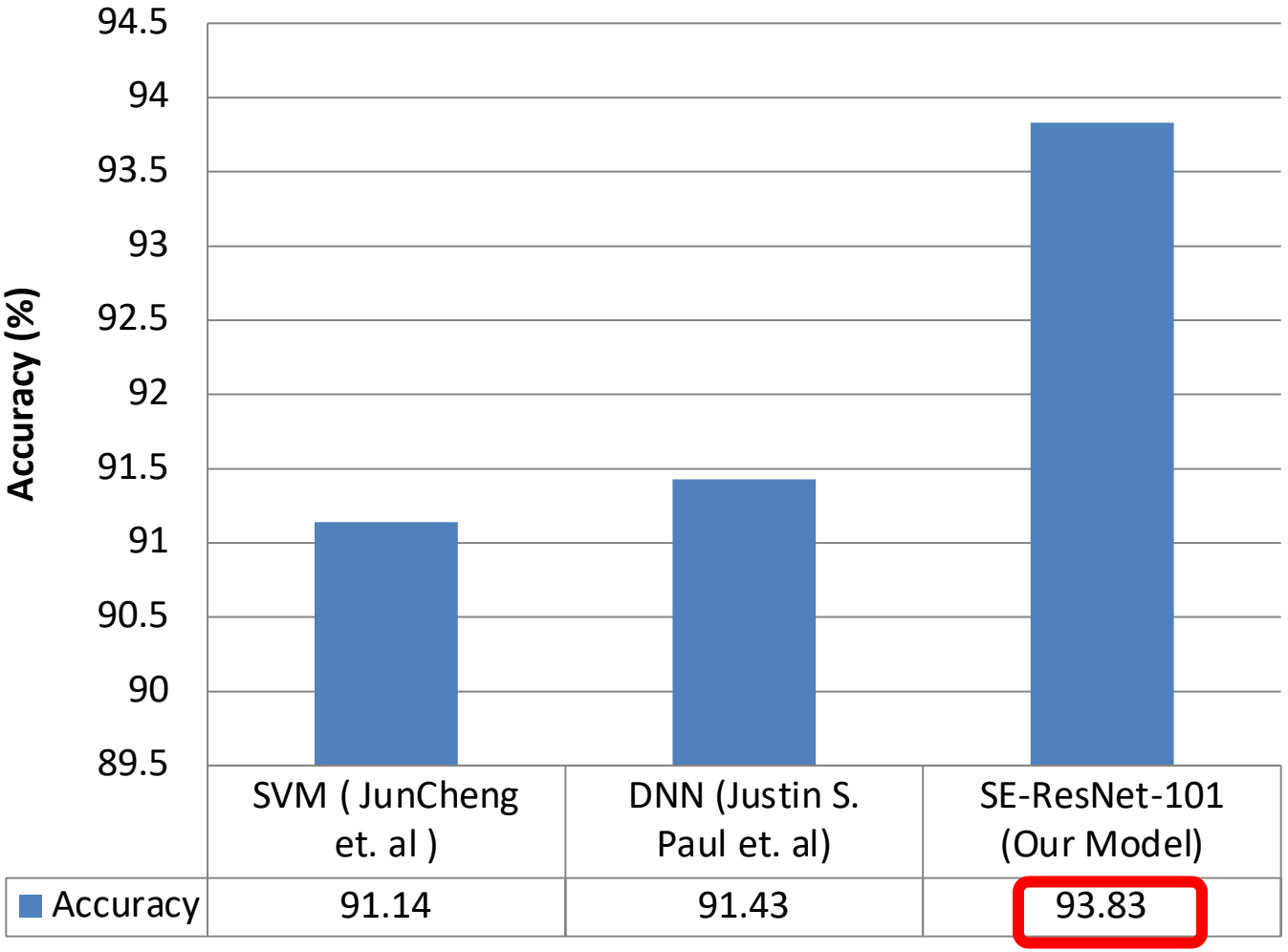
Type of Tumor	Glioma	Meningioma	Pituitary Tumor	Specificity	Sensitivity	Accuracy
Glioma	1407	9	10	0.9564	0.9867	98.67
Meningioma	16	650	42	0.9829	0.9181	91.81
Pituitary Tumor	52	30	833	0.9753	0.9104	91.03
Average				0.9715	0.9384	93.83

Experimental Results





Comparison of Proposed Method



Conclusion

- State-of-the-art method
- Handy tool to doctors
- Other Applications

Future Scope

- Extend to 3-dimensional MRI data
- Covering more number of classes of tumors.

References

*[1] J. Hu, L. Shen and G. Sun, "**Squeeze-and-excitation networks**," in IEEE Conf. on CVPR 2018, pp. 7132-7141, 2018.*

*[2] K. He, X. Zhang, S. Ren, and J. Sun., "**Deep residual learning for image recognition**," in Conf. on CVPR 2016, pp. 770-778, 2016.*

*[3] J. Cheng, et. al, "**Enhanced Performance of Brain Tumor Classification via Tumor Region Augmentation and Partition**," in PloS one, vol. 10(12), 2015.*

*[4] J. S. Paul, A. J. Plassard, B. A. Landman, and D. Fabbri, "**Deep learning for brain tumor classification,**" in Proc. SPIE 10137, Medical Imaging 2017: Biomedical Applications in Molecular, Structural, and Functional Imaging, vol. 1013710, pp. 10137-16, 2017.*

*[5] J. Cheng, ``**Brain tumor dataset**''. figshare, 02-Apr-2017 [Online]. Available: https://figshare.com/articles/brain_tumor_dataset/1512427/5. [Accessed: 24-Dec-2018]*