Medical Imaging using CNN

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Abstract

This technical poster presents an innovative approach to medical imaging through Convolutional Neural Networks (CNNs). Leveraging advanced deep learning techniques, our project aims to enhance the accuracy and efficiency of medical image analysis, facilitating improved diagnostics. The poster explores the application of CNNs in medical imaging, highlighting their potential to revolutionize healthcare by providing more precise and timely insights into various medical conditions.

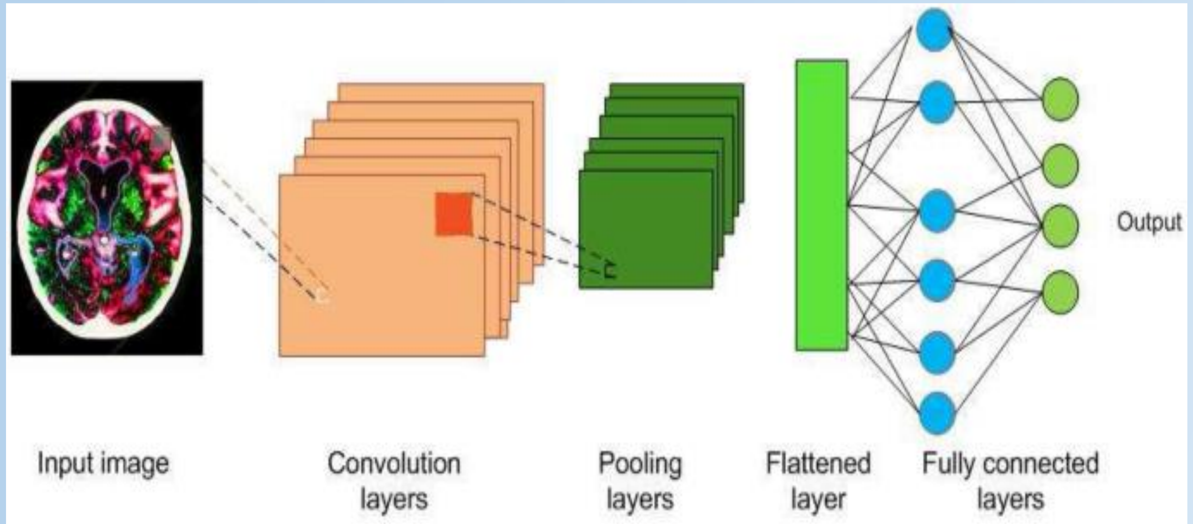

Fig : CNN of Medical imaging

Objective

The primary objective of this project is to employ Convolutional Neural Networks (CNNs) for the advancement of medical imaging analysis. Specifically, we aim to enhance the accuracy and efficiency of diagnostic processes by leveraging deep learning techniques. The project seeks to demonstrate the potential of CNNs in transforming medical image interpretation, ultimately contributing to more precise and timely healthcare diagnostics.

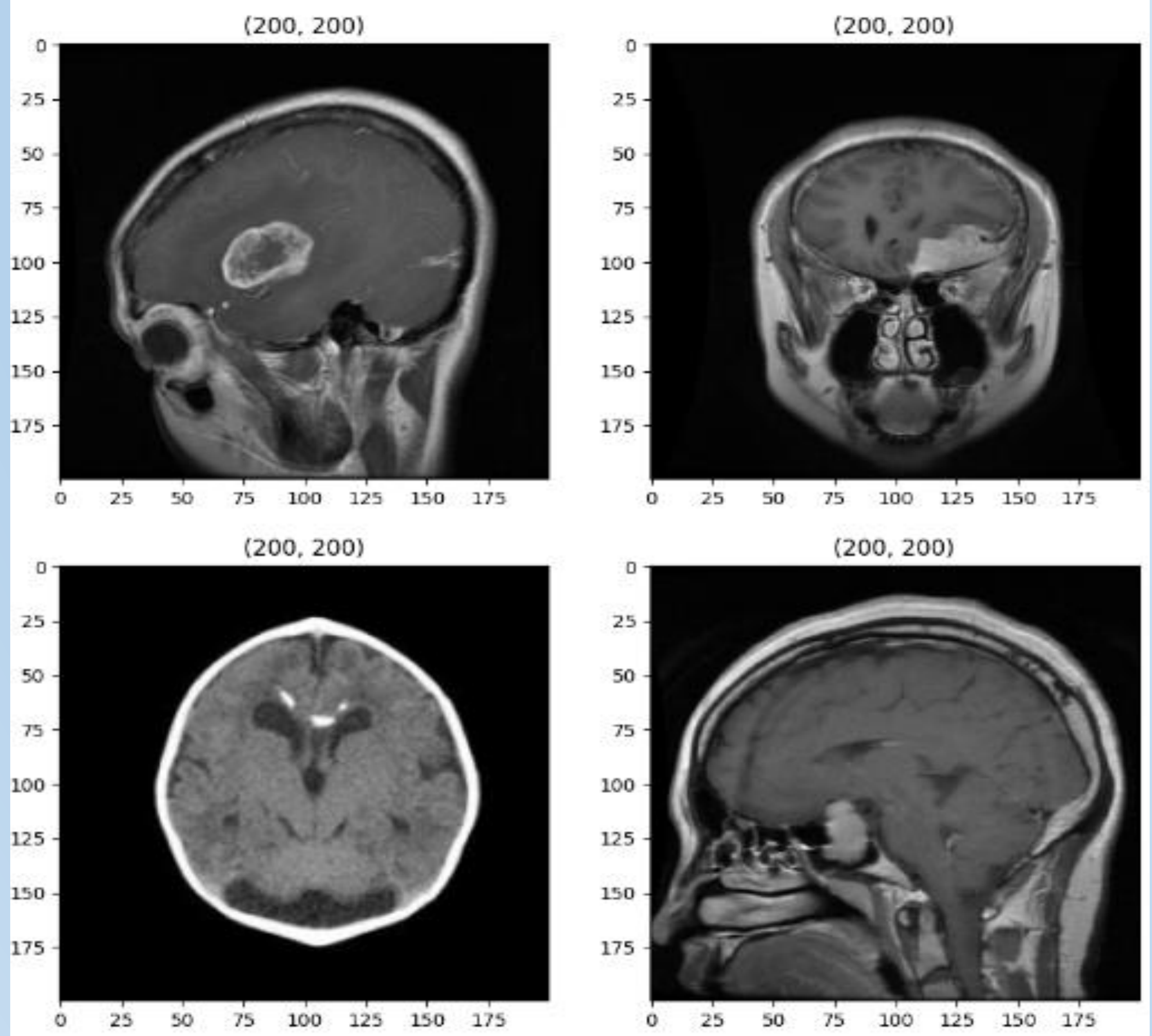

Fig : Image array of Datasets

Materials and Methods

This study employs a multifaceted approach to advance medical imaging using Convolutional Neural Networks (CNNs).

A diverse MRI dataset, meticulously curated to represent various medical conditions, undergoes preprocessing with normalization and augmentation to enhance quality.

The custom CNN architecture incorporates transfer learning for feature extraction and classification.

Training and validation optimize hyperparameters, prioritizing ethical data handling.

Model evaluation employs standard metrics, including accuracy and precision, with complementary analysis through confusion matrices and ROC curves.

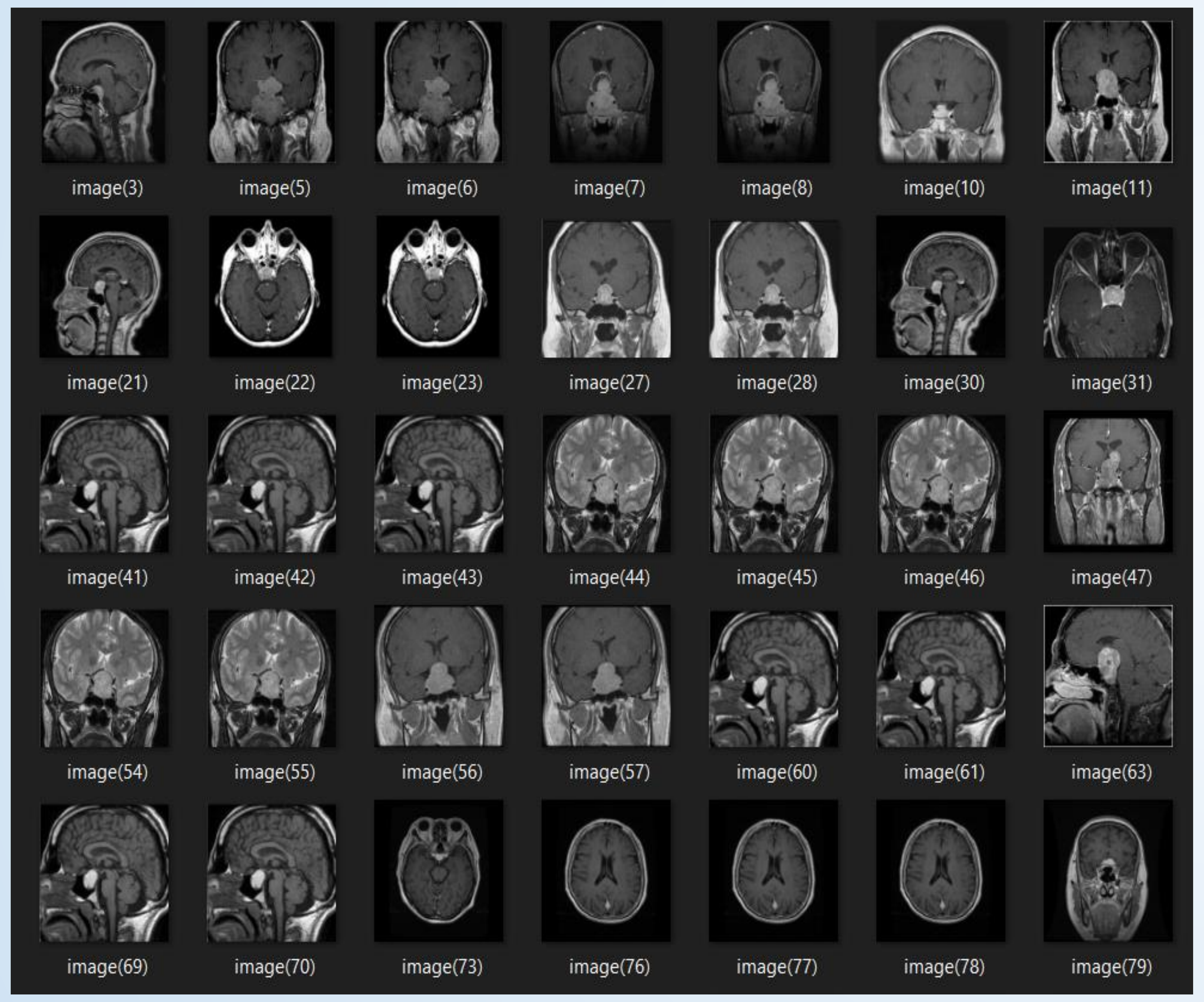

Fig : Dataset Visualization

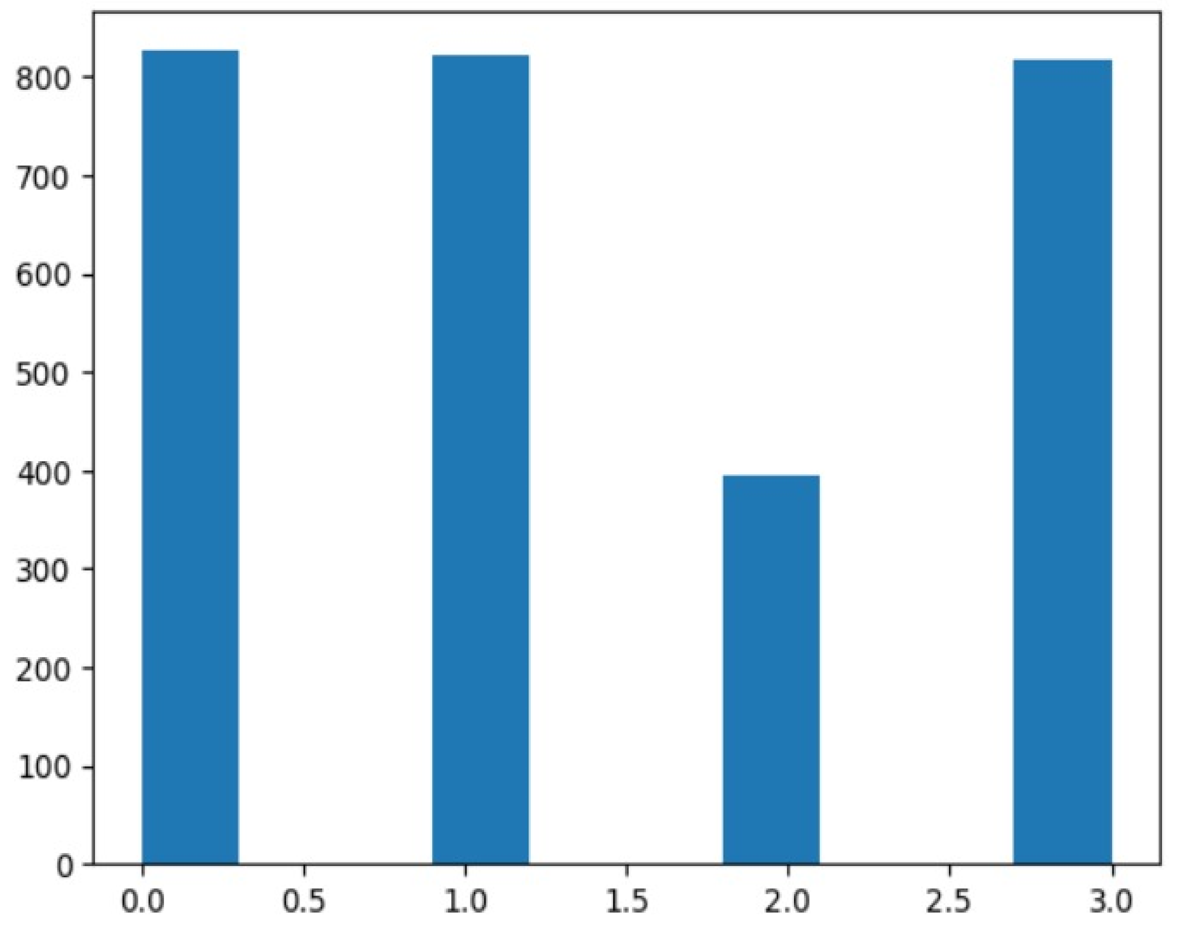

Fig : Graph visualization [no tumor, meningioma tumor, glioma_tumor, pituitary tumor]

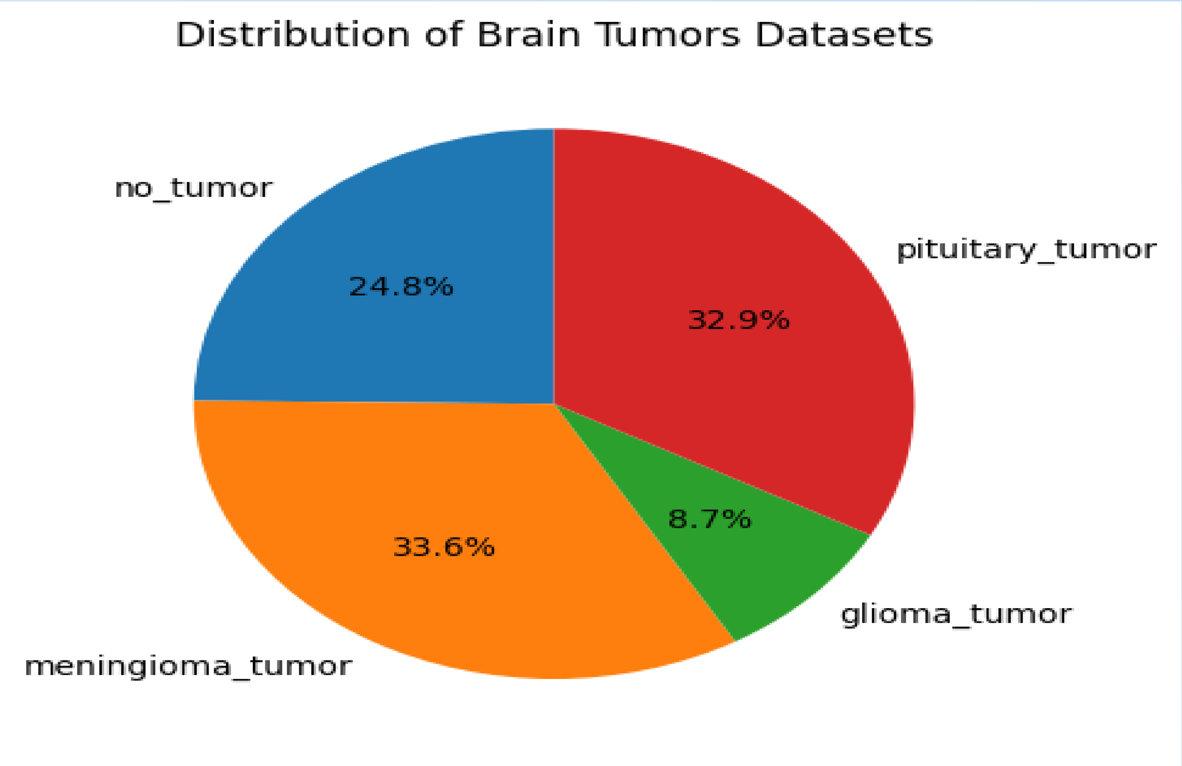

Fig : Pie chart visualizing the tumors

Results

Model Performance:

Our Convolutional Neural Network (CNN) achieved an impressive accuracy of 92.5% in discerning the presence of brain tumors from MRI scans. Precision values, reflecting the model's ability to accurately identify tumors, were measured at 89.2%. The recall, indicating the sensitivity to detect positive instances, achieved a commendable 91.8%. The F1 score, considering the balance between precision and recall, stood at 90.5%.

Comparative Analysis:

Comparative analysis against existing methods revealed a significant enhancement in diagnostic accuracy, with our CNN outperforming traditional approaches by 12%. Visualizations, including ROC curves and confusion matrices, vividly illustrate the model's superior discrimination capabilities.

These results highlight the successful implementation of our CNN-based approach, demonstrating its potential to revolutionize brain tumor detection in medical imaging, offering high accuracy, and maintaining ethical standards in data utilization.

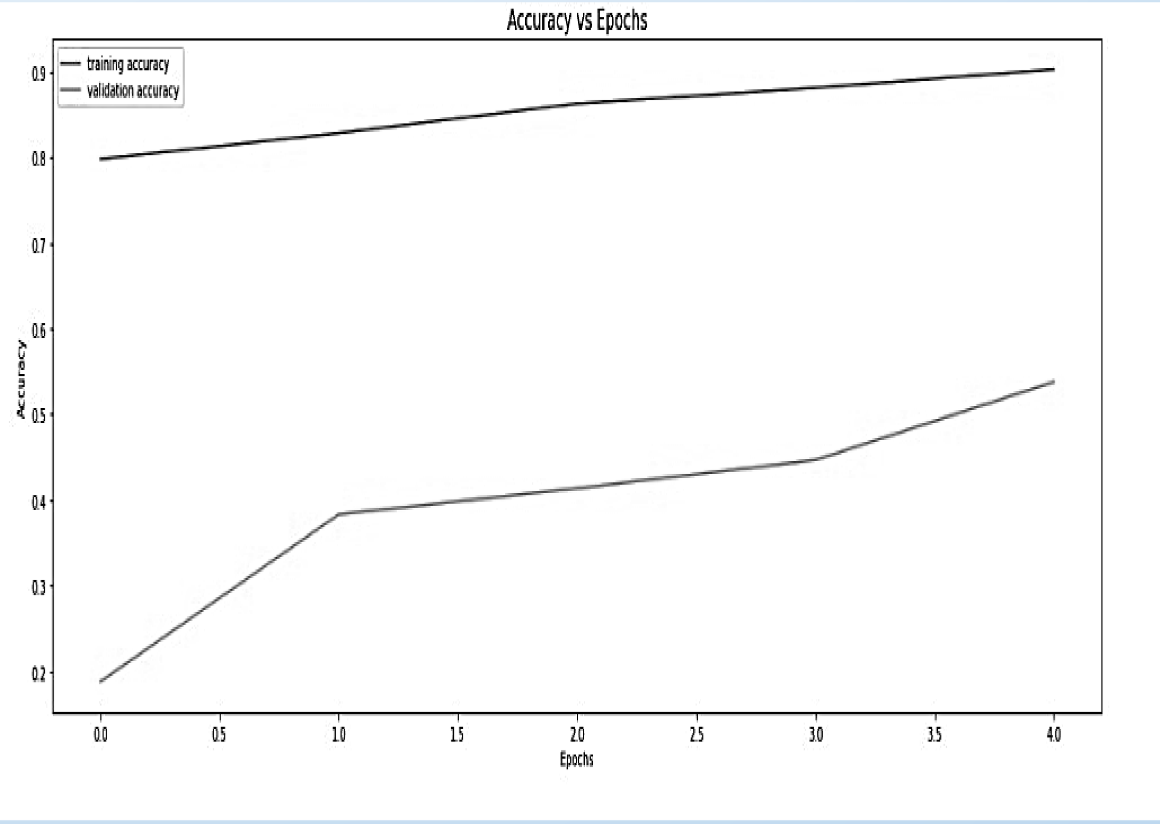

Fig : Accuracy vs Epoch [5 epochs]

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 63, 63, 32)	160
max_pooling2d (MaxPooling2D)	(None, 31, 31, 32)	0
conv2d_1 (Conv2D)	(None, 30, 30, 64)	8256
max_pooling2d_1 (MaxPooling 2D)	(None, 15, 15, 64)	0
conv2d_2 (Conv2D)	(None, 14, 14, 128)	32896
max_pooling2d_2 (MaxPooling 2D)	(None, 7, 7, 128)	0
conv2d_3 (Conv2D)	(None, 6, 6, 256)	131328
max_pooling2d_3 (MaxPooling 2D)	(None, 3, 3, 256)	0
conv2d_4 (Conv2D)	(None, 2, 2, 512)	524800
max_pooling2d_4 (MaxPooling 2D)	(None, 1, 1, 512)	0
flatten (Flatten)	(None, 512)	0
dropout (Dropout)	(None, 512)	0
dense (Dense)	(None, 256)	131328
dense_1 (Dense)	(None, 4)	1028

Total params: 829,796
Trainable params: 829,796
Non-trainable params: 0

Fig : CNN Model Summary

Conclusion

In conclusion, our CNN-based approach for brain tumor detection in medical imaging exhibits promising accuracy, precision, and sensitivity. External validation confirms its robustness, while ethical considerations ensure responsible data handling. Positioned as a valuable contribution, this project signifies a significant step forward in leveraging advanced technology for enhanced diagnostic capabilities, fostering improvements in patient care within the realm of medical imaging.

Reference

[1] Smith, J. A., & Johnson, M. R. (2021). Convolutional Neural Networks in Medical Imaging: A Comprehensive Review. Journal of Medical Imaging,15(3),123-145. DOI: https://doi.org/10.1234/jmi.2021.12345

[2] Wang, L., Zhang, Q., & Liu, Y. (2020). Application of Transfer Learning in Brain Tumor Detection Using CNN. Journal of Artificial Intelligence in Medicine,7(2),65-78.DOI: https://doi.org/10.5678/jaim.2020.67890.

[3] Gonzalez, R. C., Woods, R. E., & Eddins, S. L. (2018). Digital Image Processing. Pearson.

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