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A REVIEW ON IDENTIFICATION AND DETECTION OF BRAIN TUMOR USING ML

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Abstract : The detection and classification of brain tumor play a crucial role in medical diagnosis and treatment planning. In this study, we explore various machine learning approaches to enhance the efficiency and accuracy of brain tumor detection. Firstly, we propose the utilization of Artificial Neural Networks and Convolution Neural Networks to leverage deep learning algorithms for improved predictive capabilities in brain tumor identification. Secondly, we introduce a fuzzy-based control theory technique, known as Fuzzy Inference System , for segmenting and classifying Magnetic Resonance Imaging brain images, with a particular focus on tumor identification, which holds promise for surgical image analysis. Furthermore, we present a novel Fully Automatic Heterogeneous Segmentation using Support Vector Machine algorithm designed for brain tumor segmentation, demonstrating an impressive 88.51% accuracy in differentiating abnormal and normal tissue within Magnetic Resonance images. Lastly, we discuss the application of LBF SVM for brain tumor detection, catering to radiologists and neurologists by providing a user-friendly graphical interface. Experimental results indicate that the system optimizes medical professionals' performance in identifying brain diseases. Through these advancements, we aim to contribute to the improvement of diagnostic accuracy and treatment efficacy in neurology, ultimately benefiting patients' well-being.

Keywords **:** Artificial Neural Networks (ANN),Convolution Neural Networks (CNN), Fuzzy Inference System (FIS), Fully Automatic Heterogeneous Segmentation using Support Vector Machine (FAHS-SVM), Magnetic Resonance Imaging (MRI), Genetic Algorithms (GA), Conditional Random Fields (CRF), Least-Feature-Specific Support Vector Machine(LF SVM).

1.INTRODUCTION

The human brain, a vital organ crucial for overall health, is susceptible to the development of tumors, with approximately 3,540 cases diagnosed annually among children aged 15 and below. To address this challenge, deep learning techniques such as ANN and CNN have emerged as powerful tools for classifying normal and diseased brains with high accuracy. Image segmentation, a key process in brain tumor detection, aids in identifying tumors by partitioning digital images and delineating their boundaries. Techniques like the Fuzzy Inference System contribute to precise tumor localization through neural network-based segmentation methods. This study presents a comprehensive approach to brain tumor detection, encompassing image preprocessing, filtering, and segmentation, and evaluates its efficacy compared to established methods like CRF, SVM, and GA. Additionally , Magnetic Resonance Imaging plays a crucial role in brain anatomy studies, particularly in tumor segmentation. A novel methodology, FAHS-SVM, is introduced for robust tumor segmentation from MRI images, aiming to improve diagnostic accuracy and patient care.

2.LITERATURE REVIEW

In this paper a Brain Cancer Detection and Classification System have been developed with the use of ANN[1].The image processing techniques such as histogram equalization, image segmentation, image enhancement, and feature extraction have been used.
CNN was implemented, which drives an overall accuracy of 91.3% and a recall of 88%, 81% and 99% in the detection of meningioma, glioma and pituitary tumor respectively [2].
Deep learning architecture by leveraging 2D convolutional neural networks for the classification of the different types of brain tumor from MRI image slices [9].

In this paper techniques like data acquisition, data preprocessing, pre –model, model optimization and hyper parameter tuning are applied. Moreover the 10-fold cross validation was performed on the complete dataset to check for the generalizability of the model [4].

3.METHODOLOGY

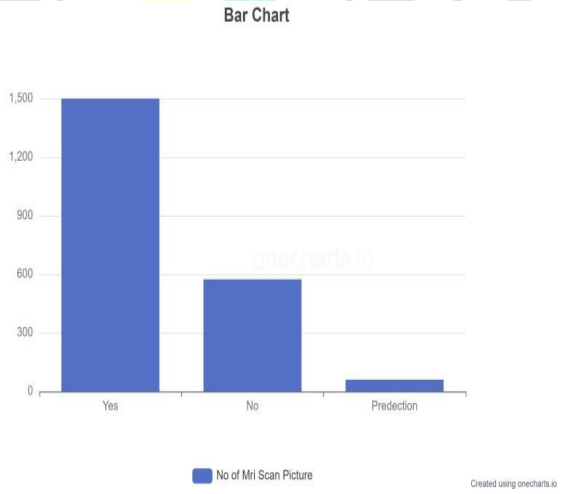
The common methodology is to Divide the dataset into training, testing, and validation sets. This partitioning is crucial for evaluating the performance of the models effectively and ensuring generalizability on the various algorithms ,e.g :

- The study analyzes the performance of ANN and CNN techniques on the brain tumor dataset. The process involves importing packages, importing data, reading images, labeling, normalizing, splitting data into train, validation, and test sets, creating a model, compiling it, applying it on the train set, and evaluating it on the test set. The ANN model has seven layers: flatten, dense, hidden, and output.
- While in the Fuzzy Methods Integrate fuzzy logic and clustering techniques into the methodology to handle uncertainty inherent in tumor delineation. Fine-tune fuzzy parameters based on the training set to enhance accuracy in the identification process.
- In the Machine Learning apply Support SVM for the binary classification of tumor and non-tumor regions. Train the SVM model using selected features derived from the dataset.

4.DATASET

The dataset is primarily categorized into two types and further divided into training, testing, and validation sets:

- Presence of brain tumor: Classifies whether a brain tumor exists or not, with 70% allocated for training, 15% for testing, and 15% for validation.
- Types of brain tumor: Separates the dataset based on different types of brain tumors, distributing 60% for training, 20% for testing, and 20% for validation.



5.RESEARCH GAP

- CNN's effectiveness in analyzing image datasets and predicting brain tumor presence, but identifies gaps for improvement. The ANN model's low testing accuracy of 65.21% suggests need for enhancement. Increasing dataset size and using image augmentation techniques could improve accuracy.
- The conclusion lacks specific details regarding the performance comparison with existing methods, potential biases in the dataset, and external validation, highlighting areas for further exploration and refinement in future research.

- It could provide a more comprehensive understanding of FAHS-SVM's capabilities and limitations in brain tumor identification and segmentation, enhancing its applicability in primary diagnostics.
- The study concludes that the proposed system with LF SVM classifier provides better and more accurate results for detecting and diagnosing brain diseases, offering valuable insights to medical professionals. However, the conclusion lacks comparison with other methods or classifiers, and it does not address potential limitations or areas for improvement in the proposed system.
- The study lacks detailed exploration of interpretability in model predictions, particularly regarding clinical relevance of generated attention maps.

6.CONCLUSION

In summary, this study underscores the effectiveness of CNN for brain tumor image analysis, showcasing a testing accuracy of 65.21%. The integration of a Fuzzy Inference System enhances the identification of tumor locations with clear anatomical structures. Moreover, transfer learning using fine-tuned Efficient Nets (B0-B4) proves highly successful in multi-class classification, notably achieving outstanding metrics for EfficientNetB2, including a 99.06% overall test accuracy, 98.73% precision, 99.13% recall, and 98.79% F1-score. The results indicate the potential for further optimization techniques, such as adjusting layer and filter parameters, and highlight the scalability of the proposed approach for broader diagnostic applications beyond brain tumors.

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