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"BRAIN TUMOR CLASSIFICATION"

Mini project report submitted in partial fulfilment of curriculum prescribed for the Artificial Intelligence (20CS540) course for the award of the degree of

Bachelor of Engineering
in
Computer Science and Engineering

By

Abhishek M	01JST21CS003
Amith K Kumble	01JST21CS014
Gagandeep D	01JST21CS039
Vikhyat G Gowda	01JST21CS171

Under the Guidance of

Prof. Aishwarya D S
Assistant Professor
Dept. of CSE, JSSSTU, Mysuru

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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JSS MAHAVIDYAPEETHA
JSS SCIENCE AND TECHNOLOGY UNIVERSITY
JSS Technical Institutions Campus, Mysuru – 570006

This is to certify that the work entitled "**BRAIN TUMOR CLASSIFICATION**" is a bonafide work carried out by team consisting of “**Abhishek M, Amith K Kumble, Vikhyat G Gowda, Gagandeep D**” in partial fulfilment of the award of the degree of Bachelor of Engineering in Computer Science and Engineering of JSS Science and Technology, Mysore during the year 2023. It is certified that all corrections/suggestions indicated during CIE have been incorporated in the report. The mini project report has been approved as it satisfies the academic requirements in respect of mini project work prescribed for the Artificial Intelligence (20CS540) course.

Course in Charge and Guide

Prof. Aishwarya D S
Assistant Professor, Dept of CS&E,
JSSSTU Mysore

Place: Date:

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Introduction

Brain tumors are a complex and often life-threatening medical condition that affects thousands of people worldwide. Early detection and accurate classification of brain tumors are critical for timely medical intervention and effective treatment planning. While predicting the presence of a brain tumor is a significant step in diagnosis, a more detailed classification system is needed to guide medical professionals in determining the tumor type, location, and potential treatment strategies.

The current project focuses on a fundamental aspect of brain tumor diagnosis – determining the presence or absence of a brain tumor. This is an essential first step in identifying individuals who require further medical evaluation. However, the scope of the project can be expanded to provide a more comprehensive solution. Classification of brain tumors into distinct types, such as gliomas, meningiomas, or metastatic tumors, and the differentiation between benign and malignant tumors can significantly enhance the diagnostic process.

Accurate classification of brain tumors not only aids in the selection of appropriate treatment strategies but also offers valuable insights into the prognosis and expected outcomes for patients. Machine learning and artificial intelligence techniques have shown great promise in improving the accuracy and efficiency of brain tumor classification, paving the way for more personalized and effective healthcare solutions.

In this project, we will explore the methods and technologies used to predict the presence of brain tumors and lay the foundation for future advancements in brain tumor classification. By doing so, we contribute to the broader goal of enhancing the medical community's ability to diagnose, treat, and ultimately improve the lives of individuals affected by brain tumors.

1. Literature Review

1.1 Textbooks

"**Biomedical Signal and Image Processing**" by Kayvan Najarian and Robert Splinter: This textbook provides a comprehensive overview of signal and image processing techniques in the context of biomedical applications, including brain tumor classification. It covers various methods, such as image segmentation, feature extraction, and classification, that are essential for binary brain tumor classification.

"**Pattern Recognition and Machine Learning**" by Christopher M. Bishop: Bishop's book is a fundamental reference for machine learning and pattern recognition. It introduces essential concepts in classification, which have been widely applied in binary brain tumor classification research. Techniques like support vector machines and neural networks are discussed, along with their applications in medical imaging analysis.

1.2 Research Papers

Zacharaki, E. I., Wang, S., Chawla, S., Soo, Y., & Yoo, D. S. (2009). Classification of brain tumor type and grade using MRI texture and shape in a machine learning scheme. Magnetic Resonance in Medicine, 62(6), 1609-1618.

This research paper demonstrates the use of texture and shape features in MRI images for binary classification of brain tumors, highlighting the importance of feature engineering limitation of the Present Work

2 Limitation of the present work

2.1 Binary Classification Only

The foremost limitation of the current project is its focus on binary classification, i.e., predicting the presence or absence of a brain tumor. While this is an important initial step in diagnosis, it falls short of providing a complete picture of the tumor. More detailed classification into specific tumor types and grading, which often requires advanced imaging techniques and histopathological analysis, is necessary for a comprehensive understanding of the condition.

2.2 Lack of Tumor Grading

Tumor grading, a critical factor in determining the malignancy of brain tumors, is not addressed in the current work. Accurate tumor grading can significantly impact treatment decisions and patient outcomes. A more sophisticated model capable of distinguishing between low-grade and high-grade tumors is essential.

2.3 Limited Dataset Size

The accuracy and reliability of machine learning models are heavily dependent on the size and quality of the dataset. The present work may suffer from limitations related to dataset size, potentially resulting in overfitting or underrepresentation of certain tumor types.

In conclusion, while the current project lays the foundation for predicting the presence of brain tumors, it is important to acknowledge these limitations. Future research and development efforts should aim to address these shortcomings to provide more comprehensive and accurate solutions for brain tumor classification and diagnosis.

3 Objective of your Work

The primary objective of this project is to develop and implement a machine learning based system for the prediction of the presence of brain tumors in medical imaging data. While the primary focus is on binary classification (tumor present or not), this project serves as a crucial building block for more advanced brain tumor classification and diagnosis systems.

3.1 Tumor Detection

Develop a robust and accurate binary classification model capable of identifying the presence of brain tumors in medical images, such as MRI or CT scans. This initial step is essential for alerting healthcare professionals to the need for further evaluation.

3.2 Data Preprocessing

Implement effective data preprocessing techniques to enhance the quality and reliability of the input medical imaging data. This includes tasks like noise reduction, image normalization, and data augmentation.

3.3 Machine Learning Model

Select and train a suitable machine learning model, which may include convolutional neural networks (CNNs) or other image classification techniques, to effectively differentiate between tumor and non-tumor cases.

3.4 High Accuracy

We strive to develop a machine learning model that demonstrates a high level of accuracy in tumor detection. This accuracy is critical to minimize false positives and false negatives, reducing the risk of both unnecessary medical interventions and missed diagnoses.

3.5 Web Interface Development

A user-friendly web interface will be designed and implemented to provide a seamless and intuitive means of interacting with the classification model. This interface should be accessible from various devices and user-friendly for healthcare professionals.

3.6 Scalability

Consider the scalability of the model for use in larger healthcare systems. Ensure that it can process a significant volume of medical images efficiently.

4 Work Plan

4.1 Data Collection and Preprocessing (Oct 5 - Nov 5)

- Collect a diverse dataset of brain tumor MRI scans, from publicly available sources.
- Clean and organize the collected data, addressing issues such as data inconsistencies, missing values, and noise.
- Standardize image resolutions, orientations, and formats for consistency.
- Split the dataset into training, validation, and testing subsets (e.g., 70%, 15%, 15%).

4.2 Model Development and Training (Nov 6 - Nov 18)

- Implement preprocessing techniques such as image enhancement, normalization, and feature extraction.
- Experiment with different feature selection methods to identify the most discriminative features for tumor classification.
- Choose appropriate machine learning or deep learning algorithms (e.g., CNN, SVM, or ensemble methods) for binary classification. Trains and fine turn the model.
- Train and fine-tune the selected models on the preprocessed dataset using the training subset.

4.3 Web Interface Development (November 18 - November 30)

- Create a user-friendly web interface for binary brain tumor classification.
- Implement interactive features for uploading images, processing the images with the developed algorithms, and displaying the classification results.

4.4 Evaluation and Reporting (Dec 1 - Dec 5)

- Compile a comprehensive report detailing the entire binary brain tumor classification process, including data sources, preprocessing, model development, and evaluation results.
- Summarize the strengths and limitations of the developed models and propose potential future improvements or research directions.