IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, January 2026
Impact Factor: 7.67

Chatbot based Brain Tumor Detection using CNN

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Abstract: *Brain tumors are one of the most serious neurological disorders, where early and accurate diagnosis plays a vital role in improving patient survival rates. Traditional brain tumor detection methods rely heavily on manual analysis of MRI scans by radiologists, which is time-consuming and prone to human error, especially in early stages. To address these challenges, this research proposes a chatbot-based brain tumor detection system using Convolutional Neural Networks (CNN). The proposed system automatically analyzes MRI brain images and classifies them into four categories: glioma, meningioma, pituitary tumor, and no tumor. Image preprocessing techniques such as resizing and normalization are applied to improve model performance and consistency. The trained CNN model provides fast and reliable predictions with confidence scores. In addition, an AI-powered chatbot is integrated to explain results in simple language and guide users regarding further medical steps. The system also assists users by suggesting nearby hospitals for consultation. Experimental results demonstrate that the proposed approach improves diagnostic accuracy and reduces dependency on manual interpretation. This system acts as an effective decision-support tool for early brain tumor detection and patient assistance.*

Keywords: Brain Tumor Detection, Convolutional Neural Network (CNN), MRI Image Analysis, Medical Image Classification, AI Chatbot Assistance, Healthcare Decision Support Systems

I. INTRODUCTION

Brain tumors represent one of the most complex and life-threatening neurological disorders, affecting patients of all age groups across the world. A brain tumor occurs due to the abnormal and uncontrolled growth of cells within the brain, which can disrupt normal brain functions and lead to severe health complications. Early detection of brain tumors plays a crucial role in improving treatment outcomes, increasing survival rates, and reducing long-term neurological damage. Medical imaging techniques such as Magnetic Resonance Imaging (MRI) are widely used for brain tumor diagnosis due to their ability to provide detailed visualization of brain tissues without exposing patients to harmful radiation.

Despite advancements in medical imaging, the interpretation of MRI scans largely depends on the expertise and experience of radiologists. Manual analysis of MRI images is a time-consuming and error-prone process, particularly when tumors are small, irregular, or located in complex regions of the brain. The increasing number of MRI scans generated daily in hospitals adds significant workload to medical professionals, increasing the risk of delayed diagnosis and inconsistent interpretations. In rural and resource-limited areas, the shortage of experienced radiologists further worsens the problem, often resulting in late detection and reduced access to quality healthcare.

Recent developments in artificial intelligence and deep learning have shown promising potential in addressing these challenges. Convolutional Neural Networks (CNNs), a specialized class of deep learning models, have demonstrated remarkable performance in medical image analysis tasks, including disease detection, image segmentation, and classification. CNNs are capable of automatically extracting meaningful features from MRI images, reducing the need for manual feature engineering and enabling accurate tumor classification. Their ability to learn complex patterns makes them well-suited for identifying subtle differences between healthy and tumor-affected brain tissues.

In addition to accurate detection, patients often face confusion and anxiety after receiving medical reports due to the lack of immediate guidance and understandable explanations. Traditional diagnostic systems rarely provide interactive support to help patients interpret their results or understand the next steps. Integrating conversational AI in healthcare applications can bridge this communication gap by offering real-time assistance, simplified explanations, and basic

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medical guidance. This research proposes a chatbot-based brain tumor detection system that combines CNN-based MRI image classification with an AI-powered conversational interface. The system automatically classifies brain MRI scans into multiple tumor categories and provides confidence scores for predictions. The integrated chatbot enhances user experience by explaining the results in simple language, offering preliminary guidance, and assisting users in locating nearby medical facilities. By combining deep learning and interactive assistance, the proposed system aims to support early diagnosis, reduce diagnostic delays, and improve accessibility to intelligent healthcare solutions.

II. PROBLEM STATEMENT

Brain tumor diagnosis primarily depends on manual interpretation of MRI scans, which is time-consuming and highly dependent on radiologist expertise. Early-stage tumors are often difficult to identify due to subtle visual differences in brain images. Increasing patient load in hospitals leads to diagnostic delays and inconsistent results. Limited availability of skilled medical professionals in rural areas further restricts timely diagnosis. Existing systems lack automated assistance and real-time decision support for doctors and patients. Patients also receive minimal guidance after diagnosis, causing confusion and anxiety. Therefore, an intelligent, automated system is required to improve accuracy, speed, and accessibility of brain tumor detection.

III. METHODOLOGY

The proposed methodology uses a Convolutional Neural Network to automatically detect brain tumors from MRI images. Image preprocessing techniques are applied to improve data quality and model accuracy. An AI-based chatbot is integrated to explain results and assist users with further medical guidance.

A. Data Collection

MRI brain images are collected from a labeled dataset consisting of tumor and non-tumor cases, including glioma, meningioma, and pituitary tumor categories.

B. Image Preprocessing

The input MRI images are resized, normalized, and enhanced to ensure uniformity and improve the learning efficiency of the CNN model.

C. CNN Model Training

A Convolutional Neural Network is trained using the preprocessed images to automatically extract features and classify brain tumors accurately.

D. Tumor Prediction

The trained CNN model analyzes new MRI images and predicts the tumor type along with a confidence score in real time.

E. Chatbot Integration and User Assistance

An AI-based chatbot explains the prediction results in simple language and guides users with medical suggestions and nearby hospital recommendations.

IV. RESULTS AND DISCUSSION

The experimental results show that the proposed CNN-based system effectively classifies brain MRI images into tumor and non-tumor categories with reliable accuracy. Image preprocessing techniques improved the quality of input data and enhanced model performance. The trained model generated predictions within a short time, making the system suitable for real-time usage. Confidence scores provided additional clarity regarding prediction reliability. The system performed consistently across different tumor types. Data augmentation helped reduce overfitting and improved generalization on unseen images. The integrated chatbot enhanced user interaction by explaining results in simple

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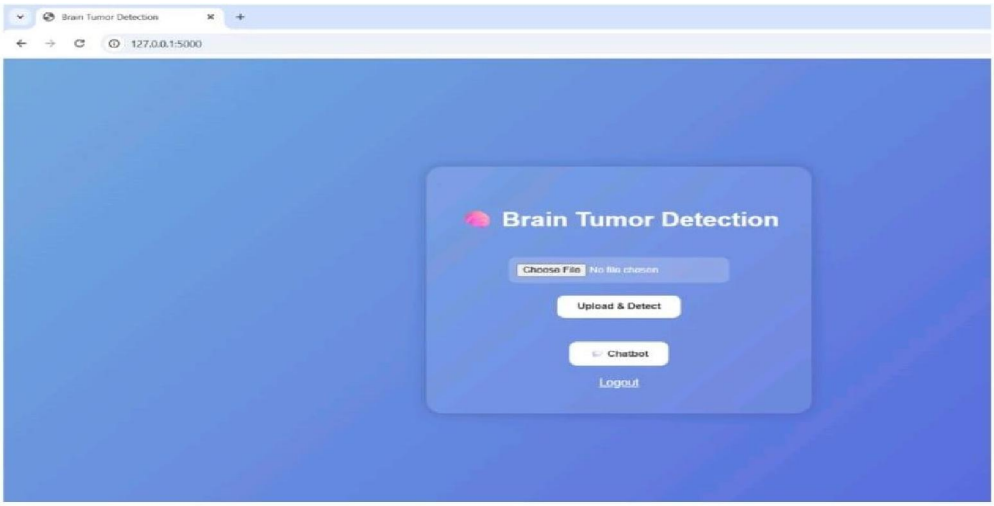
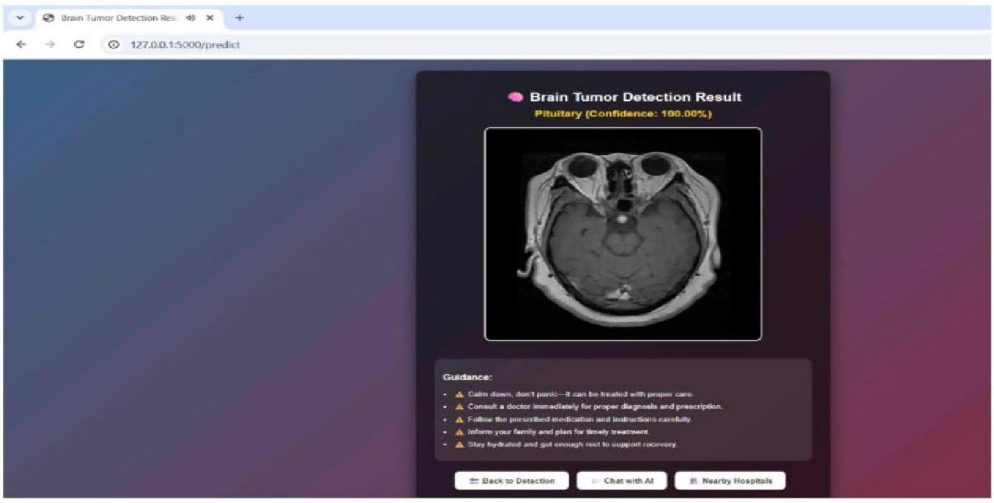
language. Users received immediate guidance without requiring medical expertise. Hospital suggestion features increased the practical value of the system. Overall, the system demonstrates strong potential as a supportive tool for early brain tumor detection.





V. CONCLUSION

The proposed chatbot-based brain tumor detection system demonstrates the effective use of deep learning techniques for medical image analysis. The CNN model accurately classifies MRI brain images into different tumor categories, supporting early detection. Image preprocessing significantly improves prediction accuracy and consistency. The system reduces dependency on manual interpretation and minimizes diagnostic delays. Integration of an AI chatbot enhances user interaction by providing clear and simple explanations. Users receive basic medical guidance and support after prediction. The system assists in faster decision-making for further medical consultation. It is designed as a supportive tool rather than a replacement for professional diagnosis. The user-friendly interface increases accessibility for non-technical users. Overall, the system highlights the growing role of artificial intelligence in improving healthcare services.

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VI. ACKNOWLEDGMENT

We express our sincere gratitude to our project guide for their constant guidance, encouragement, and valuable suggestions throughout the development of this project. Their support and technical insights were instrumental in completing this work successfully.

We would also like to thank the faculty members of the Department for providing the necessary knowledge, resources, and motivation during the course of the project. Their continuous support helped us understand the concepts and overcome technical challenges.

We extend our heartfelt thanks to our institution for providing a conducive learning environment and the required facilities to carry out this project. Finally, we are grateful to our friends and family members for their encouragement, patience, and support throughout the project duration.

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