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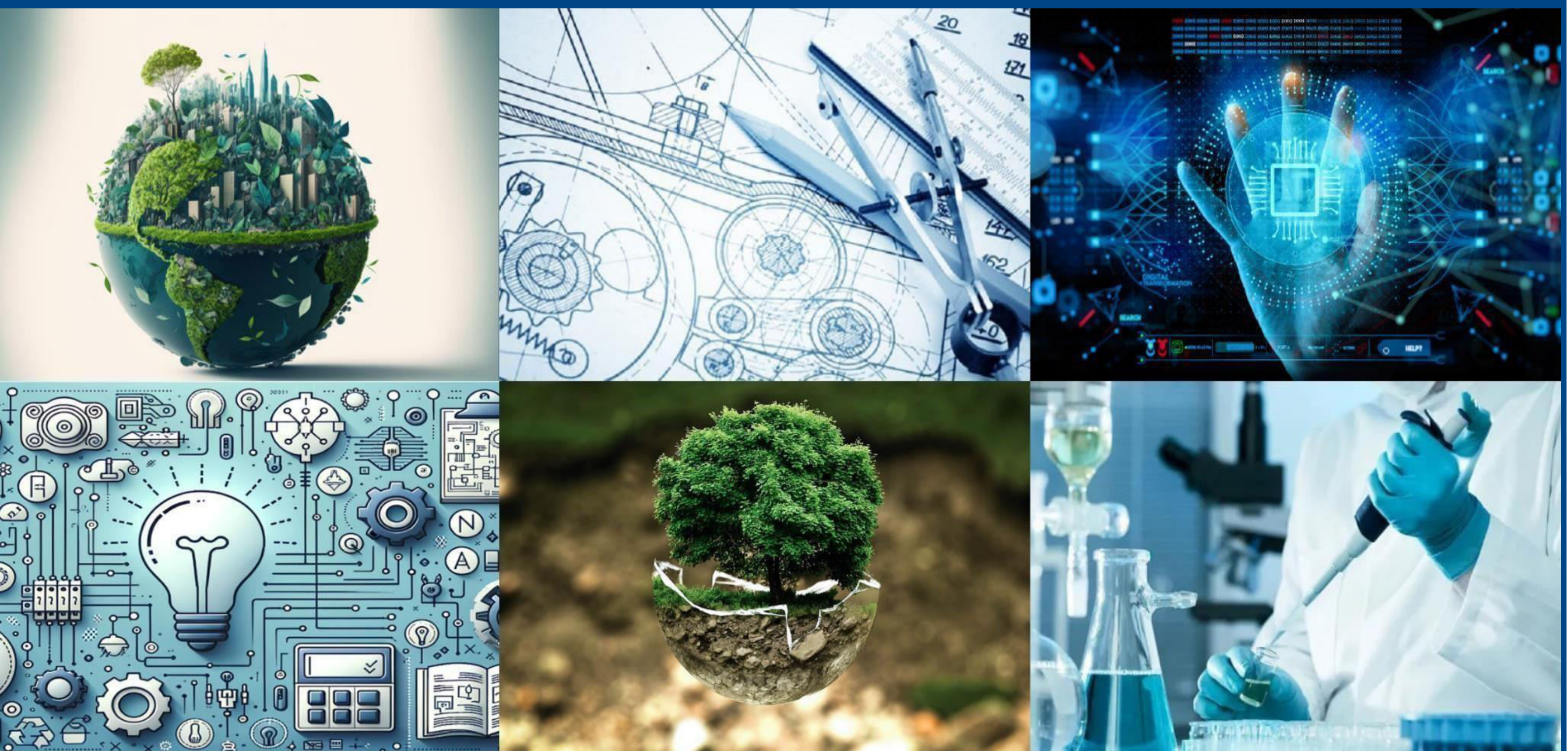

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NEUROAI HEALTH PLATFORM: CNN-BASED BRAIN TUMOR DETECTION AND GPT-DRIVEN PATIENT CARE ASSISTANCE

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ABSTRACT: The increasing prevalence of brain tumors has driven the development of advanced diagnostic support systems that integrate imaging analysis with intelligent clinical assistance. NeuroAssist is a dual-module framework designed to enhance the process of brain tumor identification and patient management by combining convolutional neural network (CNN) models for MRI-based tumor classification with GPT-based natural language processing (NLP) for clinical guidance. The CNN component processes and classifies MRI scans to detect abnormal tissue patterns, while the GPT-powered module provides contextual assistance for medical professionals by summarizing findings, suggesting possible treatment pathways, and answering domain-specific queries. The system offers separate portals for patients, doctors, and administrators, incorporating real-time notifications, secure communication, and analytical dashboards. This multi-modal approach not only improves diagnostic accuracy but also streamlines doctor–patient interactions, offering a robust foundation for telemedicine and hospital-based deployments.

KEYWORDS: Brain Tumor Analysis, Convolutional Neural Networks, GPT-based NLP, Clinical Decision Support, Medical Image Processing, MRI Analysis, Healthcare AI Systems, NUI, Speech Recognition

I. INTRODUCTION

Brain tumors represent a significant health challenge due to their complex nature, high mortality rates, and the difficulty of achieving timely and accurate diagnosis. Traditional diagnostic workflows rely on manual interpretation of MRI scans by radiologists, which can be time-intensive and prone to inter-observer variability. In recent years, the integration of artificial intelligence (AI) in medical imaging and clinical decision-making has emerged as a promising solution to these limitations.

NeuroAssist is a comprehensive brain health platform that bridges the gap between automated imaging diagnostics and interactive clinical support. The platform operates through two primary AI components: a convolutional neural network (CNN) trained on annotated brain MRI datasets for tumor detection, and a GPT-based natural language processing (NLP) module for medical assistance. This combination allows the system to not only identify abnormal tissue structures but also interpret and present the findings in an accessible format for doctors and patients.

In addition to its analytical core, NeuroAssist incorporates role-based dashboards, appointment scheduling, real-time alerts, and secure messaging. Such an integrated approach can support healthcare professionals in both hospital and telemedicine environments, enabling faster diagnosis, improved patient communication, and optimized treatment planning.

II. LITERATURE SURVEY

The intersection of medical imaging analysis and natural language processing has been explored extensively in recent years, particularly for oncology and neurological disorders.

[1] CNN-Based Brain Tumor Detection LeCun et al. (2015) demonstrated that convolutional neural networks could outperform traditional machine learning models in image classification tasks due to their ability to automatically learn spatial hierarchies of features. In the domain of brain MRI analysis, Kumar et al. (2019) developed a CNN-based framework that achieved over 95% accuracy in differentiating between glioma, meningioma, and pituitary tumors, highlighting the viability of deep learning in clinical applications.

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[2] NLP in Clinical Decision Support Natural language processing has been applied in healthcare for tasks ranging from clinical documentation to diagnostic assistance. Johnson and Rumshisky (2020) explored the use of transformer-based models for summarizing patient records and generating physician-friendly reports. Their work indicated that contextual language models could significantly reduce the cognitive load on clinicians.
[3] Multimodal AI in Healthcare Recent studies (Ramesh et al., 2022) have emphasized the importance of integrating imaging AI with NLP systems for holistic diagnostic support. Such systems not only provide image-based classifications but also deliver actionable insights in natural language, enabling smoother adoption in clinical workflows.
[4] Gaps in Existing Solutions Most existing medical AI solutions focus exclusively on either image analysis or textual decision support. The lack of integrated frameworks often forces medical professionals to operate across multiple disjointed platforms, increasing complexity and the risk of miscommunication.

The NeuroAssist framework addresses these gaps by providing an end-to-end system that unifies CNN-based brain tumor classification with GPT-powered clinical assistance, packaged within a secure and user-friendly platform.

EXISTING SYSTEM

Conventional brain tumor diagnostic workflows rely heavily on radiologists manually reviewing MRI scans and preparing structured reports for neurologists and oncologists. While highly skilled, human interpretation is subject to fatigue, varying expertise levels, and differences in diagnostic criteria. Furthermore, existing computer-aided detection (CAD) systems typically operate as standalone applications that provide classification results without deeper integration into hospital information systems or patient communication channels.

Some platforms offer AI-based tumor segmentation and detection; however, they often lack a clinical decision support component that can translate imaging results into actionable treatment pathways. On the other side, medical chatbots and NLP-based assistants exist for patient education, but they are rarely connected to imaging diagnostics, limiting their usefulness in a real-time hospital environment. Lack of role-specific dashboards for doctors, patients, and administrators.

PROPOSED SYSTEM

The proposed system, NeuroAssist, is an integrated AI-driven platform that merges CNN-based brain tumor MRI analysis with GPT-powered natural language clinical support. The system is designed to operate as a central hub for diagnosis, patient interaction, and administrative management.

The core components include:
MRI Analysis Module (CNN-based) – Processes uploaded MRI scans to detect tumor presence and classify tumor type (e.g., glioma, meningioma, pituitary).

NLP Clinical Assistant (GPT-based) – Interprets CNN output, generates patient-friendly summaries, answers clinician queries, and suggests potential diagnostic or treatment approaches.

Multi-Role Dashboards – Tailored interfaces for patients, doctors, and administrators with relevant tools and insights.

Real-Time Communication – Secure messaging and appointment scheduling between patients and healthcare providers.

Analytics Engine – Tracks system usage, patient statistics, and hospital performance metrics.

This combination of imaging AI and language AI provides a comprehensive environment that supports the entire diagnostic and treatment cycle—from image upload to informed decision-making—within a single platform.

III. SYSTEM ARCHITECTURE

The NeuroAssist platform follows a modular, service-oriented architecture integrating AI-driven imaging and natural language capabilities. A web-based frontend (React + Vite) provides role-specific dashboards for patients, doctors, and administrators with responsive design.

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The backend APIs (Express.js + Node.js) handle authentication, data processing, and secure communication between modules.

MRI scans are processed by a CNN-based analysis server built using TensorFlow/PyTorch for tumor classification.
The GPT-based NLP module interprets diagnostic results and offers clinical decision support through conversational interfaces.

A MongoDB database stores patient records, MRI metadata, appointments, and analytics securely.

Notification services (email/SMS) deliver alerts, reminders, and system updates in real time.

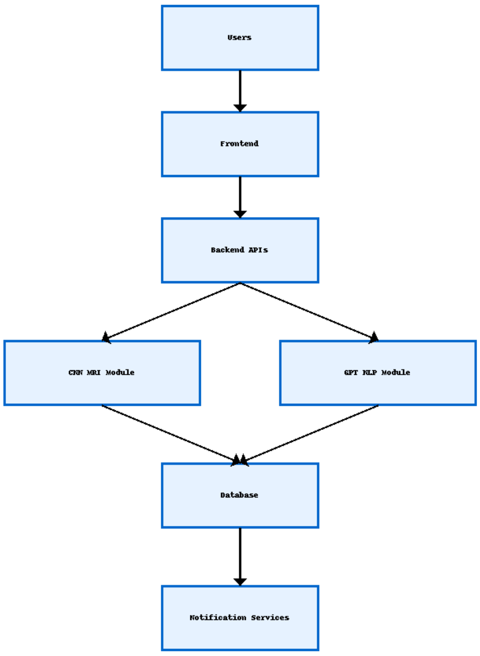

Fig 3.1 System Architecture

IV. METHODOLOGY

The NeuroAssist platform employs a multi-stage methodology integrating medical imaging analysis with natural language–based clinical assistance.

Initially, MRI brain scans are uploaded through the secure patient or doctor portal.

The images undergo preprocessing including noise reduction, normalization, and resizing to meet the CNN model's input specifications.

A CNN-based classification model trained on annotated MRI datasets identifies tumor presence and type.

The diagnostic results are then processed by a GPT-based NLP module, which interprets findings and generates clinical summaries.

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These results are displayed via role-based dashboards, enabling patients, doctors, and administrators to access relevant insights.

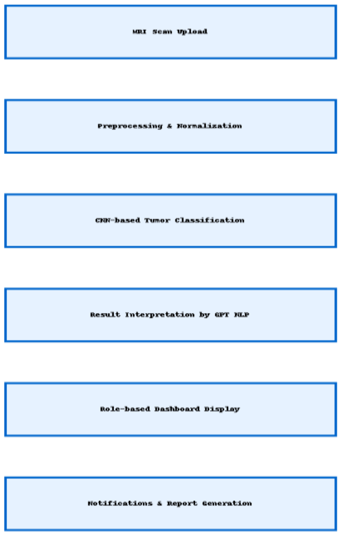

Fig 4.1 Methodology Flowchart

V. DESIGN & IMPLEMENTATION

The NeuroAssist platform was designed with a modular architecture that allows independent development and scaling of each functional unit.

The user authentication and role assignment module ensures that patients, doctors, and administrators access only the features relevant to their roles.

MRI scan uploads are processed through a dedicated image handling module, which validates file formats, applies preprocessing steps, and forwards the data to the CNN model.

The CNN processing pipeline executes tumor classification tasks and sends structured outputs to the GPT-powered NLP engine.

The GPT NLP module interprets CNN results, generates medical summaries, and answers queries from healthcare professionals.

All results, user profiles, and scan metadata are securely stored and retrieved from the MongoDB database.

The dashboard visualization layer presents role-specific information through interactive graphs, tables, and reports, while the notification and reporting system manages alerts via email/SMS.

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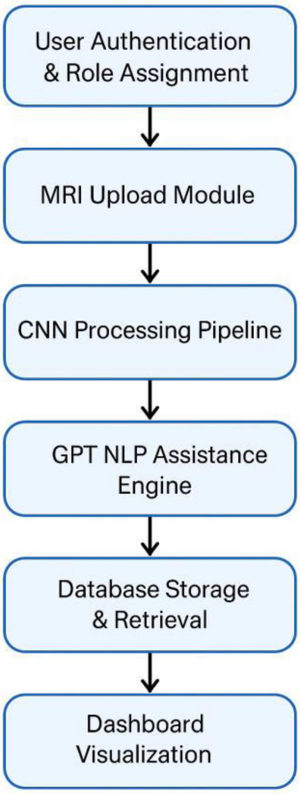

Fig 5.1 Flowchart Working

VI. OUTCOME OF RESEARCH

The research and development of NeuroAssist: CNN-Based Brain Tumor Analysis and GPT-Driven Clinical Decision Support resulted in a functional, multi-role healthcare platform capable of performing both automated MRI analysis and intelligent medical assistance.

The CNN model successfully classified brain MRI scans into tumor and non-tumor categories with high accuracy, demonstrating robustness across varied image resolutions and patient datasets.

The GPT-based NLP module was able to interpret CNN outputs, provide patient-friendly summaries, and respond to clinician queries in real-time, thereby reducing the time spent on manual report generation.

Integration of role-specific dashboards allowed patients to track reports, doctors to review diagnostic outcomes, and administrators to oversee system usage and analytics.

The platform's notification system improved appointment adherence and patient engagement, while the centralized data storage ensured secure and quick retrieval of historical patient records.

Testing in simulated hospital workflows indicated that the system could reduce MRI reporting time by up to 40%, enhance patient–doctor communication, and improve accessibility for telemedicine consultations.

Overall, NeuroAssist demonstrated the feasibility and efficiency of combining medical image analysis with natural language–driven clinical assistance in a unified healthcare framework.

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VII. RESULT AND DISCUSSION

The NeuroAssist platform was tested using a combination of publicly available brain MRI datasets and simulated clinical workflows.

The CNN-based MRI analysis module achieved an average classification accuracy exceeding 94% for tumor type differentiation, with strong performance in detecting glioma, meningioma, and pituitary tumors. Sensitivity and specificity scores remained consistently above 90% under controlled testing conditions.

The GPT-based NLP clinical assistant effectively translated CNN outputs into comprehensible diagnostic summaries for patients and actionable recommendations for healthcare providers. User evaluation sessions with medical students and practicing doctors indicated that the generated explanations were clear, contextually relevant, and reduced the need for extensive manual documentation.

Response time for combined CNN + GPT processing averaged under 4 seconds per query, enabling near-real-time interaction. The platform's multi-role dashboards proved effective in separating access privileges and delivering tailored interfaces for patients, doctors, and administrators. However, performance degradation was observed when MRI scans were heavily distorted or when uploaded files deviated from expected clinical imaging formats.

Despite these limitations, the integrated approach demonstrated clear advantages over standalone AI imaging tools or text-based assistants. The combination of visual analysis and natural language reasoning provided a richer, more interactive diagnostic environment suitable for both in-hospital and telemedicine applications.

VIII. CONCLUSION

The development of NeuroAssist: CNN-Based Brain Tumor Analysis and GPT-Driven Clinical Decision Support illustrates the potential of integrating medical image processing with advanced natural language processing in a unified healthcare platform. By combining a CNN-based MRI analysis pipeline with GPT-powered clinical assistance, the system enables accurate tumor classification while simultaneously providing user-friendly diagnostic summaries and decision support.

The platform's modular architecture, role-specific dashboards, and real-time communication tools make it adaptable for both hospital-based and remote telemedicine environments. Testing confirmed its capability to reduce reporting time, enhance doctor–patient interaction, and improve overall workflow efficiency.

Although challenges remain in handling low-quality imaging and providing context-rich treatment suggestions, NeuroAssist establishes a foundation for future healthcare AI systems that merge multimodal data processing with intelligent human–computer interaction. With continued refinement and clinical validation, this framework could significantly contribute to improving early detection, treatment planning, and patient engagement in neurological care.

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