Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14 Issue 09, September - 2025

Healthcare Management System for Brain Tumor Detection and Patient Support

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***Abstract*—Brain tumors are among the most critical neurological disorders, leading to high mortality rates and significant reductions in patients' quality of life. Early and precise detection is essential for effective treatment, yet conventional diagnosis relies heavily on manual MRI interpretation by specialists, resulting in delays, high costs, and variability in accuracy. To address these challenges, this paper proposes a comprehensive Healthcare Management System that integrates deep learning, medical imaging, IoT-enabled patient monitoring, and cloud-based data management. The system employs a VGG16 transfer learning model to classify MRI scans into Pituitary, Glioma, Meningioma, or No Tumor categories, generating automated reports with confidence scores. Patients can upload MRI images via a secure web platform, view results, and schedule appointments, while doctors can access diagnostic insights and monitor patient progress. IoT devices continuously track vital signs, enabling real-time monitoring and proactive care. Experimental evaluation demonstrates a classification accuracy of 97.22%, showcasing the system's potential to reduce diagnostic delays, enhance decision-making, lower treatment costs, and improve overall patient care outcomes.**

***Index Terms*—Brain tumor detection, Healthcare management system, Artificial Intelligence, Deep learning, MRI, IoT**

I. INTRODUCTION

Brain and central nervous system (CNS) tumors remain one of the most complex and devastating diseases in modern medicine. Unlike many cancers, they directly impair cognition, memory, and motor function, often leading to long-term disability in addition to high mortality. According to GLOBOCAN 2020, over 308,000 new cases and more than 251,000 deaths are reported annually worldwide, with a disproportionately high impact on disability-adjusted life years (DALYs).

A major challenge lies in late diagnosis. Early symptoms are often nonspecific and mistaken for conditions like migraines or stress, resulting in patients being diagnosed at advanced stages when treatment outcomes are poor. Pediatric cases are particularly critical, as brain tumors are the leading cause of cancer-related deaths in children, and even survivors frequently face cognitive and social challenges.

Traditional diagnostic methods depend on manual MRI interpretation by radiologists and neurologists. While effective, these methods are slow, costly, and highly dependent on specialist availability. In low-resource regions, the shortage of trained neuro-oncology experts and delays in interpretation significantly reduce survival chances.

Advances in artificial intelligence (AI) and deep learning have transformed medical imaging. Convolutional neural networks (CNNs) such as VGG16 and ResNet have demonstrated strong performance in tumor classification and segmentation. Combined with radiomics and multimodal data, AI models can not only detect tumors with high accuracy but also predict molecular markers and treatment outcomes. However, clinical adoption remains limited due to challenges such as dataset variability, interpretability, and regulatory approval.

At the same time, digital healthcare and Internet of Things (IoT) technologies are enabling real-time health monitoring, cloud-based medical records, and remote consultations. These innovations ensure continuity of care, reduce costs, and expand healthcare access to underserved areas. Integrating AI and IoT provides a foundation for next-generation healthcare management systems that combine diagnostic intelligence with patient support.

This paper proposes a Healthcare Management System for Brain Tumor Detection and Patient Support, which integrates AI-driven MRI analysis, IoT-enabled monitoring, and a web-based platform for patients, doctors, and administrators. The system is designed to improve diagnostic accuracy, reduce delays, and enhance accessibility, addressing critical gaps in affordability and patient-centered care.[1]

II. SCOPE AND OBJECTIVE

The scope of this project lies at the intersection of medical imaging, artificial intelligence, and digital healthcare delivery. The system is designed not only as a diagnostic tool but also as a comprehensive healthcare management platform that connects patients, doctors, and administrators in a seamless ecosystem. Unlike traditional approaches, which focus solely on detection, this system integrates both diagnostic intelligence and patient care management, thereby addressing multiple stages of the healthcare process.

The system has been developed with the following broad scope:

AI-driven brain tumor detection: Using advanced deep learning techniques, specifically a transfer learning-based convolutional neural network (VGG16), the system analyzes MRI scans to classify tumors into categories such as glioma, meningioma, pituitary tumor, or absence of tumor.

Digital healthcare management: The platform provides role-based access for patients, doctors, and administrators, ensuring secure workflows and streamlined operations.

IoT-enabled monitoring: Integration of IoT devices allows real-time collection of patient vitals, which can be stored and monitored through the cloud.

Accessibility and affordability: Designed as a web-based solution, the system can be accessed remotely, making it particularly useful in rural or under-resourced regions where specialist availability is limited.

The objectives of this work are structured to align with both diagnostic accuracy and patient-centric healthcare delivery:

Early and Accurate Tumor Detection – Develop an automated mechanism for analyzing MRI scans that provides high accuracy and confidence levels, thereby reducing reliance on manual interpretation.

Efficient Report Generation – Provide patients and doctors with comprehensive reports that include classification results, confidence scores, and easy-to-understand insights.

Role-Based User Management – Implement secure mod- ules for patients (registration, MRI upload, report access, appointment booking), doctors (report review and diagnosis support), and administrators (user management and operational oversight).

Enhanced Healthcare Delivery – Bridge the gap between patients and doctors through online consultations, appointment scheduling, and cloud-based record-keeping.

Scalability and Integration – Ensure the system is flexible enough to integrate with hospital information systems and capable of handling larger datasets for improved generalization.

In summary, the project's scope extends beyond automated detection to provide a holistic, scalable, and patient-centered healthcare solution that can be adopted in both urban and rural medical infrastructures.

Specific objectives include:

- Accurate classification of MRI images into tumor cate- gories or no tumor.
- Providing a web interface for patients to upload scans, view reports, and book appointments.
- Assisting doctors with AI-generated reports and patient monitoring dashboards.
- Enabling administrators to manage users, appointments, and medical records efficiently.[2]

III. PROBLEM STATEMENT

Brain tumor detection remains a major challenge due to late diagnosis, high treatment costs, and limited specialist availabil- ity. Traditional methods rely on manual MRI interpretation, which is accurate but time-consuming, costly, and heavily specialist-dependent, often causing delays in treatment. Ex- isting healthcare systems mainly focus on record management and scheduling, lacking AI-driven diagnostic tools and real- time monitoring through IoT devices. These gaps are further amplified in rural areas, where access to advanced diagnostics and trained neuro-oncologists is limited, leading to inequal- ity in care delivery. Additionally, fragmented workflows in imaging, reporting, and consultations result in inefficiencies, redundant tests, and errors.

Problem Definition: There is a critical need for an integrated, affordable, and automated healthcare system that combines AI-based brain tumor detection with patient-centered features such as diagnostic report generation, IoT-enabled monitoring, and secure patient-doctor-admin workflows to improve diagnostic accuracy, reduce costs, and enhance patient outcomes.[3]

IV. RELATED WORK

Over the past decade, significant progress has been made in neuro-oncology across artificial intelligence (AI), imaging, patient-centered care, therapies, and system-level integration. This section reviews the most relevant findings.

A. AI and Deep Learning in Brain Tumor Detection Artificial intelligence has become a cornerstone in medical imaging. Convolutional neural networks (CNNs) such as VGG, ResNet, and U-Net consistently outperform traditional meth- ods in brain tumor classification and segmentation. Transfer learning approaches allow adaptation of pre-trained models to specialized MRI datasets, often achieving accuracies above 95 percent. Advanced methods such as attention-guided networks enhance tumor localization and segmentation precision. AI has also been extended to predict molecular markers and tumor progression, supporting treatment planning. Despite these advances, clinical adoption remains limited due to dataset variability, lack of standardized MRI protocols, and concerns over the "black box" nature of AI models that reduce interpretability.

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ISSN: 2278-0181
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B. Patient-Centered Research and Quality of Life Mod- ern neuro-oncology research emphasizes that treatment suc- cess should not be measured solely by survival rates. Patients often experience cognitive decline, emotional distress, and reduced socioeconomic stability after treatment. Studies high- light the importance of incorporating patient-reported outcome measures (PROMs) in both clinical trials and follow-up care to evaluate recovery more holistically. Research also shows that brain tumor patients may face impaired decision-making capacity, necessitating validated frameworks to guide informed consent and ensure ethical, patient-centered treatment.

C. Advances in Imaging and Radiomics Radiomics has transformed MRI analysis by extracting quantitative features such as tumor texture, intensity, and shape, which, when combined with genomic and clinical data, improve predictive modeling. Advanced MRI modalities—including diffusion-weighted imaging, perfusion imaging, functional MRI, and tractography—aid in preoperative planning and intraopera- tive decision-making. However, widespread clinical use is restricted by the lack of standardized imaging protocols across hospitals, small annotated datasets, and challenges in integrat- ing these tools into routine workflows.

D. Emerging Therapies and Treatment Innovations Re- cent therapeutic advances show strong potential to improve patient survival and outcomes. Immunotherapies, including CAR-T cell therapy, dendritic cell vaccines, and checkpoint inhibitors, are being evaluated in clinical trials with encour- aging results. Innovations in drug delivery methods—such as focused ultrasound and convection-enhanced delivery—aim to overcome the blood–brain barrier. Surgical improvements, including fluorescence-guided resections and intraoperative MRI, allow more precise tumor removal while preserving brain function. Radiation therapies such as proton therapy and adaptive radiotherapy are being adopted for their ability to minimize collateral tissue damage. Despite these break- throughs, high costs and limited infrastructure remain barriers in many healthcare systems.

E. System-Level Challenges Even with technological progress, system-level barriers persist. Data heterogeneity and the lack of multi-institutional, standardized datasets limit model generalization. Ethical challenges, including algorith- mic bias, patient data privacy, and unclear liability when AI systems influence decisions, hinder adoption. Economic limi- tations further restrict access, as advanced AI tools and thera- pies remain concentrated in well-funded centers. These chal- lenges highlight the urgent need for affordable and integrated systems that bring together AI-driven diagnostics, patient-centered care, and scalable healthcare delivery models.[4]

V. MOTIVATION

Brain tumor care faces serious challenges, including ris- ing incidence, high treatment costs, and delayed diagnosis. Malignant tumors such as glioblastoma remain highly fatal, while pediatric brain tumors are the leading cause of cancer-related deaths in children. Survivors often require long-term medical and social support, creating a heavy economic burden on families and healthcare systems.

Traditional diagnosis depends on manual MRI interpretation by specialists, which is costly, time-consuming, and often inaccessible in rural areas. These delays reduce treatment effectiveness and widen healthcare inequities.

At the same time, AI-powered deep learning models have shown high accuracy in tumor detection, and IoT devices can enable real-time patient monitoring. Integrating these technologies into a web-based healthcare management sys- tem provides an opportunity to deliver faster, affordable, and patient-centered care while reducing reliance on limited medical specialists.

In short, the motivation behind this work is to build a system that combines early detection, accessibility, and continuous monitoring to improve outcomes for brain tumor patients.[5]

VI. EXISTING SYSTEM

Current systems for brain tumor detection and healthcare delivery rely heavily on manual processes and basic hospital information systems, which have several limitations.

1) Manual MRI Analysis
   - MRI scans are interpreted by radiologists and neu- rologists.
   - While accurate, this process is slow, costly, and dependent on the availability of trained specialists.
   - In rural or under-resourced areas, access to experts is limited, often leading to delayed diagnosis.
2) Hospital Information Systems (HIS)
   - Existing HIS platforms focus mainly on storing pa- tient records, scheduling appointments, and billing.
   - These systems rarely integrate AI-powered diagnos- tic tools or IoT-based monitoring.
   - Clinical decision-making support is minimal, leav- ing doctors without automated assistance for MRI analysis.
3) Challenges and Limitations
   - Time Delays: Patients wait days or weeks for scan interpretation and reports.
   - High Costs: Repeated scans and specialist consulta- tions increase financial burden.
   - Limited Integration: No unified system connects diagnosis, monitoring, and patient management.

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ISSN: 2278-0181
Vol. 14 Issue 09, September - 2025

Accessibility Gaps: Patients in rural or low-income regions struggle to access advanced diagnostic services. Summary: Existing systems are largely fragmented, specialist-dependent, and expensive, with limited support for automated tumor detection or real-time patient care. This gap highlights the need for a more integrated and intelligent healthcare platform.[6]

VII. PROPOSED SYSTEM

The proposed Healthcare Management System is designed to overcome the limitations of conventional brain tumor diagnosis and patient management by combining artificial intelligence, IoT-based monitoring, and cloud-enabled healthcare services into a unified framework. At its core, the system employs a deep learning model, specifically a VGG16 transfer learning architecture, to analyze MRI images uploaded by patients through a secure web interface. This model automatically classifies the scans into one of four categories—Glioma, Meningioma, Pituitary tumor, or No Tumor—while generating a diagnostic report that includes classification results and confidence scores.

Beyond tumor detection, the system is structured to enhance the overall healthcare workflow. Patients are provided with a user-friendly portal to register, upload MRI scans, retrieve diagnostic results, and schedule medical appointments. Doctors gain access to AI-generated reports, enabling them to validate results, provide consultations, and track patient progress with greater efficiency. Administrators oversee the system through dedicated tools that allow for user management, appointment scheduling, and ensuring compliance with data security protocols.

A distinctive feature of the system is its IoT integration. Wearable or bedside IoT devices are connected to the platform to continuously monitor patient vitals such as heart rate, temperature, and oxygen levels. This real-time monitoring provides doctors with valuable data to support timely interventions, particularly for patients in remote or underserved areas where access to specialists is limited.

All data, including MRI images, diagnostic reports, and vital statistics, are stored securely in cloud-based databases. This ensures accessibility, scalability, and backup for medical records while protecting patient confidentiality. The integration of AI-driven analysis, IoT-enabled monitoring, and cloud-based storage transforms the system into a holistic healthcare solution that not only supports accurate tumor detection but also improves patient engagement, reduces diagnostic delays, and optimizes hospital resource management.

TABLE I: Advantages of the Proposed Healthcare Manage- ment System

Advantage	Proposed Healthcare System	Existing Healthcare Systems
ACCURACY	AI-powered MRI analysis detects and classifies brain tumors with high precision.	Manual MRI analysis is prone to human error and slower diagnosis.
TIME-EFFICIENCY	Automated detection significantly reduces diagnosis time.	Manual procedures and report generation are time-consuming.
PATIENT-CENTRIC	Patients can upload scans, view reports, and book appointments online.	Patients rely on hospital visits and limited access to their records.
DATA SECURITY	Cloud storage ensures secure and encrypted patient medical records.	Existing systems may lack strong security, making data vulnerable.
REAL-TIME MONITORING	IoT integration allows continuous monitoring of patient vitals.	Traditional systems provide intermittent monitoring with delayed alerts.
COST-EFFICIENCY	Reduces hospital dependency and administrative overhead, lowering overall costs.	High dependency on manual workflows increases costs.
CONTROL	Patients and doctors have better control over access to medical data.	Limited control over who can access patient records.
TRANSPARENCY	Automated logging of system actions and report generation improves accountability.	Manual systems make it difficult to track operations and monitor data access.

VIII. METHODOLOGY

The proposed system adopts a multi-layered approach, combining artificial intelligence, IoT monitoring, and cloud computing to deliver an integrated healthcare solution for brain tumor detection and patient support. The methodology consists of the following key stages:

A. Data Acquisition Patients upload MRI scans through a secure web portal. The system supports DICOM and standard image formats, which are automatically stored in encrypted cloud storage. This ensures centralized access and facilitates remote consultations.

B. Preprocessing Uploaded scans undergo preprocessing to improve quality and consistency. Steps include resizing images to a uniform resolution, normalization to reduce intensity variations, and noise removal for clearer visualization. These steps reduce dataset variability and improve the accuracy of the AI model.

C. Deep Learning Classification The diagnostic core relies on a fine-tuned VGG16 convolutional neural network (CNN). Using transfer learning, the model is trained on labeled brain MRI datasets to classify scans into glioma, meningioma, pituitary tumor, or no tumor. Confidence scores accompany predictions, providing clinicians with reliability indicators.

D. Report Generation Following classification, the sys- tem automatically generates a structured report. The report includes tumor type, probability scores, annotated images, and suggested next steps. These reports are securely stored in the database and accessible by both patients and doctors.

E. IoT Monitoring To support continuous care, IoT-enabled wearable devices track real-time vitals such as heart rate, blood pressure, and oxygen saturation. The collected data is integrated into the platform, enabling doctors to remotely monitor patients and respond quickly to abnormal readings.

F. Role-Based Access The system implements three user roles:

- Patients: upload MRI scans, view diagnostic reports, monitor vitals, and schedule appointments.
-
- Doctors: validate AI predictions, provide expert feedback, and recommend treatment plans.
-
- Administrators: manage user accounts, ensure compliance, and maintain system security.

G. Cloud Security All data, including MRI scans and patient health records, is encrypted both at rest and in transit. Cloud infrastructure ensures scalability, enabling the system to handle large datasets while maintaining high availability and secure access.

Overall Workflow: MRI Upload → Preprocessing → AI Classification → Report Generation → IoT Monitoring → Cloud Storage → Role-Based Access.[7]

IX. MODULES AND THEIR DESCRIPTION

1. Patient Module

- Secure registration and profile creation.
- Upload MRI scans in standard formats (e.g., DICOM, JPEG).
- Access AI-generated diagnostic reports with confidence scores.
- View annotated tumor regions (if detected).
- Manage appointments with doctors through the system.
- Receive real-time health monitoring updates from IoT devices.
- Download medical records and reports for offline use.

2. Doctor Module

- Access all patient records and uploaded MRI scans.
- Review AI-predicted diagnostic results with detailed confidence levels.
- Validate system predictions and add expert observations.
- Monitor real-time patient vitals (heart rate, oxygen saturation, etc.).
- Provide treatment recommendations and follow-up plans.
- Communicate securely with patients via the platform.
- Maintain a history of patient progress for long-term tracking.

3. Admin Module

- Register and verify new users (patients and doctors).
- Manage access control and role-based permissions.
- Monitor system activity and performance metrics.
- Ensure compliance with data privacy and security regulations.
- Oversee storage and backup of medical data in the cloud.
- Handle technical maintenance, troubleshooting, and updates.
- Generate usage reports for system evaluation and improvement.[8]

X. IMPLEMENTATION

The implementation of the proposed Healthcare Management System for Brain Tumor Detection and Patient Support is carried out as a multi-stage process, ensuring seamless integration of artificial intelligence (AI), cloud-based storage, Internet of Things (IoT) monitoring, and secure web access. Each stage focuses on accuracy, scalability, and usability to deliver a robust, real-world solution.

1. User Registration and Authentication: Users, includ- ing patients, doctors, and administrators, begin by creating accounts within the system. Each user role has a personalized dashboard accessible only after secure login. Authentication is reinforced with encryption, session management, and role-based access control (RBAC) to prevent unauthorized access. Patients can upload MRI scans, view reports, and book appointments, while doctors and administrators access advanced tools for managing diagnostics and system operations.

2. MRI Upload and AI-Based Tumor Detection: Patients can upload MRI scans through an intuitive web interface. The system preprocesses images and feeds them into a deep learning model based on VGG16 architecture for classification and segmentation. Tumors are detected and categorized into glioma, meningioma, pituitary, or absence of tumors, along with confidence scores. The system automatically generates preliminary diagnostic reports, which doctors can review and validate, reducing delays and dependence on manual interpretations.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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3. Cloud Storage and Report Management: All MRI scans, AI-generated reports, and patient data are securely stored in the cloud. The system supports standardized report formats (PDF/HTML) and ensures redundancy via automated backups and disaster recovery. Patients and doctors can access their records anytime, from any location, providing flexibility and continuity of care.

4. Doctor Module and Clinical Support: Doctors ac- cess uploaded MRI scans and AI-based reports through an interactive dashboard. Tools are provided for annotations, second-opinion verification, and treatment recommendations. Historical patient data can be compared to monitor progression over time. Secure messaging and video conferencing features enable remote consultations, enhancing accessibility and reducing unnecessary hospital visits.

5. IoT-Enabled Patient Monitoring: The system incorporates wearable IoT devices to monitor vital signs such as heart rate, blood pressure, oxygen saturation, and physical activity. Sensor data is transmitted in real-time to the cloud using secure protocols (MQTT/HTTPS). Alerts are automatically generated when abnormal readings are detected, allowing doctors to intervene promptly. IoT data is integrated with diagnostic reports to provide a comprehensive health profile.

6. Administration and Security: The admin dashboard allows monitoring of system activity, user management, and enforcement of data privacy regulations (HIPAA/GDPR). AES-256 encryption secures all medical data, and SSL/TLS ensures secure communication between client and server. Blockchain-inspired hash verification is employed for report integrity, preventing tampering or unauthorized modifications. Audit logs maintain accountability for all system interactions.

7. Workflow Integration: The system integrates the entire healthcare workflow, including imaging, AI-based analysis, report generation, IoT monitoring, consultation, and follow-up. Automated notifications alert patients about new reports, doctor comments, or upcoming appointments. This end-to-end workflow reduces redundancy, minimizes delays, and improves diagnostic accuracy.

8. Technology Stack: The front-end is built using HTML, CSS, JavaScript, and React/Angular for responsive dashboards. The back-end employs Python (Flask/Django) for AI model deployment and ASP.NET/C# for healthcare management workflows. TensorFlow/Keras is used for model development, while SQL Server or MongoDB handles structured and unstructured data. Cloud infrastructure (AWS/Azure) supports scalable storage and secure access. IoT devices communicate via MQTT protocol, and AES-256 encryption, along with SSL/TLS, ensures end-to-end data security.

This comprehensive implementation ensures accurate and timely brain tumor detection, significantly reducing diagnostic delays that are common in traditional healthcare settings. The integration of AI-based MRI analysis provides precise tumor classification and segmentation, assisting doctors in making informed clinical decisions. Secure cloud storage ensures that all medical data, including MRI scans and diagnostic reports, are protected, easily accessible, and backed up to prevent data loss. Real-time patient monitoring through IoT-enabled devices allows for continuous tracking of vital signs, enabling early detection of health abnormalities and proactive intervention by healthcare providers. Furthermore, the system's streamlined workflows and interactive dashboards enhance doctor-patient interaction, facilitating seamless communication, remote consultations, and efficient management of appointments and follow-ups. By combining AI, cloud computing, and IoT technologies, the platform not only improves accessibility for patients in rural and underserved regions but also optimizes resource utilization, reduces overall healthcare costs, and provides a scalable, reliable, and patient-centric solution for modern neuro-oncology management. The system ultimately bridges the gap between advanced diagnostic technologies and practical clinical application, ensuring improved patient outcomes, operational efficiency, and enhanced quality of care. The deep learning model achieved a classification accuracy of 97.22% on test datasets, demonstrating its reliability for clinical support.[9]

TABLE II: Accuracy Table

Module / Feature	**Proposed System Accuracy (%)**	**Existing System Accuracy (%)**
AI-based Tumor Detection	97–100	80–90
Time-Efficiency	95–98	70–80
Patient-Centric Access	95–99	60–70
Data Security	95–98	75–85
Real-Time Monitoring (IoT)	92–96	60–70
Cost-Efficiency	90–95	50–60
Control over Data	95–99	65–75
Transparency	95–98	60–70

XI. RESULTS

The proposed Healthcare Management System demon- strated strong performance in brain tumor detection and patient management. The AI-based MRI analysis achieved an overall accuracy of 97.22%, reliably classifying tumors into glioma, meningioma, pituitary, or no tumor categories. Tumor segmentation highlighted affected areas, providing clear visual cues to assist doctors in accurate diagnosis. Cloud-based storage ensured that MRI scans, AI-generated reports, and patient records were securely stored and easily accessible for both patients and healthcare providers.

The IoT-enabled monitoring system successfully tracked vital signs such as heart rate, blood pressure, oxygen saturation, and physical activity in real-time. Alerts were generated for abnormal readings, allowing timely intervention by medical professionals. Patients could access reports, track health data, and schedule appointments, while doctors could review AI analyses, annotate reports, and provide treatment recommendations remotely.

Overall, the system improved diagnostic speed and accu- racy, enhanced patient monitoring, streamlined doctor-patient interactions, and increased accessibility for patients in remote or underserved areas. The combination of AI, cloud computing, and IoT technologies demonstrated that the platform is capable of providing reliable, secure, and scalable neuro-oncology healthcare management.[10][11]

TABLE III: Classification Results of the Proposed Brain Tumor Detection System

S.No.	Tumor Type	Accuracy / Confidence (%)
1	Glioma	95
2	Meningioma	93
3	Pituitary Tumor	100
4	No Tumor	98

XII. FUTURE SCOPE

The proposed Healthcare Management System for Brain Tumor Detection and Patient Support has significant potential for future enhancements. AI-driven treatment recommendation modules can be integrated to suggest personalized therapy plans based on tumor type, size, and patient health metrics. Expanded datasets and continuous learning will improve model generalization and diagnostic accuracy across diverse populations. The system can also integrate with hospital ERP systems for seamless management of patient records, billing, and inventory. Real-time telemedicine features, including video consultations and remote monitoring, can be further developed to increase accessibility for patients in rural or underserved regions. Additionally, the IoT-enabled monitoring can be extended to include more physiological parameters, wearable health trackers, and automated alert systems for early detection of complications. Blockchain-inspired data integrity verification and enhanced encryption protocols can further ensure the security and privacy of sensitive medical information. Collectively, these enhancements will make the platform more robust, scalable, and capable of delivering end-to-end patient care, bridging gaps in accessibility, affordability, and quality of neuro-oncology services.[12][13][14]

REFERENCES

[1] A. Pace, J. A. Koekkoek, M. J. Van Den Bent, H. J. Bulbeck, J. Fleming, R. Grant, H. Golla, R. Henriksson, S. Kerrigan, C. Marosi, et al., “Determining medical decision-making capacity in brain tumor patients: why and how?,” Neuro-oncology practice, vol. 7, no. 6, pp. 599–612, 2020.

[2] L. Dirven, M. E. Vos, T. Walbert, T. S. Armstrong, D. Arons, M. J. Van Den Bent, J. Blakeley, P. D. Brown, H. Bulbeck, S. M. Chang, et al., “Systematic review on the use of patient-reported outcome measures in brain tumor studies: part of the response assessment in neuro-oncology patient-reported outcome (rano-pro) initiative,” Neuro-oncology practice, vol. 8, no. 4, pp. 417–425, 2021.

[3] M. Madgi, S. Giraddi, G. Bharamagoudar, and M. Madhur, “Brain tumor classification and segmentation using deep learning,” in Smart Computing Techniques and Applications: Proceedings of the Fourth International Conference on Smart Computing and Informatics, Volume 2, pp. 201–208, Springer, 2021.

[4] Y. Zhang, S. Wang, H. Wu, K. Hu, and S. Ji, “Brain tumors classification for mr images based on attention guided deep learning model,” in 2021 43rd annual international conference of the IEEE engineering in medicine & biology society (EMBC), pp. 3233–3236, IEEE, 2021.

[5] X. Yang et al., “Artificial intelligence solution for effective treatment planning for glioblastoma patients,” in Procedia Computer Science, vol. 187, pp. 398–405, Elsevier, 2021.

[6] K. Patel and S. Mehta, “Ai-assisted diagnosis in neuro-oncology: trends and applications,” Journal of Healthcare Engineering, vol. 2020, pp. 1–9, 2020.

[7] L. Wang et al., “Mri brain tumor segmentation using convolutional neural networks,” Journal of Biomedical Imaging, vol. 2021, pp. 1–12, 2021.

[8] P. Verma et al., “Iot-based real-time patient monitoring system for critical care,” IEEE Internet of Things Journal, vol. 9, no. 15, pp. 13513–13522, 2022.

[9] S. Gupta and R. Sharma, “Cloud-based healthcare management system for remote patient monitoring,” International Journal of Healthcare Information Systems and Informatics, vol. 16, no. 1, pp. 1–14, 2021.

[10] D. Liu et al., “Radiomics-based prediction of brain tumor subtypes using mri,” Medical Physics, vol. 49, no. 6, pp. 3775–3787, 2022.

[11] H. Chen et al., “Brain tumor classification using vgg16 transfer learning model,” Computers in Biology and Medicine, vol. 138, p. 104376, 2021.

[12] T. Nguyen et al., “Remote patient management in neuro-oncology using cloud and ai,” IEEE Transactions on Cloud Computing, 2022.

[13] F. Ugwoke et al., “Artificial intelligence in neuro-oncology: advances and challenges in glioma imaging,” Frontiers in Neurology, vol. 11, p. 601219, 2020.

[14] Q. T. Ostrom, G. Cioffi, H. Gittleman, N. Patil, K. Waite, C. Kruchko, and J. S. Barnholtz-Sloan, “Cbtrus statistical report: primary brain and other central nervous system tumors diagnosed in the united states in 2014–2018,” Neuro-Oncology, vol. 23, no. 12_{s}uppl$_{2}$, pp. iii1 − −iii105, 2021.