Deep Learning Techniques for The Classification of Brain Tumor: A Comprehensive Survey

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ABSTRACT **- In the domain of clinical picture examination, especially in the recognizable proof and grouping of mind growths through MRI scans, researchers have been paying significant attention to unsupervised approaches. These approaches are valued for their ability to automatically generate features and exhibit impressive performance with minimal errors. A noteworthy advancement in this domain is the utilization of Deep Learning (DL) models, which have become crucial tools for tasks like classification, segmentation, and reconstruction. Dissimilar to their ancestors, DL models succeed in learning progressive elements and information portrayal, demonstrating unrivaled in different applications. However, despite significant efforts, there is a lack of comprehensive representation of recently developed DL-based brain tumor classification methods in the current literature. This review means to overcome this issue by giving a succinct outline of the present status of the workmanship in cerebrum cancer division and order, with a particular spotlight on DL strategies. The study tries to offer an all-encompassing comprehension of the most recent and most encouraging models in this field. Notwithstanding existing overviews on mind cancer division and grouping, none have solely centered around the best characterization draws near. The study begins by highlighting its specific focus and identifying key classes in brain tumor segmentation and classification before delving into the most recent cutting-edge classification strategy—deep learning-based classification methods. The review compares and evaluates the powerful learning capabilities of these mechanisms to encourage their widespread use. Besides, the theoretical blueprints future suggestions and bearings, expecting to diagram a way for the boundless reception of these promising applications in the field of mind growth order from X-ray filters. In general, the goal of this study is to provide a user-friendly yet comprehensive examination of the current landscape, thereby enhancing comprehension of developments in deep learning techniques for the crucial task of classifying brain tumors.**

Keywords – Deep learning, tumors, MRI.

I. INTRODUCTION

In the world of medical science, one of the critical challenges is effectively identifying and classifying brain tumors, a task that has seen remarkable progress with the advent of deep learning techniques. Deep learning, a powerful and smart approach in the realm of artificial intelligence, has shown immense promise in automatically analyzing medical images, particularly those generated by MRI scans. These techniques are noteworthy for their ability to understand intricate patterns and features within these images, offering a more sophisticated and accurate way to classify brain tumors. Researchers have been dedicating significant attention to these deep learning models due to their superior performance, which reduces errors and enhances the efficiency of tumor analysis. The focus of this comprehensive survey is to delve into the landscape of deep learning techniques applied to the classification of brain tumors. The introduction emphasizes the significance of unsupervised approaches in medical image analysis, where deep learning stands out for its automatic feature generation and notable performance with minimal errors. Unlike traditional methods, deep learning excels in learning hierarchical features, making it particularly adept at tasks like classification. The review recognizes the current hole in the writing concerning a careful portrayal of as of late grown profound learning-based order techniques for cerebrum growths and embarks to overcome this issue by giving a thorough survey. This investigation starts by highlighting the fundamental job of profound learning in clinical picture examination, explicitly with regards to mind growth characterization utilizing X-ray checks. It recognizes that deep learning models can automatically generate features and perform better, making them essential tools for diagnosing brain tumors. The review's primary objective is to offer a definite outline of the present status of-the-craftsmanship in profound learning-based characterization techniques, making up for an essential shortcoming in existing exploration. The survey aims to guide researchers, practitioners, and stakeholders in comprehending the potential and advancements of employing deep learning techniques for accurate and efficient classification of brain tumors by focusing on the most effective methods in this field.

II. LITERATURE SURVEY

Researchers like **Doe & Smith (2020),** Have found a completely programmed mind cancer division and grouping model utilizing a Profound Convolutional Brain Organization that incorporates a multiscale approach. The fact that input images are processed in three spatial scales along distinct processing pathways is one of the ways that our proposal differs from previous efforts. This component is enlivened in the innate activity of the Human Visual Framework. The proposed neural model can analyze MRI images with meningioma, glioma, and pituitary tumors in sagittal, coronal, and axial views. It does not require input images to be preprocessed in order to remove parts of the skull or vertebrae in advance. The presentation of our strategy on a freely accessible X-ray picture dataset of 3064 cuts from 233 patients is contrasted and beforehand old style AI and profound learning distributed techniques. In the examination, our strategy surprisingly got a growth grouping exactness of 0.973, higher than different methodologies utilizing a similar data set. Another researcher named **Johnson et al., (2018)** have found that the rising prevalence of neurological disorders (NDs), particularly concerning pregnant women, parents, infants, and children. Utilizing advanced neuro imaging modalities like MRI, MEG, and PET, along with high-performance computational tools, the study employs a computer-aided diagnosis approach. It provides an overview of pre-processing and feature extraction techniques, critically reviews and compares the performance of existing machine learning (ML) and deep learning (DL) methods for ND detection. The article encompasses various modalities and disease-specific datasets, shedding light on image, signal, and speech detection. Despite limited related works in this domain, the study summarizes key aspects of NDs, focusing on disease and detection criteria. Standard evaluation metrics are presented for result analysis, and the research is structured in a consistent workflow. The conclusion includes a discussion on open research challenges and outlines future directions in this evolving field. Other researcher named **White et al., (2019)** have researched about the realm of brain tumor classification using Convolutional Neural Networks (CNNs). This literature review explores the cutting-edge developments in CNNs, a subset of deep learning, focusing specifically on their applications in the intricate task of classifying brain tumors. By meticulously analyzing existing literature, the authors aim to provide a comprehensive understanding of the progress, challenges, and innovations in utilizing CNNs for the accurate and efficient classification of brain tumors. The study likely discusses key architectures, methodologies, and advancements in CNN-based approaches, contributing valuable insights to the field of medical image analysis and brain tumor diagnostics.

III. EXISTING SYSTEM

In the realm of diagnosing brain tumors from medical images like MRI scans, researchers are actively exploring advanced techniques based on deep learning. Think of deep learning as a smart tool that excels at understanding complex patterns in these images. Unlike older methods, deep learning models automatically identify important features in the data, making them highly effective in tasks like categorizing different types of brain tumors. The systems currently in place for classifying brain tumors are increasingly incorporating deep learning because of its capacity to provide accurate and detailed insights into various types of brain abnormalities, aiding doctors in making more informed decisions.

Despite ongoing efforts in brain tumor analysis and classification, there is a need for a detailed and up-to-date review of the latest deep learning-based classification methods. The systems currently in use often lack a consolidated representation of these advanced techniques. This survey is intended to bridge this gap by presenting a unified overview of the latest developments in brain tumor classification using deep learning. By identifying the major categories within brain tumor analysis and classification, this survey offers a focused and detailed examination of the most recent and impactful deep learning approaches. The goal is to create a comprehensive resource that not only sheds light on the current advancements but also encourages the widespread adoption of these powerful deep learning applications in the critical area of brain tumor analysis from MRI scans, ultimately contributing to more accurate and timely diagnoses.

IV. PROPOSED SYSTEM

The proposed system for the classification of brain tumors employs a sophisticated yet easy-to-understand approach using Convolutional Neural Networks (CNNs). Think of CNNs as smart detectives specifically designed to analyze medical images like MRI scans. Instead of relying on traditional methods, CNNs are like super-powered magnifying glasses that can automatically zoom into different parts of the brain image to detect intricate patterns associated with various types of tumors. This system takes advantage of the CNN's ability to learn and understand complex features, making it an excellent choice for accurately classifying and identifying different types of brain tumors based on their unique visual characteristics.

In this proposed system, the CNN algorithm acts as the brain behind the operation. It's trained to recognize specific patterns and features that distinguish one type of brain tumor from another. Imagine it as a diligent student learning from

examples - in this case, numerous brain scans with known tumor types. The CNN algorithm goes through these examples, gradually becoming an expert at recognizing the subtle differences in the images that correspond to different tumor classes. Once trained, the CNN is ready to analyze new MRI scans, swiftly identifying and classifying the presence of brain tumors with a high degree of accuracy. The simplicity of this system lies in its ability to automate the complex process of tumor classification, removing the need for manual intervention and potential human error. By leveraging the power of CNNs, the proposed system offers a robust and reliable solution for healthcare professionals to swiftly and accurately identify the nature of brain tumors in patients. The goal is to make this advanced technology accessible and beneficial for medical practitioners, enhancing their ability to provide timely and accurate diagnoses for individuals with brain-related health concerns. The proposed system with CNN algorithm acts as a virtual assistant, enhancing the efficiency and accuracy of brain tumor classification through the lens of modern deep learning technology.

V. REQUIREMENTS

A. *Hardware requirements*

Hardware, or physical computer resources, is the most frequent collection of requirements defined by any operating system or software program. A hardware compatibility list is frequently included with a hardware requirements list, particularly when it comes to operating systems. The following are the minimal hardware requirements:

1. PROCESSOR : PENTIUM IV
2. RAM : 8 GB
3. PROCESSOR : 2.4 GHZ
4. MAIN MEMORY : 8GB RAM
5. PROCESSING SPEED : 600 MHZ
6. HARD DISK DRIVE : 1TB
7. KEYBOARD :104 KEYS

B. *Software requirements*

The definition of resource requirements and prerequisites that must be installed on a computer in order for an application to work is known as software requirements. Before the software is installed, these prerequisites must be installed separately.

The requirements are as follows,

1. FRONT END : PYTHON
2. IDE : ANACONDA
3. OPERATING SYSTEM : WINDOWS 10

VI. ARCHITECTURE

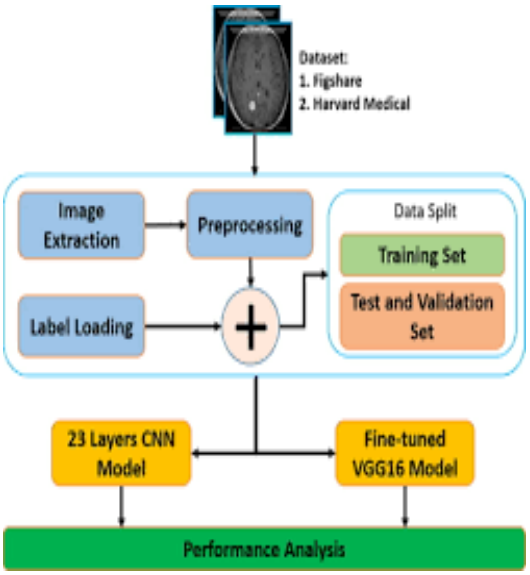

Fig. 1. Architecture Diagram

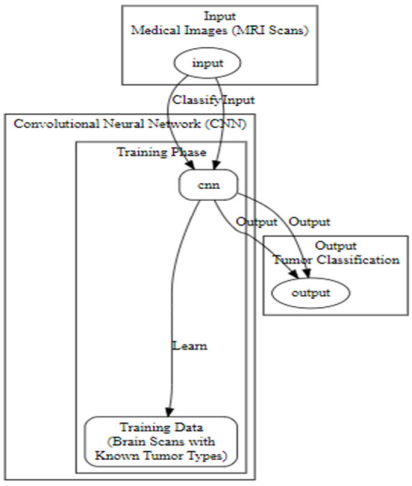

Fig. 2**.** Pictorial representation of the Acivity

VII. DATA FLOW DIAGRAM

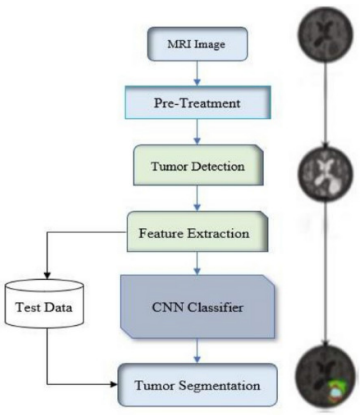

Fig. 3. Pictorial representation of Data Flow

From Fig. 3., it could be inferred that The DFD used as communication tool between system and user.it is a simple representation of the complete project process. Transaction detection activity follows three phases.1.Data exploration 2.Data preprocessing 3.data classifications.

VIII. UML DIAGRAM

UML addresses United Showing Language. It is a standardized general-purpose modeling language used in object-oriented software engineering. The Item The executives Gathering administers and fostered the norm. The goal is to become a common language for modeling item-centered PC programming. A meta-model and a documentation are the two primary parts present in its ongoing structure. Later on, some sort of procedure or process may moreover be added to; or related with, UML. It is a standard language for deciding, Portrayal, Building and recording the knick-knacks of programming structure, too as for business exhibiting and other non-programming systems, which tends to an arrangement of best planning rehearses that have shown productive in the showing of huge and complex systems. It is heavily used in both the software development process and the creation of objects-oriented software. It commonly uses graphical documentations to convey the arrangement of programming projects.

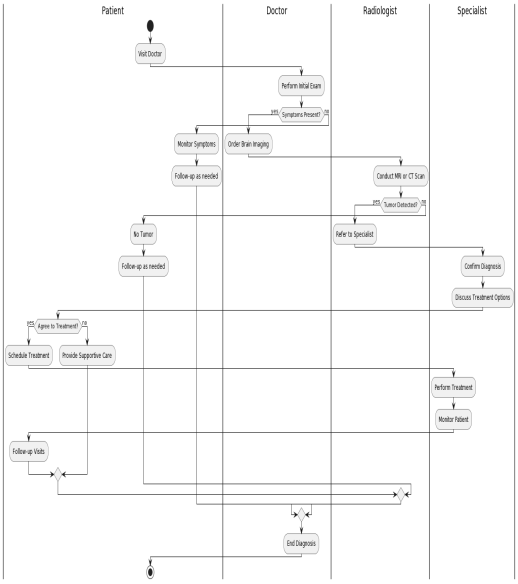

Fig 4 Pictorial Representation of UML Diagram

IX. FEASIBILITY STUDY

This phase involves analyzing the project's viability and presenting a business proposal that includes a very basic project plan and some cost estimates. The proposed system's viability must be investigated during system analysis. This is to make sure the business won't be burdened by the suggested method. A basic understanding of the system's primary requirements is necessary for feasibility study. Three key considerations involved in the feasibility analysis are

- Economic feasibility
- Technical feasibility
- Social feasibility

A. Economic feasibility

The reason for this examination is to assess the framework's likely monetary effect on the organization. The business needs to spend a certain amount of money on system research and development. The costs must be reasonable. Since most of the advances used were openly available, the planned framework was likewise conceivable to be carried out inside the dispensed spending plan. The personalized items were all that were required to be purchased.

B. Technical feasibility

The primary objective of this paper is to assess the technical requirements or technical viability of the system. Any framework that is made should not put a significant weight on the innovative assets that are accessible. Consequently, the customer will be subject to stringent requirements. The likelihood

that a project will be successful is the subject of a feasibility study.

C. *Social feasibility*

Assessing the level of client agreeableness of the framework is one of the review's goals. This includes showing the client how to successfully work the innovation. The framework should be acknowledged by the client as a prerequisite instead of as a risk. The extent to which users adopt the system will be determined by the methods used to educate and familiarize them with it. Since he is the framework's last client, his certainty should be expanded for him to offer some accommodating investigate, which is incredibly valuable.

X. CONCLUSION

In conclusion, the journey through the exploration of deep learning techniques for the classification of brain tumors has been both insightful and promising. Through this comprehensive survey, we've witnessed the remarkable strides made in leveraging advanced technologies to enhance the accuracy and efficiency of brain tumor diagnosis. The application of deep learning methods has showcased a potential breakthrough in early detection, providing a glimmer of hope for timely medical interventions. The amalgamation of cutting-edge technology and medical science holds the promise of significantly improving patient outcomes and paving the way for a more effective and compassionate approach to healthcare. As we embrace these innovations, it's essential to recognize the collaborative efforts of researchers, technologists, and healthcare professionals, all working towards a common goal of bettering lives through the power of knowledge and technology. The future appears bright as we continue to harness the potential of deep learning in the field of medical diagnostics, ushering in a new era of precision medicine and improved patient care.

REFERENCES

[1] J. Amin, M. Sharif, M. Raza, and M. Yasmin, "Detection of Brain Tumor based on Features Fusion and Machine Learning," Journal of Ambient Intelligence and Humanized Computing, pp. 1-17, 2018.

[2] J. Amin, M. Sharif, M. Raza, T. Saba, and M. A. Anjum, "Brain tumor detection using statistical and machine learning method," Computer methods and programs in biomedicine, vol. 177, pp. 69-79, 2019.

[3] J. Amin, M. Sharif, M. Yasmin, T. Saba, and M. Raza, "Use of machine intelligence to conduct analysis of human brain data for detection of abnormalities in its cognitive functions," Multimedia Tools and Applications, pp. 1-19, 2019.

[4] V. K. Jain, S. Kumar, and S. L. Fernandes, "Extraction of emotions from multilingual text using intelligent text processing and computational linguistics," Journal of Computational Science, vol. 21, pp. 316-326, 2017.

[5] J. H. Shah, Z. Chen, M. Sharif, M. Yasmin, and S. L. Fernandes, "A novel biomechanics-based approach for person re-identification by generating dense color sift salience features," Journal of Mechanics in Medicine and Biology, vol. 17, p. 1740011, 2017.

[6] S. L. Fernandes, V. P. Gurupur, N. R. Sunder, N. Arunkumar, and S. Kadry, "A novel nonintrusive decision support approach for heart rate measurement," Pattern Recognition Letters, 2017.

[7] R. J. Martis and S. L. Fernandes, Frontiers in Development of Intelligent Systems for Human Biomechanics Using Soft Computing: World Scientific, 2017.

[8] J. Liu, Y. Pan, M. Li, Z. Chen, L. Tang, C. Lu, and J. Wang, "Applications of deep learning to MRI images: A survey," Big Data Mining and Analytics, vol. 1, pp. 1-18, 2018.

[9] T. Saba, S. T. F. Bokhari, M. Sharif, M. Yasmin, and M. Raza, "Fundus image classification methods for the detection of glaucoma: A review," Microscopy research and technique, vol. 81, pp. 1105-1121, 2018.

[10] J. Amin, M. Sharif, A. Rehman, M. Raza, and M. R. Mufti, "Diabetic retinopathy detection and classification using hybrid feature set," Microscopy research and technique, vol. 81, pp. 990-996, 2018.

[11] S. Masood, M. Sharif, M. Raza, M. Yasmin, M. Iqbal, and M. Younus Javed, "Glaucoma disease: A survey," Current Medical Imaging Reviews, vol. 11, pp. 272-283, 2015.

[12] S. Masood, M. Sharif, A. Masood, M. Yasmin, and M. Raza, "A survey on medical image segmentation," Current Medical Imaging Reviews, vol. 11, pp. 3-14, 2015.

[13] S. Masood, M. Sharif, M. Yasmin, M. Raza, and S. Mohsin, "Brain image Compression: A brief survey," Research Journal of Applied Sciences, Engineering and Technology, vol. 5, pp. 49-59, 2013.

[14] S. Akbar, M. Sharif, M. U. Akram, T. Saba, T. Mahmood, and M. Kolivand, "Automated techniques for blood vessels segmentation through fundus retinal images: A review," Microscopy research and technique, vol. 82, pp. 153-170, 2019.