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# EFFICIENT SEGMENTATION METHODS FOR TUMOUR DETECTION

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***Abstract*—**The human brain is the major controller of the humanoid system. The abnormal growth and division of cells in the brain lead to a brain tumor, and the further growth of brain tumors leads to brain cancer. In the area of human health, Computer Vision plays a significant role, which reduces the human judgment that gives accurate results. CT scans, X-Ray, and MRI scans are the common imaging methods among magnetic resonance imaging (MRI) that are the most reliable and secure. MRI detects every minute objects. Our paper aims to focus on the use of different techniques for the discovery of brain cancer using brain MRI. In this study, we performed pre-processingusing the bilateral filter (BF) for removal of the noises that are present in an MR image. This was followed by the binary thresholding and Convolution Neural Network (CNN) segmentation techniques for reliable detection of the tumor region. Training, testing, and validation datasets are used. Based on our machine, we will predict whether the subject has a brain tumor or not. The resultant outcomes will beexamined through various performance examined metrics that include accuracy, sensitivity, and specificity. It is desired that the proposed work would exhibit a more exceptional performance over its counterparts.
*Keywords*— Brain tumor, Magnetic resonance imaging, Adaptive Bilateral Filter, Convolution Neural Network.

## I. INTRODUCTION:

Medical imaging is the technique and process of creating visual representations of the interior of a body for clinical analysis and medical intervention, as well as visual representation of the function of some organs or tissues. Medical imaging seeks to reveal internal structures hidden by the skin and bones, as well as to diagnose and treat disease. Medical imaging also establishes a database of normal anatomy and physiology to make it possible to identify abnormalities.

The medical imaging processing refers to handling images byusing the computer. This processing includes many types of techniques and operations such as image gaining, storage, presentation, and communication. This process pursues the disorder identification and management. This process creates a data bank of the regular structure and function of the organsto make it easy to recognize the anomalies. This process includes both organic and radiological imaging which used electromagnetic energies (X-rays and gamma), sonography, magnetic, scopes, and thermal and isotope imaging. There aremany other technologies used to record information about thelocation and function of the body. Those techniques have many limitations compared to those modulates which produceimages.

An image processing technique is the usage of a computer to manipulate the digital image. This technique has many benefits such as elasticity, adaptability, data storing, and communication. With the growth of different image resizing techniques, the images can be kept efficiently. Thistechnique has many sets of rules to perform in the images synchronously. The 2D and 3D images can be processed in multiple dimension. he brain tumor is one all the foremost common and, therefore, the deadliest brain diseases that have affected and ruined several lives in the world. The brain tumor is one all the foremost common and, therefore, the deadliest brain diseases that have affected and ruined several lives in the world. Cancer is a disease in the brain in which cancer cells ascends in brain tissues. Conferring to a new study on cancer, more than one lakh people are diagnosed with brain tumors every year around the globe. Regardless of stable efforts to overcome the complications of brain tumors, figures show unpleasing results for tumor patients. To contest this, scholars are working on computer vision for a better understanding of the early stages of tumors and how to overcome using advanced treatment options.

## II. LITERATURE SURVEY:

Based on the provided sources, here is a summary of the keypoints from each study:

1. A. Sivaramakrishnan et al. projected an efficient and innovative discovery of the brain tumor vicinity from an image that turned into finished using the Fuzzy Capproach grouping algorithm and histogram equalization.

2. Sathya et al., provided a different clustering algorithm such as K-means, Improvised K-means, C-means, and improvised C-means algorithms. Their paper presented an experimental analysis for massive dat=asets consisting of unique photographs. They analyzed the discovered consequences using numerous parametric tests.

3. B. Devkota et al have proposed that a computer-aided detection (CAD) approach is used to spot abnormal tissues via Morphological operations. Amongst all different segmentation approaches existing, the morphological opening and closing operations are preferred since it takes less processing time with the utmost efficiency in withdrawing tumor areas with the least faults.

4. K. Sudharani et al. presented a K- nearest neighbor algorithm to the MR images to identify and confine the hysterically full-fledged part within the abnormal tissues. The proposed work is a sluggish methodology but produces exquisite effects. The accuracy relies upon the sample training phase.

5. J.T. Kwok et al. [7] delivered wavelet-based photograph fusion to easily cognizance at the object with all focal lengths as several vision-related processing tasks can be carried out more effortlessly when wholly substances within the images are bright. In their work Kwok et al. investigated with different datasets, and results show that presented work is extra correct as it does not get suffering

## III. EXISTING SYSTEM:

The reliance on traditional diagnostic methods like MRI or CT scans for brain tumor prediction underscores the importance of these imaging techniques in clinical practice. MRI and CT scans are non-invasive imaging modalities that provide detailed anatomical information about the brain, allowing healthcare professionals to visualize abnormalities such as tumors with varying degrees of accuracy.

Magnetic Resonance Imaging (MRI) is widely regarded as the gold standard for brain imaging due to its superior soft tissue contrast and multiplanar imaging capabilities. MRI utilizes powerful magnetic fields and radio frequency pulses to generate detailed images of the brain, highlighting

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differences in tissue composition, vascularity, and pathology. Contrast agents, such as gadolinium-based contrast agents, may be administered intravenously to enhance visualization of tumor margins and vascular structures, aiding in tumor detection and characterization.

Computed Tomography (CT) scans, on the other hand, utilize X-rays to produce cross-sectional images of the brain. CT scans are particularly useful in the acute setting, as they provide rapid imaging with high spatial resolution, making them well-suited for detecting hemorrhage, acute ischemic stroke, or other emergent conditions. While CT scans may lack the soft tissue contrast of MRI, they remain indispensable for initial triage and assessment in patients with suspected intracranial pathology.

The interpretation of imaging studies, whether MRI or CT scans, relies on the expertise of radiologists or medical professionals trained in neuroimaging. These individuals meticulously review imaging findings, assessing for abnormalities suggestive of a brain tumor, including mass effect, enhancement patterns, edema, and othercharacteristic features.

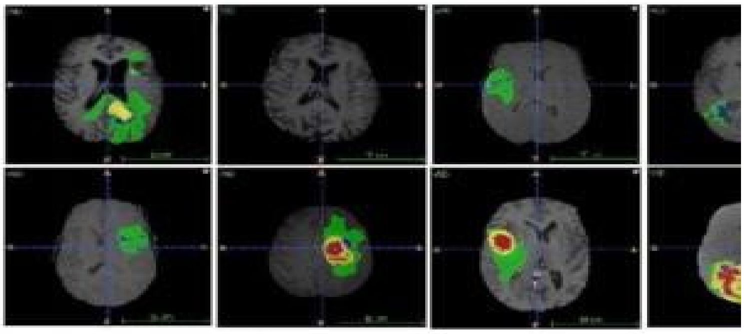

Fig.1 Location of tumors in different images

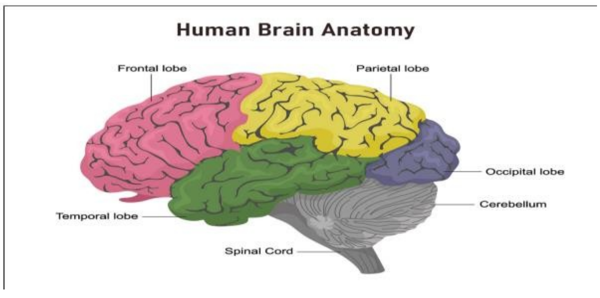


Fig.2 Brain Anatomy

## IV. PROPOSED SYSTEM:

The Proposed systems for brain tumor prediction represent a paradigm shift in healthcare, harnessing cutting-edge technologies to revolutionize the diagnostic process. At the forefront of these innovations are machine learning algorithms, particularly deep learning techniques like convolutional neural networks (CNNs), which have demonstrated remarkable capabilities in image analysis and pattern recognition. Deep learning algorithms, such as CNNs, are uniquely suited for analyzing complex medical imaging data due to their ability to automatically learn hierarchical representations of features directly from raw input data.

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IMAGE PREPROCESSING :

The Brain MRI image dataset has been downloaded from Kaggle. The MRI dataset consists of around 1900 MRI images, including normal, benign, and malignant cases. These MRI images are taken as input to the primary step. Pre-processing is an essential and initial step in improving the quality of the brain MRI images. The critical steps in pre-processing are the reduction of impulsive noises and image resizing.

In the initial phase, we convert the brain MRI image into its corresponding gray-scale image. The removal of unwanted noise is done using the adaptive bilateral filtering technique to remove the distorted noises that are present in the brain picture. This improves the diagnosis and also increases the classification accuracy rate.In image processing, image acquisition is done by retrieving an image from the dataset for processing. It is the first step in the workflow sequence because, without an image, no processing is possible. .In image processing, filters are mainly used to suppress the high frequencies in the image. The median filter is a non- linear filtering technique used to remove noise from the images.

Bilateral filter: It is also a non-linear, noise-reducing smoothing filter for images. It replaces the intensity of each pixel with a weighted average of intensity values from nearby pixels. This weight is based on the Gaussian distribution. Bilateral filtering smooths images whileconserving edges utilizing a nonlinear grouping of neighboring imagepixels. This filtering technique is simple, local, and concise. It combines a graylevel ..

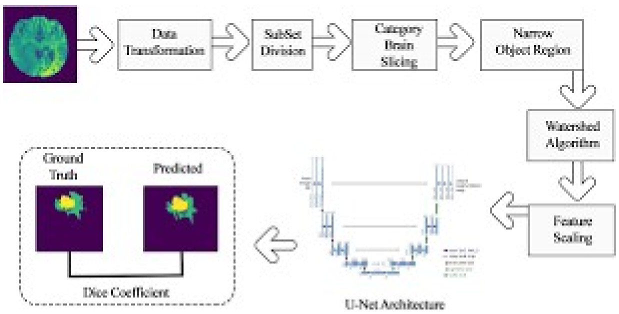

Fig.3 Image preprocessing

IMAGE ENHANCEMET :

Image enhancement is a technique used to improve the image quality and perceptibility by using computer-aided software. This technique includes both objective and subjective enhancements. It encompasses point and local operations, where local operations depend on the district input pixel values. Image enhancement has two types: spatial and transform domain techniques. The spatial techniques work directly on the pixel level, while the transform technique works on Fourier and later on the spatial technique.

BRAIN TUMOR IMAGE CLASSIFICATION USING CONVOLUTIONAL NEURAL NETWORK:

Classification is indeed one of the best approaches for identifying images, especially in medical imaging. All classification algorithms are based on the prediction of an image, where one or more features are used to predict which class the image belongs to.An automatic and reliable classification method, Convolutional Neural Network (CNN), is often utilized for this purpose due to its robust structure, which helps in identifying minute details. A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm capable of taking in an input image, assigning importance to various aspects/objects in the image, and differentiating one from the other.

The preprocessing required in a ConvNet is typically lower compared to other classification algorithms. While in primitive methods, filters are hand-engineered, with enough training, ConvNets have the ability to learn these filters/characteristics automatically. This makes CNNs particularly effective for image classification tasks.

Pooling:
The Pooling layer is indeed responsible for reducing the spatial size of the convolved feature maps. This reduction helps decrease the computational power required for processing the data through dimensionality reduction. Additionally, pooling is useful for extracting dominant features that are rotational and positional invariant, thereby aiding in effective model training.There are two primary types of pooling: Max Pooling and Typically, max pooling is preferred as it retains the most prominent features. In this step, the size of the feature map is reduced. A common practice is to create a pool size of 2x2 for max pooling, which enables us to reduce the size of the feature map while retaining important image information.

The next step is to use the vector obtained above as the input for the neural network by using the Dense function in Keras. The first parameter is the number of nodes in the hidden layer, which you can determine through experimentation. A common practice is to pick the number of nodes in powers of two to balance model complexity and computational resources. We use the sigmoid activation function since we expect a binary outcome. If we expected more than two outcomes, we would use the SoftMax function. The output dimension is set to 1 since we expect the predicted probabilities of the classes:For example: This configuration is suitable for binary classification tasks, where the output is either 0 or 1.

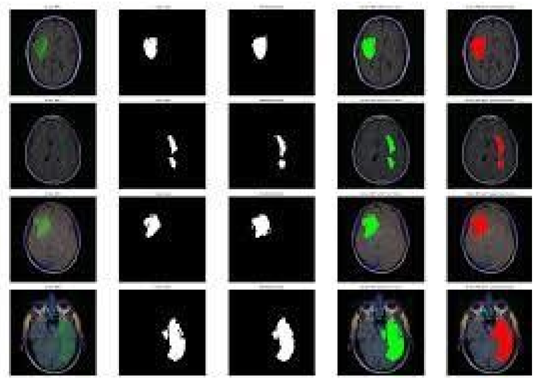

Fig.4 Proposed Model for Brain Tumour Detection

**ADVANTAGES OF PROPOSED SYSTEM:**
The proposed system presents several notable advantages in the realm of brain tumor diagnosis. Firstly, its utilization of advanced techniques like Convolutional Neural Networks (CNNs) and deep learning promises to significantly enhance diagnostic accuracy. By harnessing the power of these technologies, the system can analyze medical imaging data with remarkable precision, potentially outperforming traditional diagnostic methods. Moreover, the automation of image analysis processes leads to increased efficiency in diagnosis, enabling healthcare professionals to expedite treatment decisions. This efficiency not only improves patient care by facilitating timely interventions but also reduces the burden on healthcare resources. Additionally, the system mitigates the subjective nature of human interpretation by providing consistent and reliable results. This objectivity enhances diagnostic confidence and contributes to more standardized patient care practices. Furthermore, the scalability of the system allows for its widespread implementation

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across diverse healthcare settings, ensuring broader access to advanced diagnostic services. Overall, the proposed system holds promise in revolutionizing brain tumor diagnosis, leading to improved patient outcomes and healthcare efficiency.

## V. IMPLEMENTATION

In the fourth step of our systematic approach, Image Segmentation, we focus on dividing the enhanced images into meaningful regions, particularly isolating tumor areas from the background. This process is crucial for accurately identifying and delineating the regions of interest within the images..

By employing binary thresholding techniques, we are able to create clear boundaries between the different regions of the image, allowing us to separate the tumor areas from the surrounding tissues. This segmentation step is essential for subsequent analysis, as it provides a focused area of interest for further processing and classification.

Once the segmentation is completed, we move on to Morphological Operations in the fifth step. Here, we refine the segmented images to improve the delineation of detected regions and enhance their overall accuracy. Morphological operations such as dilation, erosion, opening, and closing are applied to fine-tune the segmented regions, ensuring that they accurately represent the underlying structures within the images.
By systematically following these steps, we aim to develop a robust and reliable system for brain tumor prediction. Each step in the process plays a crucial role in the overall workflow, contributing to the accuracy and effectiveness of the final prediction. Through the integration of state-of-the-art techniquesin image processing and machine learning, we strive to achieve optimal performance and provide valuableinsights for medical diagnosis and treatment.
In Image Enhancement, further improvements are made to the pre-processed images using techniques such as the Sobel Filter, enhancing the clarity and relevance of features crucial for tumor identification.Image Segmentation follows, where theenhanced images are partitioned using binary thresholding to isolate regions of interest, particularly tumor areas, from the background.Morphological Operations refine the segmented images, enhancing the delineation of detected regions and improving accuracy.Finally, Brain Tumor Classification using CNN employs a Convolutional Neural Network to analyze the refined images, extracting features and predicting the presence or absence of a tumor.Byadhering to this systematic approach, we aim to develop a robust and reliable system for brain tumor prediction, leveraging cutting-edge techniques in image processing and machine learning.

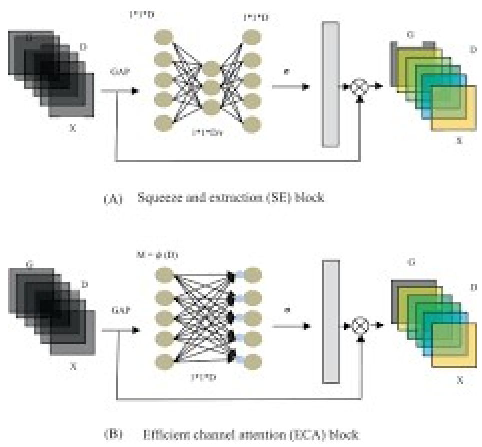


Fig.5 Implementatin model for tumor Disease Detection

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## VI. RESULTS AND ANALYSIS

The proposed algorithm has been evaluated using various performance metrics, including True Positive (TP) and True Negative (TN), which respectively denote the correct identification of damaged and non-damaged regions. False Positive (FP) represents instances where the algorithm incorrectly identifies non-damaged regions as damaged, while False Negative (FN) indicates instances where damaged regions are incorrectly classified as non-damaged.

From these metrics, several performance evaluation measures are derived. Accuracy assesses the overall correctness of the algorithm's predictions, calculated as the ratio of correctly classified samples to the total number of samples. Specificity measures the proportion of correctly identified non-damaged regions among all true non-damaged regions, while Sensitivity (also known as Recall) measures the proportion of correctly identified damaged regions among all true damaged regions.

By analyzing the values of TP, TN, FP, and FN, along with these evaluation measures, the effectiveness of the proposed algorithm can be assessed comprehensively, providing insights into its performance in correctly identifying brain tumor regions and non-tumor regions.

**PERFORMANCE EVALUTION:**

During experimentation, it was observed that the proposed methodology consistently outperformed other approaches across various sets of images. Specifically, the Convolutional Neural Network (CNN) based approach showed superior performance, particularly in terms of output quality when applied to images sized at 128x128 pixels. This finding is represented in tables and charts, indicating a significant improvement in the algorithm's effectiveness when dealing with images of this specific size compared to others.model's robustness and its ability to accurately classify instances beyond the training dataset.

TABLE 1 Represents the true positive, true negative, false positive and false negative values of the proposedapproach for different set of images.
thresholding is applied to the denoised images, followed by Convolutional Neural Network segmentation to identify thetumor region in the MR images.

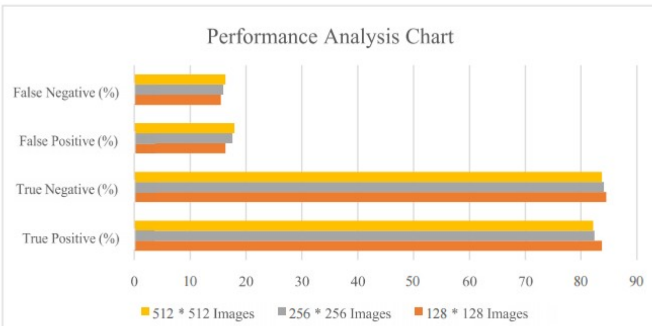


Fig.6 Represents the performance analysis of CNN

It is observed from table 2 upon performing proposed segmentation technique for different set of images that have the ability to recognize the isolated region from the MR images that are used to analyze the shape and size of the denoised image. We have used Convolutional Neural Network (CNN) for segmentation, and the output of our proposed ork is pleased with better accuracy, sensitivity, and computational time.

TABLE 2 Represents the Accuracy, Sensitivity, and Specificity of the proposed approach for

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different set of images.

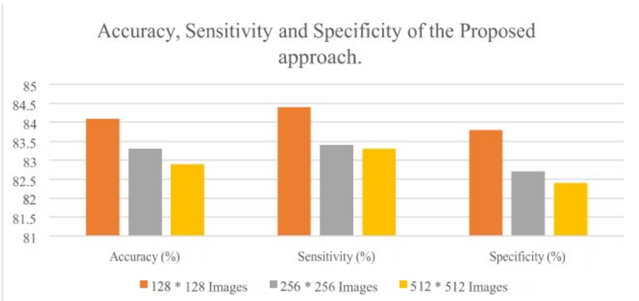


Fig.7 Represents the performance of proposed CNN

## VII. CONCLUSIONS

We have proposed a computerized method for the segmentation and identification of brain tumors using Convolutional Neural Networks (CNNs). The process begins by reading input MR images from the local device via file paths and converting them into grayscale images. These grayscale images undergo preprocessing using an adaptive bilateral filtering technique to eliminate noise present in the original images. Subsequently, binary Our proposed model has demonstrated promising results, achieving an accuracy of 84%. Importantly, it has shown to be effective without any errors and with significantly reduced computational time. This indicates the potential of our approach to streamline and improve the process of brain tumor identification, contributing to more efficient and accurate diagnosis in clinical settings.

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