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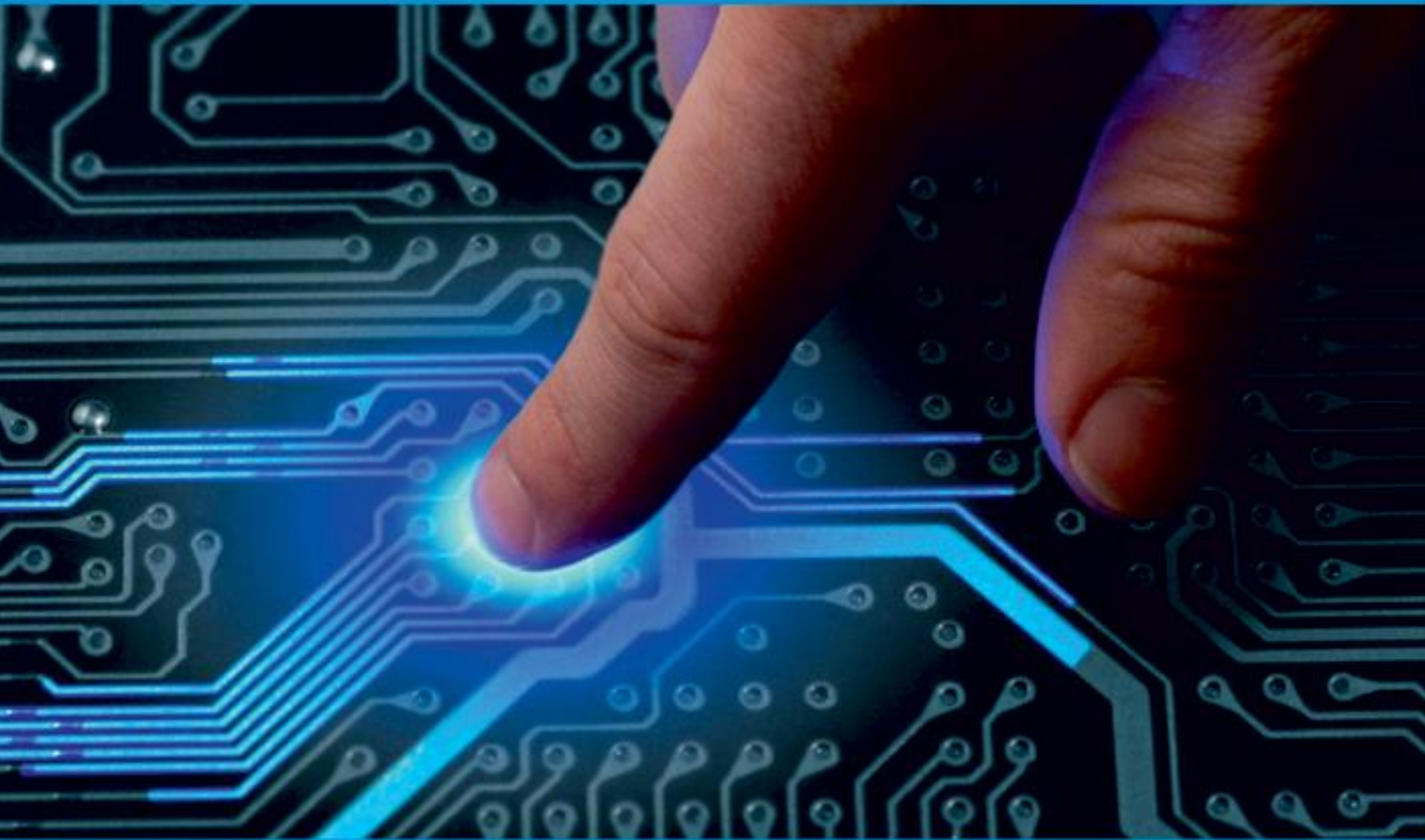

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Brain Tumor Identification Using Convolutional Neural Network

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ABSTRACT: The brain tumors, are the most common and aggressive disease, leading to a very short life expectancy in their highest grade. Thus, treatment planning is a key stage to improve the quality of life of patients. Generally, various image techniques such as Computed Tomography (CT), Magnetic Resonance Imaging (MRI) and ultrasound image are used to evaluate the tumor in a brain, lung, liver, breast, prostate...etc. Especially, in this work MRI images are used to diagnose tumor in the brain. However, the huge amount of data generated by MRI scan manual classification of tumor vs non-tumor in a particular time. But it having some limitation accurate quantitative measurements is provided for limited number of images. Hence trusted and automatic classification scheme are essential to prevent the death rate of human. The automatic brain tumor classification is very challenging task in large spatial and structural variability of surrounding region of brain tumor. In this work, automatic brain tumor detection is proposed by using Convolutional Neural Networks (CNN) classification. Magnetic resonance imaging (MRI) is the imaging technique used to diagnosing brain tumor disease. Early diagnosis of brain tumors is an essential task in medical work to find out whether the tumor can potentially become cancerous. Deep learning is a handy and efficient method for image classification. Deep learning has been widely applied in various fields including medical imaging, because its application does not require the reliability of an expert in the related field, but requires the amount of data and diverse data to produce good classification results. Convolutional Neural Network (CNN) is the deep learning technique to perform image classification. In this paper, we compared two model CNN find the best model CNN to classify tumors in Brain MRI Image and at the end, we have trained CNN and obtained a prediction accuracy of up to 93 %.

KEYWORDS: Computed Tomography; Manets; Convolutional Neural Networks; Brain Tumor, Segmentation; Magnetic Resonance imaging.

I. INTRODUCTION

In this chapter, we are dealing with introduction, overview of project, Comparison and Problem Statement. Brain tumor is one of the vital organs in the human body, which consists of billions of cells. The abnormal group of cells is formed from the uncontrolled division of cells, which is also called as tumor. Brain tumor is divided into two types such low grade (grade1 and grade2) and high grade (grade3 and grade4) tumor. Low grade brain tumor is called as benign. Similarly, the high-grade tumor is also called as malignant. Benign tumor is not cancerous tumor. Hence it doesn't spread other parts of the brains. However, the malignant tumor is a cancerous tumor. So, it spreads rapidly with indefinite boundaries to other region of the body easily. It leads to immediate death. Brain MRI image is mainly used to detect the tumor and tumor progress modelling process. This information is mainly used for tumor detection and treatment processes. MRI image gives more information about given medical image than the CT or ultrasound image. MRI image provides detailed information about brain structure and anomaly detection in brain tissue. Scholars offered unlike automated methods for brain tumors finding and type cataloguing using brain MRI images from the time when it became possible to scan and freight medical images to the computer. Conversely, Neural Networks (NN) and Support Vector Machine (SVM) are the usually used methods for their good enactment over the most recent few years. However freshly, Deep Learning (DL) models fixed a stirring trend in machine learning as the subterranean architecture can efficiently represent complex relationships without needing a large number of nodes like in the superficial architectures e.g. K-Nearest Neighbour (KNN)and Support Vector Machine (SVM). Consequently, they grew quickly to become the state of the art in unlike health informatics areas for example medical image analysis, medical informatics, and bioinformatics. Magnetic resonance (MR) imaging and computed tomography (CT) scans of the brain are the two most general tests to check the existence of a tumor and recognize its position for progressive treatment decisions.

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These two scans are still used extensively for their handiness, and the capability to yield high-definition images of pathological tissues is more. At present, there are several other conducts offered for tumors, which include surgery, therapies such as radiation therapy, and chemotherapy. The decision for which treatment relies on the many factors such as size, kind, and grade of the tumor present in the MR image. It's conjointly chargeable for whether or not cancer has reached the other portions of the body. Precise sighting of the kind of brain abnormality is enormously needed for treatment operations with a resolution to diminish diagnostic errors. The precision is often makeshift utilizing computer-aided diagnosis (CAD) systems. The essential plan of computer vision is to produce a reliable output, which is an associate estimation to assist medical doctors in image understanding and to lessen image reading time. These advancements increase the steadiness and correctness of medical diagnosis — however, segmenting an MR image of the tumor and its area itself a very problematic job. The occurrence of tumors in specific positions within the brain image without distinguishing picture intensities is an additional issue that makes a computerized detection of brain tumor and segmentation a problematic job.

II.RELATED WORK

In this, we are dealing with literature reviews, Objectives of work, motivation and contribution. In Medical diagnosis, robustness and accuracy of the prediction algorithms are very important, because the result is crucial for treatment of patients. There are many popular classification and clustering algorithms used for prediction. The goal of clustering a medical image is to simplify the representation of an image into a meaningful image and make it easier to analyze. Several Clustering and Classification algorithms are aimed at enhancing the prediction accuracy of diagnosis process in detecting abnormalities.

Hossain et al.(2019) [1] Brain Tumor segmentation is one of the most crucial and arduous tasks in the terrain of medical image processing as a human-assisted manual classification can result in inaccurate prediction and diagnosis. In this paper, we proposed a method to extract brain tumor from 2D Magnetic Resonance brain Images (MRI) by Fuzzy C- Means clustering algorithm which was followed by traditional classifiers and convolutional neural network.Seetha et al.(2018) [2] The brain tumors, are the most common and aggressive disease, leading to a very short life expectancy in their highest grade. Thus, treatment planning is a key stage to improve the quality of life of patients. In this work, automatic brain tumor detection is proposed by using Convolutional Neural Networks (CNN) classification. The deeper architecture design is performed by using small kernels. The weight of the neuron is given as small. Experimental results show that the CNN archives rate of 97.5% accuracy with low complexity and compared with the all other state of arts methods.

Ezhilarasi et al.(2018) [3] Brain tumor is the cancerous disease where abnormal cells found in the brain. This can be cured if we detect the brain tumor at an early stage. In this proposed system the tumor area is marked and defined what kind of tumor present in the brain tumor MRI image. AlexNet model is used for the classification of different types of tumors as a base model along with Region Proposal Network (RPN) by Faster R-CNN algorithm. Here, the concept of transfer learning is used during training. The proposed system helps to predict the correct type of tumor with better accuracy.

Togac¸ar et al.(2020) [4] A brain tumor is a mass that grows unevenly in the brain ˘ 7 and directly affects human life. This mass occurs spontaneously because of the tissues surrounding the brain or the skull. Accessible magnetic resonance images were used to detect brain tumor with the BrainMRNet model. BrainMRNet model is more successful than the pre-trained convolutional neural network models (AlexNet, GoogleNet, VGG- 16) used in this study. The classification success achieved with the BrainMRNet model was 96.05%.

Siar et al.(2019) [5] Brain tumor can be classified into two types: benign and malignant. Timely and prompt disease detection and treatment plan leads to improved quality of life and increased life expectancy in these patients. One of the most practical and important methods is to use Deep Neural Network (DNN). In this paper, a Convolutional Neural Network (CNN) has been used to detect a tumor through brain Magnetic Resonance Imaging (MRI) images.This is a new method based on the combination of feature extraction techniques with the CNN for tumor detection from brain images. The method proposed accuracy 99.12% on the test data. Due to the importance of the diagnosis given by the physician, the accuracy of the doctors help in diagnosing the tumor and treating the patient increased.

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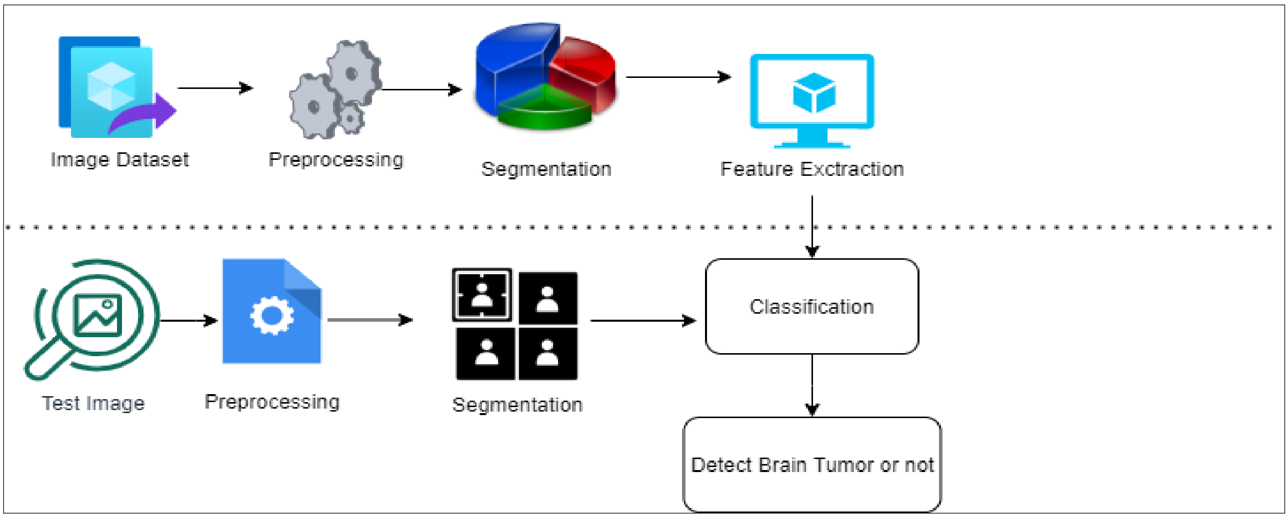
III. PROPOSED WORK

A. *System Architecture:*



B. *Description of Modules:*

We are dealing with Overview on Proposed work, H/W and S/W Selection, Importance of work and Working Principle The paper discusses the method for detecting abnormalities in the brain MRI images. To be more specific on the use case, an automated system is being developed that scans through the brain MRI images to identify the tissue growth in the brain that is the tumors. In the study a convolutional neural network architecture is devised which accepts 2D MRI image slices and determines the type of error present. The deep learning model designed is trained with three different types of brain tumors namely, glioma, meningioma and pituitary tumors.

Module 1: Image Preprocessing And Image Enhancement

1. Image Preprocessing:

The Brain MRI image dataset has been downloaded from the Kaggle. The MRI dataset consists of around 3058 MRI images, including normal, benign, and malignant. These MRI images are taken as input to the primary step. The pre-processing is an essential and initial step in improving the quality of the brain MRI Image. 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 increase the classification accuracy rate.

(a) Image Acquisition From Dataset: In image processing, image acquisition is done by retrieving an image from dataset for processing. It is the first step in the workflow sequence because, without an image no processing is possible. The image that is acquired is completely unprocessed. Here we process the image using the file path from the local device.

(b) Convert The Image From One Color Space To Another: There are more than 150 color-space conversion methods available in OpenCV. For color conversion, we use the function where flag determines the type of conversion. In our work, we convert the input image into the gray- scale image.

(c) Filters: In image processing, filters are mainly used to suppress the high frequencies in the image
Median filter: It is a non-linear filtering technique used to remove noise from the images. It is performed by sorting all the pixel values from the window into numerical order and then replacing the pixel being

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considered with the median pixel value. This filter removes the speckle noise and salt and pepper noise through 'ON' and 'OFF' of pixels by white and dark spots.

• 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 smooth images while conserving edges utilizing a nonlinear grouping of neighbouring image pixels.

This filtering technique is simple, local, and concise. It syndicates a grey level grounded on their likeness and the symmetrical nearness and chooses near vales to farther values in both range and domain.

2. Image Enhancement: 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. This technique includes points and local operations. The 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. Edge detection is a segmentation technique that uses border recognition of strictly linked objects or regions. This technique identifies the discontinuity of the objects. This technique is used mainly in image study and to recognize the parts of the image where a huge variation in intensity arises.

(a) Sobel Filter: The Sobel filter is used for edge detection. It works by calculating the gradient of image intensity at each pixel within the image. It is widely used in image analysis to help locate edges in images. Sobel operator is used for segmentation purpose. This technique can be dependent on the central difference which tends toward the central pixels on average. This technique can be expressed as 3×3 matric to the first derivative of the Gaussian kernel.

It combines smoothing and differentiation. For Sobel edge detection the gradient of the image is calculated for each pixel position in the image. After the completion of the pre-processing, the image will be free from the noises, but we still need to enhance the image since the obtained image is smoothened, edges may not be preserved, and the image will be dull. To overcome all these, we used edge detection called Sobel filtering technique. The whole thing is done by calculating the gradient of image intensities at each pixel within the image. It is widely used in image analysis to help locate edges in images. It will also enhance the darker areas of the image, slightly increase contrast and as sharp as possible.

Module 2: Image Segmentation Using Binary Threshold Image segmentation is a technique of segregating the image into many parts. The basic aim of this segregation is to make the images easy to analyze and interpret with preserving the quality. This technique is also used to trace the objects' borders within the images. This technique labels the pixels according to their intensity and characteristics. Those parts represent the entire original image and acquire its characteristics such as intensity and similarity. The image segmentation technique is used to create contours of the body for clinical purposes. Segmentation is used in machine perception, malignant disease analysis, tissue volumes, anatomical and functional analyses, virtual reality visualization, and anomaly analysis, and object definition and detection. Segmentation methods has ability to detect or identify the abnormal portion from the image which is useful for analyzing the size, volume, location, texture and shape of the extracted image. MR image segmentation with the aid of preserving the threshold information, which is convenient to identify the broken regions extra precisely. It was a trendy surmise that the objects that are placed in close propinquity might be sharing similar houses and characteristics.

1. Thresholding: Thresholding is the simplest method of image segmentation. It is a non-linear operation that converts a grey-scale image into a binary image where the two levels are assigned to pixels that are below or above the specified threshold value. In Open CV, we use cv2.threshold() function. This function applies fixedlevel thresholding to a single-channel array. The function is typically used to get 19 a bi-level (binary) image out of a grayscale image for removing a noise, that is,filtering out pixels with too small or too large values. "maxval" is the set threshold value which compares with input values, when the input is greater than the set threshold value it gives output is set maxval value and it is shown with white color in gray images. when the input pixel intensity values are less than the set threshold, its output is black color. There are several types of thresholding supported by the function. The function returns the computed threshold value and thresholder image.

(a) src - input array (single-channel, 8-bit or 32-bit floating point). This is the source image, which should be a grayscale image.

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(b) thresh - threshold value, and it is used to classify the pixel values.

(c) maxval - maximum value to use with the THRESH BINARY and THRESH BINARY INV thresholding types. It represents the value to be given if pixel value is morethan (sometimes less than) the threshold value.
(d) type - thresholding type

IV. THRESH BINARY INVY

2. Morphological Operations: Morphological operations apply a structuring element to an input image, creating an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. The Morphological techniques are also used with segmentation techniques. The morphological action is normally performed on binary images. It processes the operations based on shape and it has a wide set of the image processing operation. Erosion and Dilation are two methods of morphological operations which used in this proposed work. We perform both Erosion and dilation operations used together. Two main steps of the erosion and dilation morphological operation are opening and closing. The first step is the opening of the MRI binary image. The main work of opening operation is open up a gap which is present in between object and connect that to a small collection of pixels. After setting of the bridge, the erosionagain restored with their actual size using dilation. If the binary image has been opened then the subsequent opened same structured elements have not affected on that image. After completing the opening operations next step is the closing operation. Based on the closing operation while keeping the original region sizes, the erosion and dilation can handle different hole in the image region. Dilation and Erosion are the basic morphological operations. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries. Watershed Method: considers the gradient magnitude of an image as a topographic surface where high gradient denotes peaks, while low gradient denotes valleys. Start by filling every isolated valley with different coloured water. As the water rises, water from different valleys will start to merge. To avoid that, barriers are built in the locations where water merges. Continue the work of filling water and building barriers until all the peaks are under water. Then the created barriers give the segmentation result.

Module 3: Brain Tumor Image Classification Using Convolutional Neural Network Classification is the best approaches for identification of images like any kind of medical imaging. All classification algorithms are based on the prediction of image, where one or more features and that each of these features belongs to one of several classes. An automatic and reliable classification method Convolutional Neural Network (CNN) will be used since it is robust in structure which helps in identifying every minute details. A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm which can take in an input image, assign importance to various aspects/objects in the image and be able to differentiate one from the other. The preprocessing required in a 21 ConvNet is much lower as compared to other classification algorithms. While in primitive methods filters are hand-engineered, with enough training, ConvNet have the ability to learn these filters/characteristics. A ConvNet is able to successfully capture the spatial and temporal dependencies in an image through the application of relevant filters. The architecture performs a better fitting to the image dataset due to the reduction in the number of parameters involved and reusability of weights. In other words, the network can be trained to understand the sophistication of the image better. The role of the ConvNet is to reduce the images into a form which is easier to process, without losing features which are critical for getting a good prediction.

V. ALGORITHM

Step 1: import MRI from medical database
Step 2: linear filter via Gaussian filter
Step 3: normalization using histogram processing
Step 4: initiate patch extraction process
– (i) Patches obtained
– (ii) RGB channel separation
Step 5: initiate feature extraction process
– (i) Color mapping and obtaining threshold value
– (ii) LBP process to attain binary image a) Image is converted to a gray scale representation.
b) For each pixel (gp) in the image, select the P neighbouring pixels. gp's coordinates are specified by
c) Set the pixel in the centre (gc) as the threshold for its P neighbours.

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d) Set to 1 if the adjacent pixel's value is larger than or equal to the centre
pixel's value, and 0 otherwise.
e) Compute the LBP value now. First, write a binary number comprising digits next to the centre pixel in counterclockwise direction. ,is binary integer
(or its decimal counterpart) is referred to as the LBP-central pixel code and is
employed as a distinctive local texture.
Step 6: initiate classification process
– Multi-SVM process
* (i) Use training set, group train, and test set as variables for function
* (ii) Classify test cases and map the training data into kernel space
– CNN classification
* (i) Load train and test data
* (ii) Iterate the process with 100 epochs which yields less error value of
1.2
* (iii) Create layers and subsampling layers for CNN for varied kernel sizes
* (iv) Classify the data and predict the final output.

VI. SIMULATION RESULTS

In this, we are going to deal with result and discussion in which we have snapshots of the work we did till now and the discussion done with respective guide. The input MRI Scan for the CNN model is as shown in figure. The two-class dataset, one with the MRI scan images of the brain which does not have a tumor and another set of images with the tumor is given as the input to the proposed CNN model after the pre-processing phase. Our Dataset contains tumor and non-tumor MRI images and collected from different online resources. Radiopaedia13 contains real cases of patients, tumor images were obtained from Radiopaedia and Brain Tumor Image Segmentation Benchmark (BRATS) testing dataset. In this work, efficient automatic brain tumor detection is performed by using convolution neural network. Simulation is performed by using python language. The accuracy is calculated and compared with the all other state of arts methods. The training accuracy, validation accuracy and validation loss are calculated to find the efficiency of proposed brain tumor classification scheme. In the existing technique, the convolution neural network (CNN) based classification is performed for brain tumor detection. It needs feature extraction output. Based on feature value, the classification output is generated and accuracy is calculated. The computation time is high and accuracy is low in CNN based tumor and non-tumor detection.

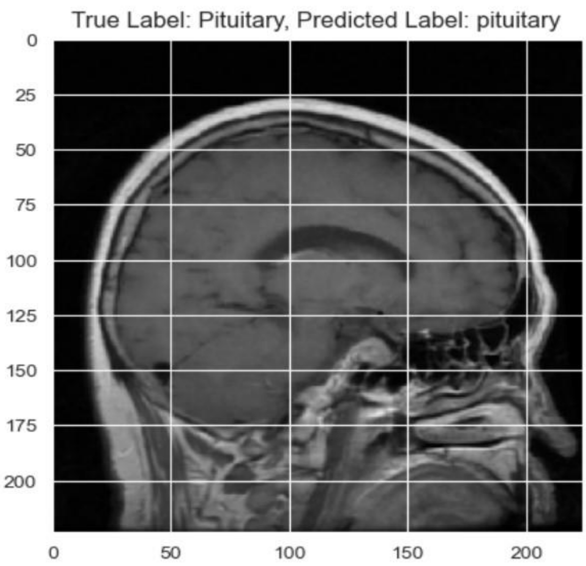

Fig.1.

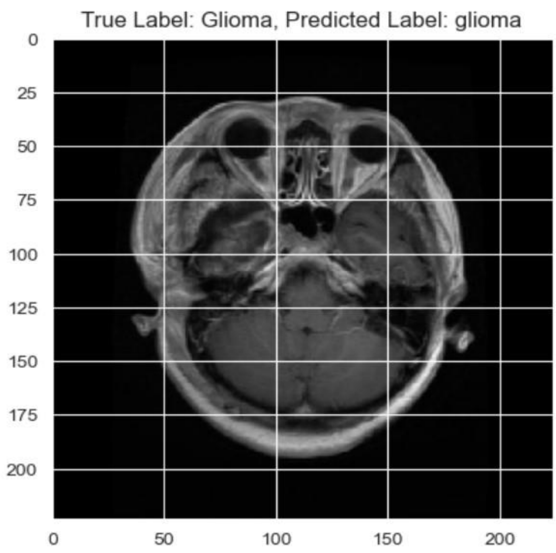

Fig.2.

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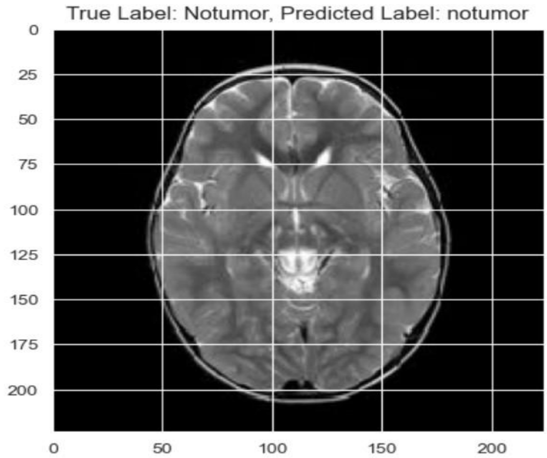

Fig.3

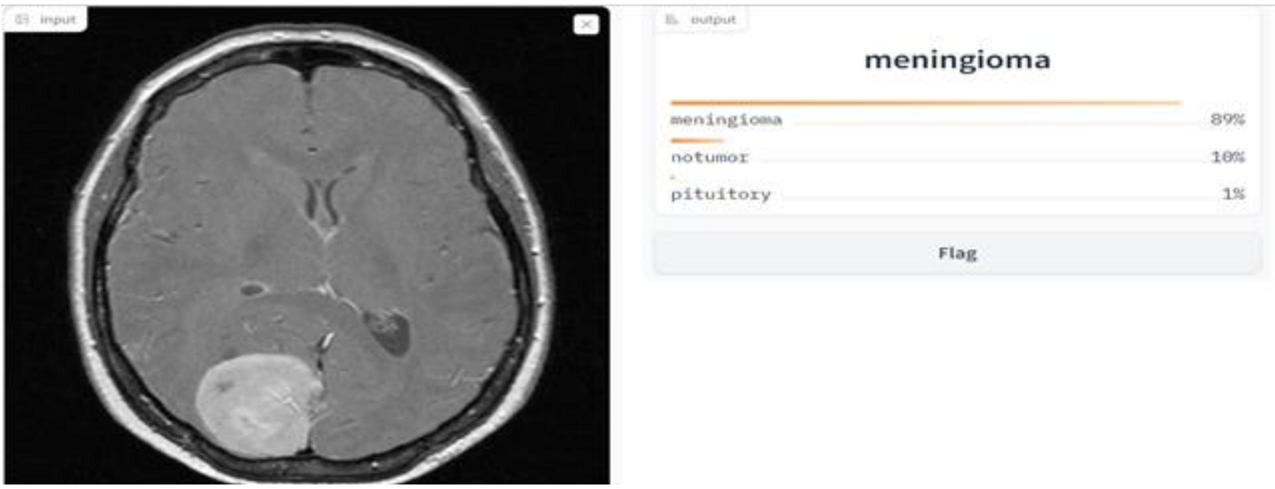

Fig.4

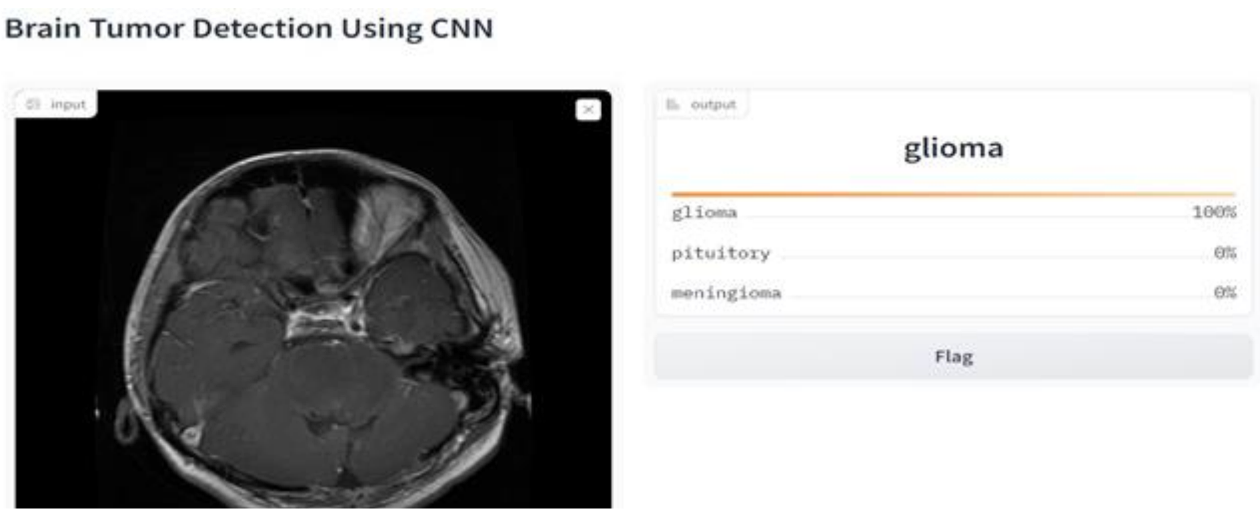

Fig.5

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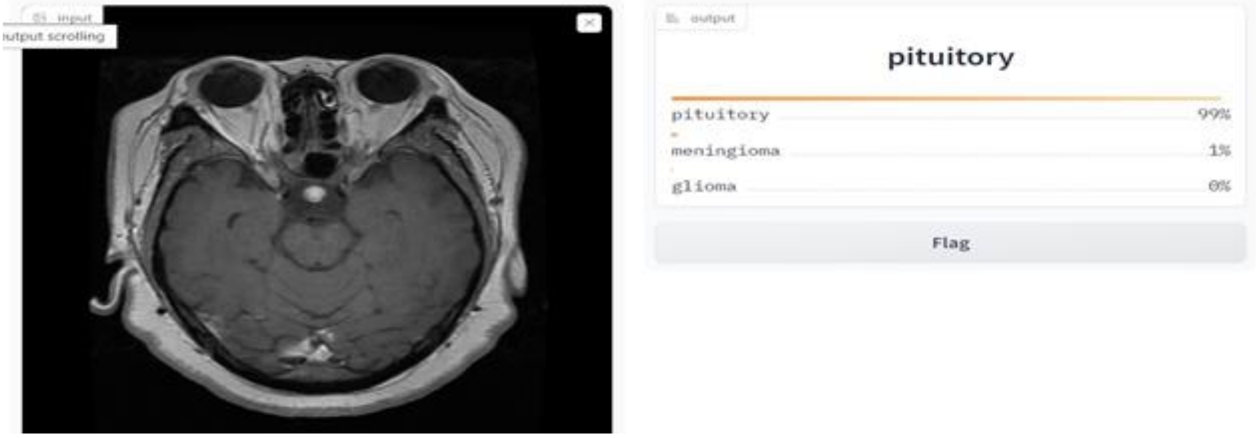

Fig.6: Detection of Pituitory

VII. CONCLUSION AND FUTURE WORK

We proposed a computerized method for the segmentation and identification of a brain tumor using the Convolution Neural Network. The input MR images are read from the local device using the file path and converted into gray scale images. These images are pre-processed using an adaptive bilateral filtering technique for the elimination of noises that are present inside the original image. The binary thresholding is applied to the denoised image, and Convolution Neural Network segmentation is applied, which helps in figuring out the tumor region in the MR images. MRI scans generate images of the brain for the purpose of diagnosing the Tumor. This technique can be developed to classify the tumors based on feature extraction. This technique can be applied Brain and also breast, lung, skin tumors

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